NET ZERO CITIES

EU MISSION PLATFORM | CLIMATE NEUTRAL AND SMART CITIES

Climate City Contract

2030 Climate Neutrality Action Plan

City of Aachen

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Summary

The abstract summarises the content of the 2030 Climate Neutrality Action Plan (CCC Action Plan) that is developed jointly by local authorities, local businesses, and other stakeholders.

The Action Plan of the Aachen Climate City Contract provides an overview of the measures that will make the 2030 climate neutrality scenario a reality. The action plan includes:

- Ongoing measures from the Integrated Climate Protection Concept, short IKSK 2020. This integrated climate protection plan had the goal of halving the GHG emissions of 1990 by 2030. The action plan includes the measures of the city administration with a direct and indirect impact on reducing GHG emissions. The IKSK 2020 has been implemented since 2020 and will run until the end of 2025.
- future measures from the IKSK 2.0, which shows the path to climate neutrality in 2030. It shows a 95% reduction in GHG emissions from 1990 levels by 2030. The action plan includes the measures taken by the municipal administration and the municipal group. The Climate Neutrality 2030 scenario also describes the necessary change processes in the city as a whole. The IKSK is to be politically approved in March 2024 and then successively implemented.
- current and future measures by the city's subsidiaries and the municipal organisation. The 133 commitments enclosed with Aachen's CCC are proof of the strong support given to Aachen's city administration and politicians on the path to climate neutrality. Expanding this support and ultimately uniting all citizens behind the mission is the major goal of the Transition Team's activities.

The economic model was used to validate the action plan and investment plan. The base year for the calculations was 2021, for which baseline emissions totalling 1,577,000 t CO_2e were determined. To achieve climate neutrality as defined by the EU's "100 Climate-Neutral and Smart Cities" mission, emissions in 2021 must be reduced by at least 80 %. This is achieved by implementing 21.2% of the measures from the IKSK 2020.

Aachen's political goal of climate neutrality by 2030 is in line with the requirements of the EU mission. The biggest levers on the road to climate neutrality in Aachen are:

- Decarbonisation of electricity generation
- Decarbonisation of the heat supply
- Refurbishment of existing buildings
- Mobility turnaround

To accelerate the reduction of GHG emissions, measures that can be implemented quickly and have high leverage are prioritised. The focus here is on strategic projects that are within the municipal group's scope of action, and which have a direct influence on GHG emissions. Direct influence means that the climate protection measures can be realised independently by the municipal group, such as the expansion of district heating or the renovation of municipal buildings.

These measures are supplemented by measures with an indirect influence. This means that the municipal group sets the framework conditions, but the realisation of the climate protection measures is highly dependent on the involvement of the municipal community. This Action Plan therefore comprises measures with which the municipal group or the municipal organisation pursue and achieve the goal of climate neutrality.

The Climate City Contract fulfils the following relevant functions in the overall process towards climate neutrality:

- Formation of a broad alliance for change in Aachen comprising the city administration, the municipal corporation, companies, associations, academia, clubs/initiatives and citizens.
- Validation and prioritisation of future climate protection measures to select those that have the greatest leverage and are socially just.
- Instrument for the comprehensive presentation of the path to climate neutrality 2030 for Aachen. The document is to be used in particular in communication with political decision-makers at all levels: state,

federal and EU, to achieve the solidarity that is necessary for the successful implementation of the Action Plan.

The Aachen Transition team will step up its efforts to implement the measures in the Action Plan and steadily grow the Alliance for Change. In doing so, it will be particularly important to organise climate protection in Aachen in a socially just way so that all of Aachen's residents can participate. Only if everyone in Aachen is reached and included in the climate protection measures can a climate-neutral Aachen 2030 succeed.

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AFOLU	Agriculture, Forestry, and Other Land Use
CCC	Climate City Contract
GHG	Green house gas
IKSK 2020	Integrated climate protection concept (Aachen SECAP 2020)
IKSK 2.0	Update of the integrated climate protection concept (Aachen SECAP 2.0)
LULUCF	Land use land-use change and forestry

1 Introduction

The introduction outlines the local geographic and policy context in which the City of Aachen's 2030 Climate Neutrality Action Plan is being developed and describes the gap it addresses in broad terms.

Introduction

The climate crisis is the greatest challenge of our time. The consequences of the climate crisis have long been felt - even in Aachen. By ratifying the Paris Climate Agreement, the Federal Republic of Germany has made a binding commitment under international law to the climate targets set out therein. According to these targets, global warming is to be limited to well below 2 degrees compared to pre-industrial levels. The urgent recommendation is not to allow the increase to exceed 1.5 degrees, if possible, as there is a risk of exceeding global tipping points from this point onwards. The urgency of consistent climate action was emphasised by the Federal Constitutional Court (April 2021) in its landmark ruling: "Climate protection targets must be aligned in such a way that the reduction of greenhouse gases is not postponed further and further into the future and the pressure on the entire younger generation is so great that their fundamental rights and freedoms are massively restricted."

Aachen is facing up to this responsibility and has set out to achieve climate neutrality by 2030. The cCity of Aachen can look back on more than 30 years of experience in ambitious climate protection, which began with the establishment of an office for energy and climate protection (1991) and joining the European Climate Alliance in 1992. In 1993, the so-called Aachen model of cost-covering remuneration for solar and wind power was adopted by the Council and introduced as binding in 1994. In the following years, valuable potential studies for wind, solar energy and biomass were carried out with the support of the state of North Rhine-Westphalia to better understand the future opportunities for an energy supply based on renewable energies. In 1998, the first CO_2 reduction concept was drawn up for the period up to 2010. In the years up to 2003, Aachen's first wind farm with 9 large wind turbines (Butterweiden), a solar housing estate with 43 energy-saving houses (passive houses) and 2 innovative office buildings were completed. In 2009, the City of Aachen's Climate Protection / Energy Coordination Centre was set up and the altbau plus e. V. was founded. In addition, the City of Aachen has been a member of the EU Commission's "Covenant of Mayors" since 2009 and has been part of "Mayors Adapt" since 2014. The City of Aachen has also been involved in the "European Energy Award" certification programme since 2009 and was awarded gold in 2011, 2015, 2019 and 2023. Since 2010, the City of Aachen has drawn up an annual energy and carbon footprint. In 2019, the City Council of Aachen declared a climate emergency. The Integrated Climate Protection Concept, short IKSK 2020 drawn up in 2020 describes how potential for greenhouse gas reduction can be leveraged in Aachen with the 2025 action programme. The measures described therein are already being implemented, meaning that a wide range of activities can be built on and existing structures can be utilised. There are funding programmes and advisory services for the expansion of renewable energies and building refurbishment, which have been running for several years and are gaining in popularity. Since 2021, municipal subsidies totalling over 7 million euros have been awarded in solar and building renovation. These have triggered an investment volume of almost 80 million euros.

1.1 Aachen - location and integration into the region

Aachen is an independent city in North Rhine-Westphalia with an area of 160.85 km^2. Aachen's urban area is divided into seven districts: Brand, Eilendorf, Haaren, Kornelimünster/Walheim, Laurensberg, Mitte and Richterich. The land area of Aachen's urban area has the following types of use: 59.9 % vegetation, 29.7 % residential area, 9.9 % transport, 0.5 % water (see Figure AP-1). Of the 9,600 ha of vegetation on Aachen's urban area, around 2,530 ha, or 26 %, are urban forest, 2,407 ha, 25 %, arable land and 49 % permanent grassland.

Due to the proximity to both Belgium and the Netherlands, there is a close connection and cooperation with both countries. In addition, the merger with the neighbouring municipalities to form the Aachen city region means that there is also a close exchange here. The municipalities of Alsdorf, Baesweiler, Eschweiler, Herzogenrath, Monschau, Roetgen, Simmerath, Stolberg and Würselen belong to the Aachen city region. Aachen is also part of the so-called Rhenish mining district. The Rhenish mining district is characterised by lignite mining in the Hambach, Garzweiler and Inden open-cast mines. The city region of Aachen, the districts of Düren, Euskirchen, Heinsberg, the Rhine-Erft district and the Rhine district of Neuss as well as the city of Mönchengladbach have joined forces for the strategic structural change of the region during the end of lignite mining. According to the coordination framework of the joint task "Improvement of the regional economic structure", the entire Aachen city region is considered a structurally weak region in Germany and is therefore entitled to regional aid provided by the EU (ERDF), the federal government and the federal states.

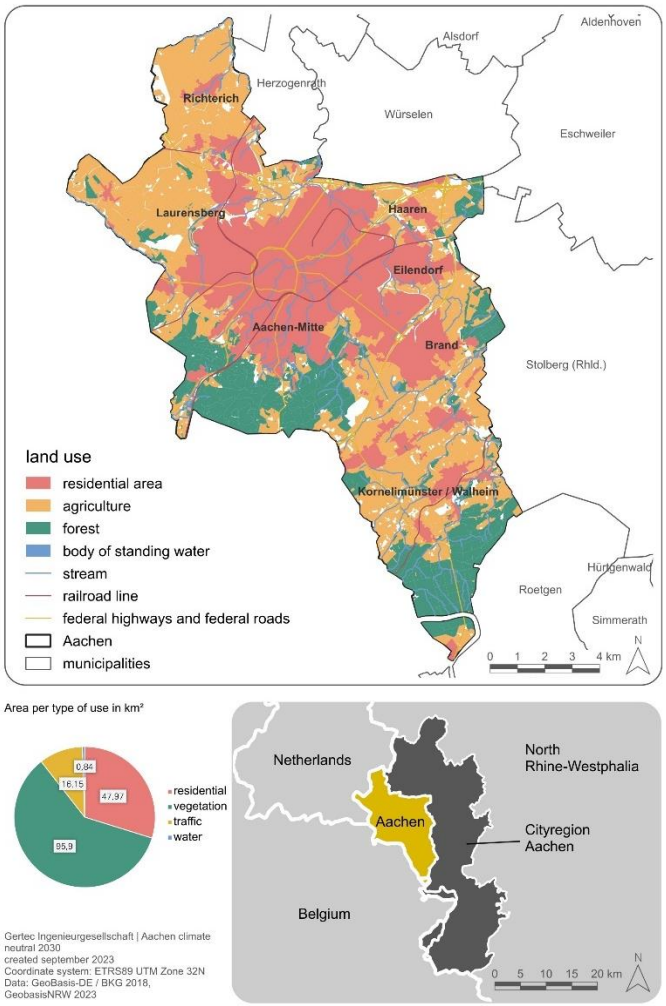

Figure AP- 1 Spatial structure of the City of Aachen and embedding in the Euregio Meuse-Rhine

1.2 Aachen - Socio-demographics

The socio-demographic structure of Aachen is of particular importance for the success of climate protection activities, as the large number of students means that the proportion of the population that will be affected by climate change for a long time is significantly higher than in other cities (see also chapter 1.13 The Aachen Alliance for Change). According to the municipal statistics office, 262,040 people lived in Aachen in 2022 (compare figure AP-3). The largest increase can be seen in the 18 to 25 age group. Only in this age group is the city's net migration positive. This is due to the influx of first-year students at Aachen's universities. In the 2019/20 winter semester, a total of 61,362 students were enrolled at Aachen's universities. This corresponds to almost a quarter of Aachen's population. These demographic characteristics are also reflected in the household structure, although not all students live in Aachen. Of a total of 152,163 households in 2020, 86,341 (56.7 %) were single-person households. Together with people over the age of 60, 20 to 30-year-olds make up the largest proportion of the total population at 23% each. Children under the age of 10 and people aged 10 to under 20 account for the smallest share, at 8% each. Aachen's population is therefore relatively young, although the birth rate has been falling since 2019 (compare figure AP-3).

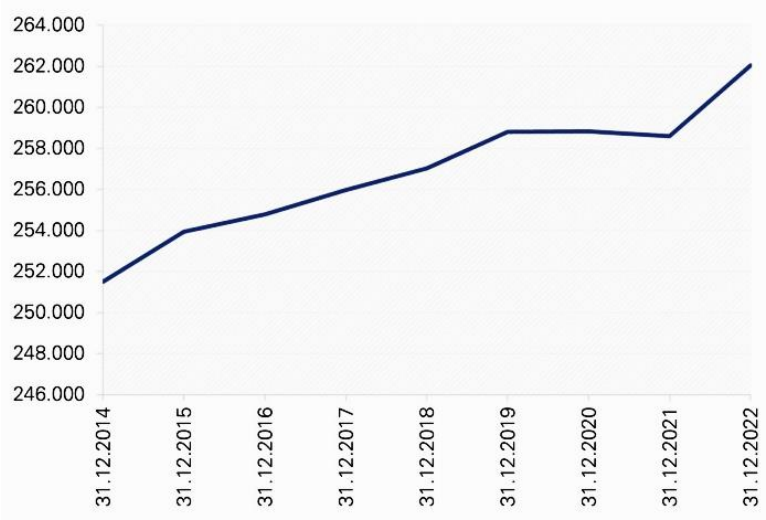

Figure AP- 2 : Population development in Aachen in the years 2014-2022
Source: Gertec GmbH

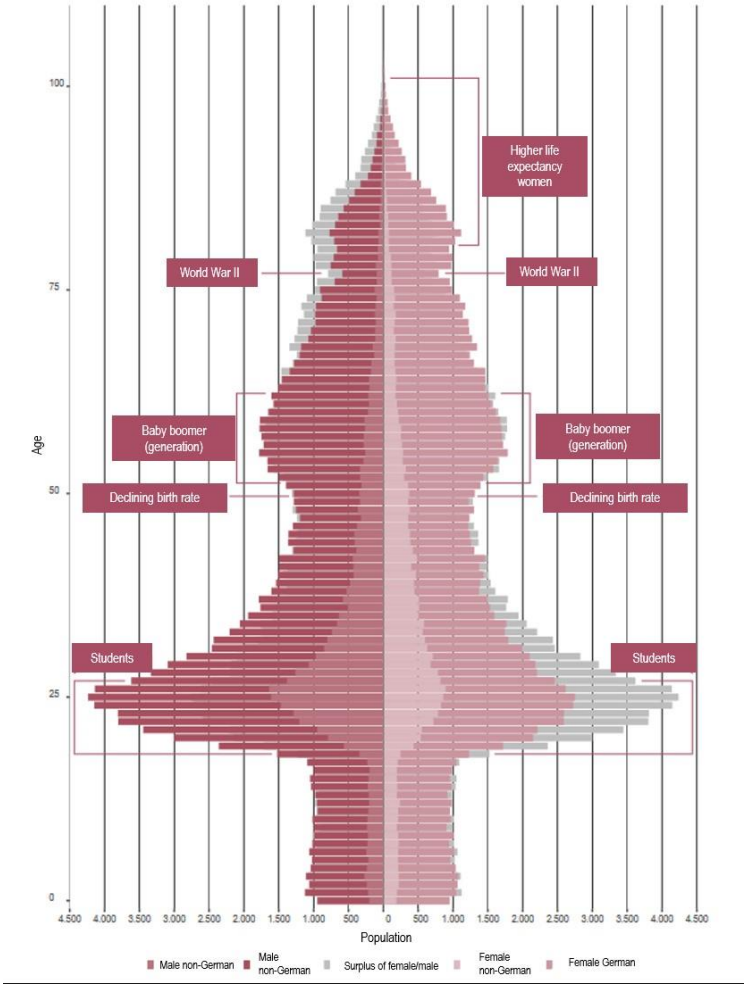

Figure AP- 3 Population pyramid City of Aachen 2022
Source: City of Aachen register

In order to utilise the opportunities arising from the socio-demographic structure - with a high proportion of younger people in the 18 to 25 age group (the student parliament has submitted a commitment to the CCC on behalf of the approx. 60.000 students in Aachen have submitted a commitment to the CCC) and movements such as Students for Future - for the long-term implementation of the Climate City Contract and to improve awareness of the socio-demographic aspects and influence on the implementation of the Climate City Contract among the population and decision-makers from politics, business and administration, intensive and target group-orientated public relations work with suitable participation formats is required. To this end, the CoLab pilot project in particular will develop innovative participation formats that are important for the initial implementation phase and the iterative updates of the Climate City Contract. Major urban redevelopment projects are already being accompanied by intensive public relations work by the City of Aachen. Residents are addressed via neighbourhood newspapers, art projects and events in order to achieve greater acceptance for urban redevelopment and active participation in urban transformation. Environmental aspects should be emphasised more than before. The measures of the urban neighbourhood management play a key role here. Neighbourhood management aims to work with local people and institutions to provide positive impetus for social development in the neighbourhood. Neighbourhood management also communicates issues, developments and needs to other areas of responsibility within the administration and to the transition team. Against the background of socio-demographic aspects, two project-related and topic-specific neighbourhood management programmes are already being implemented with the special programmes "Neighbourhood management with a focus on refugee integration" and the "Age-friendly neighbourhood" project. The consideration of Aachen's socio-demographic structure, with a high proportion of young people and citizens over 60 years of age in the population, also serves the purpose of avoiding misinvestment in public services of general interest. To this end, the implementation of Climate City Contract measures, particularly in the building sector, requires planning support for development measures. The monitoring of the implementation of the Climate City Contract will take socio-demographic aspects into account in order to be able to intervene strategically if necessary and, for example, to include long-term ecological and financial risks in the planning and implementation process for building investments or infrastructural investment decisions. The Senior Citizens' Council and the diverse Citizens' Council play an important role in the decision-making process for political decisions.

In addition, low-threshold programmes for the participation of children, young people and senior citizens are already being offered by partners (commitments) of the Climate City Contract. More are to follow as a result of the developments from CoLab. Examples include the Ocher Lab's "Senior Citizens' Café", which provides "tutoring" on digital issues relating to the use of smartphones, tablets and laptops. Or the Oecher Lab's "Smarte Kids - Smarte Stadt" (Smart Kids - Smart City) future room, which offers workshops on topics such as the use of digital media. Both are important in order to involve these groups more in the implementation of the Climate City Contract in future - also through digital formats.

1.3 Aachen - spatial structure and building stock

As a large city, Aachen has an above-average population density. With an average of 1,548.5 inhabitants per square kilometre, it is well above all other municipalities in the city region (787.5 inhabitants/km^2) and the state (525.5 inhabitants/km^2).

Nevertheless, the settlement area only accounts for just under 30% of the total area of 160.85 km2 in the urban area. At 21 km², residential areas account for the largest share of the settlement area. The industrial and commercial area accounts for around one sixth of the settlement area and is therefore roughly the same size as the area for sport, leisure and recreation. Vegetation accounts for the largest proportion of land at almost 60 %, of which almost two thirds are agricultural land and around one third is woodland. Most of the forests are in the south and west of the urban area. Around 60 % of Aachen's buildings are residential. The remainder of the building stock is divided between commercial or industrial buildings, buildings for public purposes and other buildings. Most of the Aachen's building stock was constructed between 1949 and 1978. Many buildings from the period before 1919 and the period from 1919 to 1948 still exist. However, significantly fewer new buildings have been constructed since 1978. Two thirds of the building stock in Aachen consists of detached houses, the other third are apartment blocks. A quarter of the buildings in Aachen are owner-occupied.

Table AP- 1 Aachen's building stock by building age class

BAK (Building classification based on year of construction)	Number of buildings by type	Share of overall building stock
A/B (before 1919)	5.239	13,1 %
C (1919-1948)	4.840	12,1 %
D/E/F (1949-1978)	19.487	48,6 %
G (1979-1986)	3.639	9,1 %
H (1987-1995)	1.624	7,6 %
I (1996-2000)	1.624	4,0 %
J (2001-2008)	1.813	4,5 %
K (after 2009)	459	1,1 %
Total	38.743	

1.4 Aachen - transport structure

The mobility sector currently accounts for around 25 % of CO_2 eq emissions within the city limits, of which motorised private transport makes up the largest share. According to the Mobility Report 2021, 30% of the modal split in the City of Aachen as of 2017 is accounted for by walking, 11% by cycling and 13% by public transport.

Motorised private transport has a total share of 46% of the modal split, consisting of 34% drivers and 12% passengers. The car density in 2020 was around 446 cars per 1,000 inhabitants, which compares favourably with NRW with a figure of 556 (2016). However, it should be noted that car registrations in Aachen have increased by 30% over the past 30 years, although the population has only risen by 3.1% in the same period. Accordingly, there is still a major challenge in reducing the density of cars to achieve a successful mobility transition in Aachen. In addition to good connections to three federal motorways, Aachen is connected to the trans-European rail network and is therefore part of important international passenger and freight transport routes such as the Montzen route. There are also several ICE and regional train connections from Aachen's main railway station. The Aachener Verkehrsverbund (AVV) operates the Euregiobahn and express buses to other European countries, while the city's public transport system is operated by ASEAG with over 100 bus routes. Aachen has been a member of the Association of Pedestrian and Bicycle Friendly Cities, Municipalities and Districts in NRW for many years.

The commuter flows in the city of Aachen recorded an average of 170,751 daily commuter movements in 2022, of which 31,687 were outbound commuters, 72,448 inbound commuters and 66,616 inbound commuters. The daily population in the city of Aachen thus increased by almost 40,000 people, of which around 3,810 commuter movements from Belgium and a further 1,880 from the Netherlands also took place in 2019. According to the Agora Verkehrswende city profile (as of 2020), 41% of journeys to work in Aachen were made by car, a further 3% as a passenger in motorised private transport, 19% by public transport, 23% by bike and 15% on foot. Compared to other cities of a similar size, public transport is less popular with Aachen residents, with only around 44% of those surveyed for the study enjoying or very much enjoying travelling by public transport. According to the ADFC Cycling Climate Test, satisfaction with the cycling infrastructure is also slightly below average, although around 73% of households own at least one bicycle. Regarding car-sharing use, data is only available for the entire Aachen city region. These indicate that, at 11% of households, an above-average number of people have a Car-Sharing membership.

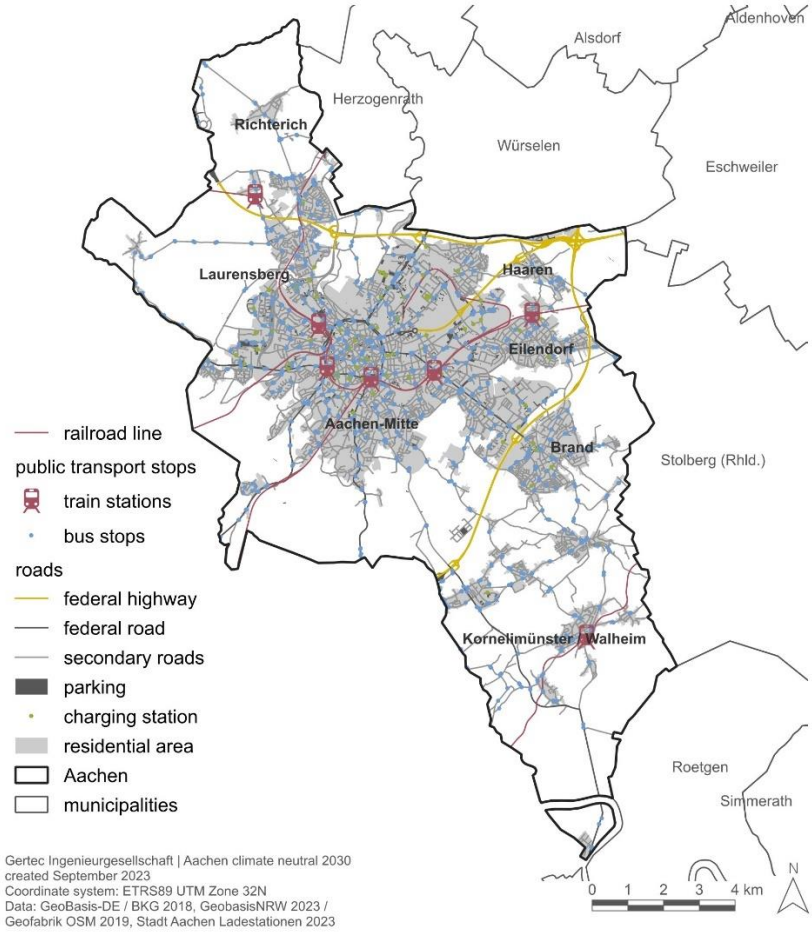

Figure AP- 4 : Overview of the mobility infrastructure of the City of Aachen
Source: Gertec GmbH

1.5 Aachen - Economic structure

Aachen is a dynamic science and business location and the regional centre for the Aachen city region.

Aachen has a heterogeneous economic structure, with around 67% of employees subject to social insurance contributions working in the service sector, a further 17% in trade, catering, transport and warehousing, followed by around 15% in the manufacturing industry, in particular mechanical engineering and confectionery production. The most important employer is RHTH Aachen University, followed by the city of Aachen and the administration of the Aachen city region. The food industry is strongly represented. In the automotive engineering sector, FEV GmbH, for example, should be mentioned as a development service provider. In the medical and healthcare sector, the Aachen University Hospital and the pharmaceutical company Grünenthal GmbH are exemplary. Sparkasse Aachen is the largest employer in the financial sector, and Generali Deutschland AG is a strong representative of the insurance industry.

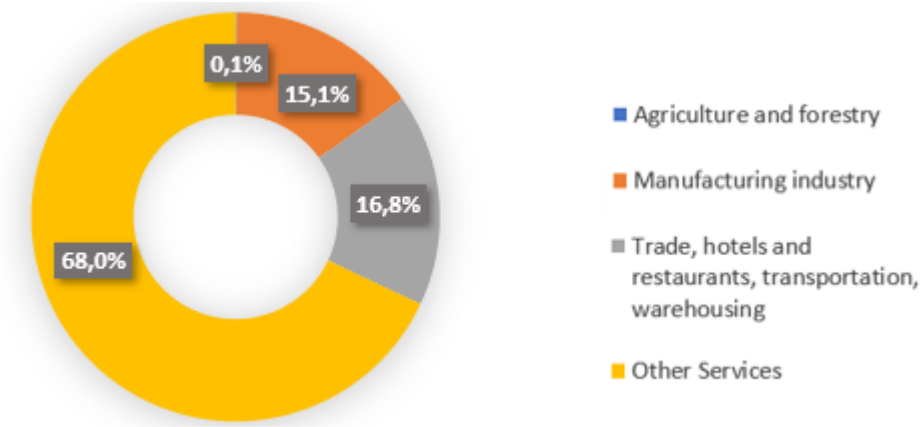

Figure AP- 5 Employees by economic sector in Aachen
Source: IT:NRW

1.6 Aachen - Energetic structure

With the Aachen model, the city of Aachen has provided an early best-practice example of how the energy transition can succeed. However, to fulfil the Climate City Contract, the entire energy infrastructure and supply in the city area must be decarbonised.

The city of Aachen has a final energy demand of 5,797 GWh [total and distribution of final energy demand by sector and energy source for 2021 are derived from the data stored in the ECOSPEED balancing tool. The data set used was retrieved in May 2023]. Natural gas has the largest share at 43 %. Natural gas is mainly used for heat supply and in second place for combined electricity and heat supply (CHP) in industry, hospitals, at RWTH Aachen University and in other public buildings (cumulatively around 8 %). In addition, a small proportion of heating oil (5%) is used in Aachen. District heating has a share of 6 %. The heat supply therefore accounts for around 60 % of the total final energy demand.

At 22%, fuels for vehicles account for the second largest share of final energy demand. Electricity consumption accounts for 19 % of final energy demand. When analysed by sector, private households account for the largest share of final energy consumption at 30%. The trade, commerce and services sector follows with a difference of only three percentage points. The transport sector accounts for 22 % and industry for 19 %. Municipal administration has the smallest share of final energy consumption at just under 2 %. Renewable energy generation in the city has so far been able to cover 15.7 % of Aachen's electricity requirements. Wind turbines account for the largest share of this at 129 GWh per year. Photovoltaics with 17.5 GWh and biomass with 26 GWh, on the other hand, only account for a small proportion.

Aachen already has a district heating network totalling 277 GWh, which already supplies 17,500 households. The district heating network is currently mainly fed with waste heat from the Weisweiler lignite-fired power plant, which is due to be decommissioned in 2029. Two combined heat and power (CHP) plants with 10 and 22 MW are currently available as alternatives. In addition, numerous feasibility studies are already underway for solar thermal supply and the utilisation of warm mine water for heat supply. Test drillings for deep geothermal energy are also planned. The realisation of a cold local heating network is planned for the RWTH Aachen's Campus West, which is currently in the planning stage. In terms of (energy) supply structures, the city of Aachen can build on a good foundation. Stadtwerke Aachen Aktiengesellschaft (STAWAG) is the majority shareholder in the grid operator Regionetz GmbH and thus bundles grid operation, management, construction and asset/meter management in the areas of electricity, gas, heating and water grids in the city of Aachen, the Aachen city region and parts of the districts of Heinsberg and Düren. By 2032, around 30,000 smart metering systems are to be installed, which will also facilitate the demand-led control of the feed-in of renewable energies, among other things.

Figure AP-6 illustrates the starting point for greenhouse gas emissions in Aachen in 2021 based on final energy consumption and energy sources.

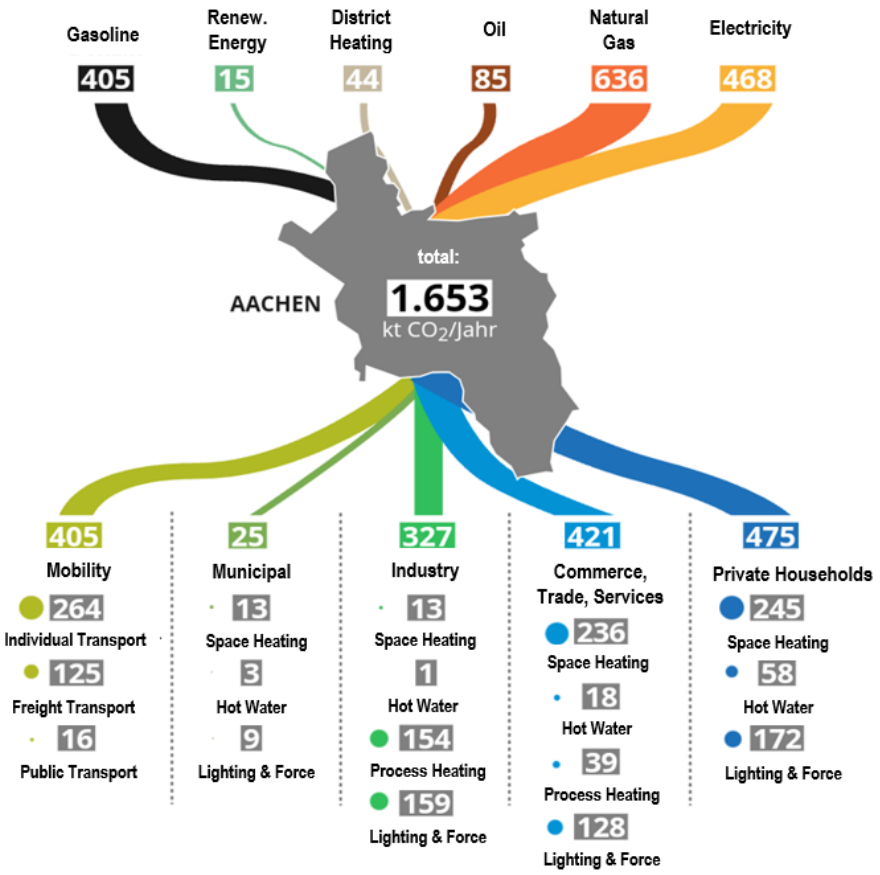

Figure AP- 6 Greenhouse gas emissions baseline 2021

Source: Gertec GmbH

Note: The calculation of electricity emissions was based on the national German generation mix. The emissions calculated using the local electricity generation mix for Aachen are slightly lower.

1.7 Aachen - climate protection target for 2030

The course for the current climate protection target for the city of Aachen was set on 22 January 2020, when the city council decided that Aachen would be the first city in Germany to take into account its share of the remaining greenhouse gas budget of 16.3 million tonnes of CO_2 eq in order to keep global warming below two degrees Celsius. The background to this decision: At the UN Climate Change Conference in Paris in December 2015, 197 countries agreed on a new global climate protection agreement: Man-made global warming is to be limited to less than two degrees, ideally to 1.5 degrees Celsius, and the necessary measures and plans are to be drawn up to achieve this. What this target of limiting global warming means for greenhouse gas emissions has been scientifically analysed. It is known that the global mean temperature rises with the amount of greenhouse gases in the atmosphere. The decisive factor for the extent of climate change is not just the current emission of greenhouse gases, but the total amount of gases that accumulate in the atmosphere over time. The average residence time of CO_2 in the atmosphere is around 120 years. Accordingly, the quantities of gas emitted in recent decades, at present and in the future must be considered cumulatively when calculating global warming. The concentration of atmospheric CO_2 will not fall quickly if emissions were to be significantly reduced immediately. Against this backdrop, the UN Intergovernmental Panel on Climate Change (IPCC) presented in its 2018 special report how much CO_2 emissions humanity can still produce to keep global warming between 1.5 and 2 °C: globally 420 gigatonnes for 1.5 °C and 1170 Gt for 2 °C. The world currently emits 42 Gt annually - and the trend is rising. If emissions remain the same, the remaining budget to limit global warming to 1.5 degrees would be used up in 2028.

In its special report, the German Advisory Council on the Environment (advisory body to the German government) averages the IPCC figures to a maximum temperature rise of 1.75 °C and a remaining global CO_2 emissions budget of 800 Gt. This results in a remaining national CO_2 budget of 6.6 Gt or 6,600 million tonnes of CO_2 for Germany from 2020 onwards, disregarding historical emissions and assuming an even distribution among the world's population. Greenhouse gas emissions in Germany currently amount to 866 million tonnes per year. This means that the permissible amount for Germany would be reached in 2028. In other words, only a quarter of current emissions should be emitted in Germany to be allowed to emit greenhouse gases by 2050. 6,600 million tonnes in 30 years means 220 million tonnes per year by 2050.

(Source: Open letter 16/09/2019, https://www.umweltrat.de/SharedDocs/Downloads/DE/04_Stellungnahmen/2016_2020/2019_09_Brief_Klimakabinett.pdf?__blob=publicationFile&v=5)

To break down the still permissible CO_2 budget of the Federal Republic of Germany to the city of Aachen, the basis of the inventory must be adjusted. While the city's CO_2 inventory only includes emissions from combustion, the Federal Republic's inventory also includes the polluters agriculture, industrial processes and waste management. This share (approx. 15%) must be deducted when transferring to the city. This leaves 5,610 Gt CO_2 of the 6,600 Gt CO_2 from incineration nationwide to meet the Paris targets (average of 1.75 degrees). CO_2 emissions in Aachen amounted to 2.139 million tonnes in 2018. If these quantities are set in relation to the comparable CO_2 emissions in Germany as a whole, the total amount of CO_2 that can still be emitted to meet the Paris targets is 16.3 million tonnes in absolute terms for the city of Aachen.

To meet the major challenges of climate protection in the city of Aachen, Department VII "Climate and Environment, City Operations and Buildings" was newly created in the Aachen city administration in 2021. Alderman Heiko Thomas was elected by the City Council in September 2021 to head this department for a term of eight years. The core tasks of Department VII are:

- Implementation of the new landscape plan with strengthening of regional marketing and agriculture geared towards sustainable production
- Exemplary function of the city as the client and operator of numerous administrative buildings in the field of sustainable construction and building refurbishment
- Strengthening municipal operations as an important municipal service provider, particularly in the areas of waste disposal, road maintenance and green maintenance

In May 2022, the "Aachen climate-neutral 2030" petition, which was signed by more than 11,000 residents, was adopted by Aachen City Council. It was not least due to this resolution that the current goal of achieving climate neutrality in 2030 was set for the city of Aachen. The **council resolution on climate neutrality in 2030** instructed the city administration to update the existing IKSK 2020 with the goal of climate neutrality in 2030 and to present it by the end of 2023 (IKSK 2.0).

The decision to make Aachen climate-neutral by 2030 is in line with the definition of the Cities Mission and includes all territorial emissions within Aachen's geographical boundaries without exception. The resolution also covers all emission sources and sectors. The climate protection targets for the city of Aachen and the information on the territorial boundaries have not changed since the expression of interest was submitted in November 2021.

1.8 Existing planning framework as a guard rail for the city of Aachen's climate protection policy

The Aachen* 2030 Masterplan was adopted in December 2012. This represents the framework plan for urban development in Aachen and was created in an intensive dialogue and with extensive participation. Developed as the basis for the redrafting of the Aachen*2030 land use plan, it is the first part of the AACHEN* 2030 process and was adopted by the Aachen City Council as the city's informal plan to be considered in the urban land use planning process. The masterplan describes the perspectives and guidelines for the city's spatial development, visualises measures in context, sets spatial priorities and identifies strategic flagship projects. Eleven guidelines and ten fields of action structure the urban development tasks described in the masterplan. Regarding climate protection and climate adaptation, the masterplan identifies the following goals and priorities:

- Energy-efficient renovation of existing buildings while preserving the architectural quality and distinctiveness of buildings that characterise the cityscape
- Limiting the amount of traffic by introducing a campus railway in conjunction with a system of networked local mobility (Note The plans to build a light rail system from Aachen-Brand to the Melaten campus under the name "Campusbahn" were ended by a referendum in 2013)
- Accelerated expansion of renewable energies based on an overall concept coordinated with the region
- Strategies and measures to mitigate the negative effects of climate change.

Further strategic concepts of the City of Aachen

In over 25 years, various strategic and programmatic concepts and action programmes have been initiated and implemented in the areas of energy and climate protection as well as mobility. The most important strategy papers from the last 10 years are listed below.

- Energy efficiency concept with 5-year plan 2006-2010
- Integrated air pollution control and action plan from 2009, updated in 2015 and 2019, 2024
- 2012 Masterplan Aachen*2030
- Traffic development planning (VEP) Aachen as a permanent process since 2012
- Energy policy work programme European Energy Award® (eea), 2010, 2015 and 2019
- Sectoral specialised planning in the areas of wind, solar, biomass or district heating
- CHP expansion concept "CHP Initiative Aachen 2014 - 2017"
- Climate protection strategy concept 2030 with action programme 2020 from 2014
- Implementation strategy #AachenMooVe! ("Model city without emissions in transport")
- Climate impact adaptation concept with implementation roadmap 2017-2021
- Aachen 2030 regional energy plan from 2018
- ISKS 2020 from the year 2020

The concepts created up to 2013 were analysed and considered in the 2030 strategy concept (completed in 2014) in terms of their degree of implementation and remaining potential. There are also numerous pioneering campaigns and advisory projects such as altbau plus, ACtiv für's Klima, energieeffizienzFACHBETRIEB, Aachen clever mobil and many more.

The following measures can be regarded as milestones of the last 15 years:

- 2009 Promotion of electric vehicles (STAWAG), five electric charging stations
- 2010 Aachen standard for the construction and refurbishment of municipal buildings
- 2011 Solar roof register
- 2011 First nationwide, fully automated DB e-Call-a-Bike station in Aachen
- 2012 difu competition for municipal climate protection, award winner with E-View - The Energy Gazette
- 2012 100 kWp PV system Ludwig Forum
- 2012 ASEAG hybrid bus in regular service
- 2013 Designation of wind concentration areas
- 2013 ACtiv for the climate at Aachen schools and daycare centres 2010-2013
- 2013 EU-GUGLE, refurbishment of municipal housing by 2018
- 2014 Adoption of the Vision Mobility 2050 in the VEP Aachen

- 2014 Decision on Mayors Adapt
- 2014 render - innovation group, regional energy dialogue until 2018
- 2015 Re-certification FSC Aachen Forest and subsequent years
- 2015 ASEAG, self-converted electric bus in regular service
- 2016 Introduction of an environmental zone
- 2016 Energy service directive - rules of behaviour for users
- 2016 First mobility station (Campus Melaten)
- 2017 Green and design statutes
- 2017 Introduction of Mobility Broker and eTicket from ASEAG
- 2017 New regulation for business trips incl. access to Mobility Broker
- 2017 Top 3 among major cities, German Sustainability Award 2018
- 2018 Award for the #AachenMooVe! project in the Municipal Climate Protection.NRW "Emission-free city centre" competition
- 2018 Expansion of Vetschau/Aachen-Nord-West wind farm, 5 turbines connected to the grid
- 2018 Completion of the Aachen-Brand refurbishment roadmap
- 2018 10-megawatt CHP plant Campus Melaten
- 2019 Re-certification European Energy Award - 2019 Mobility Strategy 2030, Part 1 (mandate & structure of the VEP) adopted
- 2019 "Aachen cycling decision" carried out and accepted
- 2019 Wind turbines in Münsterwald, 7 turbines in 2018/19
- 2020 Mobility Strategy 2030 Part 2 (objectives & indicators of the VEP) adopted
- 2020 Integrated climate protection concept (IKSK) 2020 is adopted
- 2022 "Climate Decision Aachen" carried out and adopted Council resolution Climate neutrality 2030

1.9 The Integrated Climate Protection Concept 2020 (IKSK 2020) for Aachen

Note: The document is uploaded separately, see attachment *IKSK 2020*

On 19 June 2019, the Aachen City Council adopted the climate emergency and at the same time commissioned the development of the Integrated Climate Protection Concept (IKSK 2020) for the city of Aachen. The concept is based on an inventory that analyses the successes and failures to date and considers activities such as participation in the European Energy Award (EEA) with its strategic recommendations and proposed measures.

The IKSK 2020 builds on the strategy developed in 2014 to reduce CO_2 emissions in two-time horizons, by 40 % from 1990 to 2020 and by 50 % from 1990 to 2030. It was adopted by Aachen City Council on 26 August 2020.

The resolution passed parallel to the concept development on 22 January 2020 to comply with the proportionate residual budget of CO_2 emissions that can still be emitted in the city of Aachen - while adhering to the Paris targets (staying below 2 degrees global warming) - is taken as a basis in the sense of a milestone target within the framework of the IKSK 2020. Considering the 22% reduction in CO_2 emissions already achieved since 1990, this leaves a CO_2 quantity of 768,500 tonnes that must be saved by 2030 (around 76,900 per year). Of this, 398,000 tonnes are attributable to the transport sector, which has seen a 19 % increase in CO_2 emissions since 1990. In the other sectors, where CO_2 emissions have fallen by 33% since 1990, 370,500 tonnes must be avoided by 2030. The aim of the IKSK 2020 is to identify the areas with the highest reduction potential and to identify the most promising measures - also from a cost-benefit perspective.

The City of Aachen's IKSK 2020 was developed in a year-long process together with many stakeholders from politics and administration as well as civil society. Many of the suggestions made during the participation process were incorporated directly into the planning of measures. In total, the participation process resulted in around 70 measures for the 2025 action plan (for details, see overview of measures in modules A-2). On 26 August 2020, the IKSK 2020 was unanimously adopted by the City Council of Aachen by all political groups. The Council thus followed the recommendations of the Committee for the Environment and Climate Protection, the Mobility Committee, the Planning Committee and the Housing and Logistics Committee, in which the IKSK 2020 had previously been discussed.

The 2030 strategy and the 2025 action plan both aim to halve the city of Aachen's emissions by 50 % by 2030 compared to 1990 emission levels. The programme of action, including the action profiles of the IKSK 2020, is scheduled until 2025 and includes a strategy concept until 2030. The action plan until 2025 comprises the following fields of action:

- Urban planning
- Municipal buildings
- Energy supply
- Mobility
- Building refurbishment (private, commercial, non-municipal)
- Communication
- Economy

This was supported by a communication and participation concept and strategic recommendations for decarbonisation by 2030. The action programme with an overview of measures for 2025 comprises over 200 measures spread across various sub-concepts. The energy policy work programme as part of the EEA contains most of these measures.

In line with previous climate protection concepts, the strategically most important areas include efficient energy generation using renewable energies, the energy-efficient refurbishment of existing buildings using efficient building technology and optimisation of the building envelope, the commercial and industrial sector, in particular the use of efficient technologies, and the transport sector with a focus on car volumes in urban and regional transport and vehicle technology/emissions.

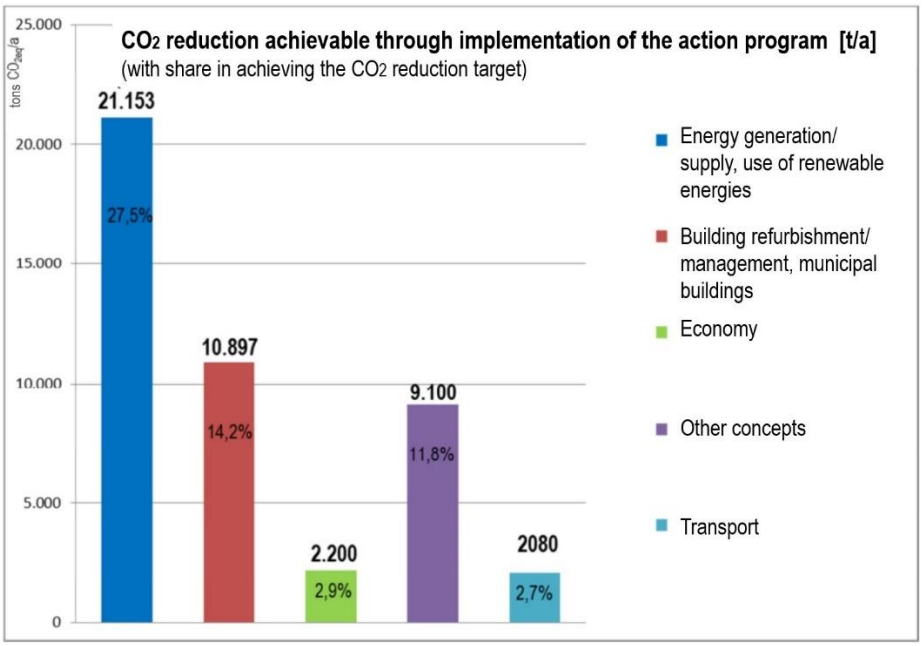

Figure AP- 7 CO_2 reduction potential in the strategic fields of action
Source Gertec, from IKSK 2020.

The IKSK 2020 contains a programme of action designed to tap into the potential shown in Figure AP-7. This programme of action also includes measures listed in earlier concepts that have not yet been implemented. It also considers the energy policy work programme from the European Energy Award process. In addition, a 5-year plan with around 70 new measures was developed as part of a participation process to accelerate climate protection in the city of Aachen in an initial phase up to 2025. The measures of the IKSK 2020 and the reduction potential in the strategic focus areas are described in detail in Module A-2. The costs of the 2025 action plan amount to 35 million euros per year for the urban measures, of which 15 million euros are allocated to the mobility sector and 20 million euros to the energy/EE, building refurbishment and business sectors.

The personnel costs for the IKSK 2020 amount to 49 full-time positions, the majority of which are to be newly created. Assuming a linear reduction process over 10 years, the 2030 action plan of the IKSK 2020, together with other concepts of the City of Aachen (e.g. energy policy work programme), achieves a reduction effect of 45,430 tCO_2eq /a. This corresponds to a reduction in CO_2 emissions from 1990 of around 51 %.

The IKSK 2020 contains climate protection measures for the municipal core administration and its own companies. Measures relating to municipal participation and the rest of the municipal community are not considered. Implementation of the measures in the IKSK 2020 began in 2021. The implementation of the IKSK 2020 action plan should be completed in 2025. The implementation status is recorded and reported annually by Department 36. The detailed profiles of measures can be found in the IKSK 2020 in chapter 5 on pages 78-143.

1.10 The Integrated Climate Protection Concept 2030 (IKSK 2.0) for Aachen

Note: The document is divided into two parts, which are uploaded separately, see attachment *IKSK 2.0_Part1 and IKSK2.0_Part2_Actions*. Part1 roughly outlines the path to climate neutrality by 2030, Part 2 concretises measures

The IKSK 2.0 "Aachen: The path to climate neutrality in 2030" is a concept paper that was developed in a participatory process by Gertec GmbH with the city administration and representatives of the city's society in 2023. It is the consistent implementation of the Aachen City Council's mandate to the city administration to present a comprehensive concept for Aachen's climate neutrality. At the time the Climate City Contract was submitted, the IKSK 2.0 was undergoing political consultation. It is to be adopted in March 2024 by council resolution as a strategic

paper on climate neutrality for the period up to 2030. The relevant departments and specialist areas will then define packages of measures that will be adopted by the relevant political committees and budgeted in the city budget.

Details on the measures of the IKSK 2.0 can be found in Module B-2. The IKSK 2.0 is to be understood as an expert opinion based on the IKSK 2020 and is intended to include an adjustment of the strategic orientation towards the goal of climate neutrality in 2030 through to concrete proposals for activities. The update also has the task of closing gaps in the City of Aachen's previous strategy. This includes governance strategies, strategies for transformation in the areas of lifestyles, consumption, nutrition and the circular economy, as well as the greater integration of land use and mobility issues.

The IKSK 2.0 describes a path to climate neutrality by 2030 and presents the municipal contribution to achieving this goal as part of the EU mission "100 Climate-Neutral and Smart Cities by 2030". It emphasises once again that a climate-neutral municipality is a joint task for the entire city that requires activities at all levels.

The municipal family, consisting of the core administration, municipal enterprises and holdings, has a maximum direct and indirect potential influence of around 50 % on the reduction of energy related GHG emissions in the city. The market players in Aachen (private households, companies) must also make their contribution. It is also necessary for the EU, federal and state governments to set the appropriate framework conditions. The IKSK 2020 provides the basis for the actions of the City of Aachen's administration. With the implementation of the IKSK 2020, financial and human resources have been made available and comprehensive climate protection measures have been initiated. However, the GHG reduction measures and the resources provided are not sufficient to achieve the formulated goal of climate neutrality by 2030. From a technical perspective, there is also a need for thematic expansion and more in-depth content. The IKSK 2.0 continues the IKSK 2020 and adds the following focal points:

- It introduces the new areas of governance, social transformation and offsetting.
- It carries out in-depth technical analyses in the existing fields of action of the IKSK 2020 (buildings, energy, mobility, economy) and adapts the target and measure levels with their municipal activities.
- It addresses important framework conditions for implementation. These include recommendations for process control and process monitoring, a more integrated view of the climate neutrality target as a cross-sectional task of urban development and climate justice as a basis for social acceptance. The IKSK update provides initial approaches in this regard.
- It estimates the resources required for climate neutrality in the city, as well as the associated benefits.
- It creates transparency by identifying and quantifying activities to be implemented in the short term and combining these with the measures of the IKSK 2020 to create an overall portfolio of measures that can be updated.
- It sets strategic guidelines for implementation by specifying fields of action, areas of activity and measures as well as formulating the respective objectives.

The update of the IKSK is not a rigid plan but describes a transformation process: to achieve the goal of climate neutrality by 2030, an understanding of transformation processes and fundamental changes in the municipal family and at a city-wide level are required. What is needed is the acceleration of implementation and the broadest possible anchoring of the goal of climate neutrality.

The path to climate neutrality requires rules and structures for cooperation. At the municipal family level, this primarily requires clear, cross-sectional and transparent cooperation within the administration and with the municipal enterprises and municipal holdings. The IKSK 2.0 formulates organisational and procedural recommendations for this. Climate neutrality pays off: Investment costs of at least 7.2 billion euros are estimated by 2030. This will avoid a total of €254.7 million in environmental costs per year. In addition, demand-related costs totalling €417.5 million per year will be saved. Aachen citizens will be relieved of €67.7 million in electricity and heating costs per year. At the same time, sales of up to 95.1 million euros per year can be generated in the region.

The fields of action of the IKSK 2.0 are:

1. **Governance**: The path to climate neutrality requires new governance that communicates, coordinates and controls both internally and externally. The range of tasks of the new governance unit to be created is very diverse. For example, it has the function of maximising and consolidating the influence of the municipal family. This influence can be exercised on four levels: Regulating | Providing and offering | Advising and motivating | Consuming and setting an example. A regular and targeted exchange format

should be established for target group-specific offers. In addition, urban development and climate protection must be strategically considered as a cross-sectional task and the relevant departments must be brought together. Conflicting objectives must be recognised, moderated and resolved. Only in this way can climate protection measures fulfil social, ecological and economic criteria in equal measure. This is a prerequisite for broad acceptance of a path to climate neutrality in civil society. Controlling and monitoring of the process are also required to check, evaluate and readjust compliance with the development path. The options for monitoring the city administration's budget and the business plans of the municipal enterprises and companies form an important basis for the ability to steer the city towards climate neutrality. The EU Mission Transition Team provides a good basis for the governance unit. However, it needs additional staff to ensure that it can fulfil its tasks in full.

2. **Energy:** The energy transition is going electric. The goal of climate neutrality can only be achieved if fossil fuels are completely replaced by renewable energies using cross-sectoral approaches. Today, electricity and heat generation in Aachen emits almost 1.2 million tonnes of CO_2eq every year. More than 60 % of this can already be saved by switching energy sources. The expansion of renewable electricity generation from wind and solar power, the expansion of cross-sector supply concepts and the system integration of renewable energies are key tasks here. Electricity, gas and heating grids must also be optimised together to create hybrid grids. Municipal heating planning, which will be carried out for the city of Aachen in 2024, will set a decisive course for the heating transition. Decarbonisation and the expansion of district heating is a lever with which the climate-neutral conversion in the city's districts and neighbourhoods can also succeed in terms of a social and sustainable urban development strategy.

3. **Buildings:** The renovation rate must be increased to 4% annually to achieve climate neutrality by 2030. Remaining energy requirements for space heating, hot water and electricity must be covered by 100% renewable energies. Sustainable urban neighbourhoods must be promoted to address the living environment, local supply and mobility services in an integrated manner. New buildings must fulfil the highest efficiency standards for buildings that are at least greenhouse gas neutral. The City of Aachen is leading the way with the energy-efficient refurbishment of its own building stock and is striving to achieve climate neutrality in its non-residential and residential building stock.

4. **Mobility:** The mobility field of action encompasses all measures that support the path already taken by the city of Aachen on the way to a climate-neutral mobility system and avoid motorised transport, shift to climate-friendly means of transport or switch to climate-friendly drive systems. Aachen is cleverly positioned with the close cooperation between the city and the neighbouring municipalities in the Aachen city region in the "Netzwerk Mobilitätswende Region Aachen" (NEMORA). The expansion of public transport, mobile stations, regional cycling and financing issues are coordinated in four working groups. The expansion of public transport, cycle and pedestrian paths and charging infrastructure play a significant role in a successful mobility transition. The conversion of the municipal family's fleet to combustion-free drives also contributes to climate neutrality. In the area of road-based commercial and freight transport, it is important to promote a shift to rail or a switch to climate-friendly drive systems wherever possible.

5. **Economy:** A significant part of the transformation task towards climate neutrality lies with market players. Around 122 thousand tonnes of annual greenhouse gas emissions must be reduced in the business sector by 2030 to achieve climate neutrality. Key activities include reducing current electricity and heating energy requirements and transforming the transport of goods and personnel. Modernisation measures in thermal production should reduce consumption for the provision of process heat in industry by around 20% to less than 550 GWh/a by 2030. The willingness of the economy to act in a climate-friendly manner is reinforced by two current trends: 1) climate neutrality is increasingly becoming the guiding principle of economic policy, 2) security of supply with electricity from renewable energies has become a location factor, not least due to the war in Ukraine. In Aachen, the growth in consumption is also to be decoupled from the consumption of non-renewable raw materials by establishing a consistent circular economy. Aachen's municipal utility company and the municipal waste - or rather recycling - management have a special role to play here. The City of Aachen has a direct influence on the agricultural use of urban farmland in the supply of food through appropriate regulations on leasing and through the procurement of municipal communal catering. There is also an indirect influence in supporting sustainable production and trading processes.

6. **Societal transformation:** Societal transformation is a systemic task. Although individual, smaller changes in behaviour contribute to protecting the climate, a societal transformation requires support to bring about a broader, more fundamental change. Furthermore, the responsibility for transformation does not lie solely with the individual, but also with other actors such as the municipality or market players. Considering and considering the effects from and on social circumstances is a fundamental prerequisite for the success of the transformation to climate neutrality. Greenhouse gas savings can be achieved across all sectors through sufficiency, i.e. savings through reduced use or consumption due to changes in behaviour. Private households offer the greatest potential for sufficiency - particularly regarding electricity consumption - with approx. 79 kt CO_2eq/a. Climate-friendly behaviour must become the new routine so that it can be implemented in everyday life by a large proportion of the population. It is therefore not a question of discussing values, but rather of emphasising the benefits of climate-friendly solutions. Incentives can help to initiate and permanently implement changes in behaviour. Although there is growing environmental awareness in society, the pressure to change is generating resistance, particularly due to the perceived loss of control. Climate protection needs a new "framing" that emphasises the benefits and enrichments, deals with challenges in a practical and transparent manner and thus reduces reservations and fears. The relationship between climate neutrality measures and the effects on the various social situations in the city is not always free of conflict. Disadvantaged social locations are often particularly negatively affected by the consequences of climate change and other environmental influences (noise, heat, etc.). It is therefore important to pay particular attention to this area of conflict. It is important to better understand the effects and, where possible, to take greater account of them when implementing measures (for example in the areas of rents and energy/heating).

7. **Offsetting**: Offsetting CO_2 emissions should only be seen as the final, unavoidable step at the end of a process whose primary aim must be to avoid emissions altogether or reduce them as far as possible. The IKSK 2.0 describes strategies for offsetting the amount of greenhouse gases required to achieve climate neutrality without undermining the success of emission reductions. The planned offsetting activities of the City of Aachen are described in Module B-2.3.

1.11 Relationship between the action plans from the CCC Action Plan, the IKSK 2020 and the IKSK 2.0

The Action Plan of the Aachen Climate City Contract is an extension of the existing IKSK 2020 and IKSK 2.0 concepts. The IKSK 2020 comprises 70 measures from the core administration and the city's own companies that will lead to a 50% reduction in greenhouse gas emissions compared to 1990 levels by 2030. These measures have been politically approved and have been allocated funding from the municipal budget totalling around € 181 million. Implementation of the IKSK 2020 began in 2021 and is scheduled for completion in 2025.

The IKSK 2.0 is an update of the IKSK 2020 with the aim of achieving climate neutrality or reducing greenhouse gas emissions by at least 80 % compared to 1990. In addition to the measures of the administration and its own companies, it also describes those of the municipal holdings that must be implemented to achieve the target. The action plan of the IKSK 2.0 partly takes up those of the IKSK 2020 and runs from 2024-2030. The extended measures of the IKSK 2.0 have not yet been politically adopted and are therefore not included in the municipal budget. The IKSK 2.0 and its measures are discussed in detail in Modules B-1 and B2.

The Climate City Contract's Action Plan looks at the measures taken by all stakeholders in the city to achieve the goal of climate neutrality. It outlines the process of change in the entire urban society and describes the steps for its implementation. The aim of the action plan is to completely reduce avoidable greenhouse gas emissions in the city of Aachen by 2030 and to eliminate at least 80 % of CO_2 emissions compared to the base year 2020. The action plan presents an offsetting strategy for unavoidable emissions in 2030.

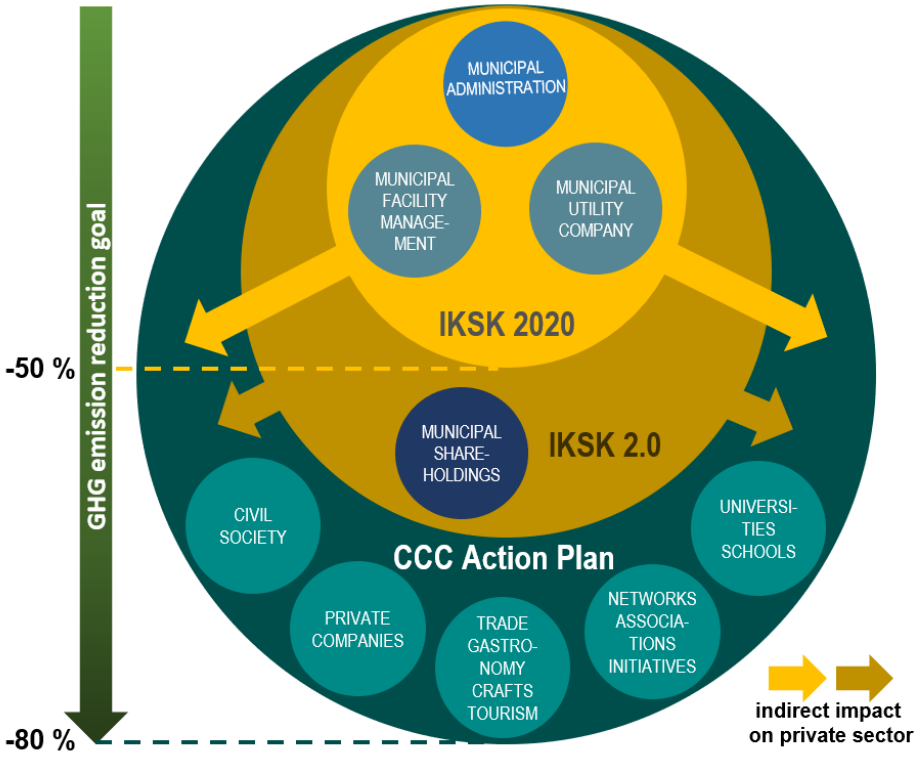

Figure AP- 8 Relationship between the CCC Action Plan, the IKSK 2020 and the IKSK 2.0

The IKSK 2020 was politically adopted in 2020 and is currently being implemented until 2025 with the aim of halving the city's greenhouse gas emissions by 2030 compared to 1990. The IKSK 2.0 lists the measures of the city administration as well as those of the municipal holdings. It shows Aachen's path to climate neutrality. It has not yet been politically adopted.

The Action Plan of the Aachen CCC comprises the measures of the IKSK 2020 (Modules A-2), those of the IKSK 2.0 (Modules B-2) and those of the rest of urban society (Modules B-2). The measures of the CCC should lead to a reduction in greenhouse gas emissions of at least 80 % by 2030 in relation to the base year 2020.

The IKSK 2020 and IKSK 2.0 have an indirect impact on urban society, e.g. via specific funding programmes or public procurement regulations.

1.12 Climate neutrality - a joint task for the entire urban society

Achieving the goal of climate neutrality in a municipality requires a comprehensive transformation of the entire city, in which everyone in Aachen must ultimately be actively involved. Transformation means a fundamental change. It describes changes in the political, economic or technological relationships of a society. It involves long-term processes and is only finalised when new system structures have become permanently established.

A key question is what triggers the transition to a climate-neutral society. Is the necessary change the result of proactive, risk-minimising behaviour and decisions or is the change reactive - i.e. the result of the greater impact of climate change? The city of Aachen wants to take a proactive approach to achieving climate neutrality. This requires an equally proactive attitude at the three decision-making levels involved (see Figure AP-F9). Specific decisions are made at these levels and the framework for action is determined. The decisions have an inhibiting or promoting effect at the respective levels. Each level is necessary, none can replace the others and the goal of climate neutrality can only be achieved through interaction. A distinction is made between three decision-making levels: state/federal government/EU, market players (suppliers and consumers) and the municipal family. From the municipal perspective, the laws are set by the EU, federal and state actors. Through their economic activities, market players create an environment with and in which municipalities operate. At the same time, there are interactions through municipal regulatory options. These relationships can set limits to the municipal sphere of

influence but can also expand it through cooperation and conscious control. The top level is the municipal family, i.e. the core administration, municipal enterprises and municipal holdings. This actor has a maximum direct and indirect potential sphere of influence of around 50 % on the reduction of energy related GHG emissions for the city. This means that the two other levels, the market players and the state/federal government/EU, also account for around 50 %.

Figure AP- 9 Multi-level analysis of the stakeholders involved in the transformation process to achieve climate neutrality
Source: Gertec GmbH

1.13 The Aachen Alliance for Change

On its path to climate neutrality, Aachen needs an alliance of visionaries, frontrunners, role models, persuaders, committed people, innovators and doers. A wave must be triggered that sweeps the entire urban society along - a wave of confidence, optimism and anticipation of what will emerge in Aachen and what Aachen will be like in 2030. The most important stakeholders for change are briefly outlined here:

I) Communal family

The municipal family, consisting of the core administration, municipal enterprises and municipal holdings, is a key player on the road to a climate-neutral Aachen. It is simultaneously active in steering, shaping and setting an example in the city-wide transformation process. As the greatest potential for saving emissions in the city of Aachen lies in the energy, heating and mobility sectors, the city's own municipal enterprises and municipal holdings, together with building management and municipal operations, the local energy supplier, grid operator and mobility provider, are key partners on the path to climate neutrality.

The core administration has a variety of functions on the way to a climate-neutral Aachen:

- Strategic direction set by the Board of Directors
- Specification and prioritisation of the climate protection measures from the IKSK 2.0, considering the criteria of leverage, speed, financial viability and social compatibility, and moderating and resolving potential conflicts of objectives.
- Recommendations for political decision-makers, such as committees and the city council
- Operational implementation of the politically agreed measures.

In addition to the core administration with its own operations, the planning and implementing bodies are the municipal holdings. With STAWAG, Regionetz, gewoge and ASEAG, key players have made a commitment to the Climate City Contract (see Commitments, Chapter 5, Table C-3). They are driving forward the energy, heating and mobility transition in Aachen and are assuming their responsibility in the overall process.

II) Private sector

Looking at the primary energy consumption of the City of Aachen for 2022 (Figure AP-10), the industry sector accounts for 22 % (357 kt CO_2 eq) and the trade/commerce/services sector for 18 % (279 kt CO_2 eq), i.e. 40 % in total.

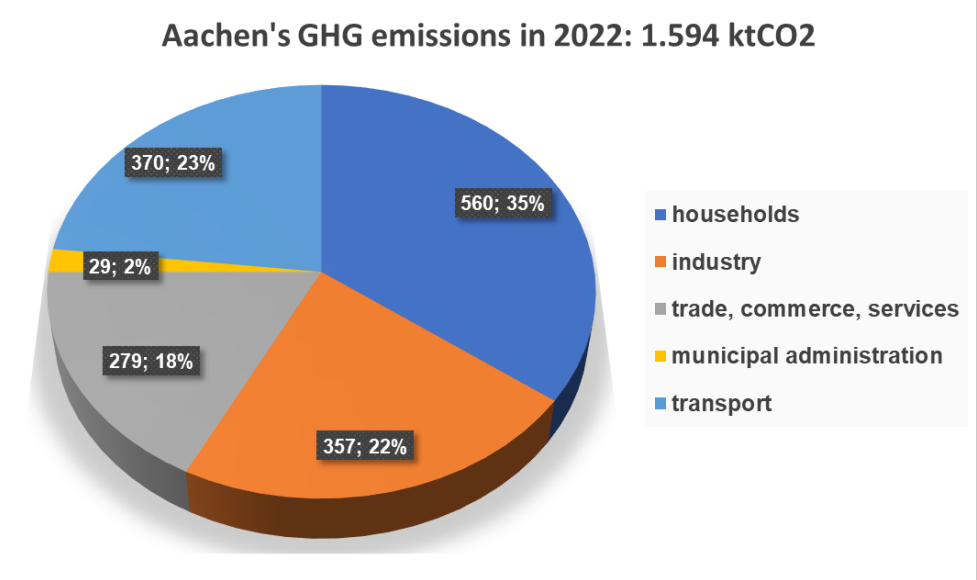

Figure AP- 10 Greenhouse gas emissions of the City of Aachen by primary energy consumption for 2022
Note: Consumption (2022) broken down by sector. Compared to the previous year, emissions have fallen by 17 % or 327 kt CO_2 eq

Key activities to achieve climate neutrality in this stakeholder group are the reduction of electricity and heating energy requirements as well as a transformation of goods and personnel transport. And finally, it is also the willingness of the private sector to invest capital in climate protection measures that will make the "climate-neutral Aachen" mission a success.

III) Universities and educational institutions

RWTH Aachen University is one of the largest technical universities in Europe, with around 45,000 students, 550 professors, 260 institutes and an area of more than 600,000 square metres, making it the size of a small town. RWTH's electricity consumption is roughly equivalent to that of 25,000 four-person households in Germany. The total energy consumption in 2021 was 260,525 MWh, of which heating energy: 121,896 MWh, electricity: 107,171 MWh, cooling: 31,458 MWh, which corresponds to around 4% of the total energy demand of the city of Aachen. RWTH Aachen University's intention to make its operations climate-neutral by 2030 is therefore important for the city's overall goal.

However, Aachen's universities are also highly relevant as drivers of innovation on the road to climate neutrality. With strong research activities in the fields of energy and mobility, RWTH and FH Aachen are important partners for the city on the road to climate neutrality. This is the ideal breeding ground for disruptive innovations that are needed to test new technologies and bring them to market maturity. In addition, both universities have a strong and successful start-up culture, so that the translation of market-oriented research results into the economy via start-ups or collaborations with existing commercial enterprises is common practice. In the transformation process, all educational institutions have the task of sensitising pupils and students to the topic of "climate protection and climate change" and communicating the potential and responsibility of everyone.

IV) Environmental, climate and sustainability initiatives

The range of sustainability initiatives in Aachen is exceptionally broad. Many of the city's citizens have been volunteering for social justice, environmental and climate protection and a future worth living in for decades. The initiatives not only bring the issue to the public, but also call for practical action. The importance of the sustainability initiatives for the transformation process was also emphasised by the fact that they were actively involved in the development process of the IKSK 2.0 throughout 2023.

IV) Civil society

The transformation process towards a climate-neutral Aachen must be supported by the entire community. To this end, it is particularly important that the entire process is transparent, socially equitable and participatory. The involvement of civil society in Aachen is facilitated by various characteristics:

1. Aachen already has a citizenry that is strongly committed to climate protection. The residents' motions for a cycling referendum and a climate referendum collected so many signatures that they were successfully submitted to the city council.
2. More than 20,000 citizens in Aachen are already involved in voluntary initiatives that focus on sustainability and climate/environmental protection. The we@aachen initiative has undertaken an extensive mapping of this initiative landscape so that this stakeholder group can be addressed in a targeted and comprehensive manner. On 3 June, an event was held in the Krönungssaal of Aachen City Hall under the patronage of the mayor, at which 30 of the climate initiatives presented themselves to the entire urban community.
3. The Fridays for Future movement is particularly strong in Aachen, as both pupils and students are working together to protect the climate.

In the first version of the Aachen Climate City Contract, individual citizens were not yet actively involved. The process of obtaining commitments from civil society and citizens is organised in two stages in the Climate City Contract process. In the first stage, information about the "Climate Neutral Aachen" mission has been provided through various communication channels and events since April 2022 (see table AP-2, following chapter). These information events, some of which were also open to citizens, served to pass on information and, above all, to arouse interest among citizens to become more actively involved in the next step. For the events, organisations that are suitable as multipliers for addressing civil society or target groups that are more difficult to reach, such as migrants or older citizens, but also actors such as SMEs from industry and trade (e.g. umbrella organisations, schools or church institutions) were also specifically addressed. Many of these organisations have also signed commitments to the CCC. In the second stage - up to the first iteration loop of the CCC - civil society and the private sector are to be actively involved in the further development of the CCC in order to implement current measures of the Action Plan in a needs- and target group-oriented manner or to develop new measures, in particular for behavioural change, in a co-creation process. This also includes the development of new innovative formats and methods for involving civil society, which are to be increasingly trialled through the CoLAB pilot project of the German Mission cities of Aachen, Mannheim and Münster. In CoLAB (Committed to Local Climate Action Building), the three German EU mission cities, together with other project partners, are testing innovative ways to reduce the behaviour-related greenhouse gas emissions of citizens. Aachen is planning to set up a climate, energy and sustainability agency as a contact point for various stakeholders. The agency is intended to facilitate access to services, enable networking and generate direct local impact.

In preparation for the establishment of the agency and the selection of possible (digital) offers, a workshop was offered to all visitors on 23 February 2024 as part of the GoDigitalAC! conference, which dealt with climate protection and citizens' wishes for future offers and information. The core questions of the workshop were:

- What are you already doing today for a climate-neutral Aachen?
- Where do you see potential to expand your own contribution?
- What (digital) services / support would you like to see for this?

The results of the workshop were captured in a graphic recording and will be incorporated into the sharpening of the offerings that are being developed in CoLAB.

Figure AP- 11 Graphical recording of the results of the "GoClimateNeutralAC!" workshop
Copyright: djangonaut

Target groups that have not yet been successfully involved in the development of the CCC by obtaining commitments and organising information events are sports clubs and cultural institutions. As described above, the first step was to integrate organisations that can act as multipliers into the CCC development process via a commitment. The Stadtsportbund Aachen is the local umbrella organisation for around 230 Aachen sports clubs and thus represents the interests of around 64,000 sports club members in Aachen. It has yet to be possible to approach sports clubs and nationally recognised sports clubs such as Alemannia Aachen or the "Ladies in Black" volleyball team as important multipliers for communicating content and participation opportunities for the development of the CCC.

Major development projects, such as the redevelopment of the Soers sports park, will also be used to inform current and future user groups about the CCC development and actively encourage participation.

For the cultural sector, innovative formats are to be found, above all through CoLab, which bring together the topic of climate neutrality and the cultural sector, in the sense of developing climate-neutral cultural enterprises and establishing cultural enterprises and institutions as places of information and extracurricular learning.

The Climate City Contract has proven to be a powerful instrument for bringing together the key partners for change. The Climate City Contract's commitments show how much support there is from the entire urban community for Aachen's ambitious climate target and the associated transformation process.

A city-wide network for a climate-neutral Aachen has developed, which is shown schematically in Figure AP-12.

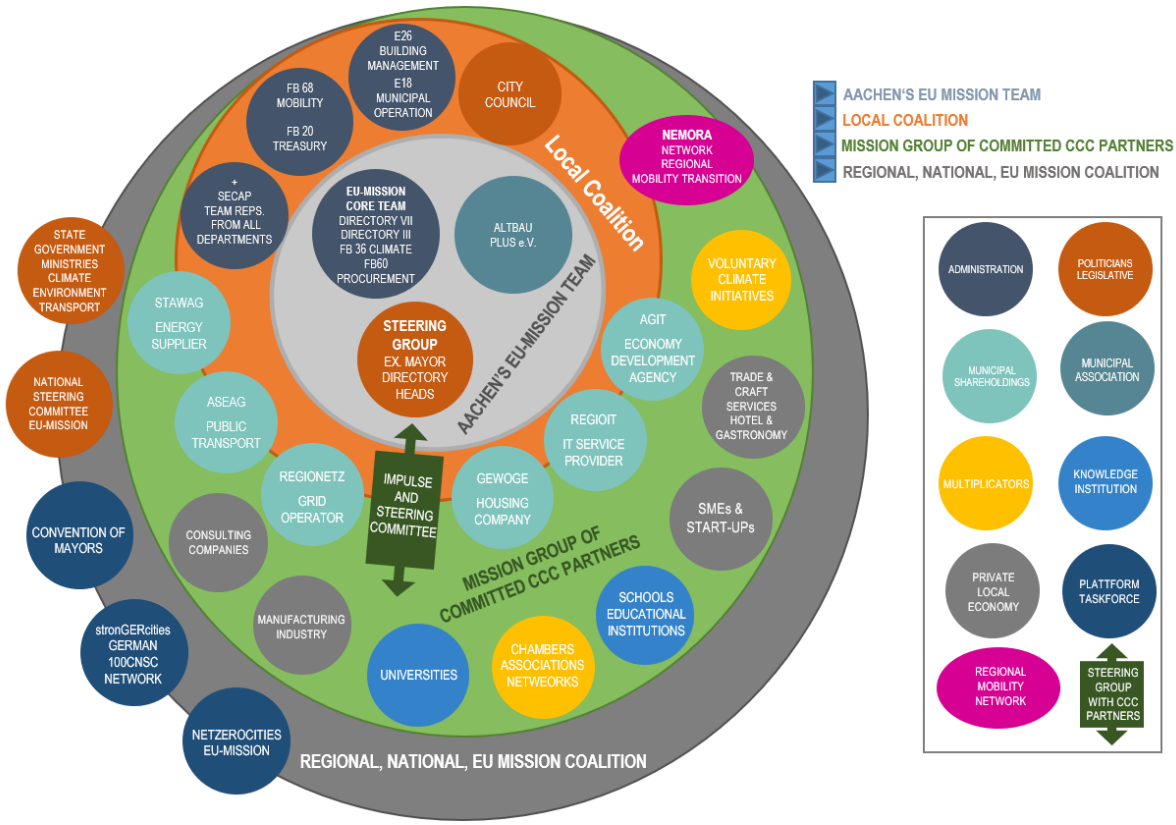

Figure AP- 12 Schematic representation of the local network for a climate-neutral Aachen

Note: Explanations in the text.

The nucleus of this network is the EU Mission Team. This consists of the administration's internal Transition Core Team, the "Climate-neutral Aachen 2030" office at the city's altbau plus association and the Administrative Board. The Transition Core Team was put together in April 2022 by the deputies of Departments III and VII, Frauke Burgdorff and Heiko Thomas, from representatives of different departments and is jointly managed by both. It works horizontally within the city administration and forms an important axis of action and communication. As representatives of the Transition Core Team, the management and Strategic Projects Unit of Department 60 carried out an administrative tour in autumn 2022. During this tour, one department from each department was informed about the objectives of the EU mission and the Climate City Contract to awaken a shared sense of responsibility for the development and implementation of climate neutrality measures in the city administration.

The "Climate-neutral Aachen 2030" office, which was set up at altbau plus e.V. in April 2023, works particularly in the direction of urban society, but also via various channels and processes in the city administration. The core team is complemented by the administrative board. This committee of department heads and the Lord Mayor serves as a source of ideas, sparring partner and catalyst for the content and implementation of the Climate City Contract.

The so-called local coalition brings together the city council, municipal enterprises, the departments for mobility and financial management and the city administration's climate protection team, supplemented by the municipal holdings, which are responsible for implementing the IKSK 2.0 measures.

The regional network NEMORA, which was founded in summer 2023, is important for a successful mobility transition. This is an association of regional authorities (all municipalities in the Aachen city region), ASEAG and the AVV (Aachener Verkehrsverbund) for a climate-oriented mobility transition.

The municipal investments form the bridge to the "Mission Group of Committed CCC Partners". This includes all supporters of the Climate City Contract. By 28 February 2024, 133 commitments from the entire urban community had been submitted (for details, see Commitments, Chapter 5).

A new impulse and steering committee will also be set up under the leadership of the Lord Mayor, which will include the administrative board, members of all council parliamentary groups and representatives of the commitment donors from industry and trade. The aim of this group is to take greater account of the needs of the business community in Aachen's future climate policy.

The framework for action required for the transformation to a climate-neutral municipality must also be set by politicians beyond the city limits. In addition to Net Zero Cities and the stronGERcities network of nine German mission cities, state and federal governments and the EU Commission are also key partners here. Adapted or new laws, guidelines and funding programmes are needed to enable local authorities to implement the necessary measures and change processes to achieve climate neutrality.

1.14 Work process for the development of the Climate City Contract Action Plan

Various processes ran in parallel to create the Action Plan for the Aachen Climate City Contract. The Local Coalition was directly involved in the development of the IKSK 2.0. In spring/summer 2023, four workshops were held with employees of the city administration to develop far-reaching measures that will lead to climate neutrality in 2030. The result was more than 200 measures, which were prioritised by GERTEC in terms of their leverage effect and speed of implementation

In an intensive exchange with the municipal holdings, their measures for a climate-neutral Aachen 2030 were recorded and analysed in terms of their impact. The starting signal for this was a workshop to which all managing directors of the municipal holdings were invited by the Lord Mayor and the department heads Heiko Thomas and Frauke Burgdorff to the town hall. The result was captured in a graphic recording (see AP-13).

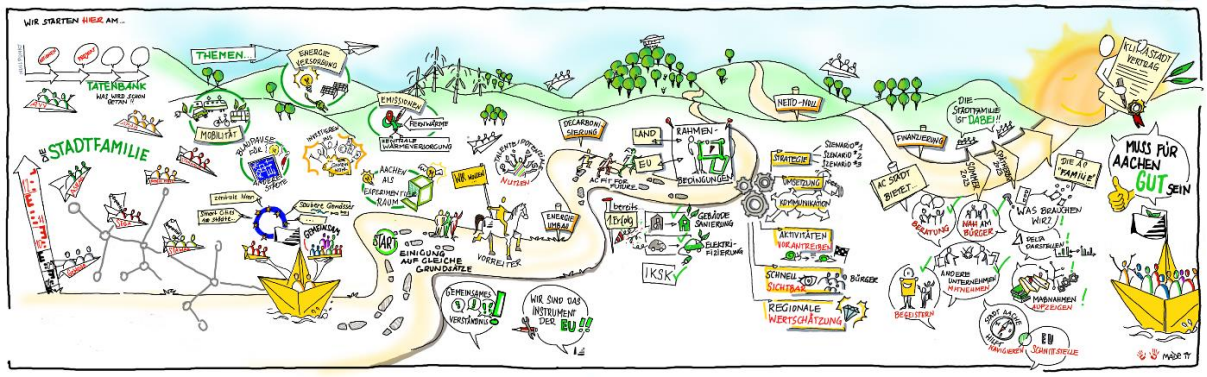

Figure AP- 13 Graphical recording of the workshop with the municipal holdings.

All measures were brought together in the report "The path to climate neutrality 2030", which was finalised in November 2023 and comprehensively describes Aachen's path to climate neutrality in 2030.

To reach as many stakeholders in urban society as possible, various events were organised and existing formats were used, for example by business networks to present the EU mission and the Climate City Contract. Meetings were also organised with individual companies/institutions/associations. The aim of this activity was to win over as many supporters as possible in the urban community for the Climate City Contract. The Lord Mayor and the heads of department also successfully persuaded relevant companies and associations to make a commitment to the Aachen Climate City Contract.

Table AP- 2 Overview of events and individual dates for the presentation of the EU mission and CCC

date	Event / Visit	date	Event / Visit
12.05.2023	Aachen Chamber of Industry and Commerce 1/2	26.10.2023	Aachen Building Experts e.V. - Climate event
15.05.2023	Information event for multipliers	02.11.2023	District craftsmen's association
22.05.2023	City Sports Association	06.11.2023	Event on the heating transition, Trianel GmbH
03.06.2023	Event Environmental and climate initiatives	08.11.2023	Press conference on the Aachen CCC

10.07.2023	Aachen Tourist Service e.V.	08.11.2023	Oecher Lab - Energy Workshop 1/4
07.08.2023	GreenZero GmbH	15.11.2023	Oecher Lab - Energy Workshop 2/4
15.08.2023	Gertec seminar "Climate protection concept" 1/2	22.11.2023	misereor e.V.
17.08.2023	Energy and Climate Council of the City of Aachen	22.11.2023	Oecher Lab - Energy Workshop 3/4
18.08.2023	Landmarken AG	27.11.2023	SCHUMAG AG
18.08.2023	Gertec seminar "Climate protection concept" 2/2	29.11.2023	Oecher Lab - Energy Workshop 4/4
23.08.2023	Aachen Building Experts e.V.	29.11.2023	Circonomit GmbH
24.08.2023	Aachen University of Applied Sciences	30.11.2023	ABE table talk "Climate-neutral Aachen"
24.08.2023	Stadtsportbund - Sustainability team	30.11.2023	Industry dialogue of the IHK Aachen
28.08.2023	Lions Club	07.12.2023	Energy and Climate Council of the City of Aachen
30.08.2023	RWTH Aachen	17.12.2023	Colourful sustainability event
30.08.2023	MedLife e.V. - Summer party	20.12.2023	Heinrich Heine Comprehensive School
07.09.2023	Institute for the European City e.V.	05.01.2024	ITA Academy GmbH
07.09.2023	STAWAG	05.01.2024	nesseler bau GmbH
25.09.2023	Fraunhofer IME	09.01.2024	Medienhaus Aachen GmbH
23.09.2023	1st Sustainability Impulse Week	10.01.2024	Bluebird GmbH
27.09.2023	Dr Babor GmbH & Co KG	12.01.2024	Protestant parish
12.10.2023	AGIT mbH	24.01.2024	Grünenthal GmbH
13.10.2023	Water Association Eifel Ruhr e.V.	24.01.2024	Courté Immobilien GmbH & Co KG
23.10.2023	Kempen Krause Engineers	30.01.2024	Mathes GmbH & Co KG
24.10.2023	Trianel GmbH	31.01.2024	misereor e.V.
25.10.2023	Aachen Chamber of Industry and Commerce 2/2	21.02.2024	Catholic University of Applied Sciences NRW

The participation process and the gathering of commitments from the urban community followed a strategic process. First of all, the transition team informed other city administration stakeholders and organisational units internally through the aforementioned "administration tour" in order to clarify key processes and relevant strategic measures for the respective departments and offices relating to the development of the CCC and, above all, to identify external stakeholders with whom relationships already exist and who are of strategic importance for the implementation of core measures from the action plan and IKSK. Categories were then formed as part of the stakeholder mapping in order to differentiate which stakeholders are essential for the development and implementation of the CCC in the initial approach (e.g. "city group" including public transport operators, energy suppliers or the housing sector or strategically important partners from science and industry), which are to be addressed downstream - in the subsequent iteration loops of the CCC - and which "stakeholder gaps" result from the mapping.

In addition, a communication plan was drawn up to determine which communication media and tools should be used to address the respective stakeholder groups. Furthermore, a "communication package" was developed that contains and provides basic information on the mission and development of the CCC and includes the planning of own events or collaborations for joint event design to address stakeholders - in terms of time and organisation. The transition team then used a Kanban board process to manage the approach, contact management, communication and obtaining commitments.

To obtain commitments from the urban community and external stakeholders, commitment templates were designed that consider different roles (e.g. core actor, multiplier) and provide for different participation formats. PREMIUM partners commit themselves to achieving climate neutrality by 2030 or 2035 and to submitting a corresponding concept by the end of 2025. FRAMEWORK partners commit themselves to implementing specific (individual) measures that contribute to reducing GHG emissions in the city of Aachen. BASIS partners support the

"Climate Neutral Aachen 2030" office and the City of Aachen, e.g. by organising certain projects or events related to climate protection. The commitment template is attached to the Commitmentc as Appendix 1.

By 28 February, 26 commitments had been submitted in the PREMIUM area, 55 in the FRAME area, 31 in the BASIS area and 18 letters of support (LOI) for the Aachen Climate City Contract.

The commitments, particularly those of the FRAMEWORK partners, are very heterogeneous in terms of their level of detail. Therefore, in this first version of the Climate City Contract, no quantitative analysis of the savings potential from the commitments of the urban community can be carried out. It is planned that concrete figures and information will be requested from the commitment donors to be able to present a quantification of the greenhouse gas savings potential from the commitments with the next iteration of the Climate City Contract.

In the Appendix 1, the commitments of the FRAME partners are assigned to the categories of the economic model.

1.15 Implementation of the Action Plan and iterations of the Aachen Climate City Contract

With the Action Plan of the Aachen Climate City Contract, a comprehensive roadmap for achieving climate neutrality for Aachen has been developed. With the IKSK 2020, numerous measures of the city administration are already being implemented. These should be completed by 2025 and lead to greenhouse gas savings of 50% compared to 1990. The gap to climate neutrality is to be closed by measures from the IKSK 2.0. These essentially comprise measures of the municipal holdings, in particular the companies involved in the energy, heating and mobility transition in Aachen. The implementation of the comprehensive action plan will make a major contribution to reducing greenhouse gas emissions in the city of Aachen. The city administration and municipal group will thus become a role model for the entire urban society.

The Climate City Contract has already been used to encourage many stakeholders from various sectors of urban society to get involved. Participation from urban society is to be steadily expanded in the coming years. In addition, it is important to maintain the network that has been created and to engage in joint dialogue. This will primarily be the task of the "Climate-neutral Aachen 2030" office. In the future, the focus will also be on citizens, for whom participation formats will be developed as part of the German pilot project CoLAB, which should ultimately lead to a lasting climate-positive change in behaviour.

Aachen's city administration aims to optimise the framework conditions for climate protection (see also Social innovations). Prioritisation regarding the implementation of climate protection concepts and measures is carried out by the Aachen City Council and the Administrative Board. Information relevant to climate protection is currently being prepared for both bodies, such as budget proposals and staffing plans, which should facilitate decision-making and provide permanent guidelines.

The status of the implementation of climate protection strategies and measures is to be reviewed and managed internally in future by the new governance structure, through multi-process control. The city's annual energy and greenhouse gas inventory provides information on where Aachen stands regarding the goal of climate neutrality by 2030. To this end, the monitoring of greenhouse gas emissions is to be expanded, automated and presented transparently.

The city of Aachen will update its Climate City Contract every two years. This serves to incorporate new strategies and plans that have been politically adopted. The update will also include a report on the implementation status of the measures and an updated list of co-signatories (commitments).

Table 1 (I-1.1) Climate Neutrality Target by 2030

Table I-1.1: Climate Neutrality Target by 2030			
Sectors	Scope 1	Scope 2	Scope 3
Stationary energy	Included	Included	
Transport	Included	Included	

Waste/waste water	Not applicable	Not applicable	Included
Other (including IPPU, AFOLU)	Included	Not applicable	
Geographical boundary	Same as city administrative boundary	Smaller than city administrative boundary	Larger than city administrative boundary
(Tick correct option)	x		
Map of City of Aachen (see Figure AP-4)			

2 Part A - Current State of Climate Action

Part A "Current State of Climate Action" describes the point of departure of the city towards climate neutrality, including commitments and strategies of key local businesses, and informs the subsequent modules and the outlined pathways to accelerated climate action.

2.1 Module A-1 Greenhouse Gas Emissions Baseline Inventory

2.1.1 GhG Emissions Baseline inventory

A carbon footprint has been drawn up regularly for the city of Aachen since 1993, and annually since 2010. This includes a final energy inventory, primary energy inventory (Life Cycle Assessment method, LCA) and a CO_2 emissions inventory (LCA) to assess development in terms of target achievement. The calculations are carried out using the ECORegion balancing tool from Ecospeed AG (Switzerland). Non-energy-related emissions in agriculture (methane, nitrous oxide) were determined based on regional average data for the CCC. These can be found in the document "The path to climate neutrality 2030. Volume 1 - Strategy". Non-energy-related emissions from industry (IPPU) are not included in the standard. As part of the CCC, the participating industrial companies prepare their own inventories. The IPPU emissions are thus recorded for the participants.

The balancing for the city of Aachen is based on the annually collected data on energy fed into the city's supply networks (Regionetz/Stadtwerke Aachen (STAWAG), consumption data from building management and city operations, chimney sweep data, data from city statistics (basic framework: Population, vehicle kilometres, labor statistics and federal statistics, as well as data provided by the state of NRW).

The final energy requirements and consumption within the Aachen balancing area are recorded, i.e. essentially the local electricity, gas, district heating, heating oil and fuel consumption. The primary energy inventory (LCA) that builds on this also includes the so-called "energy sources not bound to pipelines" (heating oil, fuels, biomass, etc.) based on national average data. The upstream chain shares of the respective final energy sources used, i.e. the effort required to extract, produce and transport the energy to the end consumer in Aachen. Based on the LCA method, the CO_2 inventory is then drawn up in accordance with the national BISKO standard. The inventories for 2019-2022 are provided in the appendix. As there may still be slight statistical adjustments for the inventory in 2022, this report refers to the inventory data from 2021.

The balancing of GHG emissions serves as a scientific basis for the City of Aachen's climate neutrality target. On this basis, suitable measures are developed in the sectors under consideration (households, commerce, industry, transport, municipal administration) and for the various energy sources (see Table A-1.1 - A-1.3).

The CO_2 inventory 2022 are uploaded separately.

These describe the CO_2 inventory of the city of Aachen in the last 3 years. Since 2022, the transport sector in Aachen has been territorially inventoried to meet the national BISKO standard. The inventory sheet was adjusted retroactively to 1990. This procedure and the adjustments are described in the document CO_2 Inventory 2022. The adjustments were considered for 2021 in this chapter.

Table 2 (A-1.1) Final energy use by source sectors

A-1.1: Final energy use by source sectors			
Base year	2021		
Unit	GWh		
	Scope 1	Scope 2	Scope 3
Buildings+Industry (Total)	3699	1075	
Electricity		1075	
Natural gas	2722		
District Heating	327		
Fuel oil	266		
Other (Renewables)	384		
Industrial Process and Product Use (IPPU)	Not recognised		
Transport (total)	1166		
Diesel	720		
Gasoline	366		
Organic diesel	50		
Organic gasoline	17		
Electricity	13		
Agricultural, Forestry and Land Use (AFOLU)	Not recognised		

Table A-1.1 shows the final energy consumption of the buildings, industry and transport sectors. The data are determined using the national BISKO methodology. The basis for the grid-based energy sources (electricity, natural gas and district heating) is measured data from the supply network operator. The remaining data is calculated by EcospeedRegion, using databases from the ifeu (Institute for Energy and Environmental Research Heidelberg) as the basis for the calculation. AFLOU and IPPU emissions are not recorded or calculated by EcospeedRegion.

Table 3 (A-1.2) Emission factors applied

A-1.2: Emission factors applied		
(Please specify for primary energy type and GHG emission factor according to methodology used).		
For calculation in t or MWh of primary energy		
method: national BISKO standard		
Primary energy/ energy source	primary energy (CO_2) [MWH]	carbon dioxide (CO_2) [1000 t CO_2 eq]
Electricity	1.882.000	507
Natural gas	3.057.000	639
District Heating	191.000	85
Fuel oil	312.000	84
Other	343.000	32
Diesel	858.448	235
Gasoline	429.780	118
Organic diesel	85.290	6
Organic gasoline	32.191	2

Table A-1.2 shows the primary energy demand in megawatt hours and the CO2 emissions in 1000 tonnes of CO2 equivalent by energy source. These are based on the final energy demand of the city of Aachen. Primary energy factors and emission factors from the GEMIS database are used as the basis for calculation (https://iinas.org/downloads/gemis-downloads/).

Table 4 (A-1.3a) GHG emissions by source sectors

A-1.3a: GHG emissions by source sectors					
Base year					
Unit	ktCO2				
	Scope 1	Scope 2	Scope 3	Total	% of Total
Transport	275948			275948	18%
Buildings & Heating	582226			582226	37%
Electricity		630793		630793	40%
Waste*			15091	15091	1%
AFOLU	29000			29000	2%
Other (incl. IPPU)	31536			31536	2%
Total	919710	630793	15091	1565595	100%

Table 5 (A-1.3b) GHG Emissions by Source Sector - Business as Usual

A-1.3b: GHG Emissions by Source Sector - Business as Usual (BAU) 2030					
Base Year	BAU 2030				
Unit	tonnes CO2 equivalent/year				
	Scope 1	Scope 2	Scope 3	Total	% of Total
Transport	275948			275948	17%
Buildings & Heating	582226			582226	37%
Electricity		644118		644118	41%
Waste*			15091	15091	1%
AFOLU	29000			29000	2%
Other (incl. IPPU)	30901			30901	2%
Total	918075	644118	15091	1577284	100%

* Includes Scope 1 Waste emissions (produced and processed in the city) and Scope 3 (produced by the city but processed outside the city border) - solid waste only; wastewater falls under "Other" sector

Tables A-1.3a and A-1.3b show the emissions according to their source sectors. A-1.3a shows the emissions from the year 2021 and A-1.3b the emissions according to the BAU scenario for the year 2030. Unlike the previous tables, this calculation was carried out using the economic model. The AFLOU emissions were published by the Tühnen Institute for Aachen. This already includes negative emissions.

Table 6 (A-1.4) Activity by Source Sector (from economic model data inputs)

A-1.4: Activity by Source Sector (from economic model data inputs)			
Base Year	2021		
	Scope 1	Scope 2	Scope 3
Transport			
Transport need - passenger cars + motorbikes (M km/year)	1103		
Transport need - buses (M km/year)	11		
Transport need - trains/metro (M km/year)	0		
Transport need - light duty trucks (<3.5 t) (M km/year)	119		
Transport need - heavy duty trucks (>3.5 t) (M km/year)	106		
Buildings & Heating			
Heating demand (space heating + domestic hot water) (GWh/year)	2600		
Electricity			
Electricity demand within city boundaries (GWh/year)		1057	
Waste			
Collected waste within city boundaries (tons)			82343
Other (incl. IPPU & AFOLU)			

2.2 Module A-2 Current Policies and Strategies Assessment

Module A-2 "Current Policies and Strategies" lists and assesses existing policies, strategies, initiatives, or regulation from local, regional, and national level, relevant to the City of Aachens climate neutrality transition.

2.2.1 Description & assessment of policies

Assessment of the existing concepts of the City of Aachen

The Integrated Climate Protection Concept, IKSK 2020, is the most important ongoing concept for climate protection in Aachen. It was adopted in August 2020 by all parliamentary groups in Aachen City Council and therefore has a broad political basis. It comprises 70 measures of the city administration for the years 2021-2025 with the aim of intensifying and sustainably accelerating climate protection efforts. Fields of action with concrete measures are: Urban planning, energy supply, mobility, building refurbishment, communication, economy.

The annual CO_2 reduction through the implementation of measures in the individual fields of action are shown in Figure AP-7 (Chapter 1.9.). The graphic makes clear that the city administration has the least influence in the "Economy" and "Transport" fields of action.

The IKSK 2020 is flanked by other concepts and plans such as the AACHEN*2030 Masterplan and the Transport and Development Plan (SUMP) for Aachen, which was adopted by the Mobility Committee in 2020 (see table AP-3).

Table AP- 3 Current local concepts and plans relevant to the reduction of greenhouse gas emissions

Type (decision date)	Name/Title	Contents / core objectives	Relevance

Concept **not yet politically decided !**	Integrated climate protection concept 2.0 SECAP Aachen	• Climate neutrality scenario 2030 • Comprehensive action plan for city administration and city group • Reduce greenhouse gas emissions by 95% compared to 1990 levels by 2030 • Duration: 2024-2030	high
Legally binding plan (26.08.2020)	Integrated climate protection concept 2020 SECAP Aachen	• 70 measures in 7 fields of action • Reduce greenhouse gas emissions by 50% by 2030 compared to 1990 levels • Term 2021-2025 • Costs: € 67 million per year https://aachen.de/DE/stadt_buerger/energie/konzepte_veranstaltungen/klimaschutzkonzept/IKSK_Juni_2020.pdf	high
Legally binding plan (27.01.2022)	AACHEN*2030 Land use plan 2030	• Presentation of the intended urban development for the entire urban area • Presentation of the resulting type of land use • Integrated overall view of municipal and official specialised planning in the urban area. • Basis for development plans • Takes into account open space, climate and soil protection https://www.aachen.de/de/stadt_buerger/planen_bauen/_materialien_planen_bauen/stadtentwicklung/stadt/aachen2030/masterplan/AC2030_beschlossen_masterplan_lowres.pdf	high
Strategy (23.05.2019, 30.01.2020)	Mobility Strategy Aachen 2030 SUMP	• High road safety • Environmentally and urban-compatible mobility • City of short distances • Reliable and convenient mobility services Efficient and affordable mobility for the city and its citizens https://www.aachen.de/de/stadt_buerger/verkehr_strasse/verkehrskonzepte/VEP/Strategie2030/2030_Teil1/Strategie2030_Teil1.pdf https://www.aachen.de/de/stadt_buerger/verkehr_strasse/verkehrskonzepte/VEP/Strategie2030/2030_Teil2/Strategie2030_T2_200716.pdf	high
Concept (23.01.2019)	Adaptation concept to the consequences of climate change	Measures against the dangers of extreme/heavy rainfall • Flood management • Heat protection • Water-sensitive planning • Fresh and cold air corridors • Green planning https://www.aachen.de/DE/stadt_buerger/energie/klimaanpassung/anpassungskonzept_V7.pdf	medium
Legally binding plan (01.05.2022)	Clean air plan 2009 with various updates, most recently 2022	• Optimisation of the bus fleet through SCRT retrofitting and early procurement of new buses (EuroVI and electric) • 30 km/h within the entire ring of avenues • Expansion of cycle path network, cycle priority routes, secure parking facilities • Expansion of electromobility and field trials with other low-emission drive types. https://www.aachen.de/de/stadt_buerger/umwelt/luft-stadtklima/luftreinhalteplan_umweltzone/luftreinhalteplan_2022/luftreinhalteplan_aachen_03_fortschreibung_2022.pdf	high

Strategy (11.12.2019)	Digital strategy for the city of Aachen	• Digital citizen service • Big Data / Open Data • Digital payment transactions • Infrastructure • Digital entrepreneurial world/trade https://www.aachen.de/DE/stadt_buerger/politik_verwaltung/digitalisierung/digitale-strategie/digitale_strategie_aachen.pdf	low
Strategy (12.11.2020)	Integrated noise action plan	• in accordance with § 47d BImSchG and the EU Environmental Noise Directive, Directive 2002/49/EC • Binding urban land-use planning • Design of the street space • Avoidance of vehicle traffic • Speed reduction • Promotion of e-mobility https://www.aachen.de/DE/stadt_buerger/umwelt/laermschutz_neu/pdf_grafiken_fotos/LAP_AC_2021_Endfassung_27Jan2021.pdf	high
Strategy (pending)	Landscape plan	• Natural forest development through set-asides • Tripling of nature conservation areas • Enrichment of the outdoor areas with woody plants • Restriction of fertilisation	medium

Note: no claim to completeness, as of 02/24

The IKSK 2020 provides a framework concept in which the strategically important areas of action are described and the potential for rapidly reducing CO_2 emissions by 2030 is analysed and quantified in a differentiated manner. The latter amount to 363,000 tonnes by 2030 in the energy/energy, building renovation and commercial/industrial sectors and 83,000 tonnes in the transport sector. Considering all the action plans in the IKSK action programme, this results in a municipal CO_2 reduction potential of xy tonnes by 2030, corresponding to z % of the municipal emissions inventory. However, it also became clear in the IKSK that considerable reduction potential is not within the municipal sphere of influence but must be activated through corresponding political regulations at state and federal level. This applies in particular to the transport sector.

The IKSK 2020 is uploaded separately (see attachement *IKSK 2020*)

Overview of the most important information contained in the IKSK 2020 on the action plans up to 2025:

- Chapters 5.1 and 5.2 - Measures of existing concepts of the city, in particular the energy policy work programme for the European Energy Award.
- Chapter 5.3 - New measures in the 2025 action plan for the fields of action Urban planning - Municipal buildings - Energy supply - Mobility - Building refurbishment - Communication - Economy
- Chapter 5.4 - Brief profiles of the 70 measures from 5.3

A total budget of around € 181 million has been set aside for climate protection measures in the municipal budget for the years 2021-2025. Until 2020, the budget amounted to around € 5-10 million per year for climate protection measures in the areas of building management, forestry, municipal operations, climate and environment, which have contributed to the goal of climate neutrality. As can be seen in Table AP-4, the share of the climate protection budget in relation to the overall budget rose steadily from 2.16% to 3.42% in the years 2021-2024.

Table AP- 4 Overview of the municipal budget

	2021	2022	2023	2024	2025
Budget Climate protection	23.538.000 €				
		31.796.000 €			

measures in the municipal budget			38.009.100 €		
				44.124.400 €	
					43.368.600 €
Total budget	1.091.248.900 €	1.096.580.400 €	1.191.050.900 €	1.289.291.900 €	tbd
Share of climate protection budget	2,16%	2,90%	3,19%	3,42%	tbd
TOTAL (2021-2024):	137.467.500 €				
TOTAL (2021-2025):	180.836.100 €				

Note: Overview of the municipal budget made available for additional climate protection measures and personnel in the years 2021-2025. The municipal budget for 2025 has not yet been politically decided, therefore subject to change.

Table AP- 5 Current laws, subsidies and strategies of the state of North Rhine-Westphalia

Type / Release date	Name/Title	Sector	Contents / core objectives	Relevance
Promotion (16.11.2022)	Incentive funding for municipal heat planning	Energy	Subsidy of up to 100 % for municipal heat planning	medium
Promotion (08.12.2020)	Framework directive for the implementation of the Coal Regions Investment Act in NRW	Energy	Implementation of the Federal Coal Regions Investment Act	medium
Strategy (09.11.2023)	Action plan for the expansion of the NRW charging infrastructure	Mobility	Expansion of private, public charging points in NRW by 2030	medium
Strategy (14.06.2023)	First climate protection package NRW	Energy	• GHG reduction target for 2030 at 65 % • Accelerated expansion of RE • Supporting local authorities with climate protection and the heating transition • Increasing the energy efficiency of buildings • Climate neutrality in the economy • Sustainable means of transport and alternative drives • Natural climate protection through forests	medium
Strategy (16.11.2022)	Action plan for heavy goods transport	Mobility	• 80,000 zero-emission, heavy goods vehicles in NRW by 2030 • 80 public charging points for road freight vehicles • Entire fleet climate-neutral from 2045	medium
Strategy (31.01.2022)	Synthetic fuels action plan	Energy	• Implementation of the hydrogen roadmap • Market ramp-up of synthetic fuels	medium

Strategy (19.10.2021)	Carbon Management Strategy NRW (English version available)	Offsetting	• CCU in industrial processes and fertilisation • CCS as part of the C-cycle • Utilisation of secondary raw materials	medium
Strategy (09.11.2020)	Hydrogen roadmap NRW (English version available)	Energy	• Electrolysers on a gigawatt scale • Utilisation of the natural gas network	medium
Agreement (08.10.2022)	Coal phase-out 2030	Energy	• BMWK and MWIKE agree to end coal-fired power generation in NRW by 2030	high

Note: Current laws, subsidies and strategies of the **state of North Rhine-Westphalia** with relevance for climate and emissions protection (no claim to completeness, as of 02/24). Source: https://www.klimaschutz.nrw.de/mediathek/medien-und-downloads

Climate protection in North Rhine-Westphalia

North Rhine-Westphalia is to become the most modern and environmentally friendly industrial location in Europe and thus make its contribution to international climate protection. On 1 July 2021, the North Rhine-Westphalian state parliament passed the most ambitious climate protection law of any federal state to date. At its heart is the commitment to achieve greenhouse gas neutrality by 2045. To achieve this goal, corresponding transformation processes are being initiated in climate-relevant areas. The major fields of action for climate protection in NRW are the energy sector, industry, buildings and mobility, as well as the intelligent interlinking of these areas (sector coupling). The targets set out in the new Climate Protection Act: By 2030, emissions are to be reduced by 65 per cent compared to 1990 levels and by 88 per cent by 2040. By 2045, the country should be greenhouse gas neutral.

Climate protection is a central task of the Ministry of Economic Affairs, Industry, Climate Protection and Energy of the State of North Rhine-Westphalia (MWIKE). Department 712 Climate Protection Policy and Municipal Climate Protection is responsible for promoting municipal climate protection. This is supported by the state in a variety of ways - for example with the KommunalerKlimaschutz.NRW project call - to promote local climate protection measures.

In addition to MWIKE, the Ministry of the Environment, Nature Conservation and Transport, the Ministry of Homeland, Municipal Affairs, Building and Digitalisation and the Ministry of Agriculture and Consumer Protection are also involved in the implementation of the first climate protection package, which was adopted by the NRW state government in June 2023.

An important decision to promote wind power in NRW was made in August 2023, when the black-green government abolished the regulation of a blanket 1000-metre minimum distance between wind turbines and residential areas.

The state government is investing a lot of money in implementing the measures from the climate protection package. More than one billion euros is being invested directly in climate protection. In addition, the measures contained in the first climate protection package will make over a further billion available in the coming years as part of European funding programmes. Added to this are subsidies for housing construction and the development of the regional economy, which are increasingly focussed on climate protection.

The energy transition and climate protection require the commitment of all stakeholder groups in the state: from large industrial companies to small and medium-sized enterprises, craft businesses, local authorities and all citizens. The state government's goal is to actively involve them all in the rollout of climate-friendly technologies. The pace of investment in climate-friendly infrastructure must increase considerably. To achieve this, the state has been pooling all previous initiatives in the field of climate protection and energy under the umbrella of the state company NRW.Energy4Climate since the beginning of 2022. The central task of the state company is to trigger the necessary investments in North Rhine-Westphalia, attract funding to North Rhine-Westphalia and thus advance the implementation of climate protection and the energy transition.

NRW.Energy4Climate GmbH is supporting the Aachen Climate City Contract with a BASIS commitment. Initial discussions on joint activities between the city administration and the state company have already taken place. A continuous informal exchange at working level is planned once a quarter.

Promoting structural change in the Rhenish mining area

The Aachen city region is part of the "Rheinisches Revier" region affected by structural change. According to the German government's decision, the generation of electricity from lignite and the associated mining in opencast mines in Germany is to end in 2038. The Coal Regions Structural Strengthening Act is the basis for successful structural change, for which a total of € 14 billion will be made available by 2038.

The key points agreement on the 2030 coal phase-out signed jointly by BMWK, RWE and MWIKE in October 2022 aims to bring forward the phase-out of coal-fired power generation in NRW by eight years. The 280 million tonnes of CO_2 that will be saved as a result are a milestone for climate protection in Germany and North Rhine-Westphalia.

This brings the state government's goal of aligning climate, energy and economic policy with the 1.5-degree path of the Paris Climate Agreement a huge step closer.

The early coal phase-out is also intended to accelerate structural change in NRW. NRW has a total of around € 5.2 billion available for this purpose. In the Coal Regions Investment Act, which regulates the funding of projects in structural change, climate and environmental protection is explicitly named as one of nine funding areas. This means that the city of Aachen has the opportunity to receive funding for structural change for climate protection measures, provided that these measures contribute to securing employment during the phase-out of lignite mining and the generation of electricity from lignite.

Table AP- 6 Current laws, directives and strategies at federal level

Type / Release date	Name / Title	Description of the	Relevance
Promotion (15.09.2022)	Federal subsidy for efficient heating networks (BEW)	Promotion • of new construction of heating networks with a high proportion of renewable energies • of decarbonisation of existing grids • for local authorities for local heating networks with a high proportion of renewable energies in new builds https://www.bafa.de/DE/Energie/Energieeffizienz/Waermenetze/Effiziente_Waermenetze/effiziente_waermenetze_node.html	high
Law (19.10.2023)	Building Energy Act (GEG)	• Specifications for the energy quality of buildings • Creation and use of energy certificates • Use of renewable energies in buildings. • for local authorities: use of renewable energies in new buildings and renovations https://www.bmwsb.bund.de/Webs/BMWSB/DE/themen/bauen/energieeffizientes-bauen-sanieren/gebaeudeenergiegesetz/gebaeudeenergiegesetz-node.html	high
Law (01.01.2024)	Act for heat planning and the decarbonisation of heating networks	• Obligation of the federal states to implement municipal heat planning • Heat plans by 30 June 2026 for municipal areas with over 100,000 inhabitants • Heat plans by 30 June 2028 for municipal areas with fewer than 100,000 inhabitants https://www.bmwsb.bund.de/SharedDocs/gesetzgebungsverfahren/Webs/BMWSB/DE/kommunale-waermeplanung.html	high
Law (12.12.2019)	Federal Climate Protection Act (KSG)	• Reduction of GHG emissions by 65 % by 2030 compared to 1990 • GHG neutrality by 2045,	high

		• Tightening of targets for each sector • Binding targets for natural sinks https://www.gesetze-im-internet.de/ksg/BJNR251310019.html	
Strategy (09.10.2019)	Climate protection programme 2030	• Measures to achieve the 2030 climate targets • Emissions trading system (ETS) for energy, industry and aviation • Reduction of emissions in the ETS sector by 43 % by 2030 compared to 2005 • Reduction of emissions in agriculture, transport and waste (non-ETS) by 38 % by 2030 compared to 2005 • Adoption of all legal measures to implement this programme by the Federal Cabinet in 2019 https://www.bundesfinanzministerium.de/Content/DE/Downloads/Klimaschutz/klimaschutzprogramm-2030-der-bundesregierung-zur-umsetzung-des-klimaschutzplans-2050.pdf?__blob=publicationFile&v=4	high
Strategy (16.11.2016)	Climate Protection Plan 2050	• develops concrete guiding principles for the individual fields of action for the year 2050, leaves room for innovation and strives to maximise sustainability. • describes robust transformative paths for all fields of action, highlights critical path dependencies and illustrates interdependencies. • in particular underpins the interim GHG target for 2030 with concrete milestones and strategically designed measures, also taking into account impact and cost analyses. https://www.bmwk.de/Redaktion/DE/Publikationen/Industrie/klimaschutzplan-2050.pdf?__blob=publicationFile&v=1	
Strategy (13.07.2022)	Climate protection immediate action programme 2022	• approx. € 8 billion for additional climate protection measures • Special focus on industry, energy, building sector https://www.bmwsb.bund.de/SharedDocs/pressemitteilungen/Webs/BMWSB/DE/2022/07/sofortprogramm-klimaschutz-gebaeude.html	high
Law (14.08.2020)	Structural Strengthening Act Coal Regions	• Basic law on the Investment Act Coal regions • Mitigating the consequences of the phase-out of coal-fired power generation in North Rhine-Westphalia, Brandenburg, Saxony-Anhalt and Saxony • Phasing out coal-fired power generation by 2038 https://www.bmwk.de/Redaktion/DE/Textsammlungen/Wirtschaft/strukturstaerkungsgesetz-kohleregionen.html	mediu m
Law (14.08.2020)	Investment Act Coal regions	• Financial aid for lignite regions to cope with structural change • 37% of the total funding amount of € 14 billion goes to the Rhenish mining area • Funding areas: 1) Business-related infrastructure 2) Traffic without federal, state and municipal roads 3) Public welfare to improve business-related location conditions 4) Urban planning, urban and regional development	mediu m

		5) Digitalisation, broadband and mobile communications infrastructure 6) Tourist infrastructure 7) Infrastructures for research, innovation and technology transfer 8) Climate and environmental protection 9) Nature conservation and landscape management https://www.gesetze-im-internet.de/invkg/InvKG.pdf	

Note: Current laws, directives and strategies at **federal level** relevant to climate and emissions protection (no claim to completeness).

Climate protection of the Federal Government Germany

The Climate Action Plan 2050, which was adopted in 2016, provides guidance for all stakeholders in business, science and society. Designed as a learning process that incorporates new findings and developments, it follows the basic philosophy of regular review, continuous learning and constant improvement of the Paris Agreement. As such, it cannot and should not be a detailed master plan that has been finalised over decades. The Climate Action Plan 2050 is the basis and guideline for the further identification and design of the respective climate protection strategies and measures in the various fields of action. Their design must be concretised with the active participation of business, science and civil society stakeholders. The Federal Government will assess the economic, social and ecological consequences of specific measures and evaluate them politically. In this way, it will be possible to secure the performance of the German economy in international competition, create planning security for companies, private households and consumers and at the same time ensure that it is possible to react flexibly to technological innovations, for example. The Energy and Climate Fund (EKF) remains the central financing instrument for the energy transition and climate protection in Germany. By 2030, funds totalling hundreds of billions are to be made available for climate protection and the energy transition, i.e. together with funding measures outside the EKF. The additional investment in climate-friendly measures that this will trigger will support the economy and make the business location fit for the future. The expenditure of the EKF is to be focussed more strongly on the core task of reducing greenhouse gases. The revenue from the Climate Action Programme 2030 is not intended to generate additional government revenue for other purposes. All additional revenue from this programme will therefore be reinvested in climate protection support measures or returned to citizens in the form of relief. The measures of the Climate Action Programme 2030 are essentially anchored in the 2020 economic plan of the Energy and Climate Fund. The financial and budgetary objectives of the Federal Government will be observed. To finance the measures of the Climate Action Programme 2030 and to compensate for the tax shortfalls directly associated with these measures, the revenue from the national CO_2 pricing, which will begin at that time, and all other revenue arising from measures under this programme will therefore be used. Expenditure for the years 2020 to 2023 (medium-term financial planning) will be secured in the EKF's business plan and in the federal budget. On this basis, it is ensured that the revenue and expenditure measures of the Climate Action Programme 2030 correspond with each other and are inventory in terms of their financial impact for the federal government. If it transpires that this inventory is no longer guaranteed, appropriate adjustments will be made. Fair burden-sharing will be discussed as part of the Bundesrat procedure on the financially effective laws.

In the Climate Action Plan 2050, the German government has agreed on sector targets that distribute the overall reduction in greenhouse gases of at least 55 per cent required by 2030 across the energy, buildings, transport, industry, agriculture and waste management (other) emission sectors. Together with the resulting annual greenhouse gas budgets for the sectors, these will be set out in law and the achievement of targets will be precisely determined each year and monitored by an external expert council. The current allocation of emissions to the sectors is based on the source principle, which is applied in reporting under the Framework Convention on Climate Change. This means, for example, that the emissions from greenhouses in horticulture listed under "industry" in the EU context are recognised nationally in the agriculture sector. Emission reductions from the use of bioenergy are not credited to agriculture as a producer of bioenergy, but to the energy sector. Emission reductions from the use of wood are also not recognised in the LULUCF sector. On the other hand, reductions in greenhouse gas emissions from electricity consumption, for example, are allocated to the energy sector, regardless of whether they were achieved by renewable energy by the electricity supplier or through more efficient electricity use in households or businesses. Allocations based on the source principle are therefore not congruent with those based on the polluter pays principle. To prevent polluters from slackening their reduction efforts as a result, explicit reference is made to this in the Federal Government's programme of measures. Irrespective of this difficulty, allocation according to the source principle makes it easier to strive for reductions in all sectors, to report on them and to develop, adopt and

implement suitable measures. As the implementation strategies for achieving the sector targets can in some cases have far-reaching consequences for our economic and social development, the sector targets were subjected to a comprehensive impact assessment, as decided in the Climate Action Plan 2050. To this end, two alternative target paths were described, both of which vary the measures for saving energy and switching to renewable energies. Sectoral target path A emphasises efficiency measures, while path B focuses more on the use of renewable energies. The sector targets are achievable on both target paths. According to these impact assessments, the sector targets will trigger additional investments totalling EUR 240 billion in path B and EUR 270 billion in path A by 2030. Target path A - which focuses on energy efficiency - is associated with lower economic costs in this analysis. In addition to other studies, this impact assessment of the sector targets served as a guide for the ministries when selecting and designing the proposed measures for the present climate protection programme.

Climate policy is aimed at everyone per se. Nevertheless, individual measures are generally aimed at specific groups of the population. This is reflected in the profiles of measures. Climate protection is a task for society as a whole. Measures to achieve the German climate protection targets therefore consider not only the direct CO_2 reduction effect but also aspects of social justice, affordability and economic efficiency as well as participation and vibrant democracy. Active participation in the design and implementation of the measures is an important component of this. The Federal Government is therefore also focussing on the enormous innovative capacity of an open society and wants to promote this through targeted support for a wide range of initiatives and stakeholders.

On 11 January 2023, the German government passed the "Act for the Immediate Improvement of the Framework Conditions for Renewable Energies in Urban Planning Law". The law stipulates that ground-mounted PV systems are privileged under building law if they are built on an area alongside motorways and multi-track railway lines.

Table AP- 7 Current EU regulations and directives

Type	Name/Relevance	Contents / core objectives
Policy (2019)	European Green Deal high Sets the political framework for climate policy during this 2019-24 mandate	• Broad framework for no net emissions in 2050 and decoupling economic growth from resource use • Outlines intention to increase GHG emissions targets for 2030 by at least 50% and towards 55% compared to 1990 levels and revise policy levers to reflect these goals • Outlines carbon border adjustment mechanism to combat potential carbon leakage Energy • Calls on Member States to revise 2023 energy and climate plans to reflect new targets • Outlines intention to increase offshore wind production, achieve smart integration, decarbonise the gas sector, and address energy poverty Circular Economy • Identifies need to leverage potential of digital transformation • Outlines intention to decarbonise energy-intensive industries • Circular economy policy will guide transition of all sectors, include a sustainable products policy, tackle unsubstantiated green claims by products, and develop a secondary raw materials and by-products market Building and Renovating • Intention to renovate public and private buildings to increase energy efficiency and decrease energy poverty • Lift regulatory barriers that prevent energy efficiency investments in rented and multi-owner buildings Mobility • Need for a 90% reduction in transport emissions for 2050 climate neutrality • Shift substantial part of inland freight carried by road to rail and inland waterways • Price of transport must reflect environmental impacts (end fossil fuel subsidies and review tax exemptions for aviation and maritime fuels)

		• 1 million public recharging and refuelling stations for 13 million zero and low emission vehicles on roads by 2025 Food system • Farm to fork strategy • Common agricultural and fisheries policies and at least at least 40% of the common agricultural policy's overall budget and at least at least 30% of the Maritime Fisheries Fund would contribute to climate action • Reduce use of chemical pesticides Ecosystems and Biodiversity • Intention to develop plans for biodiversity, forest strategy, and oceans Zero Pollution • Intention to develop plans for zero pollution of air, water, and soil and a chemical strategy Green Finance and Investment • Requirement of 260 billion euros of additional annual investment • 25% target for climate mainstreaming across EU programmes • At least 30% of InvestEU will address climate change • Just Transition Mechanism • Using green budgeting tools in national budgets Research and Innovation • 35% of Horizon Europe budget will fund new climate solutions • Europe Innovation Council will allocate funding to high potential startups and SMEs Education • Make school buildings more sustainable • Assess knowledge, skills, and attitudes on climate change • Help workers transfer from declining sectors to growing ones Leading • Emphasize supporting immediate neighbours • Use diplomatic and financial tools to support green alliances internationally • Establish European Climate Pact to include the public in green action
Regulation (2021)	European Climate Law high The climate law is the fundamental law of climate action in the EU and sets the national goals and frameworks for climate policy. The action of NZC cities has the potential to significantly advance the achievement of these goals.	• The European Climate Law writes into law the goal set out in the European Green Deal for Europe's economy and society to become climate-neutral by 2050 • Sets 2050 "climate neutrality" target for the EU as a whole (not individual MS, taking into account the importance of promoting both fairness and solidarity among MS, as well as cost effectiveness). "Aim to achieve" negative emissions thereafter. • Sets a target of -55% GHG emissions by 2030 (up from previous target of -40% set in 2014) for the EU as a whole. • Includes a process for setting 2040 target. • Creates a system for monitoring progress and taking further action if needed. • Assessment by EC of consistency of national measures with 2050 target every 5 years, starting in 2023. EC to take "necessary measures" if assessments find measures are inconsistent with climate neutrality objective, and issue recommendations to MS. • establishes European Scientific Advisory Board on Climate Change, that will provide independent scientific advice • Both sinks and emissions reductions are considered in the contribution towards the target, but sinks are capped at 225 million tonnes of CO_2 e in 2030.

Type/year	Name/Relevance	Sector	Core content/objectives

Regulation (2018)	Effort Sharing Regulation **high** The ESR sets the overall ambition level in the buildings, transport, and waste sectors of significant importance to cities.	Built Environ-ment	• The Effort Sharing Regulation translates the EU's economy-wide domestic emissions reductions target of at least 40% compared to 1990 into binding annual GHG emission reductions targets for each member state for 2021-2030. This creates a linear reduction trajectory from 2021-2030. • Covers non-ETS sectors (road transport, buildings, agriculture, waste, etc) • Targets for Member States are based on GDP per capita as Member States with higher GDP per capita take on more ambitious targets than lower income Member States. Resulting targets range from 0% to -40% compared to 2005 levels. • Maximum allowances amount to 2% of each countries' effort sharing emissions in 2005 (except Ireland, Luxembourg, and Norway which are alloted 4%) • Maintains flexibilities under the Effort Sharing Decision • Adds flexibility to nine Member States targets above Union average to use a limited amount of ETS allowances for ESR sectors • Adds flexibility for Member States with larger share of emissions from agriculture to access more credits • Commission will evaluate and report on progress annually • More formal compliance check will be conducted every 5 years • Previous year's shortfalls times a factor of 1.08 will be added to the following year's reduction
Directive (2018)	Energy Efficiency Directive, EED **medium** Local public bodies and social housing bodies governed by public law were encouraged to adopt an energy efficiency plan and put in place an energy management system	Built Environ-ment	• update to the Energy Efficiency Directive (EED), establishing an EU energy efficiency target for 2030 of at least 32.5% (compared to projections of the expected energy use in 2030), with a clause for a possible upwards revision by 2023. The 32.5 % target for 2030 translates into final energy consumption of 956 Mtoe and/or primary energy consumption of 1,273 Mtoe in the EU-28 in 2030. • Member States are required to achieve cumulative end-use energy savings for the entire obligation period 2021 to 2030, equivalent to new annual savings of at least 0.8 % of final energy consumption. Exception for Cyprus and Malta as they are small islands: they should be required only to achieve cumulative end-use energy savings equivalent to new savings of 0.24 % of final energy consumption for the period 2021 to 2030. • The EU's energy efficiency policies should be inclusive and should therefore ensure accessibility to energy efficiency measures for consumers affected by energy poverty. Improvements to the energy efficiency of buildings should, in particular, benefit vulnerable households, including those affected by energy poverty, and, where appropriate, those living in social housing. • Additionally, consumers in multi-apartment buildings with collective heating systems are given clearer rights to receive more frequent information on their energy consumption to control their bills. And by extension, all countries should have in place transparent and publicly available national rules on the allocation of the cost of heating, cooling and hot water consumption in multi-

			apartment and multi-purpose buildings with collective systems for such services
Regulation (2018)	Governance of the Energy Union and Climate Action Regulation **low** NECPs are often created without significant consultation of cities	Energy Systems	• EU countries need to establish a 10-year integrated national energy and climate plan (NECP) for the period from 2021 to 2030. • The NECPs outline how the EU countries intend to address energy efficiency, renewables, greenhouse gas emissions reductions, interconnections, and research and innovation. • Member States had to submit their 2021-2030 draft plans by the end of 2018 and final plans by the end of 2019. The Commission has assessed these both at EU and Member State level. • Each country must submit a progress report every two years; the Commission will, as part of the state of the energy union report, monitor EU progress as a whole towards achieving these targets. • Member States will need to update their national energy and climate plans by the end of June 2023 in a draft form and by 30 June 2024 in a final form in order to reflect an increased ambition. • This Regulation is part of the Clean Energy for All Package
Regulation (2019)	Electricity Regulation **medium** The Regulation is primarily addressed at national authorities to ensure the working of the internal market for electricity which affects the local electricity grids	Energy Systems	• This Regulation establishes rules to ensure the functioning of the internal market for electricity and includes requirements related to the development of renewable forms of energy and environmental policy, in particular specific rules for certain types of renewable power-generating facilities, concerning balancing responsibility, dispatch and redispatching, as well as a threshold for CO_2 emissions of new generation capacity where such capacity is subject to temporary measures to ensure the necessary level of resource adequacy, namely, capacity mechanisms. • It includes general rules for the electricity market, and provisions on network access and congestion management, resource adequacy, transmission system operation, distribution system operation, and network codes and guidelines. • This Regulation is part of the Clean Energy for All Package.
Regulation (2019)	Risk Prepareness in Electricity Sector Regulation **medium** The Regulation is addressing the electricity sector and thus affects citizens	Energy Systems	• In a context of interlinked electricity markets and systems, electricity crisis prevention and management cannot be considered to be a purely national task. The risk of an electricity crisis, as a result of natural disasters, such as extreme weather conditions, malicious attacks or fuel shortages, can never be excluded. • This Regulation lays down rules for cooperation between Member States with a view to preventing, preparing for and managing electricity crises in a spirit of solidarity and transparency and in full regard for the requirements of a competitive internal market for electricity. • The European Network of Transmission System Operators for Electricity ('ENTSO for Electricity') and the Member States should, respectively, determine concrete regional and national electricity crisis scenarios. That

			approach should ensure that all relevant electricity crises are covered, taking into account regional and national specificities such as the topology of the grid, the electricity mix, the size of production and consumption, and the degree of population density. • This Regulation is part of the Clean Energy for All Package
Regulation (2023)	CO_2 Emission performance standards for cars and vans **medium** strengthens CO_2 standards for the transition to zero-emissions mobility. establishes concrete requirements for the deployment of recharging and refuelling infrastructure	Mobility and Transport	• Contributes to the EU's 2030 greenhouse gas emission reduction target of at least 55% compared to 1990 levels, and to the 2050 climate neutrality objective, by cost-effectively reducing CO_2 emissions from new cars and vans • Provides benefits for consumers from the wider deployment of zero-emission vehicles, in terms of better air quality and lower energy expenditure • Stimulates innovation in zero-emission technologies, thus strengthening the technological leadership and competitiveness of the EU automotive value chain and stimulating employment. • The proposed amended targets for 2025 and 2030 are defined as percentage reduction from the 2021 starting points. Cars: 55% reduction from 2030 on (previously 37.5%). Vans: 50% reduction from 2030 on (previously 31%). • From 1 January 2035: 100 % for cars, and 100 % for vans compared to the 2021 target. • Removal of the incentive for zero and low emission vehicles from 2030 onwards has also been proposed.
Regulation (2024)	Alternative Fuels Infrastructure Regulation **high** This regulation establishes concrete require ments for the deploy ment of recharging and refuelling infra structure along the TEN-T core and comprehensive network, in urban nodes	Mobility and Transport	• The Act revises and repeals Directive 2014/94/EU. The regulation provides a framework for the deployment of alternative fuels infrastructure across the continent. • This regulation confirms the ban on selling new internal combustion engine (ICE) vehicles from 2035 onwards and insists on developing charging infrastructure in cities and along motorways across Europe. Its goal is to impact the quantity and quality of the public EV charging infrastructure. • The regulation provides binding targets for all Member States. In the future, for every registered Battery Electric Vehicle, a Member State must provide an electric power output of at least 1 kW in the charging system, as well as 0.66 kW for every Plug-in Hybrid vehicle. • In addition, a "charging pool" needs to be created at least every 60 km on Europe's TEN-T core network from 2025, with the minimum capacity gradually increasing. From 2030, this should also apply to the entire comprehensive TEN-T network.
Regulation (2021)	Trans Euopean Transport Netweork (TEN-T Guidelines) **high** Aachen is one of the 424 major cities ("urban nodes") which	Mobility and Transport	• The EU's Trans-European Transport Network (TEN-T) policy aims at building an effective, EU-wide and multimodal transport network across the EU. • The revision of the TEN-T Regulation offers an opportunity to align the development of the TEN-T network to the European Green Deal objectives and the climate targets of the EU Climate Law. Cutting greenhouse gas emissions from the transport sector by 90%, compared with 1990 levels, by 2050, is key to achieving climate-neutrality by

	should develop a Sustainable Urban Mobility Plan (SUMP), which is a long-term, all-encompassing integrated freight and passenger mobility plan for the entire functional urban area.		the same date. The TEN-T revisions aim to: • make transport greener by providing the appropriate infrastructure basis to alleviate congestion and to facilitate an increase in the share of rail, short sea shipping and inland waterways in view of a more sustainable modal composition of the transport system. • facilitate seamless and efficient transport, fostering multimodality and interoperability between the TEN-T transport modes and better integrating the urban nodes into the network. • increase the resilience of TEN-T to climate change and other natural hazards or human-made disasters • improve the efficiency of the TEN-T governance tools, at streamlining the reporting and monitoring instruments and at reviewing the TEN-T network design
Directive (2018)	Energy Taxation Directive (ETD) **low** There is no link in the ETD between the minimum tax rates of fuels and their energy content or environmental impact.	Mobility and Transport	• lays down structural rules and minimum excise duty rates for the taxation of energy products used as motor fuel and heating fuel, and electricity. • Individual Member States are free to set their own rates as long as those minimum rates are respected. • Certain sectors, such as aviation and maritime transport, are currently fully exempt from energy taxation in the EU.
Directive (2008)	Ambient Air Quality (AAQ) Directive **high** The AAQ establishes legal air quality thresholds which are frequently exceeded in the EU due primarily to transport and heating fuel emissions in cities. It is a legal tool that cities can use to change policies or implement sustainability measures.	Mobility and Transport	• The Ambient Air Quality Directive provides the current framework for the control of ambient concentrations of air pollution in the EU. The control of emissions from mobile sources, improving fuel quality and promoting and integrating environmental protection requirements into the transport and energy sector are part of these aims. • The AAQ sets EU air quality standards for 12 air pollutants: sulphur dioxide, nitrogen dioxide / nitrogen oxides, particulate matter (PM10, PM2.5), ozone, benzene, lead, carbon monoxide, arsenic, cadmium, nickel, and benzo(a)pyrene. The Directives take into account relevant World Health Organisation standards, guidelines and programmes. • The Directives also guide the assessment of air quality by establishing a representative high-quality monitoring network, with more than 4 000 air quality monitoring stations across the EU, and by exchanging reliable, objective, comparable information on air quality, including to a wider public. • Where levels are elevated above limit or target values, Member States should prepare an air quality plan or programme to address the sources responsible to ensure compliance and to keep exceedance periods as short as possible. In addition, information on air quality should be disseminated to the public.
Directive (2009)	Fuel Quality Directive (FQD) **high** The FQD affects the type of fuels used in	Mobility and Transport	• The Fuel Quality Directive (FQD) requires a reduction of the GHG intensity of road transport fuels by a minimum of 6% by 2020 compared to 2010 by its Member States.

	cities and therefore has an important impact on GHD emissions and the air quality.		• The directive applies to petrol, diesel and biofuels used in road transport and gasoil used in non-road-mobile machinery. • Monitoring and reducing fuel life cycle greenhouse gas emissions can contribute to helping the Community meet its greenhouse gas reduction goals through the decarbonisation of transport fuel. • Member States are obliged to ensure that suppliers respect the target of 6% after the year 2020. The monitoring and reporting obligations relating to greenhouse gas emissions intensity also remain applicable after that date. • It also regulates elements of fuel quality linked to air pollutant emissions and, together with the Renewable Energy Directive, the sustainability of biofuels.
Directive (2021)	European Industrial Strategy **medium** Support towards achieving a climate neutral and circular economy through the full mobilisation of industry and transformation of industrial sectors and all its value chains.	Industry	Highlights the importance of R&I in providing the technological foundation to transform and strengthen industrial value chains, helping to turn sustainability and digital challenges into business opportunities. Common industrial technology roadmaps are a key tool to achieve this objective.
Directive (2019)	SUP Directive low Reducing plastic pollution has implications for climate mitigation	Industry	• EU rules on single-use plastic products aim to prevent and reduce the impact of certain plastic products on the environment, in particular the marine environment, and on human health. • They also aim to promote the transition to a circular economy with innovative and sustainable business models, products and materials, therefore also contributing to the efficient functioning of the internal market.
Directive (1999)	Landfill Directive medium	Industry	The Landfill Directive aims to protect both human health and the environment. In particular, it aims to prevent, or reduce as much as possible, any negative impact from landfill on surface water, groundwater, soil, air and human health. It does this by introducing rigorous operational and technical requirements.
Directive (2018)	Waste Framework Directive (WFD)	Industry	• The Waste Framework Directive lays down some basic waste management principles. It requires that waste be managed without endangering human health and harming the environment without risk to water, air, soil, plants or animals without causing a nuisance through noise or odours and without adversely affecting the countryside or places of special interest. The amendment from 2023 • The amendment of the Waste Framework Directive focuses on textiles waste. The proposal aims to bring about a more circular and sustainable management of

			textile waste, in line with the vision of the EU Strategy for Sustainable and Circular Textiles. • Under EU rules on waste, Member States are required to set up separate collection of textiles by 1 January 2025. For this to happen, separate collection, sorting, re-use and recycling capacities within the EU have to be strengthened. This requires significant investments to build infrastructure, and to develop new technological solutions. • In particular, the Commission is proposing to introduce mandatory and harmonised Extended Producer Responsibility (EPR) schemes for textiles in all EU Member States. EPR schemes require producers to take responsibility for the entire lifecycle of their products, in particular at the end of the product's life. Under the proposal, the level of the financial contributions of the producers will be based on the circularity and environmental performance of textile products (referred to as "eco-modulation").
Directive (2009)	Carbon Capture and Storage Directive low Of importance to CCS projects and industry, less so to cities.	Industry	• Establishes legal framework for safe geologic storage of carbon dioxide, covering all geologic formations and the entire lifetime of storage sites • Establishes extensive requirements for selecting sites for carbon storage, covers end of life obligations, and sets out criteria for the transfer of responsibility from the operator to Member State • In the case of leakage, operators are required to surrender emission allowances • Member States are required to report on implementation of directive every 4 years which the Commission uses to report to the Council and Parliament
Regulation (2018)	LULUCF high high due to carbon sequestration	Nature	The EU Regulation for the Land Use, Land Use Change and Forestry sector creates the EU legislative framework for emissions and removals for the period 2021-2030. The Regulation establishes for the first time a target. It requires Member States to ensure that the LULUCF sector does not generate net emissions and contributes to the enhancement of sinks in forests and soils ("no-debit" obligation). Decision No 529/2013/EU of the European Parliament and of the Council (7) sets out accounting rules applicable to emissions and removals from the LULUCF sector and thereby has contributed to the development of policies that have led towards the inclusion of the LULUCF sector in the Union's emission reduction commitment. This Regulation should build on the existing accounting rules, updating and improving them for the period from 2021 to 2030. Member States should submit to the Commission national forestry accounting plans, including forest reference levels. Regulation should ensure that human-induced reversals of removals are always accurately reflected in LULUCF accounts. The necessary provisions related to accounting of transactions should be contained in a single instrument combining the accounting provisions pursuant to Regulation (EU) No 525/2013, Regulation (EU) 2018/842, this Regulation and Directive 2003/87/EC.

Regulation (2021)	Common Agricultural Policy (CAP) low Potential framework and funding source for nature-based solutions for carbon sequestration and storage	Nature	Sets the objective for the 2023-2027 CAP to contribute to climate change mitigation and adaptation, including by reducing greenhouse gas emissions and enhancing carbon sequestration, as well as to promote sustainable energy.
Regulation (2023)	Social Climate Fund high Very important tool for funding just transition provisions.	Social Innovation	• Aims to mitigate financial stress on vulnerable populations due to the increase in fossil fuel costs to prevent energy and transport poverty. • Provides funding for Member States to increase energy efficiency of buildings, decarbonisation of heating and cooling, integrating of renewable energies, and expanding access to zero and low-emission transportation to principally benefit vulnerable households, micro-enterprises, and transport users. • Provides temporary direct income support for vulnerable households. • By June 2025, Member States must submit plans for use of the fund. • Member States can request funds twice per year from the fund.

Note: Current **EU** regulations and directives relevant to climate protection and emissions control (not exhaustive, as at 02/24)

Setting the framework for climate protection at EU level

In accordance with the requirements of the Paris Agreement, the EU and its member states, including Germany, have submitted their nationally determined contribution (NDC) to implement the agreement to the Secretariat of the Framework Convention on Climate Change. According to this, GHG emissions in the EU are to be reduced by at least 40 per cent by 2030 compared to 1990 levels. Within the EU, it was also decided that by 2030, the share of renewable energies in the EU's final energy consumption should be increased to at least 32 per cent and the EU's primary energy consumption should be reduced by at least 32.5 per cent compared to an underlying reference development. These targets are relevant for the integrated National Energy and Climate Plan (NECP) as a new European planning and monitoring instrument for the EU member states. In addition, a decision will also have to be made in the EU regarding a new communication or an update of the EU climate protection contribution by 2030.

The EU climate target will be achieved through emissions trading (ETS: essentially large emitters from the energy and industry sectors and aviation within the EEA) and through differentiated contributions from the Member States in all other sectors (non-ETS). The EU climate targets for 2020 (- 20 per cent compared to 1990) and 2030 (at least - 40 per cent compared to 1990) are divided into targets for the ETS sector and the non-ETS sector. The reference year 2005 was chosen for both sub-targets. In addition, the member states are obliged under the LULUCF Regulation to maintain the climate protection effect of managed terrestrial ecosystems. The ETS sector is to achieve a reduction of 43 per cent by 2030 compared to 2005. The companies subject to emissions trading in all member states fulfil this reduction obligation jointly, i.e. there is no separate German ETS target. The nationally binding EU targets for the non-ETS sector (transport, buildings, industry (if not in the ETS), agriculture, waste) in the individual member states for 2030 are between 0 per cent and -40 per cent compared to 2005.

Importance of the EU framework for Germany

Germany must reduce its corresponding emissions by 38 per cent by 2030 compared to 2005. The EU member states receive (like emissions trading) so-called emission allocations in accordance with the non-ETS targets, which must be set aside for each tonne of GHG emitted (expressed in CO_2 equivalents). The emission allocations are distributed over the individual years of the 2021 to 2030 trading period in the form of CO_2 -eq. budgets). If

the allocated annual budget is not sufficient, flexibility measures can be applied, e.g. the purchase of emission allocations (credits) from other EU countries. The Regulation on the climate change mitigation contribution of land use, land-use change and forestry ("LULUCF Regulation") obliges all member states to achieve the nationally binding target of balancing the carbon footprint of managed soils, wetlands, forests and wood products (so-called no-debit rule). Natural fluctuations in carbon content are largely excluded from the accounting process. If this target is exceeded, limited credits can be counted towards the non-ETS targets. If the target is not met, measures must be implemented in the LULUCF sector that lead to a corresponding reduction in CO_2 (e.g. reforestation) or the credits must be offset by the non-ETS sectors.

The German reduction target for 2030 of at least 55 per cent compared to 1990 was first defined in the 2010 Energy Concept and confirmed several times by resolutions of the Federal Government (including the Climate Action Plan 2050) and at political level in the 2018 coalition agreement. It corresponds to an overall reduction (ETS and non-ETS) of 43 per cent compared to 2005 (base year for EU targets). The national targets of the Climate Action Plan 2050 for the non-ETS sectors are more ambitious overall than the German non-ETS reduction target of 38 per cent compared to 2005 within the EU framework. If Germany fulfils its ambitious national climate protection target for 2030, it will also meet its EU obligations. For the LULUCF sector, the German government has decided in the Climate Action Plan 2050 that this should be secured as a net sink. The connection to the nationally binding requirements of the LULUCF Regulation can only be assessed once the EU has decided on the reference level for forests in Germany. The EU is currently reviewing its targets as part of the formulation of the long-term strategy. When discussing the EU's long-term climate protection strategy, it is crucial that the EU demonstrates that its 2050 target is a fair contribution to achieving the Paris Agreement, how the transformation process can be implemented technologically and how the necessary conditions can be created. Germany and the EU must remain successful business locations in the future. Climate protection must be harmonised with economic success and social inventory. Several studies identify pathways with which a 95 per cent reduction in greenhouse gas emissions compared to 1990 is technologically feasible and achievable with additional behavioural changes; individual studies also consider a higher reduction to be possible. The remaining and unavoidable residual emissions - presumably mainly from agriculture and possibly from industrial processes - would then have to be offset.

2.2.2 Determining the 2030 emissions gap for Aachen

Explanation of the following table A-2.1 - Emission Gap: The Econmic Model was used to validate the City of Aachen's Action Plan and Investment Plan: https://netzerocities.app/group-apabilitybuildingprogrammebuildingastrongeconomiccase. There are differences between the results of the economic model and the quantifications in IKSK 2020 and IKSK 2.0 for the following reasons:

- In IKSK 2020, emissions in the city of Aachen were partly determined according to the polluter-pays principle. As a result, these are higher than those determined by the economic model.
- IKSK 2.0 aims to reduce emissions in Aachen's urban area by 95 % by 2030 compared to 1990 levels. This also differs from the Economic Model target (80% reduction compared to 2021, which corresponds to 83% reduction compared to 1990).

As some of the assumptions made in the IKSK were changed when applying the economic model to simulate a more realistic scenario, the information in the fact sheets of the IKSK 2.0 can no longer be used to calculate the emission reduction of individual measures. To determine the reduction in GHG emissions from IKSK 2020, the information in Chapter 9 of the IKSK 2020 was used:

1. All 70 measures of the IKSK 2020 lead to a reduction in emissions of 46% of the targeted 769,000 kt CO2eq, i.e. 353,740 kt.
2. Buildings and heating account for 14.5 %, renewable energies for 26.2 % and mobility for 2.7 %; waste and agriculture were not considered and therefore have no dedicated measures in the IKSK 2020.

This results in the following emission reduction values for the sectors:

- Buildings & heat: 111,505 ktCO2e
- Renewable energies: 201,478 ktCO2e

- Mobility: 20,763 kt ktCO2e

In relation to the total emissions of 1,577 kt CO2e for the base year 2021, this results in shares of:

- Buildings & heating: 7.1 %
- Renewable energies: 12.8 %
- Mobility: 1.3 %

Table 7 (A-2.1) Emission gap and key actionsto climate neutrality 2030 (Note: The table is also uploaded separately for better readability, see attachment *Table 7 (A-2.1)*

A-2.1: Emission gap and key actions to climate neutrality 2030 for the City of Aachen

Field of action	Sector	Baseline emissions (baseline year: 2021)		Core activities from IKSK 2020* and IKSK 2.0**				Emissions reduction in 2030		Emission reduction through IKSK 2020*		Emission reduction through future measures (IKSK 2.0** and urban society measures)		Residual emissions in the year 2030		
		Absolute Value (kt CO2e/a)	Share on Total Baseline (%)	Code	Description of the	IKSK 2020*	IKSK 2.0**	Absolute Value (kt CO2e)	Reduction from baseline year (%)	Absolute Value (kt CO2e/a)	Share on Total Existing Actions (%)	Absolute Value (kt CO2e/a)	Share on Total Future Actions (%)	Absolute Value (kt CO2e/a)	Share of total residual emissions (%)	Share of baseline emissions (%)
Buildings & Heating	Heat (space heating and industrial processes, IPPU)	613	38,9	BH 01	Climate-neutral electricity and heat supply for municipal properties		x	391	-89 %	111,51	7,1	436,50	92,9	65	20,8	4,1
				BH 02	Decentralised heat supply, secure district heating network, neighbourhood-specific individual solutions ⓔⓔ	x										
				BH 03	Concept for the optimised use of geothermal energy		x									
				BH 04	Waste heat utilisation	x										
				BH 05	Heat planning		x									
				BH 06	Masterplan - integrated, comprehensive energy planning		x									
	Buildings (municipal, private, industrial, residential and non-residential)			BH 07	Energy-efficient refurbishment of municipal residential buildings	x	x	157								
				BH 08	Energy-efficient refurbishment of municipal non-residential	x	x									
				BH 09	Energy-efficient refurbishment of private residential buildings	x	x									
				BH 10	Redevelopment model area: Eastern city centre		x									
				BH 11	Energy management in buildings	x										
				BH 12	Climate-neutral new buildings		x									
				BH 13	Energy in the hands of citizens - Energy Co-operative		x									
				BHS	Actions of urban society/stakeholders	Commitments⊕										
Total buildings & heating		**613**	**38,9**					**548**	**- 89 %**	**111,51**	**7,1**	**436,50**	**92,9**	**65**	**20,8**	**4,1**
Electricity	PV	644	40,8	EE 01	PV systems on municipal buildings for own use of electricity	x	x	515	- 80 %	201,48	12,8	313,52	83,2	129	41,2	8,2
				EE 02	Expansion of solar energy use, establishment of support programme	x										
				EE 03	Ground-mounted PV systems	x	x									
	Wind power			EE 04	Secure and expand renewable share from wind energy	x	x									
	Wind power			EES	Actions of urban society/stakeholders	Commitments⊕										
Total electricity generation		**644**	**40,8**					**515**	**- 80 %**	**201,48**	**12,8**	**313,52**	**83,2**	**129**	**41,2**	**8,2**
Transport	Public transport	276	17,5	TA 01	Procurement support for ASEAG e-buses	x		10	- 62 %	20,76	1,3	149,24	98,7	106	33,9	6,8
				TA 02	Procurement of 90 electric and hydrogen buses ⌂											
	Private transport			TA 03	Creation of "strong axes" in bus transport	x		160								
				TA 04	30 % additional output from ASEAG	x										
				TA 05	Strong expansion of express bus services	x										
				TA 06	RegioTram (Aachen-Baesweiler tramway)	x										
				TA 07	Expansion of cycle traffic according to the cycling decision	x	x									
				TA 08	Premium paths and squares, crossing aids	x										
				TA 09	Continuation of BMM programme for employers	x										
				TA 10	Reducing emissions from delivery traffic	x										
				TA 11	P+R / mobility hubs on all access roads	x										
				TA 12	2,000 cargo bikes funding programme	x										
				TA 13	Expansion of charging infrastructure	x	x									
				TA 14	City centre mobility for tomorrow		x									
				TA 15	Network Mobility Transition Aachen Region (NEMORA)		x									
				TA 16	BMM at city administration, municipal holdings		x									
				TA 17	Zero-emission zone		x									
				TA 18	Promotion of sharing and multimodality ⊕		x									
				TAS	Actions of urban society/stakeholders	Commitments⊕										
Total traffic		**276**	**17,5**					**170**	**- 62 %**	**20,76**	**1,3**	**149,24**	**98,7**	**106**	**33,9**	**6,8**
Waste	Waste separation	15	1,0	W 01	Sustainability competition for schools and daycare centres to reduce waste	x		8	- 52 %	0,00	0	8,00	100	7	2,2	0,5
				W 02	Ökoprofit environmental management programme for companies	x										
	Recycling/ Circular economy			W 03	Building yard of the future for Aachen's municipal services		x									
				W 04	Component and resource warehouse		x									
				W 05	Agency for Climate, Energy, Circular Economy and Sustainability		x									
				WS	Actions of urban society/stakeholders	Commitments⊕										
Total waste		**15**	**1,0**					**8**	**- 52 %**	**0,00**	**0**	**8,00**	**100**	**7**	**2,2**	**0,5**
AFOLU	Expansion of organic farming	29	1,8	A 01	Utilising lease agreements of the city of Aachen to strengthen organic farming		x	23	- 80 %	0,00	0	23,00	100	6	1,9	0,4
	Others			A 02	Pilot projects in agroforestry		x									
				A 03	Continuation of the "Sustainable Agriculture and Food" Round Table		x									
Total AFOLU		**29**	**1,8**					**23**	**- 80 %**	**0,00**	**0**	**23,00**	**100**	**6**	**1,9**	**0,4**
Total		**1577**	**100 %**					**1,264**	**- 80 %**	**333,746**	**21,2 %**	**930,254**	**77,8 %**	**313**	**100**	**20 %**

*IKSK2020: was politically approved in June 2020 and is currently being implemented, duration until the end of 2025

**IKSK2.0: is currently undergoing political discussion at the time of submission of the CCC. By summer 2024, packages of measures are to be concretised and prioritised, which will then be adopted by the committees and the City Council. Implementation of IKSK 2.0 begins in 2025

ⓔⓔ: see also STAWAG's commitment

⌂ : Commitment of ASEAG

⊕: see alsoCommitment of cambio GmbH

⊕: Individual Commitments see Appendix 2, Overview of Actions from FRAME-Partners see Table xx, Analysis of Actions according to Economic Model see Figure

2.3 Module A-3 Systemic Barriers and Opportunities to 2030 Climate Neutrality

This Chapter describes the urban systems, systemic barriers, and opportunities in the City of Aachen.

2.3.1 (A-3.1) Description of urban systems, systemic barriers, and opportunities

2.3.1.1 The municipal sphere of influence - systemic limits

Comprehensive transformations are required to achieve climate neutrality while meeting the 1.5-degree target. The potential influence of the Aachen municipal family will not be sufficient to achieve climate neutrality on its own. This requires joint action by all institutional and social stakeholder groups in Aachen as well as optimal framework conditions for action. But how much influence can the city be expected to have? A project by the Federal Environment Agency (UBA) with the participation of ifeu, Heidelberg, provides the basis. The study defines four areas of influence: "Consume and set an example", "Supply and offer", "Regulate" and "Advise and motivate". The levels of influence and decision-making are briefly described and the City of Aachen's options for action are identified.

When considering the municipal sphere of influence, three different decision-making levels must be considered, each with their own sphere of influence on the achievement of climate neutrality - the so-called multi-level approach. The three decision-making levels are

1. The European Union, federal and state governments set important legal and economic framework conditions at the higher decision-making level and have the largest sphere of influence.
2. Citizens and companies together form the market players; their sphere of influence is formed by their decision-making behaviour regarding consumption, investments and participation in activities and offers.
3. The City of Aachen acts both directly and indirectly through its administration and municipal holdings.

Neither the city administration nor the municipal holdings can achieve the goal of climate neutrality through direct and indirect action on their own. A prerequisite for achieving urban climate neutrality is a comprehensive transformation of urban society, which must be understood as both a systematic task and an agile process.

The estimated sphere of influence of the municipal family (city administration, municipal enterprises, municipal holdings) on the reduction of energy-related greenhouse gas emissions in Aachen is a maximum of 44%. The assessment and quantification of the city administration's sphere of influence is carried out in relation to the system and action potentials, divided into an ambitious-realistic and a maximum variant.

The quantification of both variants is based on the results of a project by the Federal Environment Agency (UBA) and the ifeu Institute in Heidelberg and is an expert assessment that also considers the results of the IKSK Aachen, among other things.

The city administration's sphere of influence was quantified for the following fields of action:

- Building
- Energy supply
- Mobility
- Economy
- Social transformation

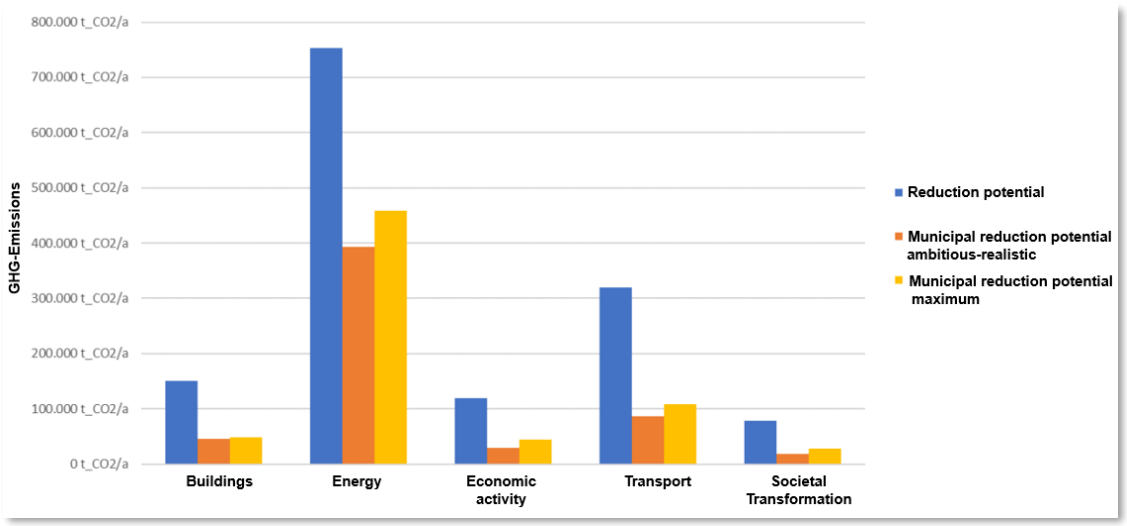

Figure AP- 14 Overview of the savings potential / local authorities

Note: Overview of the savings potential that can be influenced by local authorities in relation to the reduction potential per area of action. A realistic-ambitious and a maximum scenario are assumed, graphic: Gertec.

The maximum consideration results in a municipal sphere of influence of approx. 44 % (approx. 686,500 tonnes of CO_2eq), whereby it is assumed that all the necessary framework conditions for successful implementation at scale and in good time are in place. The calculation of the municipal sphere of influence in the ambitious-realistic variant is correspondingly lower, at approx. 37 % (approx. 574,100 tonnes of CO_2 eq), as it is not assumed here that the necessary framework conditions are available in full and on time.

Figure AP-14 clearly shows that the transport sector has the second-highest reduction potential. However, the range of influence of urban measures is very small at a maximum of 30 %. Changes in the behaviour of road users are therefore primarily necessary to exploit the emission reduction potential in this sector. One of the biggest challenges facing the city administration in the coming years will be to strengthen the eco-mobility network.

2.3.2 Area of influence consumption and role model

In the area of influence "Consumption and role model", the City of Aachen has full direct influence on the reduction of greenhouse gas emissions. This includes, for example, street lighting, the optimisation of procurement or the renovation of its own buildings.

Table AP- 8 Instruments and opportunities to influence consumption and role models

Instrument/topic area	Possibilities of influence (examples)
Municipal energy management	• Energy consumption control • Conceptual principles for reducing energy consumption
Municipal property management	• Energy-efficient building modernisation • Efficiency measures • Expansion of photovoltaics • Conversion of street lighting to LED (incl. intelligent control system)
Property management of municipal residential buildings	• Energy-efficient building modernisation • Conversion of the heat supply to renewable energies
Strategic procurement management	• Compliance with efficiency standards • Bundling of orders • Observance of quality seals
Drinking water and wastewater disposal	• Increasing the efficiency of systems for the production and treatment of drinking water or in sewage treatment plants, for example
Municipal mobility management	• Avoidance of business trips • Choice of mode of transport for business trips
Fleet management	• Choice of drive types for the vehicle fleet (incl. public transport)

2.3.3 Area of influence Supply and offer

The City of Aachen, together with its municipal enterprises and municipal holdings, provides important infrastructures with direct or indirect potential for influence.

Table AP- 9 Instruments and opportunities to exert influence in the area of supply and provision

Instrument/topic area	Possibilities of influence (examples)
Municipal property management	• Installation of PV systems
Municipal heat planning	• Decarbonising the energy supply by switching energy sources • Strategic basis for the conversion of the heat supply structure
Strategic procurement management	• Increase and standardise the availability of regional and sustainable food in public canteens
Cycling concept	• Modernisation and expansion of cycling infrastructure
Pedestrian traffic concept	• Improving the pedestrian transport infrastructure
Local transport planning	• Modernisation and expansion of public transport services

Car-Sharing is set to play an even more central role in the transport sector in future. With cambio, Aachen has already had an established car-sharing provider in 44 cities across Germany for many years. In Aachen, cambio operates 80 stations and has been gradually converting its fleet to e-cars that are charged with green electricity since 2012. The city council also primarily uses e-vehicles from cambio for local business trips. Cambio's commitment to the Aachen Climate City Contract can be found in Appendix 1 as well as in Appendix 2 of the Commitments (see *Commitment_CityOfAachen)*.

2.3.4 Area of influence Counselling and motivating

The City of Aachen has an indirect influence on all market players through counselling and motivation activities. Co-operations, e.g. with business associations, are one way of joining forces.

Table AP- 10 Tools and opportunities to influence in the area of counselling and motivation

Instrument/Topic area	Possibilities of influence (examples)
Information and counselling services, participation	Activating participation Possible topics for citizens and companies • Energy-efficient building modernisation • Heating replacement (switch to renewable energies) • Mobility behaviour
Municipal funding programme	Possible topics • Energy-efficient building modernisation • PV expansion (in particular preparatory studies) • Promotion of cargo bikes • Courtyard and façade design • Attic conversion

2.3.5 Regulatory sphere of influence

Within the framework of local self-government, the City of Aachen can exert influence through its planning and decision-making authority.

Table AP- 11 Instruments and opportunities to influence regulation

Instrument/topic area	Possibilities of influence (examples)
Land use plan	• Site planning of new construction areas, e.g. consideration of solar radiation possible • Definition of traffic areas, open spaces, areas for restricted use, etc. • Definition of areas for the use of renewable energies (e.g. ground-mounted PV systems) • Definition of wind power areas in land use planning
Development plan	Determination for residential and non-residential buildings, e.g. • Construction method • Compactness or A/V ratio • Roof shape • Building orientation • Shading (restriction of planting to increase the solar yield) • Height and spacing with regard to solar yields • PV obligation • Labelling of statutes on the obligation to connect and use
Urban development contract	Building standard for residential and non-residential buildings, e.g. • Thermal insulation standard • Energy requirement/ energy standard, e.g. low-energy construction • Energetic quality • Utilisation of renewable energies, including PV • Obligation to connect district heating • Heating and cooling supply • Creation of energy concepts and implementation of the variants described therein Obligation for mobility measures
Property purchase agreement (purchase agreement)	Building standard for residential and non-residential buildings e.g. • Thermal insulation standard • Energy requirement/ energy standard, e.g. low-energy construction • Energetic quality • Utilisation of renewable energies, including PV Financial influence options, e.g: • Linking property prices to energy efficiency and sustainability Building standards

Supplementary in the transport sector: Local transport plan as a legally binding framework plan for the development of local public transport. This has been regularly updated since its adoption in 2014.

2.3.6 The challenge of monitoring greenhouse gas emissions

The Climate and Environment Department of the City of Aachen has been preparing an annual CO_2 inventory sheet in accordance with the BISKO standard (Municipal Balancing System) for over 20 years. The BISKO standard inventory the energy-related greenhouse gas emissions of the sectors private households, transport, industry as well as trade, commerce, services, other and municipal facilities and has been used as a benchmark and control instrument by numerous cities active in climate protection. The areas of agriculture, waste and wastewater as well as industrial process emissions are not yet included in the BISKO standard, mainly due to problems with data availability.

A much more differentiated monitoring of climate protection measures and the resulting greenhouse gas emission reductions is becoming increasingly important. Not least to provide a transparent response to the social pressure that is driving climate protection ambitions. The recording of non-energy-related greenhouse gas

emissions should not be overlooked. These emissions have so far played a subordinate role in municipal climate protection and are not yet included in BISKO-compliant greenhouse gas inventories. A fully greenhouse gas-neutral municipality must therefore also establish a monitoring system for non-energy greenhouse gas emissions in addition to the BISKO-compliant greenhouse gas inventory.

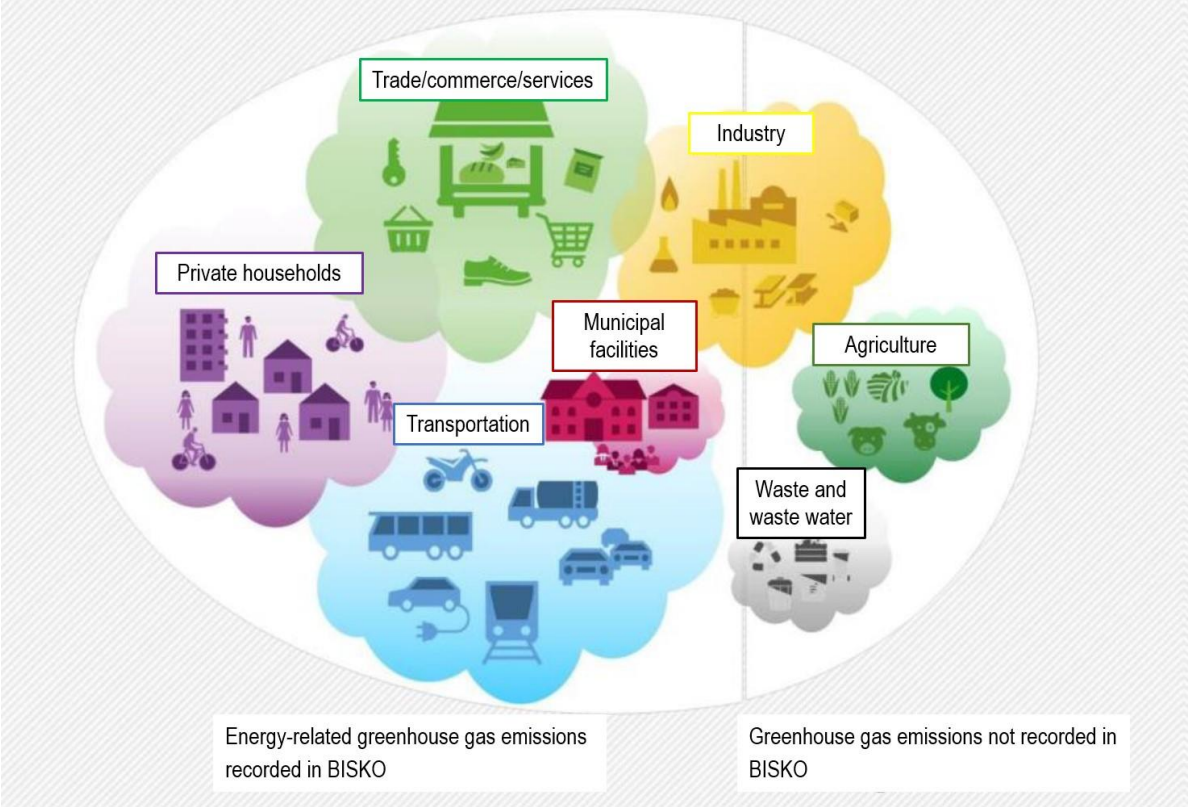

Figure AP- 15 Schematic representation of greenhouse gases in municipal
Source: Federal Environment Agency
Note: Area and colour intensity of the clouds roughly represent the greenhouse gas emission quantities).

It is therefore essential to expand the greenhouse gas accounting to include the non-energy-related greenhouse gases emitted by local authorities in order to achieve greenhouse gas neutrality. In the IKSK 2.0, the greenhouse gas emissions for Aachen in the AFOLU sector were estimated at approx. 29,045 tonnes of CO_2eq for 2020 according to a standard of the Thünen Institute in Braunschweig, which accounts for approx. 1.5 % of the city's GHG emissions in this year.

In addition to agriculture, the waste and wastewater sectors and industrial processes should also be included in the assessment in future. In future, the city of Aachen will collect the relevant data and determine suitable indicators for monitoring greenhouse gas emissions (see modules A-1).

In future, a digital sustainability tool will provide online information on the progress of climate protection measures and CO_2 emission savings. The tender for such a tool via the Aachen city administration is to be issued shortly. This process is being supported by regioIT GmbH, the city's IT service provider, which has conducted comprehensive market research into the various sustainability tools available on the market.

2.3.7 Dependencies and obstacles to municipal climate protection

I) Politics

Municipal climate protection is highly dependent on political decisions.

More than 30 years ago, the city of Aachen committed itself to the goal of protecting nature, the environment and the climate. Since then, this goal has been pursued continuously and independently of political majorities in the city council. For example, the resolution on climate neutrality in 2030 was also supported by all parliamentary

groups in Aachen City Council. The IKSK 2.0 was unanimously adopted by the Committee for the Environment and Climate Protection at its meeting on 23 January 2024. The final vote on IKSK 2.0 will take place in the City Council in March 2024. On the administrative side, broad approval is also assumed here, which means that the city administration is tasked with swiftly implementing the measures to maximise the reduction of the city's greenhouse gas emissions. As climate protection in Aachen has a broad political basis, the majority should continue to support Aachen's path to climate neutrality even after the next municipal elections and mayoral elections in autumn 2025. In this respect, Aachen is on a very good and stable path when it comes to climate protection.

More than 30 years ago, the city of Aachen committed itself to the goal of protecting nature, the environment and the climate. Since then, this goal has been pursued continuously and independently of political majorities in the city council. For example, the resolution on climate neutrality in 2030 was passed unanimously by all political groups in Aachen City Council. The IKSK 2.0 was unanimously adopted by the Committee for the Environment and Climate Protection, chaired by Iris Lürken (CDU, Christian Democratic Union), at its meeting on 23 January 2024, thus setting the course for its implementation. Aachen City Council is expected to adopt the IKSK 2.0 in March 2024. All departments and divisions involved in the implementation of measures will then draw up and prioritise packages of measures to maximise the reduction of the city's greenhouse gas emissions. These packages of measures will be submitted to the relevant committees for approval. As climate protection in Aachen has a broad political basis, Aachen's path to climate neutrality should continue to be pursued after the next municipal and mayoral elections in autumn 2025. Aachen is on a very good and stable path when it comes to climate protection.

However, the implementation of climate protection measures and their financial viability is influenced by one important circumstance: climate protection and climate adaptation have so far been voluntary tasks for cities, municipalities and districts in Germany. The lack of a systematic, federal legal basis for climate protection and adaptation in local authorities is an obstacle to the urgently needed socio-ecological transformation: as voluntary tasks, climate protection and adaptation compete with mandatory tasks for the scarce human and financial resources of local authorities. Although federal and state subsidies have provided important impetus in the past, they do not enable the comprehensive and long-term integration of climate change mitigation and adaptation into municipal action.

By establishing climate protection and climate adaptation as a mandatory municipal task, basic funding for municipal climate protection independent of subsidies, better staffing and prioritisation of climate protection and climate adaptation in weighing up competing municipal tasks should be achieved.

The state of North Rhine-Westphalia and its government are leading the way on climate protection in Germany. With the adoption of the 2nd Climate Protection Act in July 2021 and the decision to bring forward the phase-out of lignite by eight years to 2030, the state government is providing important impetus towards climate neutrality. Support services and programmes are continuously being offered for municipal climate protection. For example, the city of Aachen benefits from the impulse funding programme for municipal heat planning. This funding enabled the city of Aachen to commission a consortium to carry out heat planning for Aachen as early as the end of 2023. The heat planning should be available by the end of 2024 and offer orientation and perspective to the entire urban community.

As the climate protection targets of the state of North Rhine-Westphalia and the associated legislation are based on those of the federal government, it can be assumed that the course taken will continue after the state elections in spring 2027.

At federal level, the German Climate Protection Act passed in May 2021 sets clear targets. It stipulates that Germany must reduce greenhouse gas emissions by at least 65% by 2030 compared to 1990 levels. By 2040, the target is 88%, with Germany finally achieving greenhouse gas neutrality by 2045. To maintain this ambitious course, we need firm and clear guidelines from a strong federal government. The Climate and Transformation Fund (KTF) was set up in 2010 as a special fund for the implementation and financing of measures to change the German economy towards climate neutrality and sustainability. The KTF will provide a total of € 49 billion for the year 2024. This gives the German government strong leverage, particularly for the energy and heating transition. Some projects from the KTF, such as the expansion of hydrogen infrastructure in Germany, may have a direct impact on the city of Aachen's climate protection plans, as one of the planned hydrogen pipelines may run through Aachen's urban area. Such current developments will be directly considered in the city's action planning.

However, the path to a climate-neutral Aachen will not only depend on political decisions at local, national and EU level, but will also encounter uncertainties that need to be dealt with. The extent to which (global) political developments can influence climate protection was impressively demonstrated in 2023 in private heating supply. A total of 1.3 million heat generators were sold in Germany in 2023, 34% more than in the previous year. In the first half of the year, demand for heat pumps was extremely high due to the Russian war of aggression in Ukraine and the resulting concerns about a possible gas shortage. In the second half of the year, the discussion surrounding the amendment to the German Building Energy Act (GEG) and future subsidies led to increased demand for oil and gas heating systems. Meanwhile, sales of heat pumps declined. As a result, 788,000 units (60%) of the heat generators sold in Germany in 2023 were oil and gas heating systems - clearly counterproductive for the path to climate neutrality (https://www.tagesschau.de/wirtschaft/gasheizung-rekord-verkauf-2023-100.html).

Conclusion: Successful climate protection requires at least domestic political stability, foresight and clear legislation, and even more target group-orientated, honest but at the same time unagitated communication.

A steering forum for climate protection has been set up at federal level with the participation of several ministries, which exchanges information at working level with representatives of the nine mission cities. It is chaired by the Federal Ministry of Housing, Urban Development and Building, BMWSB, and the Federal Ministry of Education and Research, BMBF. In this steering forum, the mission cities are given the opportunity to address needs and obstacles and work on solutions.

The European Union sets binding climate protection targets for all member states. The European Green Deal aims to make Europe climate-neutral by 2050. To make this target legally binding, the Commission has presented the European Climate Law, which also sets a new, more ambitious target to reduce net greenhouse gas emissions by at least 55% by 2030 compared to 1990. In February 2024, the Commission proposed a milestone target for 2040, setting the EU on course to achieve climate neutrality by 2050. Net greenhouse gas emissions are to be reduced by 90% by 2040 compared to 1990 levels. This target is currently being discussed by the European Parliament and the Council.

The following Federal Environment Agency roadmap from November 2022 to support municipal climate protection summarises the strategic recommendations to the federal and state governments for effective support of municipal climate protection (AP-16).

This can be broken down into the following six points:

- Securing funding and anchoring strategic climate protection in municipalities
- Establish climate protection reporting
- Increase commitment to municipal climate protection
- Further develop promotion
- Establish nationwide counselling and support structures
- Integrating municipal companies

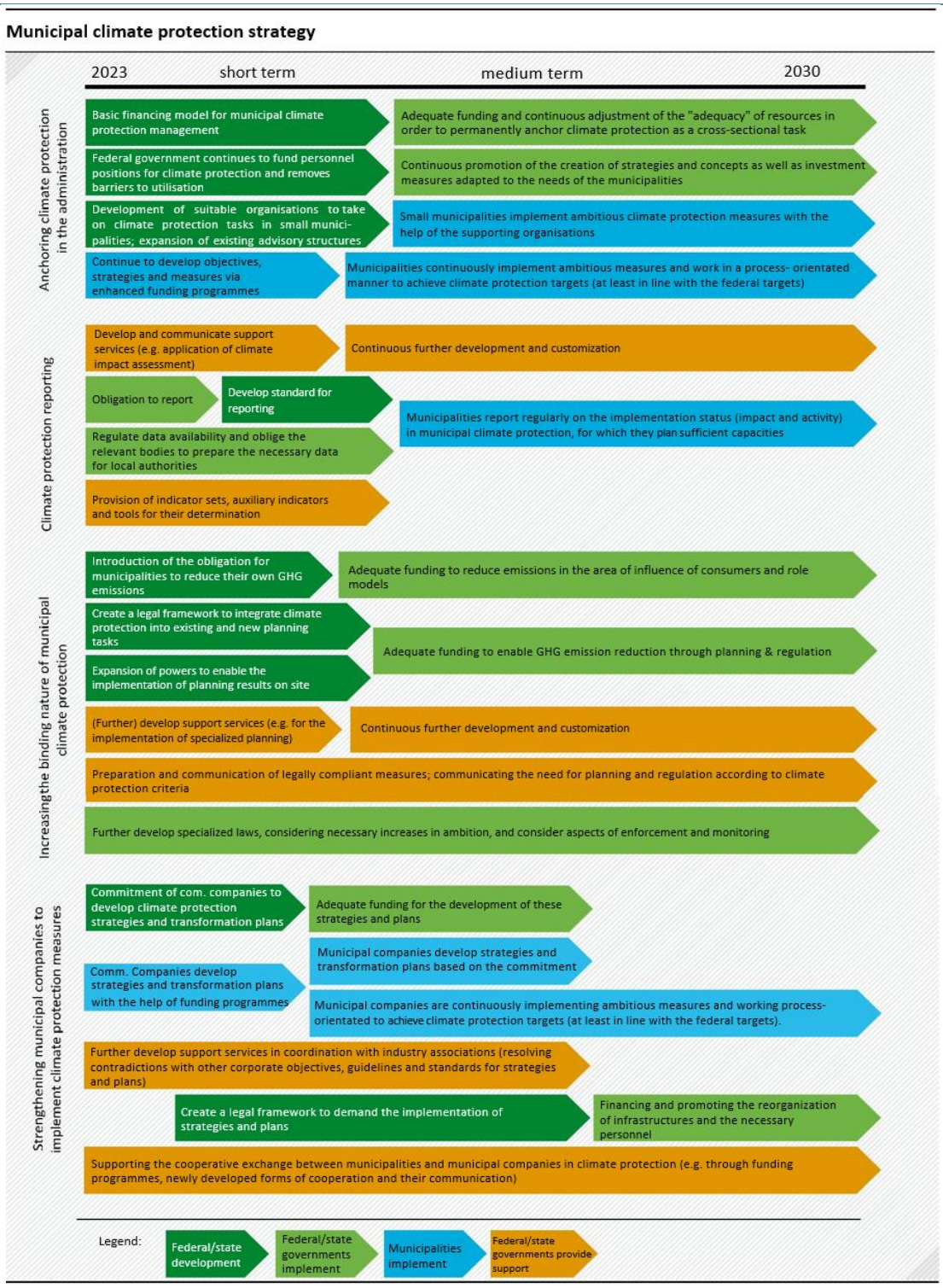

Figure AP- 16 Strategic recommendations of the support of municipal climate protection action

Description: Strategic recommendations to the federal and state governments for effective support of municipal climate protection, Source: Federal Environment Agency, November 2022 (https://www.umweltbundesamt.de/sites/default/files/medien/376/publikationen/broschuere_klimaschutzmanagement_und_treibhausgasneutralitaet_in_kommunen_bf.pdf)

II) Limits to municipal action and bureaucratic hurdles

To achieve the ambitious climate protection and climate adaptation targets, bureaucratic hurdles must be removed, planning and authorisation procedures accelerated, and local authorities financially supported in their implementation measures.

In Germany, 80% of electricity is to be produced from wind, solar and other renewable energy sources by 2030. The federal and state governments must therefore swiftly initiate legal changes to further simplify authorisation procedures, preserve municipal planning and control options and strengthen municipal participation to promote local acceptance of the energy transition, for example.

Since 2022, the BMWK has already amended numerous regulations that contribute to a faster expansion of the renewable energy supply and a modern infrastructure. This applies, for example, to the expansion of a climate-neutral electricity grid. The need for a comprehensive reduction in unnecessary bureaucracy at both European and national level has been addressed by the Federal Government as a whole since the end of 2023.

Practical and enforceable guidelines must be drawn up that respect municipal planning sovereignty and are also fully funded. Regulations such as the planned Climate Adaptation Act or the Building Energy Act are a step in the right direction but are too complex in their design and difficult to implement. The federal and state governments need to place greater trust in the municipal level. Fewer mandatory requirements, but more incentives and the necessary freedom of action to continue measures that have already been initiated and to launch new concepts for climate protection and climate adaptation at local level.

In the transport sector in particular, municipal decision-making authority needs to be strengthened to achieve the goal of climate neutrality. Local authorities need more room for manoeuvre to be able to shape their own transport systems according to the wishes of their citizens.

The "Liveable cities and communities" initiative was founded in July 2021 to emphasise the demand for more personal responsibility. The initiative calls on the federal government to create the legal conditions for local authorities to impose a 30 km/h speed limit in urban areas where they deem it necessary. In addition to the initial eight cities, including Aachen, 800 cities and municipalities have now joined forces to address this demand to the Federal Ministry of Digital and Transport. The reform of the Road Traffic Act that has now been announced is the first result of this initiative. According to the draft bill presented, local authorities will be able to justify 30 km/h zones, car-free roads or separate bus lanes based on climate and environmental protection, health and urban development objectives, rather than just the safety and fluidity of traffic.

The European Green Deal also harbours opportunities and risks for international competitiveness. Whether the concept presented by the EU Commission will turn out to be a driver of value creation and prosperity in Europe depends on its actual implementation. In connection with the implementation of the Green Deal, companies are primarily concerned about cost increases, increasing bureaucracy and more regulation. The IHK Aachen has joined forces with the other IHKs in the Rhineland to work with representatives from business and politics to develop perspectives and solutions for companies so that the European Green Deal does not become a threat to domestic industry and its jobs. In December 2023, the DIHK and the CCIs responded to an EC consultation with a statement. This proposed 50 bureaucracy reduction measures to the EU Commission.

The EU Commission has already taken account of the reduction in bureaucracy with an initial package of measures that pursues the reduction target of 25 %.

III) Procurement

The potential of municipal procurement for climate protection is considerable, as a 2014 study by the German Institute of Urban Affairs shows. Cities, municipalities and districts in Germany spend more than 30 billion euros annually on purchases in the areas of buildings, office equipment and IT, mobility and transport routes, supply and disposal as well as electricity and heat generation. By consciously making climate-friendly and energy-efficient purchases, the greenhouse gas emissions of municipalities can be significantly reduced, and sustainability strengthened at the same time. However, sustainable municipal procurement that aims to make a concrete contribution to climate protection, sustainable mobility, infrastructure, etc. requires new procurement regulations that prioritise and integrate environmental and climate protection criteria much more strongly.

In addition, there is the problem that the growing demand for sustainable technologies meets with a short supply or long delivery times, for example when purchasing electric and hydrogen buses or photovoltaic systems. With a view to strengthening the national economy, it is therefore also incumbent on politicians to ensure the ramp-

up of regional/national production of important key technologies and components and the accelerated expansion of the necessary infrastructure to achieve the ambitious climate protection targets.

IV) Shortage of skilled labour

According to a study from 2021, the implementation of investments for a climate-neutral Germany will require a considerable domestic workforce of up to 767,200 people in 2035, 58% of whom will be skilled workers. Around 40% of the labour demand for climate neutrality in 2035 will be accounted for by occupational groups in which the Federal Employment Agency identified a shortage of skilled workers, specialists or experts in 2019[1] .

The "10,000 Days" implementation alliance was initiated by the Federal Ministry of Education and Research and ProjectTogether in 2023 to close this glaring gap in skilled labour. The aim of 10,000 Days is to bring together partners from civil society, business, government and science in unusual collaborations. The mission is the broad mobilisation, training and strengthening of specialists for the decarbonisation of the German economy and society (https://10000tage.org/).

However, the city of Aachen also wants to take local action against the shortage of skilled labour. High school and university graduates are very interested in contributing their labour to companies that operate sustainably and green. In addition, skilled workers are being made redundant during structural change in the Rhenish mining area and need to be given new career prospects. Matching supply and demand will be a task for the coming years.

[1]: https://www.gruene-bundestag.de/fileadmin/media/gruenebundestag_de/themen_az/klimaschutz/pdf/2105_Kurzstudie_Arbeitskra__ftebedarf_Klimaneutralitaet.pdf

V) Conflicting objectives

In a city, numerous objectives and interests have to be balanced. Citizens, politicians and the city administration in Aachen have recognized and accepted climate protection as an urgent task, but it is important to reconcile this goal with others and find the fairest possible solution for everyone. The main conflicting objectives are briefly outlined below.

V.I) Climate protection and social justice

When it comes to climate change, it is an open secret that groups of people who structurally contribute little to emissions due to their own limited resources will often be the hardest hit by the consequences. At the same time, their limited resources prevent these groups from actively and actively participating in the transformation process. They are therefore structurally trapped on two levels. This results in a social responsibility for all those actively shaping the transformation.

The IKSK 2.0 is based on proactively shaping the transformation to climate neutrality. Proactive action goes hand in hand with various decision-making processes that have direct and indirect effects on uninvolved stakeholders. There are various approaches here that consider the inherent social responsibility that goes hand in hand with the decision-making processes and implement them in measures that contribute to climate neutrality and at the same time improve the living conditions of stakeholders.

This means:

- Weighing up: Taking the interests of unrepresented population groups into account during the decision-making process and avoiding or mitigating the negative consequences of activities as far as possible.
- Accept responsibility: This means initiating measures and activities quickly and prioritising those that improve the structural situation of people at the same time.
- Addressing citizens from different socio-economic backgrounds and involving them in processes.

V.II) Climate protection and monument preservation

In order to meet the UNESCO requirement to protect the Aachen Cathedral World Heritage Site with a legally secured buffer zone, the city of Aachen protected the historic city centre and the silhouette of the cathedral and town hall by issuing a monument area statute in 2011. Changes to façades and roofs, including roof extensions in the city centre, are therefore subject to approval.

(https://www.aachen.de/de/stadt_buerger/planen_bauen/_materialien_planen_bauen/denkmalpflege/welterbe/2010-04-26_denkmalbereich_innenstadt_net.pdf)

The historic centre of the Kornelimünster district of Aachen is also a listed building. All measures that have an impact on the exterior are subject to approval to protect and preserve the special quality of the historic town centre. This applies not only to rooftop PV but also to the installation of heat pumps.

To resolve potential conflicts of interest between climate protection and heritage conservation, Department VII and the heritage authorities of the city of Aachen are working together on the AIX-Heat project. This BMWK-funded project for the development of (digitally) networked and agile municipal heat planning in neighbourhoods aims to develop solutions for the heat transition for Kornelimünster, among others.

V.III) Wind power and Einstein telescope

Aachen is in one of the regions in Europe that want to apply as a location for the Einstein Telescope. The Einstein Telescope has been included in the European Roadmap for Large Research Infrastructures. The investment costs are currently estimated at around € 2 billion. The telescope, which will be located at a depth of 250-300 metres, will be used to make gravitational waves visible, which are created when black holes or neutron stars orbit or collide with each other. The aim is to gain new insights into the universe. The location is to be decided in 2025 and construction is to begin in 2028. If the Euregio Meuse-Rhine is selected as the location, the 3x10 km long arms of the triangular facility would also extend into the Aachen region. The construction and operation of the plant are expected to have great economic potential, creating up to 1,500 new jobs in the region. The problem, however, is that the sensitivity of the telescope is not compatible with vibrations, e.g. from wind turbines. In East Belgium and the province of Limburg, permits for wind turbines have therefore already been withdrawn as a precautionary measure so as not to jeopardise the award of the project. The state of NRW is also planning an above-ground protection zone around the expected radius of the Einstein Telescope. If this is established, it is likely that no new wind turbines will be allowed to be erected in the city of Aachen.

2.3.8 Overall assessment of the Aachen network for climate protection

The goal of climate neutrality by 2030 is ambitious and challenging. Time is short, resources are scarce, but motivation is high. The latter is a good prerequisite for success, but more is needed, namely external input and support. As with all major projects, the same applies to the path to climate neutrality: smart alliances and the pooling of experience, resources and strengths provide the decisive push. Participation in the EU mission "100 Climate-Neutral and Smart Cities by 2030" and the development of the Climate City Contract are acting as a catalyst here.

The local ecosystem in Aachen is already well established: The city council, city administration and the municipal corporation have formed a well-functioning system for many years, which is now focussing even more strongly on climate protection. In addition, there are the commitment donors: the companies, universities, associations, schools, churches and institutions that will contribute directly or indirectly to the reduction of greenhouse gas emissions with their own measures. Civil society is a very important group of stakeholders. The aim here is to initiate lasting changes in behaviour so that emissions outside the city's sphere of influence are also reduced to a minimum. This is where CoLAB, the pilot project of the German mission cities of Mannheim, Münster and Aachen, should provide solutions. The plan for Aachen is to establish an agency for climate, energy, circular economy and sustainability, which will serve as a physical contact point for the entire urban community and bundle a wide range of offers and advisory services.

This creates a constantly growing local network of stakeholders who influence urban emissions through their actions and lives. The local ecosystem is influenced by state and federal policy and decisions made by the EU Commission. It is therefore particularly important to be in direct and constant dialogue with all political levels. This is the only way to communicate and listen to the needs and demands of cities that want to achieve climate neutrality by 2030. The City of Aachen utilises various committees and networks in this regard. Figure AP-F18 shows a schematic representation of Aachen's ecosystem, which influences the city's greenhouse gas emissions.

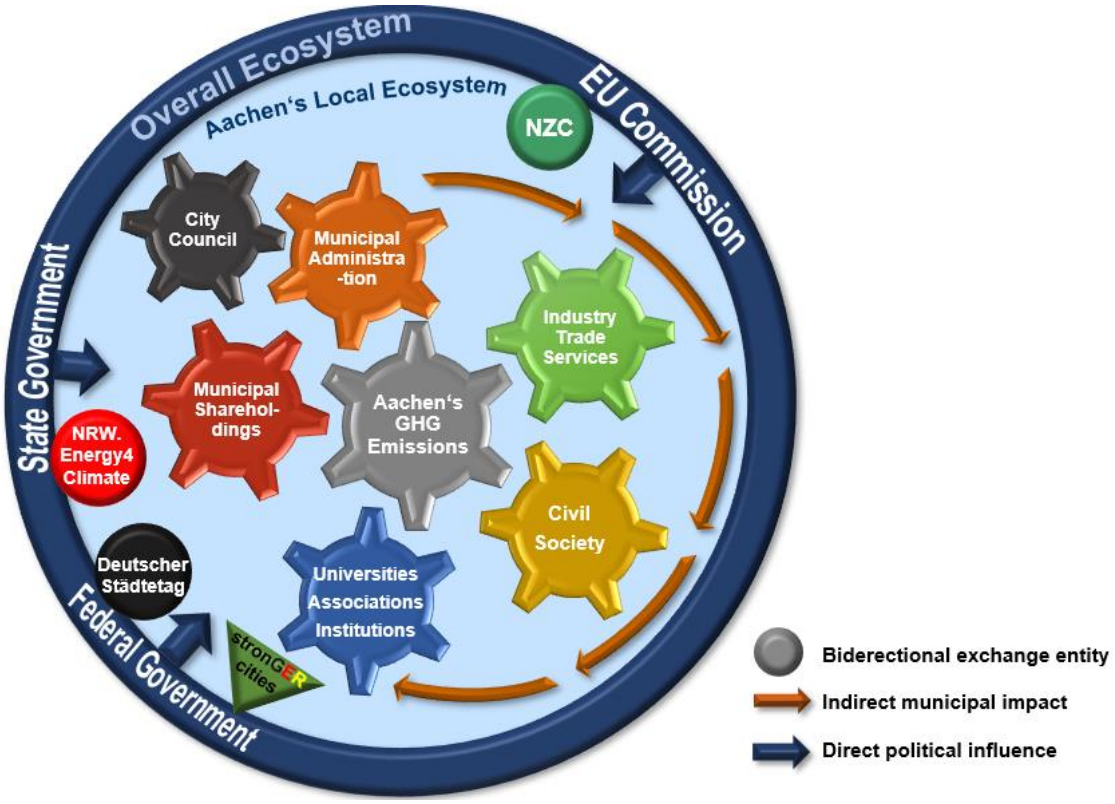

Figure AP- 17 Schematic representation of the greenhouse gas emissions ecosystem in Aachen

The Local Aachen Ecosystem consists of the City Council, which has a direct influence on the city administration and the municipal holdings, which in turn have a direct influence on greenhouse gas emissions through their measures. The city administration also exerts indirect influence, e.g. through funding programmes or procurement guidelines, on the economy/trade/services, civil society and institutions/associations/universities, which in turn have a direct influence on the city's emissions. A bidirectional exchange has been established with the state government via NRW.Energy4Climate GmbH and with the federal government via the stronger cities network and the German Association of Cities. At EU level, Net Zero Cities is used for bidirectional exchange.

NRW.Energy4Climate GmbH: The aim of the state organisation for energy and climate protection is to make NRW completely climate-neutral and a pioneer of the energy transition. To achieve this as quickly as possible, NRW.Energy4Climate is pooling NRW's activities in the areas of climate protection and energy transition and thus accelerating the transformation across all sectors. It actively supports the local authorities by reflecting their investment and funding requirements to the state government and helping to create the framework conditions for innovations and new technologies.

German Association of Cities: The German Association of Cities is an association of 16 state associations and 13 extraordinary members, including the Aachen city region. The NRW Association of Cities brings together 39 cities, including Aachen, Dortmund and Münster. The Association of German Cities

- Represents the interests of all independent cities and most of the cities belonging to the district
- is in talks with the German government, the Bundestag, the Bundesrat, the European Union and numerous organisations
- influences legislation
- respects local self-government, which is guaranteed in the German Basic Law.

The current President of the Association of German Cities is the Lord Mayor of Münster, the Vice-President is the Lord Mayor of Leipzig. The Lord Mayor of Aachen is Deputy President. The cities of the EU mission are therefore well represented in the Association of German Cities. However, the German Association of Cities is only suitable for communicating the specific needs of the nine German mission cities to a limited extent, as it

always represents the interests of the German cities as a whole. Nevertheless, it is an important body for the implementation of general requirements for municipal climate protection from the German cities.

stronGER cities: This is the network of the nine German mission cities of Aachen, Dortmund, Dresden, Frankfurt am Main, Heidelberg, Leipzig, Mannheim, Munich and Münster. For around 1.5 years, representatives of the cities have been meeting every fortnight for a 1.5-hour digital dialogue. In particular, they discuss common issues and challenges, exchange solutions and formulate requests for the Net Zero Cities city advisors. The exchanges are currently focussing on the development of climate city agreements.

Representatives of the Mission Cities are permanent guests in the "Climate Protection" steering forum of the federal ministries, where they put the needs and support requirements of the Mission Cities on the agenda.

As an initial result of the stonGERcities' work, a joint statement was submitted to the BMWK consultation on the Real-World Laboratories Act in September 2023. It emphasised that it is particularly important for all mission cities to be able to test innovations and new technologies quickly and unbureaucratically on a pilot scale in real-world laboratories.

NZC (Net Zero Cities): NetZeroCities is part of the Horizon 2020 research and innovation programme in support of the European Union's Green Deal. NetZeroCities is a consortium of 33 international institutions and organisations and supports cities in overcoming structural, institutional and cultural barriers on the path to climate neutrality in 2030.

The NetZeroCities project operates as a service-orientated platform. It helps European cities by providing them with the support and solutions they need to achieve their net zero target in a socially inclusive way.

New and existing tools, resources and expertise are being developed and brought together in a central platform that is accessible to all cities via an online portal.

Aachen benefits in particular from the exchange with other cities on their solutions and best practices on the path to climate neutrality, the implementation of a socially just transformation of urban society and expertise in the area of financing such as the Mission Cities Capital Hub.

Aachen also participates in NZC's Policy Labs in order to help shape the content of regulations and rules at EU level.

3 Part B - Pathways towards Climate Neutrality by 2030

Part B represents the core of the CCC Action Plan, shaped by local authorities, local businesses, and stakeholders, comprising of the most essential elements: scenarios, strategic objectives, impacts, action portfolios and indicators for monitoring, evaluation, and learning.

3.1 Module B-1 Climate Neutrality Scenarios and Impact Pathways´

The "Climate-neutral Aachen 2030" scenario from the IKSK 2.0, Part 1 "Climate-neutral 2030" by Gertec GmbH (see Attachement IKSK2.0_Part1) describes "thinking from the goal" what a path to climate neutrality in 2030 could look like and which measures are theoretically necessary for this. This results in recommendations for the implementation strategy that are in line with those of the economic model. Possible development paths for reducing greenhouse gas emissions in the consumption and energy sectors follow three main strategies: efficiency, consistency and sufficiency.

- Efficiency (doing better): Achieving the same benefits while reducing energy and resource consumption to avoid greenhouse gas emissions.
- Consistency (doing things differently): Achieving the desired benefits with a climate-friendly use of energy and resources.
- Sufficiency (using less): Saving energy and resources by changing behaviour and consumption patterns.

Offsetting is only considered to compensate for unavoidable greenhouse gas emissions.
The IKSK 2.0 does not represent a rigid plan for Aachen on the way to climate neutrality by 2030, but rather offers guidelines for the strategic evaluation of measures in terms of leverage, speed and feasibility.

Reduce quickly - acceleration has top priority

To achieve the goal of climate neutrality by 2030, it is a top priority to accelerate the reduction of greenhouse gas emissions. The city administration must lead the way as a role model and best practice. It can maximise its influence on urban society through targeted information and advisory services or the creation of incentives and improved quality of life.

It should be noted that the various stakeholders in urban society have different interests and motivations that need to be addressed. Table AP-12 lists interests/motivation, possible obstacles to climate protection measures and solutions for overcoming the obstacles for different stakeholder groups in Aachen.

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Table AP- 12 Interests/motivation stakeholder groups

Stakeholder group	Interests/Motivation	Obstacles to (more) climate protection	Aachen's solution
City administration / politics	- Sustainability - Taking responsibility for the future of all - Implementation of laws and regulations - Secure and climate-neutral energy supply for the city - Conservation of resources - Attractive business location - Safe and attractive living space - Excellent science centre	- Lack of coordination between administrative units - Conflicting goals between climate protection and other tasks - Lack of flexibility in higher-level ordinances/regulations, e.g. public procurement law - Climate protection not a mandatory municipal task → No basic funding - Lack of financing	- Climate neutrality 2030 agreed by all parliamentary groups for Aachen - Horizontal transition team - New governance structure Multiprocess management - Revision of the procurement guidelines and other relevant regulations - Committee work at state, federal and EU level - Climate protection anchored as a strategic goal in the municipal budget - Strategic projects staff unit for the acquisition of third-party funds
Economy	- Secure energy supply - Stable electricity and energy prices - Energy self-sufficiency - Resource efficiency - Competitiveness - Competitive advantage - Compliance with laws and regulations, e.g. CSRD report - Attractiveness for customers - Securing skilled labour	- Bureaucracy, lengthy authorisation procedures - Legal hurdles, e.g. building law, parking space regulations - inflexible regulations - High costs - Long ROI times	- Acceleration of authorisation procedures - Promotion of sustainable measures - Energy concepts for industrial estates - Setting up an impulse and steering group for regular dialogue between business, administration and politics - Representation of interests in committees
Science	- Excellent research - Developing solutions for major societal challenges - Attractive university location → Student acquisition	- No investment funds from the state - Pendencies of state government and state authorities - Limited decision-making authority	- Close co-operation between universities and city administration - Joint research projects, e.g. for heat planning

	- Training the intellectual elite of tomorrow - Translation of the results into business	- different research focus	- Regular exchange in advisory boards/committees
Retail/catering	- Attractive and lively (inner) city - Good accessibility - Low basic costs - Secure and cost-effective energy supply - High quality of stay	- Lack of capital - Official requirements, e.g. monument protection	- City centre of tomorrow" concept - Participation of GHD in decision-making processes - Concept for city centre mobility - NEMORA
Agriculture	- Future security - competitive food production - Climate resilience - Compliance with (subsidy) regulations, e.g. individual climate accounting	- Climate protection often associated with high investment costs - Organic farming ekes out a niche existence - Price structure for food in the retail trade	- Round table on agriculture and nutrition with stakeholders, politicians and administration
Pupils / students	- A future worth living and free of fear - Climate protection as a core political objective - Excellent training - liveable, attractive city	- Ignorance of own levers and possibilities - Shifting responsibility to the older generation	- IKSK 2.0 as a strategic basis - Education for Sustainable Development (ESD) programme - Oecher Lab - Offers from the VHS and other educational institutions
Senior citizens	- A future worth living - Stable prices and costs - Mobility - Independence	- Insufficient knowledge, as offers are often only available digitally - Shifting responsibility to the next generation(s) - Lack of financial resources	- Advice on neighbourhood offices - Seniors' café in the OecherLab - Subsidies/grants for age-appropriate conversions - Subsidies/grants for energy-efficient refurbishment - Expansion of public transport services - City of short distances

Employees/ Commuters	- Fast and reliable routes - Good accessibility of the workplace - future-proof employer - Attractive (working) environment	- Inadequate public transport services - Inadequate cycling infrastructure	- Optimisation of construction site planning - Public transport expansion / RegioTram - Implementation of the cycling decision - Expansion of P&R services - Expansion of urban greenery
Inhabitants	- High quality of life - Lively and open city - Good transport infrastructure - Reliability of politics and administration - Secure future - Stability in costs and supply - Orientation and planning security - High resilience of the overall system - Participation	- No information on the topic - Misinformation - Information overload has a paralysing effect - Lack of guidelines for own actions, e.g. CO handprint$_2$ - No role models for climate protection - Progress in climate protection not communicated - Other topics are more important - Fear of the future / resignation - Lack of capital	- Transport development plan - Climate campaign / Homepage - Climate Agency / CoLAB - Monitoring tool for climate protection measures - Strategies for energy supply, heat planning - Binding targets, e.g. for the expansion of district heating - Exchange platforms, e.g. on voluntary initiatives - Solar/heat pump parties - Counselling services for citizens - Participation portal, Citizens' Council,

Figure AP-18 shows the theoretically possible reduction pathway for urban emissions from 2021 to 2030. At the beginning of the process, the annual reduction is around 12% (based on 2021). From 2025, the increased implementation of behaviour-related potential will lead to a significant increase in the reduction. The scenario assumes an overall reduction in GHG emissions in 2021 of 80 % by 2030. The unavoidable residual emissions of 313 $ktCO_2$ e in 2030 are offset.

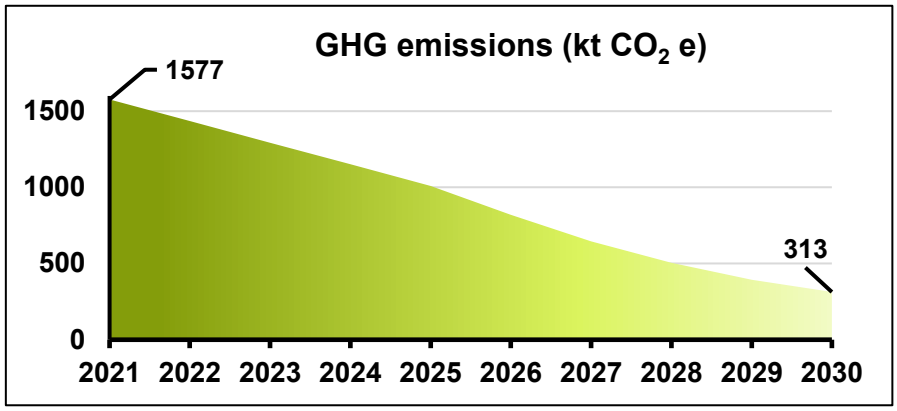

Figure AP- 18 Reduction pathways

Note: Reduction pathway for greenhouse gas emissions in the city of Aachen from 2021 to 2030 according to Gertec, IKSK 2.0, Part 1, adapted to the results of the economic model.To achieve the necessary reductions in GHG emissions in the individual sectors to achieve climate neutrality, the following strategic goals should be realised:

- Climate neutrality should be anchored and strategically planned as a fundamental goal of urban development. This requires a holistic approach that reconciles energy-efficient refurbishment, behavioural changes, resource efficiency, cost optimisation and the use of renewable energies. Such an integrated approach requires an interdisciplinary planning culture, space for innovative ideas and solutions with impact.
- In terms of electricity supply, a consistent expansion of solar plants and wind turbines is required to increase the proportion of electricity from renewable sources without nuclear power to 80 %. In photovoltaics, ground-mounted PV will play an increasingly important role.
- The refurbishment rate for the city's entire building stock is to be increased to 4% annually with the consistent implementation of high energy standards in existing buildings with an average energy saving of 70%. The highest energy standards must be consistently implemented in new buildings to generate zero emissions from new buildings by 2030.
- District heating plays a key role in the decarbonisation process when it comes to heat supply. A top priority is to expand the existing infrastructure and provide 50% of the heat supply via district heating by 2030. This requires the implementation of comprehensive municipal heating planning. From 2029, Aachen will be supplied with "green district heating".
- To achieve the mobility targets, 30% of motorised journeys in the city are to be either completely eliminated by 2030 or primarily made on foot or by bicycle. The proportion of electric cars is to be increased to 35% by 2030. 70% of the bus fleet is to be electrified and delivery traffic is to be optimised and avoided.
- In the area of waste, the proportion of recyclable materials that end up in waste incineration in 2030 is to be reduced to zero through additional recycling and better waste separation.
- In agriculture, reductions in GHG emissions are achieved by increasing organic farming and reducing livestock numbers.

Table B-1.1 summarises the impact pathways per emissions area derived from the NZC Theory of Change. A distinction is made between short-term and long-term results (strategic goals), which lead to the desired effects in the fields of action and the associated additional benefits.

Table 8 (B-1.1) Impact Pathways

B-1.1: Impact Pathways					
Fields of action	Systemic levers	Early changes (1-2 years)	Late outcomes (3-4 years)	Direct impacts (Emission reductions, ktCO2e)	Indirect impacts (co-benefits)
Energy systems Electricity	Technology/Infrastructure Governance & Policy Finance & Funding Participation	- PV on roof surfaces of municipal, commercial and private buildings - Concept for open space PV utilisation - Comprehensive energy roadmap - Solar subsidy programme for apartment buildings	- Expansion of ground-mounted PV - Expansion of wind power plants - PV systems on all suitable roof surfaces - Expansion of distribution grids - Energy partnership	515	- Energy self-sufficiency - Job creation - Local added value - Increased competitiveness through green economy - Local market stability and resilience - Favourable/stable energy costs - Clean air
Energy systems Heating	Technology/Infrastructure Governance & Policy Finance & Funding	- Municipal heat planning - Concept for geothermal utilisation - Neighbourhood solutions for heat supply	- Expansion of district heating network - Conversion to green district heating (2029) - Utilisation of geothermal energy for local heating networks - Interlocking of urban development plans	391	- Energy self-sufficiency - Decarbonisation of the heat supply - Cost-effective and stable heat supply
Mobility & transport	Technology/Infrastructure Governance & Policy Social Innovation Learning & Capabilities	- Expansion of e-bus fleet - Expansion of charging infrastructure - Expansion of public transport	- Construction of the regional tram - Implementation of cycling decision	170	- Clean air - Less noise pollution - Conversion of traffic areas for urban greenery

		- Update SUMP - Cargo bike promotion - Regional mobility concept (NEMORA) - Expansion of corporate mobility management	- Electrification of motorised private transport and delivery traffic - Strengthening the environmental network - Zero-emission zone		- Increased quality of stay
Waste	Governance & Policy Social Innovation Learning & Capabilities	- Building yard of the future - Component and resource warehouse - Agency for Climate, Energy, Circular Economy and Sustainability - Increased textile recycling	- Expansion of the recycling rate for recyclable materials - Energy recovery from waste	8	- Less rubbish collection - Clean air - Less noise emissions - Sustainability - Cost savings through second life/upcycling
Green infrastructure & nature-based solutions	Technology/Infrastructure Governance & Policy Social Innovation Finance & Funding Learning & Capabilities	- Implementation of the landscape plan - Implementation of green space planning - Strengthening urban greenery - More vegetarian food - Update of the climate adaptation concept	- Tripling of nature conservation areas - Expansion of natural forest - More organic farming - Less livestock farming - Sponge city concept	24 (Agriculture)	- Clean air - Higher quality of stay - Biodiversity - Climate improvement - Resilience against extreme weather conditions
Built environment	Technology/Infrastructure Governance & Policy Learning & Capabilities	- Strengthening the energy-efficient refurbishment of municipal, commercial, private residential and non-residential buildings - Subsidy programmes for commercial and private owners - Expansion of consulting services	- Refurbishment rate reaches 4 % - New buildings are climate-neutral - Green roofs and PV systems mandatory in new builds -	156	- Falling cost of living - Improved quality of life - Increasing the attractiveness of Aachen as a place to live and work - Less shortage of skilled labour

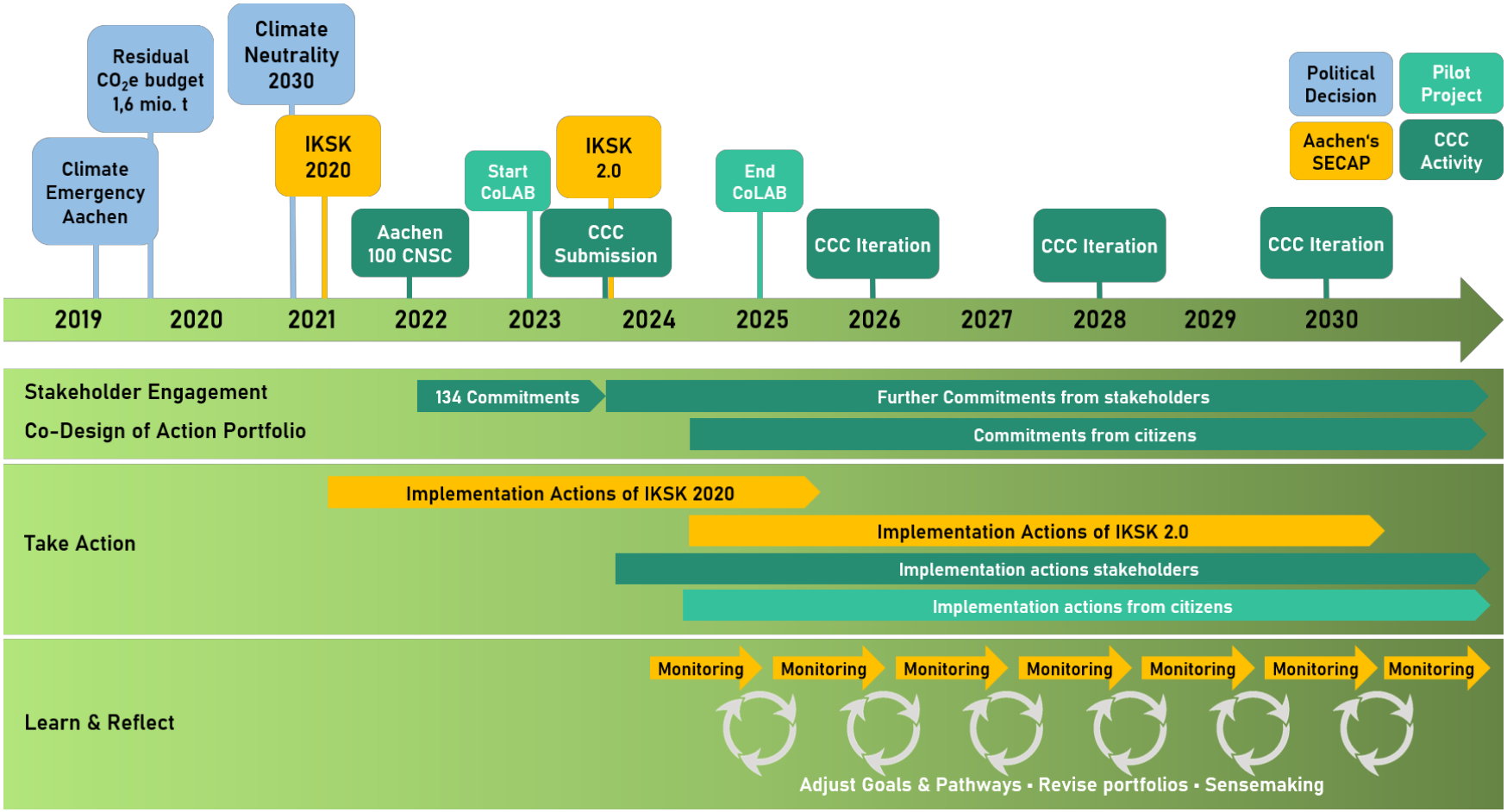

Figure AP- 19 Milestones in climate protection and the CCC process of Aachen, 2019-2030

Description: Timeline of the most important processes for the creation and implementation of the Aachen Climate City Contract from 2019-2030.

The impact of the measures taken by the municipal group, all stakeholders and citizens on the reduction of GHG emissions is monitored on an ongoing basis. If measures prove to be ineffective or unrealisable, they are adjusted or replaced by others. This applies to technical measures as well as pull and push measures to change behaviour.

3.2 Module B-2 Climate Neutrality Portfolio Design

In this chapter, a distinction is made between the following measures:

- Measures by the municipal administration and municipal holdings from the **IKSK 2020, which has already been politically approved and is currently being implemented** (term: 2020-2025)
- Measures by the city administration and municipal holdings from the **IKSK 2.0, which is expected to be adopted by Aachen City Council in March 2024**. The implementation of these measures will begin once prioritised packages of measures have been adopted by the relevant committees.
- **Measures from the urban community**

In addition, an overview with the page references to the measures from the IKSK 2020 and 2.0 has been uploaded separately, see attachement *PageReferencesActions*

3.2.1 Mobility

The measures in the mobility sector deal with motorised and non-motorised transport in Aachen, which includes private mobility as well as commercial transport and logistics. Commuter transport is also included here. Accordingly, all passenger transport as well as commercial and freight transport in the city of Aachen that is handled by road or rail is considered. This includes destination traffic that ends in Aachen, domestic traffic with a start and end point in Aachen, source traffic with a starting point in Aachen and a destination outside the city limits as well as transit traffic with a start and end point outside Aachen that crosses the city limits. In the inventory sheet analysis, only the proportion of journeys within Aachen city limits is considered, but there are greater savings if journeys are avoided or are made by eco-mobility instead of by car.

Initial situation Mobility

The analysis of traffic-related emissions in 2020 (see Figure AP-6) shows that around 65% are caused by private transport, 31% by freight transport and 4% by public transport.

The evaluation using the Economic Model tool showed that 170 kt CO2e of the 276 kt CO2e in 2021 will be saved in the mobility sector by 2030, which corresponds to a reduction of 62%.

Table AP- 13 Subsectors for GHG reduction in the mobility sector incl. GHG savings in 2030
Source: Economic Model

	Subsector	Savings in 2030 (ktCO2/a)
Mobility	T1 - Reduced motorised passenger transportation need	18
	T2 - Shift to public & non-motorised transport	24
	T3 - Increased car pooling	21
	T4 - Electrification of cars + motorbikes	32
	T5 - Electrification of buses	10
	T6 - Optimised logistics	50
	T7 - Electrification of trucks	15
	Total	170

The mobility transition in Aachen is also strongly driven by the will of the citizens. In November 2019, the Aachen City Council adopted the cycling referendum and thus decided to massively expand the cycling infrastructure in the city. In the mobility field of action, measures from the "Mobility turnaround" scenario are introduced: The scenario focuses on a strong expansion of the eco-mobility network. The key measures are

- the realisation of the plans for the premium trails
- a massive expansion of cycle paths (complete and consistent implementation of the cycling decision)
- a significant increase in the attractiveness of public transport services in line with ASEAG's Vision 2027 with 30% more services, a halving of public transport fares, a significant expansion of express bus services and the infrastructural implementation of bus lanes on "strong axes"

- a practical implementation of the relocation of on-street parking spaces to multimodal neighbourhood car parks that are also bicycle parking, car sharing and e-charging stations.
- the expansion of P+R/mobility hub facilities on the outskirts of the city
- the construction of the RegioTram (based on the feasibility study currently underway)
- Continuation and expansion of the measures of the #AachenMooVe! project (in particular mobility management, city logistics and electric mobility programme)
- Renewal of traffic light systems to optimise traffic control and communication options between traffic lights and vehicles

The core measures in mobility of the city administration and the municipal holdings from SUMP, IKSK 2020 and IKSK 2.0 are listed in Table AP-14.

As private transport is largely responsible for emissions in the transport sector, the city administration's measures are intended to bring about a change in mobility behaviour. This is achieved through:

- Attractive public transport services
- Expansion of e-mobility
- Expansion of cycle traffic
- Neighbourhood solutions "City of short distances"
- Support for company mobility management

Measures from the urban society

Of the 134 co-signatories of the Aachen Climate City Contract, 26 have made a PREMIUM commitment, i.e. they are also aiming for climate neutrality in mobility by 2030. Of the 57 FRAME partners, 48 have announced changes in corporate mobility (see Appendix 2). This lays the foundation for a reduction in emissions, which is supported and further expanded by the city administration with the "Clever Mobil" programme (measures TA09).

Table AP- 14 Core measures - mobility

Measure		IKSK 2020	IKSK 2.0	T1	T2	T3	T4	T5	T6	T7
Code	Title									
TA 01	Procurement support for ASEAG e-buses	x								
TA 02	Procurement of 90 electric and hydrogen buses		x							
TA 03	Creation of "strong axes" in bus transport	x								
TA 04	30 % additional output from ASEAG	x								
TA 05	Strong expansion of express bus services	x								
TA 06	RegioTram (Aachen-Baesweiler tramway)	x								
TA 07	Expansion of cycle traffic according to the cycling decision	x								
TA 08	Premium paths and squares, crossing aids	x								
TA 09	Continuation of BMM programme Clever Mobil for employers	x								
TA 10	Reducing emissions from delivery traffic	x								
TA 11	P+R / mobility hubs on all access roads	x								
TA 12	Support programme for 2,000 cargo bikes	x								
TA 13	Expansion of charging infrastructure	x	x							
TA 14	City centre mobility for tomorrow		x							
TA 15	Network Mobility Transition Aachen Region (NEMORA)		x							
TA 16	BMM at municipal administration and municipal holdings		x							
TA 17	Zero-emission zone		x							
TA 18	Promotion of sharing and multimodality		x							
Reduction in 2030 (ktCO2e)				18	24	21	32	10	50	15

Note: Overview in the area of mobility of the city administration and municipal holdings, including effects on the subsectors of the economic model
T1: Reduced motorised passenger transportation need, T2: Shift to public & non-motorised transport,T3: Increased car pooling, T4: Electrification of cars + motorbikes, T5: Electrification of buses, T6: Optimised logistics, T7: Electrification of trucks

3.2.1.1 Brief profiles of the core measures in the area of mobility of the city administration from the IKSK 2020 and IKSK 2.0

TA01_Field of action: Reduction of vehicle emissions / No. 4.3.3 Procurement support for e-buses at ASEAG (IKSK 2020)

Brief description:

With the procurement of 14 electric buses at ASEAG, we have set the course for an emission-free ASEAG fleet.

As part of the "mobility turnaround" scenario, 60 ASEAG buses will be replaced with emission-free buses by 2030. Additional costs of €2 million per year for 6 e-buses are estimated for this.

At the same time, it must be clarified what requirements and costs are necessary to charge the vehicles.

First steps for action:

Purchase of a further 6 e-buses

Target group:	**Those responsible and those involved:**
Logistician	FB 61/300

Criteria:	**Evaluation:**
$CO2_{reduction}$	110 t/a per bus, i.e. 6.6 thousand t/a in 2030 with 60 buses
Financial expenditure	2 million €/a from 2021
(ASEAG) Time expenditure (personnel)	
Regional added value	

Explanation of the evaluation criteria:

Durchführungszeitraum: 2021-2025

Note: TA02 not included in the IKSK / External commitment (ASEAG)

TA03_ Field of action: Reduction of car traffic in urban areas / No. 4.1.3 Creation of "strong axes" in bus transport (IKSK 2020)

Brief description:

Strengthening the most important bus routes with separate bus lanes

First steps for action:

Target group:	**Those responsible and those involved:**
Inner-city bus users and commuters	**FB 61/300**

Criteria:	**Evaluation:**
$CO2_{reduction}$	
Financial expenditure	2.5 million € / a
Time expenditure (personnel)	1 new position (already included in fin. expenditure)
Regional added value	

Durchführungszeitraum: 2021-2026

TA04_Field of action: Reduction of car traffic in urban areas / No. 4.1.4 Expansion of bus transport by 30 % (IKSK 2020)

Brief description:

The expansion of bus services by around 30 % is part of ASEAG's Vision 2027.

A concept will be drawn up for this purpose, the financial resources will be made available and the offer will be successively expanded.

An expert report for the AVV is currently analysing which service changes are advisable for Aachen.

In the medium term, reactivation of the rail link from Baesweiler, Würselen via Merzbrück airfield to the bus station on Grabenring in Aachen "regiotram".

First steps for action:

1. densification line 51

Concept development, adaptation of local transport plan
Clarification of the extension of the public service contract awarded to ASEAG until 2027

Target group:

Residents

Those responsible and those involved:

FB 61/300, ASEAG

Criteria:

$CO2_{reduction}$

Financial expenditure

Time expenditure (personnel)

- Regional added value

Evaluation:

20 million €/a (successive expansion to 40 million/a from 2026)

Implementation period: 2020 - 2026

TA05_Field of action: Reduction of car traffic in regional transport / No. 4.2.1 Expansion of express bus services (IKSK 2020)

Brief description:

The new NRW state funding guideline is to be used to create 8 attractive, regional express bus routes of a quality comparable to rail transport.

First steps for action:

One express bus route to Jülich and one to the south of Aachen

Target group:

Commuters from the Aachen region

Those responsible and those involved:

FB 61/300, ASEAG, FB 20

Criteria:

$CO2_{reduction}$

Financial expenditure

1,700,000 / a Time expenditure (personnel)

Regional added value

Evaluation:

Approx.

Explanation of the evaluation criteria: approx. €300 thousand per year per express bus line

Implementation period: 2021 - 2025

TA06_ Field of action: Reduction of car traffic in regional transport / No. 4.2.2 RegioTram (IKSK 2020)

Brief description:

A feasibility study is currently being carried out for the expansion of the Euregio railway between Baesweiler, Würselen, Merzbrück airfield and the bus station in Aachen under the name "RegioTram".

In the medium term, reactivation of the rail link from Baesweiler, Würselen via Merzbrück airfield to the bus station on Grabenring in Aachen "regiotram".

First steps for action:

Continuation of planning based on the results of the feasibility study

Target group:

Residents

Those responsible and those involved:

FB 61/300

Criteria:

$CO_{2\ reduction}$ Financial

outlay

Time expenditure (personnel)

- Regional added value

Evaluation:

Explanation of the evaluation criteria: Successive expansion with financial expenditure of 40 million/a from 2026

Implementation period: 2020 - 2026

TA07_ Field of action: Reduction of car traffic in regional transport / No. 4.1.1 Expansion of cycle traffic according to cycle decision (IKSK 2020)

Brief description:

The citizens' petition for a different design of cycling facilities in Aachen was signed by 37,000 Aachen residents in 2019 and adopted by the city council in November 2019. The most important points are as follows:

- Creation of at least 5 km of structurally separated cycle paths with a width of at least 2.30 m on main roads per year
- Creation of at least 10 km of main cycle routes per year
- Conversion of three major junctions per year according to the Dutch design principle
- Design new cycle paths in red
- 15,000 new bicycle parking spaces in 8 years
- Transparent notification and reporting system

Additional resources would have to be made available for measures that go beyond this.

First steps for action:

1. Discussions with the initiators regarding consideration of the new principles in measures that have already been decided,
2. Recruitment of 7 additional transport planners
3. Construction of the priority cycle routes Eilendorf, Campus Melaten, Brand, Vaals, Berensberg
4. Expansion of bicycle parking facilities at the main station administration building,
5. Expert opinion on bicycle parking and digital reporting platform for new bicycle racks
6. Construction of approx. 20 lockable and covered bicycle car parks on the street as part of the "AachenMooVe!" project

Target group:

Residents, especially children, senior citizens, cyclists in need of safety

Those responsible and those involved:

FB 61/300, FB 61/400, FB 61/700

Criteria:

$CO_{2\ reduction}$

Financial expenditure

Time expenditure (personnel)

positions Regional added value

Evaluation:

Part of the mobility transition scenario

Approx. € 10 million p.a. (planned in the budget)

7

Implementation period: 2020 - 2027

TA08_Field of action: Reduction of car traffic in urban areas / No. 4.1.2 Realisation of premium routes (IKSK 2020)

Brief description:

Implement concept with 10 premium paths for pedestrians from the city centre into the countryside: Upgrading squares, recreational areas and crossing points.

First steps for action:

Premium path to Frankenberger Park with redesign of the town square in Lothringer Straße

Target group:

Inhabitants

Those responsible and those involved:

FB 61/500, FB 61/300, FB 36

Criteria:	**Evaluation:**
$CO_{2\,reduction}$	
Financial expenditure	approx. 1 million €/a
Time expenditure (personnel)	1 new position (already included in fin. expenditure)
Regional added value	

Durchführungszeitraum: 2020-2030

TA09_Field of action: Reduction of car traffic in regional transport / No. 4.2.5 Company mobility management (BMM) for employers (IKSK 2020)

Brief description:

The #AachenMooVe!3 mobility management project is establishing structures for systematic mobility management in Aachen. Many instruments such as analysis tools, intensification of the public relations work "Aachen clever mobil" and personnel are financed until 2022.

After that, a solution must be found to finance the continuation of the programme.

First steps for action:

Discussions with the initial partners IHK Aachen, AVV and Städteregion Aachen about a joint continuation from 2022

Target group:

Employees of large employers

Those responsible and those involved:

FB 61/300, FB 02

Criteria:	**Evaluation:**
$CO_{2\,reduction}$	
Financial expenditure	300 thousand €/a from 2022
Time expenditure (personnel)	and 3 new jobs
Regional added value	

Implementation period: 2022 - 2025

TA10_Field of action: Reduction of vehicle emissions / No. 4.3.4 Reducing emissions in delivery traffic (IKSK 2020)

Brief description:

The foundations for viable solutions for emission-free delivery transport in Aachen are being laid in the #AachenMooVe! project. Deliveries in the immediate city centre area are to be made using electric cargo bikes and electric vans. Intensive cooperation between CEP service providers through to bundled deliveries and interim storage facilities close to the city centre (micro-depots) and new approaches to delivery in neighbourhoods, which are intended to avoid unsuccessful multiple deliveries, are intended to slow down the growth of delivery journeys.

First steps for action:

Target group:

Logistician

Those responsible and those involved:

FB 61/300

Criteria:	**Evaluation:**
$CO_{2\ reduction}$	
Financial expense	250 thousand € from 2022
Time expenditure (personnel)	1 new position (included in fin. expenditure)
Regional added value	

Durchführungszeitraum: 2022-2025

TA11_ Field of action: Reduction of car traffic in regional transport / No. 4.2.7 P+R / mobility hubs on access roads (IKSK 2020)

Brief description:

In order to achieve a reduction in car journeys in the Aachen city area, more P+R spaces ("mobility hubs") are also needed on the main access routes, possibly also outside the Aachen city area.

In order for these places to be accepted, it is necessary that there is an attractive connection from there to the city centre (see measures no. 4.1.4 and 4.1.5). It is also necessary to make it significantly more expensive to drive on (or park in the city centre) (see measure no. 4.2.8).

It is assumed that a car park with 500 P+R spaces will cost around EUR 10 million.

First steps for action:

Identification of possible locations

Target group:

Employees of large employers

Those responsible and those involved:

FB 61/300, FB 02

Criteria:	**Evaluation:**
$CO_{2\ reduction}$	
Financial expenditure	3.25 million €/a
Time expenditure (personnel)	1 new position
(plus) Regional added value	

Explanation of the evaluation criteria: €20 million for 2 locations with 500 places each

Implementation period: 2021 - 2025

TA12_ Field of action: Reduction of vehicle emissions / No. 4.3.1 Cargo bikes funding programme (IKSK 2020)

Brief description:

Following the expiry of the funding programme for cargo bikes for businesses, a new funding programme will be launched for cargo bikes for families; with a volume of 500 thousand euros per year, it is expected that 333 cargo bikes per year can be funded.

First steps for action:

Decision on the programme in the Mobility Committee, prompt start of funding

Target group:	**Those responsible and those involved:**
Families	FB 61/300, B03

Criteria:	**Evaluation:**
$CO_{2\ reduction}$	
Financial expenditure	340.000 €/a
Time expenditure (personnel)	2 new jobs (plus)
Regional added value	

Explanations of the evaluation criteria: €150 thousand in 2020; €500 thousand p.a. from 2021

Durchführungszeitraum: 2020-2025

TA13_ Mobility / 4.5.1.1 Expansion of the charging infrastructure (IKSK 2.0)

Note: also addressed in IKSK 2020

Thematic focus	Introduction	Development of effect	Sphere of influence
Climate-friendly drives and fuels	2025	Medium-term, long-term	Offer and supply

Goal and strategy

The city of Aachen has a great interest in realising its climate targets by 2030, which is why it should promote the development of charging infrastructure. In order to achieve the aforementioned target of approx. 2,400 charging points by 2030, extensive advisory services are required for entrepreneurs and owners of parking spaces, e.g. in finding and selecting suitable funding programmes and identifying potential operators.

Initial situation

As at 31 August 2023, 4,741 electric vehicles and 3,233 plug hybrid vehicles were registered in Aachen. These vehicles make up 6.77% of the total fleet. The German government has set a target of 15 million fully electric cars being registered nationwide by 2030 and around one million public charging points being available. If these figures are broken down to the city of Aachen, the assumed total number of approx. 117,000 cars results in approx. 35,000 electric vehicles and approx. 2,400 charging points. For a target electrification rate of 90 % of cars, this figure would be tripled in purely mathematical terms. However, parallel developments, such as the reduction of car traffic overall, must be taken into account. There are currently around 540 publicly accessible charging points in Aachen, over 300 of which were installed as part of the ALigN project.

Description of the

In order to reach the number of charging points determined in this way, further locations for the charging infrastructure must be found in order to achieve the climate policy targets and generally make the switch to e-vehicles attractive. The next step should therefore be to address vehicle operators, e.g. taxi companies and car-sharing companies, who are frequently on the move in the city and for whom a switch to locally emission-free vehicles therefore has a disproportionately favourable effect on inner-city emissions. Furthermore, charging points (AC/DC/HPC) could be installed in various private parking spaces, e.g. at retail companies and in multi-storey car parks. Based on the charging points already installed, it is assumed that around 1,800 new charging points will need to be installed by 2030. The costs per charging point (AC/DC/HPC), including connection costs, are estimated at an average of €27,500, resulting in a total investment volume of €49,500,000.

The city of Aachen has a great interest in realising its climate targets by 2030, which is why it should support the development of the charging infrastructure. Based on a funding requirement of 30% of the new charging points to be installed and a subsidy of 40%, the total funding requirement for the period 2025 to 2030 is approx. 5,940,000 and a staff requirement of one 50 % position.

First steps for action

- Identification of further locations for the charging infrastructure
- Addressing vehicle operators, e.g. taxi companies and car-sharing companies that are frequently on the road in the city
- Creation of charging points in various private parking areas, e.g. at retail companies and in multi-storey car parks

Target group

Logistics companies, courier/express and parcel service providers (CEP), trade businesses, politics

Time required	Duration of the activity
1 full-time equivalent	6 years

Material costs	Financing approach
approx. €5,940,000 for the funding programme	Budget funds, possibly electric mobility funding

GHG savings

Currently not quantifiable. Estimation possible using the new balancing methodology (see activity 4.2.1.2. Balancing and impact assessment of mobility measures in the ICSK)

Synergy effects	Conflicting goals
Neighbourhood car parks and neighbourhood mobile stations	-

Success indicators/milestones

Number of additional charging points

TA14_Mobility / 4.2.1.4 City centre mobility for tomorrow (IKSK 2.0)

Thematic focus	Introduction	Development of effect	Sphere of influence
Transport planning and mobility concepts	2024	Medium-term, long-term	Offer and supply

Goal and strategy

The activity aims to make the city centre more accessible and safer for all road users.

Initial situation

A network interruption for car traffic on the Grabenring was installed at Elisenbrunnen back in the 1990s. In 2021, a further network interruption was added at Templergraben via a real-world laboratory, the continuation of which was decided in 2023. In November 2023, the decision on three further "control points" for car traffic is pending. At the same time, this decision marks the start of the transformation of the Grabenring into a cycle distribution ring as a connecting element of the priority cycle routes leading to the city centre, which was already announced in 2019.

Description of the

With the help of an overall concept that follows three central objectives, this city-friendly and safe accessibility of the city centre is to be ensured for all road users:

- Easily accessible city centre: Everyone can easily reach the cultural, gastronomic, educational and shopping facilities in the heart of Aachen. The city centre is easily accessible by all modes of transport.
- Fair and safe traffic: The interaction is considerate and relaxed.
- Good neighbourhoods: Neighbourhoods are quiet, the quality of life is enhanced and people can enjoy each other's company.

In order to achieve these overarching goals, measures were developed for the individual modes of transport. For each mode of transport, the measures are aimed at different sub-goals, which are presented below:

- Strengthen walking, improve quality of stay
- Making car traffic compatible with the city
- Enabling safe cycling
- Improve public transport

The concept also includes measures for the following areas

- Strengthening consideration,
- Networking of mobility services and
- Making urban transport climate-neutral.

The implementation of the changed traffic routing is currently planned for 2024. This new routing of car traffic will prevent through traffic in the city centre by dividing the area into five zones with defined access points. The overall city centre mobility concept for tomorrow clearly shows how the reduction of the car traffic share of the modal split in the city centre is to be reduced from 46% to 36% by 2030: Reduced space requirements for car traffic will be used to make eco-mobility more attractive.

First steps for action

- The implementation of the changed traffic routing is currently planned for 2024.

Target group

Citizens

Time required

0.25 full-time equivalents

Duration of the activity

Establish in the long term

Material costs

Not quantifiable

Financing approach

-

GHG savings

Currently not quantifiable. Estimation possible using the new balancing methodology (see activity 4.2.1.2. Balancing and impact assessment of mobility measures in the ICSK)

Synergy effects

4.3.4.3 Mobility management for visitors

Conflicting goals

Feedback from citizens

Success indicators/milestones

Development of the modal split

TA15_ Mobility / 4.2.1.5.Network Mobility Transition Aachen Region (NEMORA) (IKSK 2.0)

Thematic focus	Introduction	Development of effect	Sphere of influence
Transport planning and mobility concepts	2024	Medium-term, long-term	Offer and supply

Goal and strategy

The mobility transition in the region is to be organised in close cooperation with the StädteRegion Aachen and the municipalities belonging to the region.

Initial situation

The network began its activities in spring 2022 and spent the first project phase in 2023 fine-tuning its content and developing objectives, standards, evaluation criteria and basic concepts in working groups, which are to be implemented as the project progresses. Public relations issues have also been addressed.

Description of the

The cooperation in NEMORA is currently focussing on the regional future fields of "strong public transport axes", "Mobile stations and multimodality" and "regional cycling infrastructure" were each developed further in independent working groups. All working groups have defined content and binding objectives that are to be implemented and achieved as part of the work. New topics (e.g. mobility and traffic management) are to be added from 2024. The regional perspective will promote structures for climate-friendly settlement and mobility development at an early stage and create alternatives for commuter transport to and from Aachen.

First steps for action

- Development of further projects in new subject areas
- Realisation of projects and ongoing adaptation

Target group
Aachen city region

Time required
Not quantifiable

Duration of the activity
Establish in the long term

Material costs
Not quantifiable

Financing approach
-

GHG savings
Not quantifiable

Synergy effects
Various activities in the field of action

Conflicting goals
-

Success indicators/milestones
Development of the modal split

TA16_ Mobility / 4.1.1.1. BMM at the city administration of Aachen and at the municipal holding companies (IKSK 2.0)

Thematic focus	Introduction	Development of effect	Sphere of influence
City as a role model: Mobile city group	2024	Short to medium term	Offer and supply

Goal and strategy

The expansion of operational mobility management in the municipal family aims to reduce, shift and handle transport in the most climate-friendly way possible. The expansion of existing services is intended to further improve mobility behaviour.

Initial situation

With almost 6,000 employees, the City of Aachen has a great responsibility to organise sustainable mobility for its employees. So far, the first major steps have been taken with the introduction of the employee job ticket and the soon to be available company bike leasing scheme. In other areas, such as car park management or the creation of secure bicycle parking spaces, there have been few successes. However, there is great potential if the appropriate incentives and framework conditions are created. Successes in this area will also have a positive impact on employer attractiveness, which is an important parameter in times of a shortage of skilled labour. The role model function vis-à-vis the municipal holding companies and other state authorities is also very high and has already been addressed by politicians as a field of action in the area of mobility management.

Description of the

The City of Aachen is significantly expanding its concept for corporate mobility management within the administration and is also actively supporting the municipal subsidiaries in following this example. It is conceivable that management could be based on climate protection-related target indicators (key performance indicators), the achievement of which should be evaluated annually. The KPIs could include, for example Proportion of employees in the department who travel to work by eco-mobility or measures implemented in their own area of responsibility that relate to climate protection. At the same time, the municipal subsidiaries (e.g. STAWAG, ASEAG, APAG...) are also being persuaded to introduce company mobility management. Encouraging competition between the individual organisations in terms of the modal split achieved or car kilometres saved per year could serve as an incentive for special efforts at all levels.

First steps for action

- Conception and realisation of further offers
- Establishment and regular collection of climate protection-related target indicators
- Direct approach of the municipal holding companies and, if necessary, conceptualisation of a competition
- Evaluation of the target indicators and adjustment of the offers if necessary

Target group

City administration and municipal affiliated companies

Time required

0.5 full-time equivalents

Duration of the activity

Establish in the long term

Material costs

Not quantifiable, depending on the new

- offers

Financing approach

GHG savings

Currently not quantifiable. Estimation possible using the new balancing methodology (see activity 4.2.1.2. Balancing and impact assessment of mobility measures in the ICSK)

Synergy effects

Various activities in the field of action

Conflicting goals

-

Success indicators/milestones

Modal split of the city administration and municipal family, evaluation of target indicators

TA17_Mobility / 4.2.1.6 Zero emission zone (IKSK 2.0)

Thematic focus	Introduction	Development of effect	Sphere of influence
Transport planning and mobility concepts	2024	Medium-term, long-term	Offer and supply

Goal and strategy

The aim of the activity is to develop solutions for setting up zero-emission zones so that from this point onwards only locally emission-free cars are allowed to drive there.

Initial situation

The EU has set itself the goal of becoming climate-neutral by 2045. According to the City of Aachen's technical understanding, climate-neutral transport requires the complete elimination of the use of fossil fuels. To achieve this goal, the EU decided in 2022 that vehicles powered by conventional petroleum products would no longer be allowed to be registered from 2035. To date, the average lifespan of passenger cars is 15 to 20 years; a vehicle purchased in 2034 is therefore expected to reach the end of its service life between 2049 and 2054. For the acceptance of a ban on the use of such vehicles, it would be very important for people who are about to make a purchase decision to know how long this vehicle may be used in their home region. Such a ban should therefore include a sufficient lead time that takes the service life into account. It is irrelevant for the amount of CO_2 emissions - which alone is decisive worldwide - whether the CO_2 emissions of a vehicle are released into the atmosphere in Aachen or elsewhere for any remaining time until the end of its service life. Whether the EU intends to achieve the goal of climate-neutral transport in 2045 by banning the use of such vehicles is still unclear.

In the past, the city of Aachen has always favoured solutions that prioritise a voluntary changeover. When this was no longer legally possible, it was decided in 2019 to establish an environmental zone for Aachen within the outer ring road.

Description of the

With this activity, the City of Aachen undertakes to work with other pioneering cities and the EU Commission to coordinate the possibilities of introducing a zero-emission zone in Aachen. If this possibility exists, it would be highly recommended to reach an agreement with the surrounding area on at least an (EU) regional or nationwide solution.

First steps for action

- Establishment of a working group
- Development of solutions
- Prospective establishment of zero-emission zones

Target group

City of Aachen, other pioneering cities and the EU Commission

Time required

1.5 full-time equivalents

Duration of the activity

Establish in the long term

Material costs

Not quantifiable

Financing approach

Budget funds

GHG savings

Currently not quantifiable. Estimation possible using the new balancing methodology (see activity 4.2.1.2. Balancing and impact assessment of mobility measures in the ICSK)

Synergy effects

-

Conflicting goals

Legal framework and Control options, acceptance by citizens

Success indicators/milestones

Solutions have been developed, zero emission zone has been established

TA18_ Mobility / 4.3.3.1 Promotion of sharing and multimodality (IKSK 2.0)

Thematic focus	Introduction	Development of effect	Sphere of influence
Avoiding and shifting passenger transport	2024	Medium-term, long-term	Offer and supply

Goal and strategy

On the one hand, the activity aims to expand the range of sharing and multimodal services and, on the other, to secure funding for these services.

Initial situation

Aachen already has a large number of car and bike sharing stations, and there are currently 3 e-scooter providers operating in the city. With the expansion of the mobility transition efforts to the entire Aachen city region, the topic of shared mobility is also becoming increasingly important in the Aachen city region. In order to achieve the highest possible number of users, optimal integration with public transport and a broad range of services, good organisation and user communication of the sharing system is required.

Description of the

Shared mobility follows the principle that means of transport are available to users when they need them (flexibility), but are available to other users at other times.

In combination with public transport, shared mobility offers the opportunity to make it so attractive that it is possible to do without a personal car. This is because places that are difficult to reach by public transport can be reached with car sharing or bike sharing and the last mile from the bus stop to the destination can be covered quickly and easily with e-scooter sharing or bike sharing (reliability, accessibility).

The promotion of sharing and multimodality is therefore an important building block in Aachen's climate neutrality programme. In addition, the expansion of sharing offers reduces land consumption, as these vehicles are available to several people throughout the day.

The activity includes attracting new users to the various sharing offers (e.g. through integrated or new tariff products (such as subscriptions incl. basic sharing fee or public transport day pass incl. Velocity), communication, use on long journeys in the case of car sharing). In addition, the offer should be further expanded, e.g. at P+R car parks, peripheral districts.

In order to finance the operation of the sharing offer in the long term, larger employers in Aachen must be systematically involved in financing the sharing offer, either by setting up and financing sharing stations on their own premises and concluding purchase agreements for employees or by means of a levy that is used to finance the operation of the city-wide sharing system.

The aim is also for public transport operators and Deutsche Bahn to co-finance the sharing offer (e.g. integration into the city fare for train tickets), as the sharing offer benefits public transport. In addition, sharing providers will pay special usage fees to the city.

First steps for action

- Attracting new users for the various sharing offers
- Conception of (participation) models for financing the offers
- Addressing companies directly

Target group

Citizens

Time required	Duration of the activity
0.5 full-time equivalents	k. A.

Material costs	Financing approach
Not quantifiable	-

GHG savings

Currently not quantifiable

Synergy effects	Conflicting goals
Various activities in the field of action	Response from companies

Success indicators/milestones

Offer has been expanded, utilisation of offers

TA19_Brief description: Mobility / 4.1.2.2 Electrification of urban vehicles (IKSK 2.0)

To make the municipal vehicle fleet climate-neutral, combustion vehicles in the municipal fleet are being replaced by vehicles with electric drives. The only exceptions are emergency vehicles for the fire brigade. The main basis for this activity is equipping the municipal sites with charging infrastructure

3.2.2 Buildings & heating

The city of Aachen is leading by example. It is endeavouring to renovate its own building stock and to make the non-residential and residential building stock of the municipal family climate neutral. As of April 2022, the City of Aachen's building management is responsible for 860 properties in around 622 properties of various uses. In addition, the city has around 10,000 publicly subsidised housing units, of which 5,577 flats will no longer be subject to rent and occupancy restrictions by 2029. The city has a direct influence on around 5% of the flats in Aachen. There are refurbishment plans for these residential buildings as of 2022.

The energy-efficient refurbishment of private buildings is to be massively increased through an expansion of advisory services and subsidies.

In the area of heat supply, the challenge of a climate-friendly supply of space heating and hot water as well as process heat in industry is particularly high. In 2024, the city administration began municipal heating planning, which is expected to be adopted in 2025. The heat planning will show how a climate-neutral heat supply can be achieved.

Particularly regarding the refurbishment of the private building stock, it is of central importance that the federal government and the state of NRW exploit their scope for action, e.g. within the framework of the Building Energy Act, the modernisation guideline RL MOD NRW 2023 plus funding programme, the CO2 pricing as part of the climate package. The portfolio of measures in the "Construction and refurbishment" field of action thus forms the basis for achieving the necessary emission savings as part of the EU mission. To this end, the measures it contains are constantly being developed and adapted to new standards.

The evaluation using the Economic Model tool has shown that 522 kt CO2e of the 582 kt CO2e in 2021 will be saved in the Buildings & Heating sector by 2030, which corresponds to a reduction of 90 %.

Source: Economic Model

Table AP- 15 Subsectors for GHG reduction in the buildings and heating sector incl. GHG savings in 2030

	Subsector	**Savings in 2030 (ktCO2/a)**
Buildings & heat	B1 - Building renovations (envelope)	107
	B2 - New energy-efficient buildings	1
	B3 - Efficient lightning and appliances	23
	B4 - Decarbonising heating generation	391
	Total	**522**

The core measures in buildings and heating for the city administration and municipal holdings from IKSK 2020 and IKSK 2.0 are listed in Table AP-T16.

Measures from the urban society

Of the 134 co-signatories of the Aachen Climate City Contract, 26 have made a PREMIUM commitment, i.e. they are also aiming for climate neutrality in energy and heat consumption by 2030. Of the 57 FRAME partners, 30 have specified measures for buildings and heat (see Appendix 1). This lays the foundation for a reduction in emissions, which is supported and further expanded by the city administration with the "Eco Funds" programme, among other things.

Table AP- 16 Core measures - Building & heating

Measure		IKSK 2020	IKSK 2.0	B1	B2	B3	B4
Code	Title						
BH 01	Climate-neutral electricity and heat supply for municipal properties		x				
BH 02	Decentralised heat supply, securing the district heating network, neighbourhood-specific individual solutions	x					
BH 03	Concept for the optimised use of geothermal energy		x				
BH 04	Waste heat utilisation	x					
BH 05	Heat planning		x				
BH 06	Masterplan - integrated, comprehensive energy planning		x				
BH 07	Energy-efficient refurbishment of municipal residential buildings	x	x				
BH 08	Energy-efficient refurbishment of municipal non-residential buildings	x	x				
BH 09	Energy-efficient refurbishment of private residential buildings	x	x				
BH 10	Redevelopment model area eastern city centre	x	x				
BH 11	Energy management of buildings, extension to the entire city group	x					
BH 12	Climate-neutral new buildings	x	x				
BH 13	Climate cooperative	x					
BH 14	Energy-efficient monument preservation		x				
BH 15	Funding programmes for renovating old buildings	x	x				
BH 16	Neighbourhood-specific refurbishment advice	x					
BH 17	Advice on the use of renewable energy for heating buildings	x					
BH 18	Mobilisation of commercial property owners for energy efficiency measures	x	x				
BH 19	Ökoprofit environmental management programme for companies	x					
BH 20	"Sustainable and efficient economy" funding programme		x				
BH 21	Resource-saving refurbishment of existing buildings	x					
Reduction in 2030 (ktCO2e)				107	1	23	391

Note: Overview in the buildings & heating sector of the city administration and municipal holdings, including effects on the subsectors of the economic model
B1: Building renovations (envelope), B2: New energy-efficient buildings, B3: Efficient lighting and appliances, B4: Decarbonising heating generation

3.2.2.1 Brief profiles of the core measures in the area of buildings and heating from the municipal administration from the IKSK 2020 and IKSK 2.0

BH01_Energy supply / 2.1.1.1. Climate-neutral electricity and heat supply for properties under municipal control (IKSK 2.0)

Thematic focus	Introduction	Development of effect	Sphere of influence
City as a role model: energy supply and - production	2024	Medium and long term	Care/ role model

Goal and strategy

With the help of this activity, the conversion to a climate-neutral and therefore fossil-free electricity and heat supply for the properties of the municipal family Stadt Aachen is to be supported and the self-generation of electricity is to be accelerated through the expansion of photovoltaics.

Initial situation

In relation to the city of Aachen's total final energy consumption, the municipal sector accounts for less than 2 %, of which just under two-thirds is for the provision of space heating, mainly through district heating and natural gas. In connection with an imminent conversion of the city's heating supply without the use of fossil fuels, the city of Aachen has already analysed the challenges and opportunities in the city area together with STAWAG, RWTH, FH, Fraunhofer IEG and IHK and published the results in spring 2022 under the title "Wärmewende Aachen - Eckpfeiler für eine klimaneutrale Energieversorgung 2030". Based on this, it was decided to draw up a city-wide heating plan, which the city of Aachen - as a city with more than 100,000 inhabitants - would have to complete by 30 June 2026 if the federal government's current draft law comes into force.

The City of Aachen is already actively involved in the expansion of renewable electricity generation through wind power as well as ground-mounted and rooftop PV. As part of the determination of energy-related refurbishment requirements, suitable roof areas for PV expansion have already been identified and prioritised for municipal properties in order to increase the proportion of self-generated renewable electricity in the future.

Description of the

Against the backdrop of the City of Aachen Group's goal of climate neutrality, the current energy supply needs to be converted and buildings extensively renovated. The first priority is to carry out the refurbishments (see activities: 3.1.1.1. Refurbishment of municipal residential and non-residential buildings). The first priority is to carry out the refurbishments (see activities: 3.1.1.1. Refurbishment of municipal residential and non-residential buildings) in order to reduce energy requirements and then efficiently convert the reduced energy requirements. The electricity should be sourced entirely from renewable energy sources, ideally in part from the city's own rooftop photovoltaic systems. The choice of heat energy source should be made on the basis of municipal heat planning (see activity 2.2.1.2. Heat planning). Connection to local and district heating networks should be prioritised where possible. Municipal properties could, for example, serve as anchor customers for local and district heating networks and thus contribute to the conversion of the primary supply solution at neighbourhood level. The low percentage share of municipal properties in final energy consumption would therefore have an impact beyond sectoral boundaries. Further multiplier effects in society could be achieved by prioritising schools and daycare centres. The municipal group would set a good example and thus act as a role model.

By 2030, all municipal properties and the properties of companies under municipal control (City of Aachen Group) are to be converted to climate-neutral solutions wherever possible. This also includes Gewoge AG, which has considerable potential as the owner of more than 5,000 residential units in Aachen.

As massive investments will be required for the process, the development and implementation of an investment programme for the gradual conversion of the properties of the City of Aachen Group is recommended. The respective investment plans in all Group subsidiaries are based on individual action plans that are to be finalised by the end of 2025. The first selected measures should be started by then if possible. A cost-benefit analysis should also compare the annual energy savings for tenants - including tenant electricity - and the rent increases made possible by the refurbishment with the investment costs.

First steps for action

- Development of an investment programme with individual action plans
- Energy-efficient refurbishment of municipal properties (see 3.1.1.1. and 3.1.2.1.)
- Preparation of municipal heat planning
- Energy conversion based on municipal heat planning

Target group

Municipal family City of Aachen

Time required	Duration of the activity
1 full-time equivalent	2024 - 2030

Material costs	Financing approach
100.000 € for external support in the development of an investment programme including individual action plans; Investment funds not quantifiable	Budget funds, possibly subsidies

GHG savings

Expansion potential for rooftop PV of 13.8 MWp exhausted by 2030
GHG savings from the heat conversion can only be quantified after the municipal heat planning has been drawn up

Reduction of the annual emission level (t/a):	Cumulative GHG savings (tonnes):
4,000 tonnes CO2eq/a	12,500 tonnes CO2eq

Synergy effects	Conflicting goals
2.1.1.1 Masterplan (concept plan) integrated, comprehensive energy planning, 2.3.3.1 Solar campaign on all suitable roof surfaces 3.1.1.1 Refurbishment roadmap for urban non-residential buildings, 2.2.1.2 Heat planning, 3.1.2.1 Action plan: Energy-efficient refurbishment of municipal residential buildings	Remaining useful life of installed heating systems, shortage of skilled labour

Success indicators/milestones

Investment programme launched, municipal heating planning completed, development of energy sources in municipal properties, development of GHG emissions

BH02_Field of action: Energy supply, renewable energies / No. 3.4 Secure decentralised heat supply, district heating network and implement neighborhood-specific individual solutions (IKSK 2020)

Brief description:

The municipal energy supplier STAWAG operates a district heating (DH) network based on heat cogeneration from the Weisweiler lignite-fired power plant. As this power plant will be decommissioned in spring 2029, solutions need to be generated to safeguard the district heating network, in particular ways to increase the proportion of renewable energy (improve the primary energy factor). A concept for renewable district heating and cooling is to be drawn up.

In order to improve the utilisation of the FW network, a compulsory FW connection in redeveloped districts is being examined.

A feasibility study for a solar storage facility in an old quarry in Walheim will show the potential for minimising local supply in this area.

First steps for action:

1. Construction of a 20 MW CHP plant in the Schwarzer Weg area for feeding into the FW grid
2. Concept for transformation towards renewable district heating

Target group:		**Responsible and involved parties:**
Potential customers for district heating		STAWAG
Criteria:		**Rating:**
$CO2_{reduction}$	+++	8200 t CO2/a through CHP Schwarzer Weg
Financial expenditure Time		Costs at STAWAG
expenditure (personnel)		
Regional added value	+	

Explanation of the evaluation criteria:

The savings from the Schwarzer Weg CHP plant and the associated connection of three industrial companies to the district heating network were analysed. The effects on the emissions of the FW from Weisweiler, which are taken into account in the $CO2_{balance,}$ have not yet been determined here.
Costs at STAWAG

Implementation period: 2021 - 2025

BH03_Energy supply, Brief description / No.2.4.2.1 Concept for the structurally optimised use of geothermal energy in Aachen (IKSK 2.0)

The city of Aachen is working with STAWAG to develop a concept in which the potential of near-surface and deep geothermal energy is to be recorded and compared with the differentiated, settlement structural needs of the city.are to be related to each other. The identification of areas that are particularly suitable for efficient utilisation forms the basis for future urban development and the targeted conversion of existing buildings.

BH04_ Field of action: Energy supply, renewable energies / No. 3.5 Waste heat utilisation (IKSK 2020)

Brief description:

Suitability test for the utilisation of waste heat as part of the development of new building projects. For example, the use of waste heat from the new computer centre to be built on the West Campus is planned.

First steps for action:

Concretisation in the course of planning progress

Target group:		**Responsible and involved parties:**
Heat supplier		STAWAG
Criteria:		**Rating:**
$CO2_{reduction}$ Financial	++	500 t/a
outlay		Costs at STAWAG
Time expenditure (personnel)		
Regional added value		

Explanation of the evaluation criteria:

The construction of the data centre is accompanied by an expansion of IT applications that increase CO2 emissions. The use of waste heat contributes to the energy efficiency of the data centre. Overall, the CO2 reduction depends on the potential and extent of waste heat utilisation and therefore quantification is only possible with caution.
Costs at STAWAG

Implementation period: 2023

BH05_ Energy supply / 2.2.1.2 Heat planning (IKSK 2.0)

Thematic focus	Introduction	Development of effect	Sphere of influence
Urban energy planning	2024	Medium and long term	Supply/ offer

Goal and strategy

The aim of this activity is to create a central and reliable conceptual planning basis for the transformation to a decarbonised heat supply for the entire city. This should take an integrated view of the necessary reductions in demand and the adaptation of supply structures.

Initial situation

The heating sector accounts for the largest share of annual greenhouse gas emissions in Aachen and therefore also offers the greatest potential for reduction.

Together with STAWAG, RWTH, FH, Fraunhofer IEG and IHK, the city of Aachen has analysed the challenges associated with an imminent change in the city's heating supply. The results were published in spring 2022 under the title "Aachen's heating transition - cornerstones for a climate-neutral energy supply in 2030". The Aachen City Council subsequently decided to draw up a city-wide heating plan and made initial budget funds available for preparatory work.

According to the federal government's draft law on heat planning and the decarbonisation of heating networks, the city of Aachen - as a city with more than 100,000 inhabitants - would be obliged to complete this by 30.06.2026 when it comes into force.

Description of the

Converting the heating sector to a heat supply without fossil fuels is essential for achieving climate neutrality, meaning that municipal heating planning is a key management tool in the climate neutrality strategy.

Municipal heat planning should support this transformation process and provide the city of Aachen with a reliable planning basis that considers centralised and decentralised supply options, including storage, control and distribution, in an integrated manner. To this end, different and individual supply options for sub-areas of the city (neighbourhoods) are to be developed, while a further focus is on reducing energy demand. This is necessary in order to be able to cover future heating requirements with local and renewable energies. The reduction potentials must be worked out and visualised in terms of space and time. There is therefore a direct link between energy supply and urban development, including the urban refurbishment roadmap. Both focal points - supply solutions and demand reduction - must be considered in an integrated manner for a successful transformation.

Examples of specific projects in the area of heat supply include the utilisation of waste heat from the Aachen crematorium or the use of wood waste from the municipal enterprise. As the study "Rough Concept - Sustainability - Aachener Stadtbetrieb" has shown, over 2,000 tonnes of wood are produced annually by the municipal services alone as part of urban and landscape maintenance. These are currently disposed of for a fee, although alternative uses are conceivable that would allow the wood waste to be processed further and utilised for energy in the future.

External planners are to support the city of Aachen in the (conceptual) development of heat planning.

First steps for action

- Preparation of a bill of quantities
- Realisation of the tender
- Creation process with integrated consideration of urban development and energy supply

Target group

Municipal family City of Aachen

Time required

1 full-time equivalent

Duration of the activity

2024 - 2026

Material costs

250.000 €
for the creation of a heating plan (concept) by external planners

Financing approach

Budget funds, subsidies

GHG savings

Currently not quantifiable. Savings result from switching to a fossil-free heat supply, taking alternative energy sources into account.

Synergy effects

2.2.1.1 Masterplan - integrated, comprehensive energy planning
energy planning
3.1.1.1 Refurbishment roadmap for urban non-residential buildings
3.1.2.1 Action plan: Energy-efficient refurbishment of municipal residential buildings
3.2.2.1 Energy-efficient monument conservation
3.3.3.1 Redevelopment model area: Eastern city centre

Conflicting goals

-

Success indicators/milestones

Municipal heat planning has been created,
reduction of GHG emissions in the heating sector

BH06_ Energy supply / 2.2.1.1 Masterplan - integrated, comprehensive energy planning (IKSK 2.0)

Thematic focus	Introduction	Development of effect	Sphere of influence
Urban energy planning	2024	Short term	Care/ role model

Goal and strategy

With the help of the masterplan, an integrated planning basis is to be created that considers different renewable energies, such as wind, PV and geothermal energy, together. Existing potential studies are to be bundled and expanded for this purpose.

Initial situation

As a result of the legal mandate for the energy and heating transition, the city of Aachen, like all other German cities and municipalities, is facing major challenges that need to be solved.

Together with STAWAG, RWTH, FH, Fraunhofer IEG and IHK, the city of Aachen has already worked on analysing these challenges with regard to the conversion of the heat supply in the city area and describing them in a report entitled "Aachen's heat transition - cornerstones for a climate-neutral energy supply in 2030". STAWAG's district heating campaign, which aims to drive forward the expansion of district heating, should be included here. There are also potential studies for the expansion of renewable energies, such as photovoltaics and wind power, which need to be considered in an integrated manner.

Description of the

In order to create an integrated concept as a basis for planning, it is first necessary to determine the status quo in order to determine the potential based on this. The legal basis should be checked and existing data researched. It is also advisable to enter into dialogue with other cities and municipalities in order to find out how similar issues are dealt with elsewhere.

For some areas, potentials are already available in varying degrees of detail, which have been created or commissioned by various stakeholders, such as the above-mentioned organisations or the LANUV. These need to be reviewed in accordance with current legislation and, if necessary, adapted or expanded in line with the criteria to be defined in order to ultimately create a comprehensive and integrated potential study for the expansion of renewable energies in the heating and electricity sector. Overlaps with other uses, such as residential, commercial, landscape conservation and nature and flood protection, must be taken into account.

Concrete measures for implementation are to be derived from a prioritisation of uses and included in an action plan. The masterplan should be drawn up in collaboration with external consultants. Appropriate consultancy services and existing funding opportunities should be examined. The subsequent implementation of the master plan ties in with many other points, such as integration into land management and land use planning, existing PV and wind planning or in development plans.

First steps for action

- Analysing the status quo
- Determination of potential including prioritisation
- Develop action plan
- Check funding opportunities and counselling services
- Implementation of the action plan

Target group

Municipal family City of Aachen

Time required

1 full-time equivalent

Duration of the activity

2024 - 2025

Material costs

250.000 €

Financing approach

Budget funds, subsidies for the creation of a master plan by external consultants

GHG savings

No direct savings. Savings result from realising the potential identified.

Synergy effects

2.2.1.2 Heat planning
2.1.2.1 Ground-mounted PV systems on urban areas
2.3.1.1 Energy in the hands of citizens
2.4.2.1 Concept for the structurally optimised use of geothermal energy in Aachen

Conflicting goals

Land use conflicts, e.g: Residential, commercial, landscape conservation, nature conservation, flood protection

Success indicators/milestones

Potential study and action plan drawn up, development of the expansion of renewable energies

BH07_ Field of action: Municipal buildings / No. 2.4 Energy-efficient refurbishment of municipal buildings, residential buildings (IKSK 2020)

Note: also addressed in IKSK 2.0 Chapter 3.1.2.1. (p. 60)

Brief description:

The city of Aachen has its own portfolio of around 2,700 flats, which are to be successively upgraded in terms of energy efficiency. This includes measures to optimise the building services and energy supply structure as well as insulating the building envelope. The use of renewable heat (versus district heating connection) and renewable electricity (installation of PV systems) will also be examined. Where possible, the roofs should be greened in future as part of the building refurbishment.

The city of Aachen can build on the positive experiences with the EU project EU-GUGLE (Joseph-von-Görres-Strasse and Rehmviertel, 254 flats) and the refurbishment of the Burggrafenstrasse properties. Final energy savings of between 60 and 75 % were achieved as part of EU-GUGLE, which also benefit the tenants.

The aim is to modernise the energy efficiency of around 160 flats per year.

First steps for action:

Analysing the condition of the buildings in order to draw up a list of priorities. Planning of the first conversions.

Target group:		**Responsible and involved parties:**
Public housing stock		FB 23
Criteria:		**Rating:**
$CO_{2\,reduction}$ Financial	++	800 tonnes CO2/a
outlay		City costs: € 4,000,000 per year
Time expenditure (personnel)		
Regional added value	+	

Implementation period: from 2021

BH08_ Field of action: Municipal buildings / No. 2.3 Energy-efficient refurbishment of municipal buildings, non-residential buildings

Note: also addressed in IKSK 2.0 Chapter 3.1.1.1. (p. 58)

Brief description:

Refurbishment planning for schools, daycare centres and sports buildings is based on an annual key performance indicator report. In addition, the effects of climate change are taken into account and corresponding adaptation measures such as roof greening/sealing and the selection of materials/technology are included in the planning.
The refurbishment rate over the last 10 years has averaged 1% per year (one major refurbishment per year plus partial refurbishments, ventilation/lighting refurbishment). Monitoring is mandatory according to performance phase 10 PHPP. The aim is to at least double the annual refurbishment rate to 2%.
Energy-efficient refurbishment (refurbishment rate of 2%) is also to be introduced for other buildings in the City Group. The city's role model function, particularly in relation to the state properties (university buildings), is important here.

First steps for action:

Development of a prioritised list based on potential/needs:
- Schools: from 100 kWh/m², 13 properties, € 82 million
- Daycare centres from 100 kWh/m², 26 properties, € 35 million
- Administration building € 10 million
- Fire brigades € 5 million
- Indoor swimming pools € 20 million
- Other buildings € 10 million
- Total approx. €162 million by 2050, i.e. €5.5 million per year over 30 years

According to the priority list, identification of the first property and further specification of the measures in the property including cost calculation, planning costs for this in 2020 around 300,000 euros.

Target group:		**Those responsible and those involved:**
Public buildings		E 26
Criteria:		**Evaluation:**
$CO_{2\,reduction}$	++	928 t/a
Financial expenditure		City costs: €5,500,000 per year
Time expenditure (personnel)		3 MÄ
Regional added value	++	

Explanation of the evaluation criteria:

Orientation values according to refurbishment of various daycare centres/schools, heat savings between 62-80 %. 370 municipal. properties consume 74 million kWh of heat → around 200,000 kWh/year, savings at schools 477 t/a, daycare centres 226 t/a

Implementation period: 2021 - 2050

BH09_ Field of action: Municipal buildings / No. 2.5 Energy-efficient refurbishment of gewoge residential buildings (IKSK 2020)

Note: also addressed in IKSK 2.0 Chapter 3.3.2.1. (p. 69)

Brief description:

The housing company gewoge AG has its own portfolio of around 4,700 flats, which are to be successively upgraded in terms of energy efficiency. This includes measures to optimise the building services and energy supply structure as well as to insulate the building envelope. The use of renewable heat (versus district heating connection) and renewable electricity (installation of PV systems) will also be examined. Where possible, the roofs are to be greened in future as part of the building refurbishment.

Among other things, gewoge can build on its positive experience with the EU project EU-GUGLE. The refurbishment of the 4 blocks of flats in Wiesental (123 flats) resulted in savings of 54% in heating energy, 62% in final energy and 71% in $CO_{2\ emissions}$.

The aim is to refurbish at least 80 flats per year, corresponding to 1.7 % of gewoge AG's own portfolio.

First steps for action:

Analysing the condition of the building and drawing up a renovation roadmap, planning and preparing initial implementation measures.

Examination of the option of financing by waiving parts of the profit transfer to the City of Aachen.

Target group:		**Responsible and involved parties:**
gewoge flats		gewoge, FB 23
Criteria:		**Rating:**
$CO_{2\ reduction}$ Financial	++	400 tonnes CO2/a
outlay		Costs verb. Companies: € 2,000,000 per year
Time expenditure (personnel) Regional		
added value	+	

Implementation period: from 2021

BH10_ Buildings / 3.3.3.1 Redevelopment model area: Eastern city centre (IKSK 2.0)

Thematic focus	Introduction	Development of effect	Sphere of influence
Residential building stock	2024	Short and medium term	Advise/ motivate

Goal and strategy

With the help of this activity, an alternative approach to increasing the refurbishment rate is to be tested in a model area, which could possibly serve as a blueprint for other projects and neighbourhoods.

Initial situation

Developments in Aachen in recent years, particularly in the eastern part of the city centre, have raised the question of urbanity. Retail use has declined and private transport has characterised the structure. High pedestrian numbers on the main streets, combined with vacant, inflexible retail properties and a transport system that offers little space for encounters, culture and leisure, illustrate the existing challenges. The majority of private property owners are no longer involved in urban development. Reasons for this could be, for example, the physical distance of the owners or speculation on increases in value by leaving properties lying around.

In order to meet these challenges, the eastern city centre needs a transformation geared towards the common good. In addition to a more diverse usage programme, more sustainable mobility adapted to climate change, a future-oriented development of public and private space and the involvement of private property owners are required. It is clear that these goals cannot be achieved through appeals and dialogue alone. In order to ensure the city's ability to act in this transformation process, it will be examined by mid-2024 whether additional instruments of special urban development law can be sensibly used that go beyond the existing "city centre" redevelopment area and the associated city centre concept of 2022. To this end, the planning committee decided to initiate preparatory studies in November 2021.

Description of the

An approach to increasing the redevelopment rate is to be tested in a selected model area, the eastern city centre. Two key elements form the core of the approach, namely the use of a right of first refusal by the city in the context of redevelopment areas and the creation of a municipal redevelopment company. The right of first refusal enables the city to actively intervene in the property purchase process and thus to act strategically on the property market and control the redevelopment process. The existing Städtische Entwicklungsgesellschaft Aachen GmbH & Co KG (SEGA) could provide a suitable starting point for the redevelopment company, which could play a key role in the implementation of the redevelopment projects. It would be responsible for the coordination, planning and implementation of the redevelopment measures in the model area.

In addition to these main elements, the concept would include a pool of craftsmen (see activity 2.5.6.1.) and a special support programme for private owners who do not wish to sell their buildings. The pool of tradespeople would ensure that qualified specialists are available for the refurbishment work, while the support programme would create incentives for owners to refurbish their properties and thus contribute to the sustainable development of the model area.

Alternative approaches focussing on climate-neutral refurbishment of buildings should also be examined as part of the concept. This could include the integrated consideration of innovative technologies and materials, the use of renewable energies and the implementation of energy concepts. The aim is to realise a future-oriented, sustainable and socially acceptable refurbishment in the model area.

First steps for action

- Finalise inventory and analysis of potential land purchases
- Creation of an urban redevelopment company
- Develop redevelopment goals and need for action
- Conception of the action programme for the refurbishment measures
- Preparation of a results report and reorganisation statutes
- Develop a consulting and communication concept with the help of external consultants
- Conception of suitable information materials
- Introduction of a funding pot

Target group

Citizens, local businesses, trade / commerce / service providers, building owners / owners' associations, administration

Time required	Duration of the activity
2 Full-time equivalents	2024 - 2030

Material costs	Financing approach
2.100.000 €, (300.000 €/a) for public relations work; external consulting or concept development and funding	Budget funds

GHG savings

Not quantifiable

Synergy effects	Conflicting goals
2.3.3.1 Solar campaign on all suitable roof surfaces 2.5.6.1 Establishment of a city-wide pool of tradespeople and a platform including training opportunities	High personnel and financial expenditure, lack of skilled labour / resources, increased number of construction measures, acceptance of property / building owners

Success indicators/milestones

Completion of the inventory, finalisation of a refurbishment concept,
Number of space purchases, number of Information and advisory activities, number of subsidies and total subsidies paid out per year, refurbishments initiated and supported, total energy and GHG savings achieved

BH11_ Field of action: Municipal buildings / No. 2.1 Energy management of buildings, extension to the entire city centre (IKSK 2020)

Brief description:

Expansion of energy management to all buildings in which the City Group holds a majority stake: monitoring and visualisation of consumption data. The prerequisite for the energy-saving management of buildings is that an overview of the energy consumption points is first created and the consumption occurring there is analysed. Over the last 15 years, the Municipal Building Management Department has established a differentiated analysis of the consumption of heat, electricity and water by installing intermediate meters and analysing the data by developing its own software. The software enables quarter-hourly readings to be taken via Internet access. The caretakers in the buildings, e.g. in the schools, have been trained to use the system.
Automated monitoring of characteristic values also makes it possible to set up alarm messages in the event of overruns. User behaviour can also be optimised - as a two-year project with the city's schools impressively demonstrated - using such a system, which is publicly visible to everyone.

The introduction of analogue energy and water management systems in the buildings of the city's associated companies offers both high savings potential and a good role model for imitation in other companies.

First steps for action:

Introduction of a monitoring system analogue to e2watch in headquarters buildings of STAWAG, ASEAG, regioIT, gewoge, Kur- u. Badegesellschaft. Installation of meters, purchase of hardware and software.

Target group:		Those responsible and those involved:
Public buildings in the city as a whole		E 26, municip. operations
Criteria:		**Evaluation:**
$CO_{2\ reduction}$	++	180 t/a
Financial expenditure		Costs city: Costs verb. Companies: €5,000 per year (€5,000 per year for software and €5,000 one-off for hardware)
Time expenditure (personnel)		
Regional added value	+	

Explanation of the evaluation criteria:

At least 2 % savings are expected in the areas of heat and electricity. The city's consumption of 74 million kWh of heat & 19 million kWh of electricity per year serves as a guide. consumption of 74 million kWh heat & 19 million kWh electricity /a → around 90 million kWh in total, with 2 % savings → 900 t/a, assuming 20 % of municipal consumption → 180 t/a. consumption → 180 t/a.

Implementation period: 2021 - 2025

BH12_ Field of action: Urban development planning / No. 1.3 Climate-neutral new buildings as part of property purchase agreements and urban development contracts (IKSK 2020)

Note: also addressed in IKSK 2.0

Brief description:

Development of a standard with energy and sustainability parameters from construction to demolition: definition as the "Aachen Standard" (partly based on the planning guidelines of the municipal building management). Building Management).

As a result, the previously climate-friendly requirements are supplemented by the aspect of resource-conserving construction. As a result, the energy-related expenses for the production, maintenance and end of life of the building materials are taken into account. The use of non-renewable energies and the climate impact in the form of equivalent $CO_{2\ emissions}$ are included in the assessment.

The allocation of urban properties should be based on concept quality, taking into account climate-relevant and social aspects, among other things.

First steps for action:

In the case of municipal properties, it should be stipulated with immediate effect in the property purchase contract that an energy consultation (including sustainability aspects) is mandatory. The energy advice centres of the consumer advice centre and altbau plus e.V. can provide this advice.
Development of a guideline for awarding concepts (from 2020)
Development of new specifications as "Aachen Standard". Introduction planned for 2021

Target group:

Building owners, investors

Those responsible and those involved:

FB 23, FB 61, B 03, altbau plus

Criteria:	Evaluation:
$CO_{2\ reduction}$	+
Financial expenditure Time	
expenditure (personnel)	
Regional added value	

Implementation period: Decision 2020

BH13_ Field of action: Communication, cooperation, participation / No. 6.3 KlimaRegion - regional energy efficiency cooperative (IKSK 2020)

Brief description:

Together with the city region, the city will set up a platform for civic engagement and support for climate protection projects, in particular energy efficiency projects, under the name "KlimaRegion". The platform is based on the REEG (Regional Energy Efficiency Cooperative) project, which is subsidised by the federal government and supported by the state of North Rhine-Westphalia. Following the creation of a concept, the first steps towards implementation are in preparation.

First steps for action:

Support of the City of Aachen for the "KlimaRegion", e.g. in the promotion of the platform and the dissemination of the "KlimaRegion" offer, and participation in the "Regional Energy Efficiency Cooperative"

Target group:

General public

Responsible and involved parties:

FB 36

Criteria:	Rating:
$CO_{2\ reduction}$ Financial	+
outlay	500 € decided for membership fee
Time expenditure (personnel)	
Regional added value	++

Implementation period: 2020 - 2025

BH14_Buildings / 3.2.2.1 Energy-efficient monument conservation (IKSK 2.0)

Thematic focus	Introduction	Development of effect	Sphere of influence
Climate-friendly and Adapted urban development	2024	Short and medium term	Advise/ motivate

Goal and strategy

The activity is aimed at the energy-efficient refurbishment of listed buildings. Through a combined consideration of climate protection and monument preservation, potentials are to be utilised and target-oriented solutions for the upgrading of listed buildings are to be developed.

Initial situation

On 6 April 2022, the North Rhine-Westphalian state parliament passed an amendment to the North Rhine-Westphalia Monument Protection Act (DSchG NRW), which for the first time explicitly enshrined climate protection concerns and the use of renewable energies in the DSchG. This is of particular importance, as climate protection and monument protection are two public concerns worthy of protection, which in practice are often in a strong state of tension and frequently mutually exclusive. Accordingly, Section 9 (3) states: "In particular, the interests of the [...] climate and the use of renewable energies [...] must be given appropriate consideration in the decision."

The city of Aachen is endeavouring to meet its own high standards on the way to becoming a climate-neutral city. In addition, the city is experiencing an increase in enquiries from monument owners who are not only interested in clear information about the upcoming steps, but are also keen to make their monuments energy-efficient. This increased demand has already had a noticeable effect on the practical preservation of historical monuments in the city of Aachen, with at least 75% of consultations and licences granted in connection with the changes to the legal situation. The granting of licences takes particular account of housing, climate, the use of renewable energies and accessibility. Climate issues include both climate protection and climate adaptation measures.

Description of the

In order to successfully implement the energy transition, cities with a historic building stock, such as the city of Aachen, must find ways to realise energy savings and at the same time tap into renewable energy sources. The challenge is to fulfil both the energy requirements and the core concept of monument protection. In the course of general technological development, the development of technologies and methods in this area is also progressing rapidly. One example of this is roof-integrated photovoltaic systems with special polymer coatings. However, upgrading the energy efficiency of monuments does not always mean installing photovoltaic systems as the sole or best solution in the overall context. The decision must always be made on an individual basis, depending on factors such as the size, utilisation and protected status of the building. The aim is to improve the overall energy balance without compromising the historic fabric of the building. This can be achieved, for example, by using efficient heating technology to compensate for the often inadequate insulation properties of the building envelope. Not every façade can be insulated. In general, energy measures, including insulation and optimisation of window and door systems, should be developed in accordance with the principles of monument protection. As the design of such measures is the responsibility of the local authority, the city of Aachen has clearly positioned itself in this regard and offers support in the form of funding programmes and campaigns.

The City of Aachen is also expanding its information and advisory services on the subject of climate protection and energy efficiency in listed buildings. To this end, both the staff and the budget for advising building owners on the changed legal framework conditions, e.g. with regard to photovoltaic systems on listed buildings, will be increased. This also includes the provision of training programmes for employees on innovative forms of PV technology implementation and the provision of renewable heat. Advice is offered on options for a self-sufficient heat supply, particularly in peripheral districts.

First steps for action

- Expansion of existing counselling services
- Targeted employee training on innovative solutions
- Conceptualisation of low-threshold information opportunities
- Effective publicity for the offers

Evaluation and, if necessary, adaptation of the offers

Target group

Municipality of the City of Aachen, Department of Urban Development, Planning and Mobility Infrastructure

Time required

1 full-time equivalent

Duration of the activity

2024 - 2030

Material costs

350,000 € or 50,000 €/a (information material and public relations work)

Financing approach

Budget funds

GHG savings

Not quantifiable

Synergy effects

2.1.1.1 Climate-neutral electricity and heat supply for properties under municipal control
2.2.1.2. Heat planning
2.3.3.1. Solar offensive on all suitable roof surfaces
3.1.1.1. Refurbishment roadmap for urban non-residential buildings
3.1.2.1 Action plan for the energy-efficient refurbishment of municipal residential buildings
3.3.2.1 Advice campaign: Energy-efficient modernisation of the multi-family housing stock (privately and commercially rented, owners' associations)

Conflicting goals

Acceptance by citizens, acceptance by homeowners, changes to the cityscape, aesthetics, monument protection vs. climate protection

Success indicators/milestones

Number of consultations carried out, number of employee training courses held, refurbishment projects implemented

BH15_ Field of action: Buildings - refurbishment in the private and commercial sector / No. 5.1 Re-introduction of a funding programme for the renovation of old buildings (IKSK 2020)

Note: Brief description in IKSK 2.0

Brief description:

In order to reduce the heat demand in the building sector, private and commercial building owners must be incentivised to renovate their buildings to make them more energy efficient, as the measures are difficult to implement economically. There is good experience with subsidy programmes at municipal level, for example in the cities of Cologne and Düsseldorf. Until the expiry of the energy efficiency concept (EEK, 2006-2010), STAWAG also subsidised the energy-efficient refurbishment of buildings. During the evaluation of the EEK, this subsidisation was identified as one of the most effective measures for reducing CO2. A municipal funding programme should therefore be launched to initiate a refurbishment push. As outlined in chapter 4.3.2, a $CO_{2\ reduction}$ potential of 8840 tonnes per year must be tapped. A funding programme can make a major contribution to this by initiating the refurbishment of 450 buildings per year (1.5% of the housing stock in need of refurbishment) with an average investment volume of €80,000 per building. With a subsidy rate of 10%, an average subsidy of €8,000 per refurbishment would be paid out (in purely mathematical terms). This would trigger investments totalling €36 million per year.

First steps for action:

1. Development of funding criteria, i.e. concrete design of the funding conditions such as maximum amount and funding quotas for individual funding objects depending on the component/technology.
2. Orientation towards well-running programmes in other cities.
3. Integration of sustainable materials (conservation of resources, life cycle).
4. Application of the funding programme.

Target group:	Those responsible and those involved:
Building owner	altbau plus, FB 36

Criteria:		Evaluation:
$CO_{2\ reduction}$	+++	7,200 t/a
Financial outlay		3.6 million € per year
Time expenditure (personnel)		2 MÄ
Regional added value	+++	

Explanation of the evaluation criteria:

36 million euros of investment in refurbishments are required per year to generate the savings potential. The funding programme is based on a funding rate of 10%. For every euro invested, 0.2 kg of $CO_{2\ savings}$ are recognised. Investments in energy-efficient refurbishments and the replacement of heat generators are estimated to generate regional added value effects totalling EUR 7.6 million per year through entrepreneurial profits, employee income and municipal tax revenue (https://owr-eg.difu.de/rechner/).

Implementation period: from 2020

BH16_ Field of action: Buildings - refurbishment in the private and commercial sector / No. 5.2 Neighbourhood-specific refurbishment consulting - Permanent consulting service in changing neighbourhoods with a target group-specific approach (IKSK 2020)

Brief description:

Neighbourhood-based advice on energy-efficient building refurbishment is to be expanded. The positive experiences with increased refurbishment rates due to neighbourhood work in AC-Nord and AC-Haar are to be rolled out while simultaneously implementing a target group-optimised approach. To this end, an advice centre will be present in the neighbourhood for 2-3 years, after which it will be continued in the next neighbourhood.

An important component is the neighbourhood-specific analysis of the target group and the development of specific approach strategies and support services. An analysis (external commission) of the housing stock is being carried out with regard to

- Building types with high savings potential,
- Ownership structure,
- financial and socio-cultural characteristics of the owners,
- buildings of significance to the cityscape.

Building on this, spatially focused, specific approach strategies and accompanying support services are being developed for selected target groups (including housing associations) within the building owners in one neighbourhood per year (external commission).

First steps for action:

1. Recruitment of neighbourhood manager, office search (can also be in the district office), office costs and overheads €13,000, €13,000 for public relations work in the neighbourhood.
2. Application of a target group-specific approach strategy: Selection of a suitable neighbourhood for a starter project.
3. Development of the strategy and implementation of the approach in the neighbourhood.
4. Costs are neighbourhood analysis, development of the approach strategy, implementation; per neighbourhood 25.000 €

Target group:	Those responsible and those involved:
Private homeowners	altbau plus e.V., FB 36

Criteria:		Evaluation:
$CO_{2\ reduction}$	++	90 t/a Financial outlay
		51,000 € per year
Time expenditure (personnel)		1 MÄ
Regional added value	++	

Explanation of the evaluation criteria:

If around 50 refurbishments are achieved, around 90 tonnes of CO2eq/a can be saved

Implementation period: 2020 ff

BH17_ Field of action: Buildings - refurbishment in the private and commercial sector / No. 5.3 Advice on the use of renewable energy to heat buildings (IKSK 2020)

Brief description:

The main share of energy demand in households is in the area of heat supply. However, in addition to the use of energy-efficient technologies, increased promotion of the use of renewable energies in the heating sector is necessary. In the interests of decarbonising heat generation, more information on renewable heat must be included in the advice provided.

First steps for action:

Proactively integrate the use of renewable energy heating systems into ongoing advisory work.
Invite external speakers, obtain expertise for techniques that are not yet standardised. Obtain expertise for techniques that are not yet standardised, if necessary create information and argumentation material.

Target group:	**Those responsible and those involved:**
Private homeowners	altbau plus e.V., FB 36

Criteria:		**Evaluation:**
$CO2_{reduction}$	++	386 t/a
Financial outlay		10,000 € per year
Time expenditure (personnel)		
Regional added value	++	

Explanation of the evaluation criteria:

Replacing 100 heating systems with RE in the single-family home sector can save 386 tonnes per year.

Implementation period: from 2020

BH18_ Field of action: Buildings - refurbishment in the private and commercial sector / No. 5.4 Mobilisation of commercial property owners to take energy efficiency measures (IKSK 2020)

Note: Brief description in IKSK 2.0

Brief description:

Inform and sensitise owners of commercial properties. Commercial properties are often in a poor energy condition, as the buildings are not used by the owners themselves but are rented out. Institutions and networks that have access to the owners of commercial properties should be used for this measure to sensitise owners in addition to directly addressing them. Topics include the building envelope, building technology, PV systems, renewable heat, property protection due to climate adaptation.

One good reason to approach property owners is to inform them about their own property protection measures based on the heavy rain hazard map, which will be available in 2021.

First steps for action:

1. Coordination by the city. Economic development
2. Creation of information material to address business owners Specialist monitoring/support by altbau plus

Target group:	**Those responsible and those involved:**
Owners of commercial property	City of Aachen (36, 02), altbau plus, IHK, VUV

Criteria:		**Evaluation:**
$CO2_{reduction}$	+++	400 t/a
Financial outlay		15,000 € per year
Time required (personnel)		1 employee, as there has been no activity in this direction to date
Regional added value	++	

Explanation of the evaluation criteria:

Reaching around 50 companies could save around 400 tonnes of CO_2/a. 1 employee, as there has been no activity in this direction to date. 15,000 € for external expertise.

Implementation period: from 2021

BH19_ Field of action: Economy / No. 7.10 Ecoprofit (IKSK 2020)

Brief description:

A total of nine ÖKOPROFIT projects have been carried out in the Aachen region since 2001 as part of a co-operation between the city and city region of Aachen. A total of 97 companies, small and large, manufacturing companies and service providers, craft businesses and social institutions have successfully participated in the ÖKOPROFIT environmental management programme and achieved considerable savings:

- 12,436 tonnes of CO_2
- 52 million kWh of energy
- 211,000 cubic metres of water
- 6200 tonnes less waste

The tenth ÖKOPROFIT project in the Aachen region is due to start in 2020. There is close cooperation with FB 36, the cooperation partners and the city region to recruit companies. Targeted advertising at companies, support measures such as workshops, public relations, etc. are being organised.

First steps for action:

Target group:

The company

Responsible and involved parties:

FB 02

Criteria:		**Rating:**
$CO_{2\ reduction}$	+++	1200 t/a (planned in the budget)
Financial expenditure		
Time expenditure (personnel)		
Regional added value	+	

Explanation of the evaluation criteria: The $CO_{2\ reduction\ is}$ based on the evaluation of implemented Ökoprofit projects (since 2001)

Implementation period: 2020 - 2022

BH20_ Economy/ 5.2.1.1. "Sustainable and efficient economy" funding programme (IKSK 2.0)

Thematic focus	Introduction	Development of effect	Sphere of influence
Economic promotion and location development	2024	Short to medium term	Advise and motivate

Goal and strategy

The "Sustainable and efficient economy" programme promotes consulting services and investments in the areas of sustainable economy, energy and material efficiency as well as renewable energy generation plants. The aims of the programme include increasing energy and material efficiency, expanding renewable energies and generally securing the future of Aachen companies.

Initial situation

A wide range of advisory services for companies are already being implemented in the StädteRegion Aachen. The "Sustainable and efficient economy" funding programme aims to focus even more strongly on climate neutrality and sustainability.

Description of the

With the "Sustainable and Efficient Economy" funding programme, the City of Aachen ensures access to advice and funding with short processing times, simple and uncomplicated application procedures and incentives for short-term and immediately effective measures. The topics are deliberately broadly selected in order to take into account the individual needs of Aachen's diverse economic landscape. An attractive funding rate is intended to incentivise investment.

First steps for action

- Establish a funding programme for consulting and investment in the areas of sustainable business, energy and material efficiency and renewable energies.
- Establish criteria for the award. The criteria are feasibility, effectiveness, financial viability, innovation, implementation period and sustainability.

Target group

The company

Time required	Duration of the activity
1 full-time equivalent	3 years
Material costs	**Financing approach**
300.000 € (100.000 €/a)	Budget funds

GHG savings

Savings through consulting and innovation support

Reduction in the annual level of emissions (t/a):	Cumulative GHG savings (tonnes):
3,000 tonnes CO2eq/a	6,100 tonnes CO2eq/

Synergy effects	Conflicting goals
1.1.2.2 Introduction of climate funds: through the combination of subsidies	-

Success indicators/milestones

Number of consultations
Investments realised

BH21 Field of action: Buildings - refurbishment in the private and commercial sector / No. 5.5 Resource-saving refurbishment of existing buildings

Brief description:

In future, the topic of "grey energy" should be given greater consideration when advising on energy-efficient refurbishment, as every construction activity has a negative impact on the climate. The expertise for this must be built up among the consultants.

The aim is to inform those wishing to build that, wherever possible, only materials characterised by economical use of materials and resources will be used in future.

First steps for action:

1. Further training for employees;
2. Creation of a material and technology catalogue;
3. Creation of a counselling guideline

Target group:	**Those responsible and those involved:**
private homeowners	old building plus

Criteria:		**Evaluation:**
$CO_{2\ reduction}$	+	18 t/a Financial
outlay		47,000 € per year
Time expenditure (personnel)		0.5 MÄ
Regional added value	+	

Explanation of the evaluation criteria:

Additional savings of approx. 20 % $_{CO2}$ for each refurbishment. With 10 % of the targeted refurbishments, this is 20 % of 90 tonnes.

Implementation period: from 2021

3.2.3 Power generation, waste and AFOLU - Forestry, agriculture and land use

Power generation

In terms of electricity generation, climate-neutral generation from solar energy and wind power is essential to achieve the goal of climate neutrality. Nevertheless, it is not to be expected that the entire electricity required in the city will be generated by the city's own operations. It is assumed that the proportion of electricity generated from non-renewable sources will be 20 % in 2030.

The evaluation using the Economic Model tool has shown that 515 kt CO2e of the 644 kt CO2e in 2021 will be saved in the electricity sector by 2030, which corresponds to a reduction of 80 %.

The core measures from the IKSK 2020 and IKSK 2.0 are listed in Table AP17.

Measures from the urban society

Of the 134 co-signatories of the Aachen Climate City Contract, 26 have made a PREMIUM commitment, i.e. they are also aiming for climate neutrality in electricity consumption by 2030. Of the 57 FRAMEWORK partners, 30 have specified measures for electricity consumption, of which 17 want to purchase green electricity and 19 want to install a PV system (see Appendix 1). This lays the foundation for reducing emissions. The Eco Fund of the Department of Economic Development offers further advice and incentives.

Waste

The limits of resource consumption have already been reached in many cases in view of the ecological limits. Sustainable production and consumption patterns must therefore be promoted and the demand for resources reduced. In Aachen, the growth in consumption is therefore to be decoupled from the consumption of non-renewable raw materials by establishing a consistent circular economy. In particular, the aim is to establish and expand the circular economy in industry - especially in the construction sector - and the tertiary sector.

The evaluation using the Economic Model tool has shown that 8 kt CO2e of the 15 kt CO2e in 2021 will be saved in waste by 2030, which corresponds to a reduction of 80 %. The reduction is due to an increase in the recycling rate.

The core measures from the IKSK 2020 and IKSK 2.0 are listed in Table AP-18.

Measures from the urban society

With the implementation of the pilot project CoLAB "Committed to Local Climate Action Building", an agency for climate, energy, circular economy and sustainability will be founded for the citizens of Aachen, which will also offer a wide range of advisory services on recycling and waste separation. The aim is to permanently reduce the volume of waste in Aachen.

AFOLU - Forestry, agriculture and land use

Of the approx. 15 hectares of permanent crops in Aachen's urban area, around 26 % is urban forest and only 2,407 hectares is arable land. According to the Tühnen Institute standard, this results in annual emissions in the AFOLU area of approx. 29 kt CO e.$_2$

The evaluation using the Economic Model tool has shown that 23 kt CO2e of the 29 kt CO2e in 2021 will be saved by 2030, which corresponds to a reduction of 80 %.

The core measures from the IKSK 2020 and IKSK 2.0 in the municipal administration's agriculture sector are listed in Table AP-19.

Measures from the urban society

In addition to the activities of the existing "Agriculture and Food Round Table" format, further measures to reduce emissions will be developed with the Aachen District Farmers' Association. A letter of support from the Kreisbauernschaft Aachen for the Climate City Contract is enclosed. (see Commitments Appendix 1: Sign).

Note AP-17: Core measures in the city administration's electricity generation sector, including effects on the subsectors of the economic model

Table AP- 17 Core measures - electricity generation sector

Measure		IKSK 2020	IKSK 2.0	E1
Code	Title			
EE 01	PV systems on municipal buildings for own use of electricity	x	x	
EE 02	Expansion of solar energy use, establishment of a support programme	x		
EE 03	Ground-mounted PV systems	x	x	
EE 04	Secure and expand renewable share from wind energy	x	x	
Reduction in 2030 (ktCO2e/a)				515

E1: Decarbonising electricity generation

Note AP-18: Core measures in the area of municipal waste management, including effects on the sub-sector of the economic model

Table AP- 18 Core measures - of municipal waste management

Measure		IKSK 2020	IKSK 2.0	W1
Code	Title			
W 01	Sustainability competition for schools and daycare centres to reduce waste	x		
W 02	Ökoprofit environmental management programme for companies	x		
W 03	Building yard of the future for Aachen's municipal services		x	
W 04	Component and resource warehouse		x	
W 05	Agency for Climate, Energy, Circular Economy and Sustainability		x	
Reduction by 2030 (ktCO2e/a)				8

W1: Increased waste recycling

Note AP-19: Core measures in the area of AFOLU by the city administration and stakeholders

Table AP- 19 Core measures - AFOLU

Measure		IKSK 2020	IKSK 2.0
Code	Title		
A 01	Lease agreements of the city of Aachen are used to strengthen organic farming		x
A 02	Pilot projects in agroforestry		x
A 03	Continuation of the "Sustainable Agriculture and Food" Round Table		x
Reduction in 2030 (ktCO2e/a)		**23**	

3.2.3.1 Brief profiles of the core measures in the areas of electricity generation (EE), waste (W) and AFOLU (A) from the municipal administration from the IKSK 2020 and IKSK 2.0

EE01-05 Core measures in the city administration's energy supply from IKSK 2020 and IKSK 2.0

EE01_Field of action: Municipal buildings / No. 2.7. PV systems on municipal buildings for own use of electricity (IKSK 2020)

Note: also addressed in IKSK 2.0 but without any details

Brief description:

PV systems are to be installed with immediate effect in all new municipal buildings and major renovations (especially roof refurbishments). The summer electricity load will be used as the basis for determining own requirements.

A fundamental investigation is being carried out with the aim of 100% PV on municipal buildings in order to cover the entire municipal electricity demand of 20 GWh. To this end, a model for the local grid feed-in of renewable energies from municipal systems (distribution via regional direct marketing) will be developed in the short term with the grid operator Regionetz and STAWAG. Energy consumption is to be offset across all buildings.
PV systems with an area of 138,000 m² and an output of 20,000 kWp are required to cover the city's electricity needs (costs €1,300/kWp + €200/kWp ancillary costs = €30 million), spread over 10 years, i.e. 10,000 kWp in 5 years.

First steps for action:

PV systems as part of a refurbishment on the buildings: Einhard-Gymnasium (2019 f), Hander Weg (2020), Inda-Gymnasium (2021 ff)

New buildings 2020-2022: Reimser Strasse and Kaiserstrasse primary schools, Kollenbruch and Stettiner Strasse daycare centres Installation of a 9.9 kWp system in 2020 (costs EUR 17,000)

Target group:		**Those responsible and those involved:**
City AC		E 26
Criteria:		**Evaluation:**
$CO_{2\,reduction}$	++	982 t/a
Financial outlay		City costs: € 3,000,000 per year (PV systems are economical)
Time expenditure (personnel)		2 MÄ
Regional added value	++	

Explanation of the evaluation criteria:

The emission factor is currently 554 g/kWh. If the emission factor of PV electricity is deducted, the emission factor of municipal electricity procurement is 491 g/kWh.

With electricity generation of 900 kWh/kWp, → 20,000 kWp are required to cover the city's entire electricity demand. The generation of 20 GWh of PV electricity saves a total of 9.82 million kg of CO_2. Spread over 10 years, this means savings of just under 4,910 tonnes and 982 tonnes per year by 2025.

Implementation period: 2020 - 2025

EE02_ Field of action: Energy supply, renewable energies / No. 3.1 Expansion of private solar energy use, launch of a subsidy programme (IKSK 2020)

Brief description:

The expansion of the use of solar energy is a central pillar of this climate protection concept. As early as 2011, the city of Aachen created a solar roof register and identified enormous potential for solar installations. The cadastre was published and the topic was promoted by writing to owners of large suitable roof areas, among others. However, the framework conditions of the EEG have led to a slump in the construction of systems.

In order to achieve the climate protection target, suitable existing roof surfaces must be mobilised for energy generation, either via PV or solar thermal systems. Following the great success of the 1000 Roofs Programme in the district of Düren and based on the experience with the funding for private systems offered by STAWAG until the end of 2018, a new funding programme is the central component of this measure.

First steps for action:

1. Concept for the further utilisation of PV systems that are no longer eligible for EEG remuneration.
2. Subsidy programme, promotion of PV systems, approx. 10% subsidy rate, review of Model 1000 roofs in the district of Düren and relief for balcony systems.
3. Continuation of the STAWAG subsidy for solar thermal energy and applications to tap this potential (discontinued on 1 April 2020)
4. Campaign, stakeholder network and cooperation see HF Communication

Target group:	**Those responsible and those involved:**
Private and commercial rooftop owners	City, STAWAG, altbau plus

Criteria:		**Evaluation:**
$CO_{2\ reduction}$	+++	6,540 t/a
Financial expenditure		City material costs: € 1,900,000 per year
Time expenditure (personnel)		1 MÄ
Regional added value	++	19 million in investments are made annually solves

Explanation of the evaluation criteria:

Reduction potential to be tapped by 2030: 60,700 tonnes of $_{CO2}$ and 123.6 GWh of PV electricity. Per year 6070 t/a (municipal costs only 10 % subsidy share)

Through continuation and more advertising for solar thermal promotion (cf. HF communication) 470 t/a

Implementation period: 2020 - 2025

EE03_ Energy supply / 2.1.2.1Ground-mounted PV systems on urban areas (IKSK 2.0)

Note: also addressed in IKSK 2020

Thematic focus	Introduction	Development of effect	Sphere of influence
City as a role model: energy supply and generation	2024	Medium and long term	Care/ role model

Goal and strategy

With the help of this activity, the realisation of ground-mounted PV systems is to be specifically promoted on areas owned by the City of Aachen in order to contribute to increasing the existing potential in the sense of setting an example.

Initial situation

The City of Aachen is active in the field of open-space PV planning and has already included a corresponding activity in the ICSK of 2020 to examine the potential identified from the "render" project with regard to legal implementation options and the use of buildable areas.

Description of the

Building on the potential study and the requirements of the IKSK from 2020, the expansion of photovoltaic systems on open urban spaces must be successively promoted and the potential identified and developed. In doing so, it is important to take into account areas within and outside the EEG area framework. For the above-mentioned areas along motorways and railway lines, the city's own share must be determined and updated in accordance with the currently valid distance regulations. Suitable municipal areas for car parks and agricultural PV should also be identified and equipped with PV systems. However, the focus should initially be on open spaces in privileged areas along infrastructure routes, as no active urban land-use planning is required for these, meaning that open-space systems can be realised more quickly.

With this activity, the city of Aachen would not only contribute to the expansion of renewable energies, but also act as a role model for private property owners, among others. In addition, the City of Aachen could also campaign for better energy industry framework conditions at federal level in order to simplify and thus accelerate the expansion of renewable energies in the city.

First steps for action

- Updating and expanding the potential already identified (e.g. current distance calculations)
- Identification of potential areas owned by the City of Aachen
- Identification of support requirements and clarification of plant manufacturers (e.g. STAWAG)
- Talks with the federal motorway and railway on specific areas
- Creation of area-related PV concepts

Target group

Municipal family City of Aachen

Time required	Duration of the activity
0.5 full-time equivalents	2024 - 2025

Material costs	Financing approach
40.000 € for area analysis and conceptual design plus investment funds for the construction of the PV systems	Budget funds, subsidies

GHG savings

Preliminary assumption, as area screening is still pending:
Quantification in line with the previous target of 32 GWh/a by 2030, of which 5 % will be installed on municipally owned land

Reduction of the annual emissions level (t/a):	Cumulative GHG savings (tonnes):
500 tonnes CO2eq/a	1,650 tonnes CO2eq (by 2030)

Synergy effects

2.2.1.1 Masterplan - integrated, comprehensive energy planning
2.3.1.1 Energy in the hands of citizens
2.3.4.1 Concept development: Determination and utilisation of PV open space potentials

Conflicting goals

Shortage of skilled labour, competing uses (e.g. solar thermal energy, agriculture), nature conservation concerns

Success indicators/milestones

Successful agreements and plans for land utilisation, PV concepts created, installed PV power

EE04_Energy supply / 2.3.3.1 Solar offensive on all suitable roof surfaces (IKSK 2.0)

Note: also addressed in IKSK 2020

Thematic focus	Introduction	Development of effect	Sphere of influence
Local and renewable electricity	2024	Short term	Advise/ motivate

Goal and strategy

With the help of advisory services, building owners are to be supported in the realisation of PV systems on roof surfaces.

Initial situation

The city of Aachen has been running a funding programme for solar energy systems since 2020. The city's website (www.aachen.de/solar) provides information on the funding programme, including the funds available and general information on the topic of solar energy. By May 2023, almost 1,800 solar installations had been subsidised since the start of the funding programme in September 2020, with a funding volume of €1.6 million in 2023 alone.

Description of the

In order to promote the expansion of PV systems on roof surfaces, an activation campaign should be designed and implemented in addition to the funding. In addition to purely providing information, this should also include a target group-specific advisory programme for residential and non-residential buildings. Another component is a separate funding programme for preparatory investigations, for example in the area of structural analysis of buildings. Obstacles should be minimised at an early stage in order to accelerate and successively drive forward the expansion of PV.

First steps for action

- Identification of specific counselling needs and requirements for additional support
- Conception of the support services
- High-profile application
- Realisation of consultations and distribution of subsidies
- Evaluation and, if necessary, adaptation of the offers

Target group

Building owners of residential and non-residential buildings

Time required

1 full-time equivalent

Duration of the activity

2024 - 2026

Material costs

300.000 € (150.000 €/a)
for subsidising consultant costs and promoting e.g. structural analyses

Financing approach

Budget funds

GHG savings

Savings result from the realisation of the systems
Assumptions: Funding of 750 systems per year for the next 3 years (2026) with an average capacity of 16 kWp

W01-05 Core measures in the city administration's waste management from IKSK 2020 and IKSK 2.0

W01_ Field of action: Communication, cooperation, participation / No. 6.2 Sustainability competition for schools and daycare centres (IKSK 2020)

Brief description:

Development and organisation of a competition that creates incentives and rewards activities or projects in climate protection and sustainability. Activities in the areas of mobility, waste, energy saving, solar energy, consumption/purchasing, nutrition, green/trees, climate adaptation, integration/living together, One World are all conceivable. Good ideas and activities are honoured, e.g. financially or materially. Personnel support is also conceivable.

First steps for action:

1. Concept for preparatory information work at schools, organisation of workshops and other offers (external contract, € 20,000 from foundation funds are available)
2. Preparation of a competition
3. Realisation / evaluation (ext. order)

Target group:

Schools, daycare centres

Those responsible and those involved:

FB 36, E 26, FB 45

Criteria:		**Evaluation:**
$CO_{2\ reduction}$	+	cf. measure no. 2.2
Financial expenditure		20,000 € (see below)
Time expenditure (personnel)		
Regional added value		

Explanation of the valuation:

cf. measure no. 2.2, reintroduction of a bonus system, possibly financed by foundation funds

Implementation period: from 2020

W02_Field of action: Economy / No. 7.10 Ecoprofit (IKSK 2020)

Brief description:

A total of nine ÖKOPROFIT projects have been carried out in the Aachen region since 2001 as part of a co-operation between the city and city region of Aachen. A total of 97 companies, small and large, manufacturing companies and service providers, craft businesses and social institutions have successfully participated in the ÖKOPROFIT environmental management programme and achieved considerable savings:

- 12,436 tonnes of $_{CO2}$
- 52 million kWh of energy
- 211,000 cubic metres of water
- 6200 tonnes less waste

The tenth ÖKOPROFIT project in the Aachen region is due to start in 2020. There is close cooperation with FB 36, the cooperation partners and the city region to recruit companies. Targeted advertising at companies, support measures such as workshops, public relations, etc. are being organised.

First steps for action:

Target group:

The company

Responsible and involved parties:

FB 02

Criteria:		**Rating:**
$CO_{2\ reduction}$	+++	1200 t/a (planned in the budget)
Financial expenditure		
Time expenditure (personnel)		
Regional added value	+	

Explanation of the evaluation criteria: The $CO_{2\ reduction}$ is based on the evaluation of implemented Ökoprofit projects (since 2001)

Implementation period: 2020 - 2022

W03_Economy / 5.5.1.1 Circular economy in practice: developing a building yard of the future for Aachen's municipal services (IKSK 2.0)

Thematic focus	Introduction	Development of effect	Sphere of influence
Waste and circular economy	n.a.	Medium-term	Consume

Goal and strategy

Large quantities of greenhouse gases are used for the production of building materials (grey energy). The recycling of building materials is therefore an important contribution to the conservation of resources and the reduction of greenhouse gases that would otherwise be generated by the production of new building materials. The aim of the activity is to create the framework conditions for an improved circular economy in Aachen. In particular, this includes saving grey energy, reducing transport energy and conserving resources by reusing components and/or using/producing secondary materials such as recycled aggregate for R-concrete.

Initial situation

Aachener Stadtbetrieb is an in-house organisation of the City of Aachen that bundles central services. These include, for example, green space maintenance and waste disposal. In this context, the municipal company operates two recycling centres.

Description of the

The specific aim is to develop a "building yard of the future". Aachen's municipal services are aiming for centralisation at the Madrider Ring/Freunder Weg sites. The Freunder Weg property is being redesigned and developed into the "building yard of the future". The aim is to create a sustainable and climate-neutral site, taking into account a modern and flexible working environment, occupational health and safety, resource recycling management and the redevelopment of the neighbouring "Rothe Erde" industrial estate (Continental's departure). An initial cost estimate of around 15 million euros is available for the project, although this is still subject to uncertainties.

First steps for action

- Ongoing planning and feasibility checks

Target group

Building trade, building materials industry

Time required

3 full-time equivalents

Duration of the activity

k. A.

Material costs

The necessary investment and planning costs are taken into account in the budget of Aachener Stadtbetrieb

Financing approach

k. A.

GHG savings

Not quantifiable

Synergy effects

5.5.5.1. Component and resource warehouse
5.5.5.2. Circular economy in the construction industry

Conflicting goals

5.5.5.3. Develop criteria for a climate-neutral construction site

The preservation of building fabric binds grey energy and contributes to the conservation of resources

W04_Economy / 5.5.5.1 Component and resource warehouse (IKSK 2.0)

Thematic focus	Introduction	Development of effect	Sphere of influence
Waste and recycling management	2024	Short term	Consume

Goal and strategy

Produce, use and throw away describes the linear logic that still largely prevails in the construction industry. The recycling of building materials breaks through this logic and opens up potential for saving resources. In order to be able to utilise the potential for recycling in the future and also achieve positive regional employment effects, it is recommended that the development of a recycling infrastructure be initiated.

Initial situation

The "Bauteilnetz Deutschland" can serve as a model: The initiative is supported by the non-profit organisation Bauteilnetz Deutschland e.V. and aims to establish a nationwide cooperative network for the reuse of well-preserved, used components. This is linked to positive employment effects through the establishment of component exchanges. They take over the removal of components, refurbish them and store them until they can be resold. Resale is promoted via a central internet platform.

Description of the

A component and resource warehouse is to be developed and set up in Aachen. The aim of the component and resource warehouse is to save grey energy by reusing building materials, for example. The component and resource warehouse enables the reuse or recycling of building materials on the construction site for new construction projects or the refurbishment of existing buildings. It handles the inventory of building materials, (online) brokerage, the removal of building materials in demand, temporary storage, sale and removal. It also provides services and qualifications for reuse for the construction industry and private construction companies.

First steps for action

- Development of a concept
- Examination of the location issue
- Implementation

Target group

Construction industry, private households

Time required

1 full-time equivalent

Duration of the activity

2 years

Material costs

100,000 € for concept development

Financing approach

Budget funds

GHG savings

Not quantifiable, as outside the current balance sheet limits.

Synergy effects

in particular with 5.5.1.1. Circular economy in practice: developing a building yard of the future for Aachen's municipal services

Conflicting goals

None, conserves resources through reuse

Success indicators/milestones

Successful concept development and clarification of the location issue, realisation of the concept

W05_Governance / 1.1.3.3 Agency for Climate, Energy and Sustainability (IKSK 2.0)

Thematic focus	Introduction	Development of effect	Sphere of influence
City as a role model	2024	Short to medium term	Motivating and advising

Goal and strategy

Building on the "Climate-neutral Aachen 2030" office, which supports the implementation of the EU mission plan across departments by addressing and involving external stakeholders, the agency for climate, energy and sustainability to be established will fulfil the role of ambassador and mediator between various initiatives and stakeholder groups. The aim is to provide a place for enablers and users from urban society where holistic solutions to problems can be developed. The CoLab pilot project will serve as a testing ground for the agency.

Initial situation

The Agency for Climate, Energy and Sustainability is initially founded from the "Climate Neutral Aachen 2030" office.

Description of the

The Agency for Climate Protection orients itself in the elaboration of its strategies and coordinates its activities with the findings from the participation processes in the partner cities of Mannheim and Münster. It creates suitable formats to accelerate processes initiated by the urban community, including evaluation and monitoring mechanisms.

First steps for action

- Foundation of the Agency for Climate, Energy and Sustainability
- Collaborative development of participation formats based on the CoLab project
- Development of evaluation and monitoring mechanisms for the participation formats

Target group

Urban society, economic players

Time required	Duration of the activity
3 Full-time equivalents	2024 - 2030

Material costs	Financing approach
-	Promotion with EU funds

GHG savings

Not quantifiable, as it depends on the type and scope of the measures managed by the agency.

Synergy effects	Conflicting goals
Various activities in all fields of action	-

Success indicators/milestones

Foundation of the Agency for Climate, Energy and Sustainability

A01-03 Core measures in the city administration's agriculture from IKSK 2020 and IKSK 2.0

A01_ Economy / 5.6.2.1 Lease agreements of the city of Aachen are used to strengthen organic farming (IKSK 2.0)

Thematic focus	Introduction	Development of effect	Sphere of influence
Agriculture, food industry and regional trade structures	2024	Medium-term	Regulate

Goal and strategy

The City of Aachen uses its role as landlord to initiate criteria, support services and an implementation framework for the long-term ecological management of urban agricultural land in cooperation with farmers and associations. In addition, the adaptation of multiple land use with Agri-PV, climate impact adaptation, regional marketing concepts as well as evaluation and follow-up mechanisms are to be initiated.

Initial situation

The lease agreements that the City of Aachen has concluded for its land have different terms, so the activity can only be implemented gradually and over an extended period up to 2035. The basis for successfully strengthening organic farming is legal certainty in future lease agreements. In addition to pure agricultural use, dual use should also be considered, e.g. in combination with agri-PV or agroforestry. A guideline for implementation in lease agreements may be necessary here.

Description of the

The city of Aachen is developing criteria and the legal basis for anchoring organic farming on city-owned land in lease agreements. This also includes a regulation for the five-year transition period until the areas in transition are certified, during which the yield cannot yet be sold as organic and therefore often represents a loss for the farmers. In order to utilise particularly productive land primarily for food production, it is advisable to consider not only land values but also, for example, applications for direct payments under the CAP.

First steps for action

- Development of criteria that tenants must fulfil in addition to organic farming methods (e.g. social sustainability, use of seed-resistant varieties)
- Creation of a guideline to be able to consider dual utilisation through agro-PV and agroforestry in lease agreements
- Preparation of a timetable for expiring leases

Target group

Tenants of the city of Aachen,

Time required	Duration of the activity
0.25 full-time equivalents	2024 - 2035

Material costs	Financing approach
None expected	-

GHG savings

Can only be quantified to a limited extent, as it depends on the size of the area and crops. Assumption: The conversion of leased land to organic farming eliminates emissions from nitrogen fertiliser. A penetration rate of 50 % is achieved by 2035.

Reduction in the annual level of emissions (t/a):	Cumulative GHG savings (tonnes):
Average of 18 tonnes per year with increasing penetration rate by 2030 (25 %)	Approx. 400 tonnes by 2035.

Synergy effects	Conflicting goals
5.6.1.1 Regional BioHub - Sustainable food production and distribution	Land conflicts with other forms of use such as open-space PV, tenants for e.g. horse farming

Success indicators/milestones

Adaptation and awarding of the first leases according to organic cultivation criteria

A02_ Economy / 5.6.2.2 Pilot project in agroforestry (IKSK 20)

Thematic focus	Introduction	Development of effect	Sphere of influence
Agriculture, food industry and regional trade structures	2024	Medium to long term	Advise and motivate

Goal and strategy

As a pilot project, the city of Aachen is supporting the establishment and expansion of agrofrost systems on city-owned land in order to strengthen the green infrastructure and create natural CO2 reservoirs and habitats.

Agroforestry systems are relatively uncommon in Germany, but by combining woody plants with arable crops, livestock or horticultural crops, they offer advantages for the preservation of biodiversity, water and nutrient supply and the landscape. The agroforestry systems are adapted to the respective agricultural production technology in order to enable economically competitive production. Agroforestry systems are particularly suitable for increasing yields as well as protecting animals and preventing erosion on areas where livestock is kept or for shading larger areas that are prone to drought. Valuable and fruit trees in particular serve as natural CO2 reservoirs in the medium to long term, while shrubs and hedgerows can be used regularly for biogas production. As agroforestry systems entail higher establishment and operating costs and can limit the operational flexibility of the land[6], the leased land of the city of Aachen, which is mainly used for livestock farming, should be considered for agroforestry systems where appropriate.

Initial situation

The basis for the expansion of agroforestry systems is the provision of information and advice to farmers and tenants on the advantages and disadvantages of the system, planning security with regard to municipal lease agreements and a review of the city of Aachen's landscape plan, which is currently under revision, with regard to the possible dual use of land.

Description of the

In cooperation with the Chamber of Agriculture of North Rhine-Westphalia, the City of Aachen organises information and advisory services for farmers and land leaseholders in the city of Aachen on the topic of agroforestry systems and includes the topic in its funding advice. The city is also examining the extent to which the implementation of agroforestry systems on city-owned land can be included in new lease agreements. This will start with a smaller pilot area (approx. 2-5 ha) and will be continuously monitored (e.g. biodiversity, groundwater enrichment, biomass growth).

First steps for action

- Research and acquisition of funding
- Organisation of information events and consultation contingents
- Comparison of the new landscape plan with regard to possible dual use of areas
- Examination of the extent to which lease agreements for urban agricultural land can be adapted in future

Target group

Farmers in the Aachen urban area

Time required	Duration of the activity
0.5 full-time equivalents	2024 -2026

[6] Federal Information Centre for Agriculture, 2023. carbon sinks in agriculture. Agroforestry - ecologically and economically promising. [online] Available at: https://www.praxis-agrar.de/pflanze/ackerbau/agroforstwirtschaft (Last accessed: 25 October 2023, 13:20).

Material costs	Financing approach
Consultancy costs approx. 5,000 €/a, if applicable	Possible federal funding (announcement 13.01.2021)

GHG savings

Not quantifiable, as it depends on the age and health of the trees and the type of utilisation (e.g. hedgerows for bioenergy production)

Synergy effects	Conflicting goals
5.6.2.1 Lease agreements of the City of Aachen are used to strengthen organic farming	Flexible use of space is restricted

Success indicators/milestones

Full use of the counselling services

A03_Brief description 5.6.2.4 Continuation of the "Sustainable Agriculture and Food" Round Table (IKSK 2.0)

The Round Table, which has already been established, is able to bring together the various activities in the areas of agriculture and nutrition, provide new impetus and prepare suitable measures. Many of the issues addressed by the Round Table have a direct impact on nutritional behaviour and indirectly on climate neutrality. Last but not least, the cultivation of the fields has a major influence here.

3.2.4 Visualisation of the results of the economic model for the reduction of GHG emissions in 2030

The reduction potential of the action plans from the IKSK 2020, the IKSK 2.0 and other concepts such as the transport development plan were quantified using the economic model. The base year was 2021 with 1,577,000 t CO2eq. In 2030, 80 % of these emissions will have been reduced and unavoidable residual emissions of 313,000 tonnes of CO_2 eq will remain. Figure AP-20 visualises the emission reductions in % in the transport, buildings and heating, electricity, waste/wastewater and residual (incl. IPPU and AFOLU) sectors from 2021 to 2030.

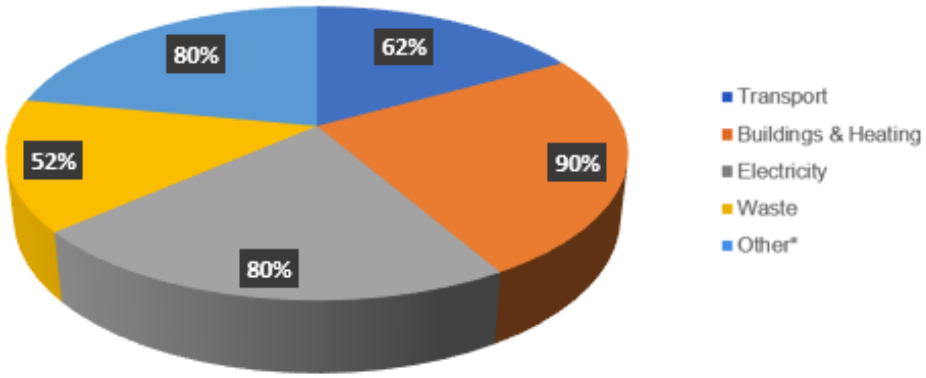

Figure AP- 20 Reduction of CO_2 emissions in 2021 in 2030 in percent per sector

The following figure visualises the percentage shares of the individual sectors in residual emissions of 313.000 t CO_2eq in 2030.

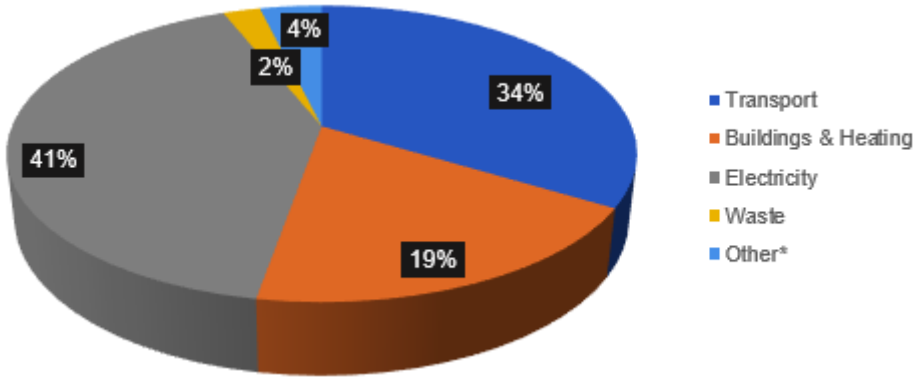

Figure AP- 21 Percentage distribution of unavoidable residual emissions in 2030

Note: Percentage distribution of unavoidable residual emissions in 2030 totalling 313,000 t CO_2 eq across the transport, buildings and heating, electricity, waste/wastewater and residual (incl. IPPU and AFOLU) sectors.

3.2.5 Effects of the co-signatories' commitments on the path to climate neutrality

Chapter 5 of the commitment shows that 26 of the 134 commitment donors have concluded a PREMIUM partnership. This means that they have committed themselves to achieving net zero by 2030 or 2025 with their company/institution or as an individual. 56 co-signatories have signed a commitment for a FRAMEWORK partnership. This means that they will implement individual measures with an effect on greenhouse gas emissions. As the commitments are quite heterogeneous and in some cases still somewhat unspecific, it was not possible to quantify the effects on climate neutrality at this stage.

The commitments from the FRAME area were assigned to the categories of the economic model. This is intended to visualise the relevant sectors in which the measures of the FRAME partners are located. See Appendix 1 of the Action Plan for the table.

The 56 FRAMEWORK partners submitted a total of 192 individual measures as their contribution to achieving climate neutrality.

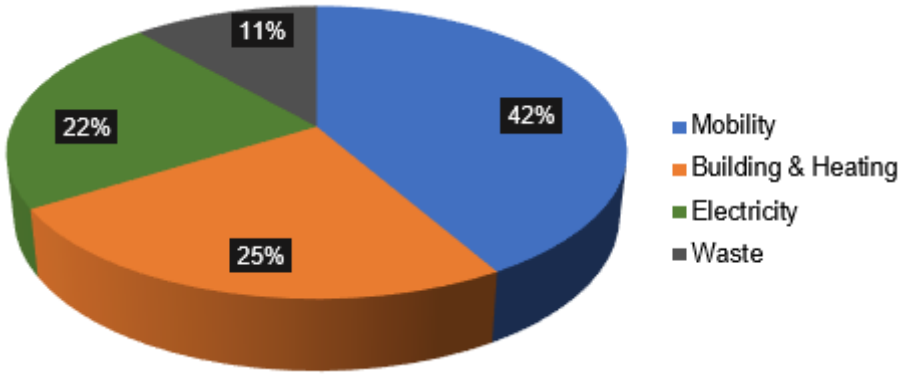

Figure AP- 22 Distribution of the 192 measures of the FRAMEWORK partners

Description: Distribution of the 192 measures of the FRAME partners across the sectors: mobility, buildings & heating, electricity and waste.

A more detailed breakdown by sub-sector of the economic model shows that the most common measures are as follows:

- Climate-neutral electricity, mostly from our own PV systems (43)
- Electrification of the vehicle fleet (31)
- Strengthening public transport and cycling (30)

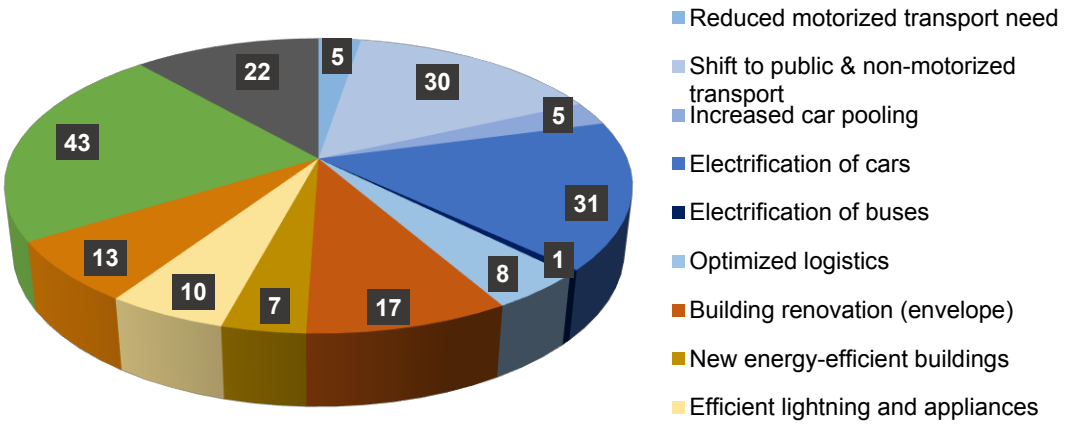

Figure AP- 23 Analysis of the 192 individual measures of the FRAMEWORK partners

Description: Analysis of the 192 individual measures of the FRAMEWORK partners by sub-sector of the economic model.

The high proportion of measures in the mobility sector is a promising signal that the mobility turnaround in Aachen can succeed. The same applies to the generation and purchase of climate-neutral electricity. The city administration will pull out all the stops to massively increase the number of measures from urban society in all sectors.

3.2.6 (B-2.3) Summary strategy for residual emissions

The top priority for the City of Aachen is to reduce greenhouse gas emissions as much as possible by 2030 by increasing the principles of efficiency, consistency and sufficiency. Nevertheless, certain emissions in the

individual fields of action remain unavoidable. The result of the economic model indicates which residual emissions in the individual sectors are likely to be unavoidable in 2030.

In total, this amounts to 313,000 tonnes of CO_2eq, which are distributed as follows:

i) Energy/heat sector - 189,000 tonnes of CO_2eq

The generation of CO_2 is to be largely avoided through decarbonisation in the energy and heating sector. However, there are processes, e.g. in industry, where the generation of CO_2 cannot be avoided in the future either. There are also areas of the heating supply that are technically challenging to convert to CO_2-neutral technologies, such as existing properties in the city centre that are currently supplied with heat based on natural gas.

ii) Mobility sector - 106,000 tonnes of CO_2eq

Mobility is a sector that the urban family can only influence to a very limited extent. The mobility transition must be largely supported by citizens. It is therefore assumed that a maximum of 62% of the emissions of the base year 2021 can be reduced in this sector by 2030.

iii) Waste sector - 7,000 tonnes of CO_2eq

With a share of less than 1%, the waste/wastewater sector already accounts for a very small proportion of the city's greenhouse gas emissions. The transport of waste to the waste incineration plant in Weißweiler will not be completely avoidable in 2030 either, meaning that Scope 3 emissions will remain here.

iv) Industrial processes and agriculture sector - 12,000 tonnes of CO_2eq

In the agricultural sector, residual emissions will be unavoidable in 2030.

In total, this results in unavoidable residual emissions of 313,000 tonnes of CO_2eq in the city of Aachen in 2030.

Evaluation of natural sinks for binding the unavoidable residual emissions of Aachen in 2030

Aachen's urban area covers 16,085 hectares of land. The following table shows the natural sinks in Aachen's urban area by type of use, area in ha, area in % of Aachen's total area and the amount of bound CO_2 in tonnes per year (as at 31 December 2020, source: Statistical Yearbook 2020/21 of the City of Aachen, statistisches_jahrbuch_2020-2021.pdf):

Table AP- 20 Characterisation of the natural sinks in Aachen's urban area

Type of utilisation	Area in ha	Area in %	CO_2 -binding/year
Forest	3.020	18,78	33.220 t
Wood[1]	244	1,52	2.440 t
Heath[1]	2	0,10	20 t
Swamp	2	0,10	0 t
Green spaces in housing estates *1	552	3,43	3.680 t
Green space in cemeteries[1] **	73	0,91	365 t
total	3.893	24,83	39.725 t

* 2/3 permanent planting, **: 1/2 permanent planting,[1] Assumption: binding of 10 tonnes/ha

Note: including calculation of the CO_2 binding capacity per year.

This results in an annual sequestration of approx. 40,000 tonnes of CO_2 per year through all the permanently existing vegetation in Aachen's urban area, i.e. the existing natural sinks. An expansion of the urban green spaces is only planned to a very limited extent in the Landscape Plan 2030 or is even still possible.

Conclusion: Natural sinks will only be able to bind around 12.8 % of residual emissions in 2030.

Evaluation of technical solutions to capture and bind Aachen's unavoidable residual emissions in 2030

Decentralised CO_2 capture from the atmosphere, independent of CO_2 point sources, is known as direct air capture (DAC). However, DAC systems require large amounts of energy, are cost-intensive and are therefore not suitable for municipal applications.

When it comes to technologies for the direct capture of CO_2 from process gases, post-combustion carbon capture (PCCC) is currently of interest for municipal use. PCCC technologies can be retrofitted relatively easily and quickly to existing plants, including those under municipal responsibility. Their use is particularly useful for larger CO_2 point sources, such as existing CHP plants in urban areas.

Carbon capture and storage (CCS): There are currently no concrete plans for the storage of captured CO_2 in the city of Aachen. However, there are already some storage options across Europe. The development of a CO_2 transport infrastructure, particularly in the Rhine-Ruhr region, has already begun. Connecting the city of Aachen to this infrastructure would probably involve high costs, for example through the construction of a pipeline. In addition, geological CO_2 storage has only met with limited social acceptance.

Carbon Capture and Utilisation (CCU): CCU can be used to achieve complete climate neutrality if the entire value chain and energy requirements are climate neutral. CCU is primarily of interest to produce chemicals, fuels or building materials, i.e. in industries that are rarely located in Aachen.

Conclusion: According to the current assessment, carbon capture will play a subordinate role in achieving climate neutrality in the city of Aachen by 2030. The development requirements and costs of the available technologies are still too high.

To accelerate progress in this area, the City of Aachen will actively support the research activities of Aachen's universities and participate in suitable third-party funded projects.

According to the current analysis, it can therefore be assumed that 87.2 % of the residual greenhouse gas emissions expected in the city of Aachen in 2030, i.e. 273,000 tonnes of CO_2eq, will have to be offset.

Certificates from the company MoorFutures are used to calculate the offsetting costs. MoorFutures is dedicated to the protection and rewetting of moors in Mecklenburg-Western Pomerania, Brandenburg and Schleswig-Holstein.

MoorFutures' certificates are based on the Verified Carbon Standard and the Kyoto Protocol and follow the requirements of internationally recognised environmental standards (ISO 14064 and 14065). MoorFutures charges €64 for offsetting 1 tonne of CO_2. Offsetting the remaining budget of 273,000 tonnes of CO_2 per year from 2030 would result in costs of around €23 million per year.

If calculations by the Federal Environment Agency are used to determine the environmental costs per tonne of CO_2 emitted, the current figure is € 180 per tonne of CO_2eq. This results in a total offsetting amount of € 49 million per year.

Assuming conformity with municipal procurement law, offsetting will be carried out in cooperation with the Aachen-based GREENZERO Group. Offsetting is carried out in accordance with the CEC offsetting approach formulated by the TU Berlin and Braunschweig and deposited with DIN as a DIN SPEC (see "Offsetting environmental impacts beyond climate change: the Circular Ecosystem Compensation approach", Moore et al., Berlin 2023) from the standard for environmentally neutral action - multidimensional analysis, reduction and offsetting of environmental costs (https://greenzero-group.com/ and Commitments, Appendix 2). The initiative driving the standard, "Acting together in an environmentally neutral way", led by the GREENZERO Group, pursues a holistic approach to offsetting. Ecologically degraded areas are comprehensively renaturalised with a strong focus on biodiversity gains. The environmental values created in this way are economically assessed in line with the standard monetisation approaches of environmental science (here: CE Delft, Handbook of Environmental Costs, Delft 2023) and offset against the environmental costs that arise (among other things) from greenhouse gas emissions.

The offsetting projects are carried out in Aachen's urban area wherever possible - also utilising urban structures - and ensure long-term environmental gains in the urban area, which simultaneously improve the climate impact adaptation of the urban structure and have a positive impact on the quality of life of the city's population. As part of this, a comprehensive examination of potential areas and the ecological enhancement potential available there is carried out. If no sufficiently large areas for offsetting residual greenhouse gas emissions are identified in the urban area, Department 36 will examine whether it is possible to acquire certificates from GREENZERO projects in NRW or from joint offsetting projects - for example with companies from the city and city region. The expertise of the NZC consortium will be utilised in this review.

3.3 Module B-3 Indicators for Monitoring, Evaluation and Learning

Module B-3 "Indicators for Monitoring, Evaluation and Learning" contains a selection of indicators to monitor and evaluate progress along the selected impacts pathways and fields of action described in Module B-1. as well as a monitoring and evaluation plan, i.e., metadata on each indicator selected, in addition to milestones and timeline.

Table 9 (B-3.1) Economic Indicators by Sector

B-3.1 Economic Indicators by Sector					
Sector	**Code**	**Indicator**	**Indicator Unit**	**Indicator Baseline**	**Indicator Target 2030**
Transport	**T1**	Reduced need for motorised passenger transport	% reduction by 2030		10%
	T2	Reduced passenger kilometres by car through shift to public & non-motorized transportation	% reduction in car passenger kilometres by 2030		20%
	T3	Car pooling	average passengers per car	1,4	1,6
	T4	Electrification of cars + motorbikes by 2030	% of fleet electrified	4%	35%
	T5	Electrification of buses	% of fleet electrified	0%	70%
	T6	Optimisation of trucking logistics - light duty trucks (< 3.5 t)	average utilisation of maximum load weight for light duty trucks (< 3.5t)	23%	45%
	T7	Optimisation of trucking logistics - heavy duty trucks (> 3.5 t)	average utilisation of maximum load weight for heavy duty trucks (< 3.5t)	45%	60%
	T8	Electrification of light duty trucks <3.5t by 2030	% of fleet electrified	0%	33%
	T9	Electrification of heavy-duty trucks <3.5t by 2030	% of fleet electrified	0%	33%
Buildings & Heating	**B1**	Building renovation (envelope)	% annual renovation rate	1,0%	4,0%
	B2	New buildings built to top performing standard	% of buildings built to the top standard	0%	0%
	B3	Efficient lighting and appliances	% annual renovation rate	1,0%	5,0%
	B4	Heating technologies	share of heating as district heating	13%	27%
	B5	Decarbonising district heating	share of district heating produced using fossil fuels	100%	0%
	B6	Decarbonising district heating	share of district heating produced using electric heat pumps	0%	30%
	B7	Decarbonising district heating	share of district heating produced using bio fuels	0%	23%
	B8	Heating technologies	share of heating as local heating	87%	73%

	B9	Decarbonising local heating	share of local heating produced using fossil fuels	91%	20%
	B10	Decarbonising local heating	share of local heating produced using electric heat pumps	4%	70%
	B11	Decarbonising local heating	share of local heating produced using bio fuels	5%	10%
Electricity	**E**	Renewable / fossil fuel electricity production	share of electricity produced using fossil fuels	42%	8%
Waste	**W1**	Paper recycling	% recycling rate	100%	100%
	W2	Metal recycling	% recycling rate	100%	100%
	W3	Plastic recycling	% recycling rate	93%	100%
	W4	Glass recycling	% recycling rate	85%	100%
	W5	Organic recycling	% recycling rate	97%	100%

The indicators originate from the economic model used to validate the Action Plan and Investment Plan.

Table 10 (B-3.2) Indicator Metadata 1

B-3.2: Indicator Metadata 1	
(For each indicator selected)	
Indicator name	**T1** Reduced motorised passenger transportation need
Indicator Unit	% reduction by 2030
Definition of	
Calculation	passenger kilometres/capita
Indicator Context	
Does the indicator measure direct impacts (reduction in greenhouse gas emissions?)	[Yes]
If yes, which emission source sectors does it measure?	Transport
Does the indicator measure indirect impacts (i.e., co-benefits)?	[Yes]
If yes, which co-benefit does it measure?	improvement of air quality, lower noise emissions
Is the indicator useful for monitoring the output/impact of action(s)?	[yes]
If yes, which action and impact pathway is it relevant for?	interaction of all mobility measures especially:. Company mobility management Expansion of public transport Cycling infrastructure and pedestrian traffic Zero emission zone
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	[yes/no]
Data requirements	
Expected data source	Ifeu (Institute for Energy and Environmental Research Heidelberg) and Wuppertal Institute
Is the data source local or regional/national?	national / in future local
Expected availability	the data is published annually
Suggested collection interval	yearly
References	
Deliverables describing the indicator	economic model
Other indicator systems using this indicator	

Table 11 (B-3.2) Indicator Metadata 2

B-3.2: Indicator Metadata 2	
(For each indicator selected)	
Indicator name	**T2** Reduced passenger kilometres by car through shift to public & non-motorized transportation
Indicator Unit	% reduction in car passenger kilometres by 2030
Definition of	
Calculation	(passenger car kilometres)/ (total number of citizens of the city of Aachen)
Indicator Context	

Does the indicator measure direct impacts (reduction in greenhouse gas emissions?)	[Yes]
If yes, which emission source sectors does it measure?	Transport
Does the indicator measure indirect impacts (i.e., co-benefits)?	[Yes]
If yes, which co-benefit does it measure?	improvement of air quality, lower noise emissions
Is the indicator useful for monitoring the output/impact of action(s)?	[yes]
If yes, which action and impact pathway is it relevant for?	Interaction of all mobility measures especially Zero emission zone Expansion of public transport Cycling infrastructure and pedestrian traffic Multimodal mobility Promotion of sharing and multimodality Incentives for the switch
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	[yes/no]
Data requirements	
Expected data source	Ifeu (Institute for Energy and Environmental Research Heidelberg) and Wuppertal Institute
Is the data source local or regional/national?	National / in future local
Expected availability	the data is published annually
Suggested collection interval	yearly
References	
Deliverables describing the indicator	Economic model
Other indicator systems using this indicator	

Table 12 (B-3.2) Indicator Metadata 1

B-3.2: Indicator Metadata 3	
(For each indicator selected)	
Indicator name	**T3** Car pooling
Indicator Unit	average passengers per car
Definition of	
Calculation	
Indicator Context	
Does the indicator measure direct impacts (reduction in greenhouse gas emissions?)	[Yes]
If yes, which emission source sectors does it measure?	Transport
Does the indicator measure indirect impacts (i.e., co-benefits)?	[Yes]
If yes, which co-benefit does it measure?	improvement of air quality, lower noise emissions
Is the indicator useful for monitoring the output/impact of action(s)?	[yes]

If yes, which action and impact pathway is it relevant for?	Interaction of all mobility measures Promotion of sharing and multimodality Company mobility management
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	[yes/no]
Data requirements	
Expected data source	Study "Mobility in Germany"
Is the data source local or regional/national?	regional
Expected availability	annually
Suggested collection interval	annually
References	
Deliverables describing the indicator	Economic model
Other indicator systems using this indicator	

Table 13 (B-3.2) Indicator Metadata 4

B-3.2: Indicator Metadata 4	
(For each indicator selected)	
Indicator Name 4 Indicators	**T4** Electrification of cars + motorbikes **T5 Electrification** of buses **T8 Electrification** of light duty trucks **T9 Electrification** of heavy duty trucks
Indicator Unit	% of fleet electrified
Definition of	
Calculation	(number of electrified vehicles)/ (total number of vehicles)
Indicator Context	
Does the indicator measure direct impacts (reduction in greenhouse gas emissions?)	[Yes]
If yes, which emission source sectors does it measure?	Transport
Does the indicator measure indirect impacts (i.e., co-benefits)?	[Yes]
If yes, which co-benefit does it measure?	improvement of air quality, lower noise emissions
Is the indicator useful for monitoring the output/impact of action(s)?	[yes]
If yes, which action and impact pathway is it relevant for?	Interaction of all mobility measures Expansion of public transport Zero-emission zone Expansion of the charging infrastructure
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	[yes/no]
Data requirements	
Expected data source	Federal Motor Transport Authority, ASEAG
Is the data source local or regional/national?	local
Expected availability	the data is published annually

Suggested collection interval	yearly
References	
Deliverables describing the indicator	Economic model
Other indicator systems using this indicator	

Table 14 (B-3.2) Indicator Metadata 5

B-3.2: Indicator Metadata 5	
(For each indicator selected)	
Indicator name	**T6 + T7** Optimisation of trucking logistics, light- and heavy-duty trucks
Indicator Unit	average utilisation of maximum load weight for light- or heavy-duty trucks
Definition of	
Calculation	
Indicator Context	
Does the indicator measure direct impacts (reduction in greenhouse gas emissions?)	[Yes]
If yes, which emission source sectors does it measure?	Transport
Does the indicator measure indirect impacts (i.e., co-benefits)?	[no]
If yes, which co-benefit does it measure?	
Is the indicator useful for monitoring the output/impact of action(s)?	[yes]
If yes, which action and impact pathway is it relevant for?	Interaction of all mobility measures
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	[yes/no]
Data requirements	
Expected data source	Companies participating in the ccc
Is the data source local or regional/national?	local
Expected availability	yearly
Suggested collection interval	yearly
References	
Deliverables describing the indicator	Economic model
Other indicator systems using this indicator	

Table 15 (B-3.2) Indicator Metadata 6

B-3.2: Indicator Metadata 6	
(For each indicator selected)	
Indicator name	**B1 + B3** Building renovation (envelope) Efficient lighting and appliances
Indicator Unit	% annual renovation rate
Definition of	
Calculation	

Indicator Context	
Does the indicator measure direct impacts (reduction in greenhouse gas emissions?)	[Yes]
If yes, which emission source sectors does it measure?	Buildings and Heating
Does the indicator measure indirect impacts (i.e., co-benefits)?	[no]
If yes, which co-benefit does it measure?	
Is the indicator useful for monitoring the output/impact of action(s)?	[yes]
If yes, which action and impact pathway is it relevant for?	Consultancy campaign: energy-efficient modernisation of the multi-family housing stock Energy-efficient neighbourhood development promotion of energy-efficient measures in buildings
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	[yes/no]
Data requirements	
Expected data source	thermal energy demand CO2 Inventory heated building area Housing market report, census
Is the data source local or regional/national?	Local
Expected availability	yearly
Suggested collection interval	yearly
References	
Deliverables describing the indicator	Economic model
Other indicator systems using this indicator	

Table 16 (B-3.2): Indicator Metadata 7

B-3.2: Indicator Metadata 7	
(For each indicator selected)	
Indicator name	**B 3** Efficient lighting and appliances
Indicator Unit	% annual renovation rate
Definition of	
Calculation	
Indicator Context	
Does the indicator measure direct impacts (reduction in greenhouse gas emissions?)	[Yes]
If yes, which emission source sectors does it measure?	Buildings and Heating
Does the indicator measure indirect impacts (i.e., co-benefits)?	[no]
If yes, which co-benefit does it measure?	
Is the indicator useful for monitoring the output/impact of action(s)?	[yes]
If yes, which action and impact pathway is it relevant for?	measures in this indicator are cost-effective, no further measures are necessary here
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	[yes/no]

Data requirements	
Expected data source	thermal energy demand CO2 Inventory heated building area Housing market report, census
Is the data source local or regional/national?	Local
Expected availability	yearly
Suggested collection interval	yearly
References	
Deliverables describing the indicator	Economic model
Other indicator systems using this indicator	

Table 17 (B-3.2) Indicator Metadata 8

B-3.2: Indicator Metadata 8	
(For each indicator selected)	
Indicator name	**B2** New buildings built to top performing standard
Indicator Unit	% of buildings built to the top standard
Definition of	
Calculation	(new buildings with performing standard)/(total new buildings)
Indicator Context	
Does the indicator measure direct impacts (reduction in greenhouse gas emissions?)	[Yes]
If yes, which emission source sectors does it measure?	Buildings and Heating
Does the indicator measure indirect impacts (i.e., co-benefits)?	[no]
If yes, which co-benefit does it measure?	
Is the indicator useful for monitoring the output/impact of action(s)?	[yes]
If yes, which action and impact pathway is it relevant for?	New construction of climate-neutral detached houses New construction of climate-neutral flat blocks
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	[yes/no]
Data requirements	
Expected data source	Housing market report
Is the data source local or regional/national?	local
Expected availability	yearly
Suggested collection interval	yearly
References	
Deliverables describing the indicator	Economic model
Other indicator systems using this indicator	

Table 18 (B-3.2) Indicator Metadata 9

B-3.2: Indicator Metadata 9	
(For each indicator selected)	
Indicator name	**B4 + B8** Heating technologies

Indicator Unit	share of heating as district heating, share of heating as local heating
Definition of	
Calculation	(District heating consumption) /(total heat consumption)
Indicator Context	
Does the indicator measure direct impacts (reduction in greenhouse gas emissions?)	[Yes]
If yes, which emission source sectors does it measure?	Buildings and Heating
Does the indicator measure indirect impacts (i.e., co-benefits)?	[Yes]
If yes, which co-benefit does it measure?	improvement of air quality
Is the indicator useful for monitoring the output/impact of action(s)?	[yes]
If yes, which action and impact pathway is it relevant for?	Expansion and decarbonisation of district heating Integrated heat and energy planning appliances
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	[yes/no]
Data requirements	
Expected data source	Regionetz, STAWAG
Is the data source local or regional/national?	local
Expected availability	yearly
Suggested collection interval	yearly
References	
Deliverables describing the indicator	Economic model
Other indicator systems using this indicator	

Table 19 (B-3.2) Indicator Metadata 10

B-3.2: Indicator Metadata 10	
(For each indicator selected)	
Indicator name	**B5, B6, B7** Decarbonising district heating
Indicator Unit	share of district heating produced using fossil fuels share of district heating produced using electric heat pumps share of district heating produced using bio fuels
Definition of	
Calculation	(district heating generation from fossil fuels) /(total district heating generation) (district heating generation from heat pumps) /(total district heating generation) (district heating generation from bio fuels) /(total district heating generation)
Indicator Context	
Does the indicator measure direct impacts (reduction in greenhouse gas emissions?)	[Yes]
If yes, which emission source sectors does it measure?	Buildings and Heating

Does the indicator measure indirect impacts (i.e., co-benefits)?	[Yes]
If yes, which co-benefit does it measure?	improvement of air quality
Is the indicator useful for monitoring the output/impact of action(s)?	[yes]
If yes, which action and impact pathway is it relevant for?	Expansion and decarbonisation of district heating
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	[yes/no]
Data requirements	
Expected data source	Regionetz, STAWAG
Is the data source local or regional/national?	local
Expected availability	yearly
Suggested collection interval	yearly
References	
Deliverables describing the indicator	Economic model
Other indicator systems using this indicator	

Table 20 (B-3.2) Indicator Metadata 11

B-3.2: Indicator Metadata 11	
(For each indicator selected)	
Indicator name	**B9, B10, B11** Decarbonising local heating
Indicator Unit	share of local heating produced using fossil fuels share of local heating produced using electric heat pumps share of local heating produced using bio fuels
Definition of	
Calculation	(local heating generation from fossil fuels) /(total local heating generation) (local heating generation from heat pumps) /(total local heating generation) (local heating generation from bio fuels) /(total local heating generation)
Indicator Context	
Does the indicator measure direct impacts (reduction in greenhouse gas emissions?)	[Yes]
If yes, which emission source sectors does it measure?	Buildings and Heating
Does the indicator measure indirect impacts (i.e., co-benefits)?	[Yes]
If yes, which co-benefit does it measure?	improvement of air quality
Is the indicator useful for monitoring the output/impact of action(s)?	[yes]
If yes, which action and impact pathway is it relevant for?	Promoting efficient decentralised heating systems with renewable energies
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	[yes/no]
Data requirements	

Expected data source	Regionetz, STAWAG
Is the data source local or regional/national?	local
Expected availability	yearly
Suggested collection interval	yearly
References	
Deliverables describing the indicator	Economic model
Other indicator systems using this indicator	

Table 21 (B-3.2) Indicator Metadata 12

B-3.2: Indicator Metadata 12	
(For each indicator selected)	
Indicator name	**E** Renewable / fossil fuel electricity production
Indicator Unit	share of electricity produced using fossil fuels share of electricity produced using renewable fuels
Definition of	
Calculation	there is a national value local: (Stawag value of renewable electricity)*0.7 + (national value renewable electricity) *0.3 Stawag's (local energy supplier) market share in Aachen: 70%
Indicator Context	
Does the indicator measure direct impacts (reduction in greenhouse gas emissions?)	[Yes]
If yes, which emission source sectors does it measure?	Electricity
Does the indicator measure indirect impacts (i.e., co-benefits)?	[Yes]
If yes, which co-benefit does it measure?	improvement of air quality
Is the indicator useful for monitoring the output/impact of action(s)?	[yes]
If yes, which action and impact pathway is it relevant for?	Climate-neutral electricity and heat supply for properties under municipal control Expansion of renewable electricity generation in the urban family Ground-mounted PV systems on urban areas Safeguarding / expansion of wind energy Solar offensive on all suitable roof surfaces Concept development: Identification and utilisation of PV open space potential
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	[yes/no]
Data requirements	

Expected data source	Regionetz, STAWAG
Is the data source local or regional/national?	local
Expected availability	yearly
Suggested collection interval	yearly
References	
Deliverables describing the indicator	Economic model
Other indicator systems using this indicator	

Table 22 (B-3.2) Indicator Metadata 13

B-3.2: Indicator Metadata 13	
(For each indicator selected)	
Indicator name	**W1, W2, W3, W4, W5** paper-/ metal-/ plastic-/glass-/ organic recycling
Indicator Unit	% recycling rate
Definition of	
Calculation	there is a national value
Indicator Context	
Does the indicator measure direct impacts (reduction in greenhouse gas emissions?)	[Yes]
If yes, which emission source sectors does it measure?	Waste
Does the indicator measure indirect impacts (i.e., co-benefits)?	[no]
If yes, which co-benefit does it measure?	
Is the indicator useful for monitoring the output/impact of action(s)?	[yes]
If yes, which action and impact pathway is it relevant for?	development of a building yard of the future for Aachen's municipal operations to promote the use of renewable raw materials as building materials Waste avoidance Establish and expand the circular economy in industry and the tertiary sector Component and resource warehouse Circular economy in the construction industry Develop criteria for a climate-neutral construction site
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	[yes/no]
Data requirements	
Expected data source	E18
Is the data source local or regional/national?	currently national, in future local
Expected availability	yearly

Suggested collection interval	yearly
References	
Deliverables describing the indicator	Economic model
Other indicator systems using this indicator	

The climate neutrality strategy for Aachen is a living process consisting of practical and implementation-orientated measures and activities. They form the backbone of the implementation process and bring together people, knowledge, money and commitment - geared towards the goal of climate neutrality by 2030. This living process requires an ongoing target/actual value comparison of target achievement (measurement) as well as constant readjustment, correction, stopping and restarting (adaptation).

3.3.1 Monitoring and controlling instruments

Project portfolio plan: The project portfolio plan allows all projects to be visualised at a glance. It provides quick information about the main focus and project category, project status and the most important players in each individual project. The project portfolio plan depicts the overarching action plan. All measures are structured according to fields of action, key areas of action, measures and activities. As a process-accompanying tool, measures can be differentiated and clustered according to the offices or project organisers involved, time and financial expenditure.

Measures and project database: The measures and project database record all important data and allows the ongoing measures and projects to be analysed and communicated. Measures and project profiles: The profiles describe the content of the measures and objectives as well as the most important indicators for monitoring success.

Factor analysis: The factor analysis is a regular screening procedure to identify changes in the environment for achieving the goal of climate neutrality and to derive measures from this. The factor analysis is therefore both an early warning system and an important basis for developing realisable measures.

Digital monitoring: Digital monitoring automates the recording of relevant indicators and improves the data exchange workflow. The digitalisation of monitoring as an instrument of multi-project management and support for the departments during its introduction is recommended in the long term.

3.3.2 Indicator system

In line with the "thinking from the goal" approach, a key task for the process is to generate suitable measures and projects to achieve the goals. The development and introduction of an indicator system is therefore recommended. The indicator system formulates specific, year-specific sector targets for GHG reduction for each field of action and the key areas of action.

The key objectives provide the strategic framework for implementation. Depending on the level, objectives can be ecological, social and economic objectives. They can be technically or politically justified. They must therefore be defined at the individual levels according to their meaningfulness and the possibility of binding definition. As a minimum, the following should be defined

- Greenhouse gas reduction targets (city-wide, fields of action with direct relevance for GHG savings are described)
- Targets for compliance with the residual CO2 budget (city-wide level)
- Targets for final energy savings (city-wide, fields of action with direct relevance for final energy savings)

Recording and analysing the indicators for target achievement: Compliance with the targets is indicated with the help of indicators. The leading indicators are the annual CO2 emissions, the residual CO2 budget and the final energy consumption. The following levels are recommended for the indicator system:

- City-wide indicators
- Indicators at the level of the fields of action
- Indicators at the level of measures and activities

The selection of indicators should be based on the criteria of relevance and availability. Finally, the process for recording the indicators and providing the necessary data must be ensured by Controlling.

Controlling instruments are

- Baseline inventory: The continuously updated baseline inventory forms an important data basis for determining the baseline values and comparative values for controlling the overarching municipal GHG reduction targets. The formal inventory sheet is the BISKO inventory sheet. The inventory sheet should be updated annually.
- Target/actual value comparison of GHG emissions and final energy consumption: By regularly comparing the indicators with the formulated targets, information can be derived as a basis for process control via multi-project management. The annual agreement between the target values and actual values is displayed at the level of the city as a whole and at the level of the fields of action.

3.3.3 Recording of indicators

The strategy for achieving climate neutrality is described by a portfolio of measures. The portfolio of measures is not a rigid plan, but represents an ongoing process - activities are added and completed activities are removed from the portfolio.

Documentation as a monitoring tool: It is therefore particularly important that activities in the fields of action and key action areas are documented, that the status is recorded using indicators and that the success of implementation can be evaluated and presented transparently. One basic problem is the availability of data and the effort involved in recording it. In climate protection processes, indicators should be surveyed annually if possible. As indicators are usually recorded "manually" and data sources, contact persons or data transfer processes often change, this process is very time-consuming. In practice, evaluations are therefore often carried out at intervals of 3 to 5 years. As a result, the controlling system is incomplete and out of date. A digital organisation and management tool with a database connection is therefore required to map the portfolio of measures. It must be usable within the framework of multi-project management at the City of Aachen and have freely configurable input options and output options in text and graphics. The evaluation and presentation of the monitoring results must be transparent, informative and easy to understand. This includes the presentation of the target-actual development (e.g. GHG emissions (annual), final energy (annual), CO2 residual budgets (annual)), the presentation of specific indicators in real time (e.g. feed-in of PV electricity into the power grid) or dashboard displays.

The development and introduction of a digital system for recording indicators is therefore recommended. Recording and output should be possible on three levels:

- Restricted data access: The system must ensure the confidentiality of sensitive data in exchange with organisations and companies within (administration, investments) and outside the City of Aachen Group. It is necessary to define access rights and an authorisation concept that enables access by multi-project management.
- Open data access (Open Date): Climate protection is in the public interest. The system should therefore also enable the open exchange of data with organisations and citizens. Data that is not subject to restrictions should be usable and viewable by everyone.
- Dashboard: Transparency regarding the results of accounting and compliance with the formulated targets is an essential prerequisite for successful management. Dashboards can play an important role in communicating key data and facts. Dashboards are electronic graphical user interfaces that summarise key data and visualise it in a way that is appropriate for the target group.

4 Part C - Enabling Climate Neutrality by 2030

Part C "Enabling Climate Neutrality by 2030" aims to outline any enabling interventions, i.e., regarding organizational setting or collaborative governance models or related to social innovations - designed to support the climate action portfolios (Module B-2) as well as aiming to achieve co-benefits outlined in the impact pathway (Module B-1). These interventions also address the identified opportunities, gaps and barriers identified Module A-2 and A-3.

4.1 Module C-1 Governance Innovation Interventions

4.1.1 (C-1.1) Description or visualisation of the participatory governance model for climate neutrality

The path to climate neutrality is a systemic task and an agile process in which the city, citizens and stakeholders such as companies, associations and interest groups must be equally involved. The path that has already been taken in this respect is described in detail in the introduction to the Action Plan. The IKSK 2.0 proposes further governance innovations for the future in the following key areas of action:

Among other things, this also requires governance innovations. In this context, the following key areas of action are at the centre of administrative action:

4.1.1.1 City as a role model: transformation as a management task

The administration translates climate neutrality into an action-oriented idea; begins to set up new processes within itself, restructure old processes and reorganise them. The CO_2 budget for each field of action must not be burdened beyond a target value. Controlling and monitoring of the process is required to check, evaluate and readjust compliance with the development path as well as a binding mechanism for follow-up control. The following activities, among others, should contribute to this:

- Introducing and anchoring multi-project management
- Dashboard: Monitoring & controlling with inventory sheet
- Climate neutrality transformation strategy - practical solutions for implementation
- Updating a climate relevance assessment to prioritise climate-relevant decisions
- Introduction of climate funds
- Comprehensive subsidy management
- Steering group for the transport development plan as a coordinating body for climate-neutral mobility
- Innovation space management for a climate-neutral Aachen 2030
- Introduce climate coordinators in all departments
- Climate protection in and further adaptation of the infrastructure of the fire and rescue services and municipal operations
- Agency for Climate, Energy and Sustainability
- Establishment of a climate council
- Climate Salon as a format for promoting cross-sectoral exchange and networking in the administration
- Climate-neutral" guideline for all municipal publications and instructions

4.1.1.2 Urban development as a climate management task

The spatial planning and spatial conceptual framework for these necessary developments is provided by integrated, climate-friendly and sustainable urban development. The actions of the city administration always consider the settlement areas of the city as a whole as well as possible land conflicts. The following activities, among others, are intended to contribute to this:

- Establishment of an urban data working group - advertisement for an urban data coordinator position to pool and analyse urban data

- Climate protection management for integrated urban development concepts and projects to redesign public spaces
- Urban development as a task of climate management
- Sustainability criteria / requirements for the allocation of urban land
- Centralised climate protection management for collecting ideas and further development

4.1.1.3 Communication

Change processes require active communication to deal with resistance and increase acceptance. The transformation can be actively shaped through the type of communication, education, the creation of incentives for action and decision-making impulses as well as the consideration of behavioural characteristics. Good internal administrative communication and networking form the basis for accelerated and consistent implementation of the process towards climate neutrality. This includes clarity about the communication and decision-making channels for the implementation of climate protection measures, interdisciplinary dialogue between departments and learning from each other. The following activities, among others, should contribute to this:

- "Öcher Solardach" alliance and campaign
- Communication strategy
- Employee training "Climate neutrality communication training", training concept

4.1.1.4 Transformation in civil society responsibility / participation

To achieve the goal of climate neutrality by 2030, strong participation of the urban community is required. New ideas and projects are initiated and further developed in direct dialogue with citizens, and the implementation of projects, measures and activities is accompanied and supported. Community action promotes social cohesion. Initiatives run open workshops, neighbourhood centres, online platforms for swapping, lending and co-creation. Citizen participation should be organised on an ongoing basis. A hybrid approach that combines both analogue (e.g. project workshops, focus groups, citizens' councils) and digital formats (e.g. citizens' panels) makes sense. The following activities, among others, should contribute to this:

- Citizen participation formats for climate neutrality
- Centralised customer relationship management
- Climate protection and carnival
- Climate protection and sport

4.1.1.5 Regional relations and co-operation

Administration needs strong contact partners and players outside the administration; this requires networks and alliances between which paths can be established. The following activities, among others, should contribute to strengthening cooperation across the city's borders:

- CoLab pilot project
- Climate region

4.1.1.6 Climate protection and health

The quality of life of Aachen's citizens is closely linked to the protection of health and the climate. From the prevention of heat stress to protection against the spread of pathogens. Climate change has a direct or indirect impact on the physiological and mental state of Aachen's citizens. In this respect, a city-wide strategy and targeted management of measures across various fields of action are required.

4.2 Module C-2 Social Innovation Interventions

This module lists the actions taken by the city to support and foster social innovation initiatives or non-technological innovation more broadly (e.g., in entrepreneurship, social economy, social awareness & mobilisation, social cohesion and solidarity, etc) aimed to address the systemic barriers and leverage the opportunities identified in Module A-3[1] . It also includes:

4.2.1 (C-2.2) Description of social innovation interventions

The goal of climate neutrality also requires a comprehensive transformation and social innovation in society as a whole. This can be understood as a change in awareness in all parts of society. Everyone should be involved. The following key areas of action are therefore at the centre of administrative action:

4.2.1.1 Climate awareness

It is crucial that climate-friendly behaviour is equally enabled and promoted in all parts of society. Determining factors for the penetration of the population can be, for example, age, level of education, language skills and economic opportunities. The following building blocks can be part of a strategic approach to the population: activate, encourage, qualify and multiply. The following activity, for example, falls into this area:

- Making climate neutrality tangible and best practices visible

4.2.1.2 Climate-friendly living environment

Improving the quality of life of all people in Aachen in the face of climate change and the associated challenges is an integrated task of urban development. The following activities, for example, fall within this area:

- Drinking water fountains in public spaces
- Pilot projects for unsealing school and nursery grounds

4.2.1.3 Climate protection in everyday life

Personal behaviour and individual decision-making routines determine everyday actions and therefore the ecological footprint of every citizen. The communication and practical application of climate-friendly behavioural routines are successes in everyday life that strengthen self-efficacy, activate people to take further steps and also motivate others. The following activities, for example, fall into this area:

- Participatory campaign with volunteer climate trainers
- Healthy and sustainable communal catering

4.2.1.4 Climate protection and social participation

Climate protection must go hand in hand with greater social justice. The fight against the climate crisis also means standing up for social and intergenerational change. Life satisfaction depends on the opportunity to participate. Strong communities build social capital and are stable in situations of crisis and change. Major differences and perceived injustices hinder transformation and lead to resistance. Combating inequality and strengthening the community is therefore a success factor. The following activity, among others, is intended to contribute to this:

- Introduction of a municipal climate fee

4.2.1.5 Climate protection and education

Education is a key factor in achieving climate protection goals. Sustainability and climate protection are lifelong educational topics. Education for sustainable development (ESD) shows ways in which our own actions and climate-friendly lifestyles can have an impact on the environment. This not only strengthens the individual's perceived self-efficacy, but also has positive consequences for others. Aachen pursues a broad approach in the sense of an ESD educational landscape and educational offensive on sustainability topics. The anchoring and implementation of Education for Sustainable Development (ESD) should therefore be ensured in cooperation with all education providers and stakeholders. This area includes the following activities, for example:

- Monitoring and support of climate and sustainability activities at schools for structural change
- Develop and implement climate education concepts

4.2.1.6 Climate protection in culture and leisure

Social transformation processes begin with people willing to change as pioneers and role models. Aachen has a broad cultural scene and is known worldwide as a tourist destination. The culture, leisure and tourism sectors therefore offer great potential to promote sustainability and climate protection issues in Aachen and beyond the city's borders as role models and multipliers. The following activity, for example, falls into this area:

- Structural changes with the handprint! - Workshops and support for implementation within the administration and with multipliers in associations and initiatives.

5 Outlook and next steps

This section should draw any necessary conclusions on the CCC Action Plan above and highlight next steps and plans for refining the CCC Action Plan as part of the Climate City Contract in future iterations.

5.1 Plans for next CCC and CCC Action Plan iteration

Climate protection. We. Now. - is the slogan of Aachen's climate campaign, which will be launched in May 2024 and is aimed in particular at citizens.

After all, climate neutrality can only succeed if everyone in Aachen gets actively involved. Therefore, the main goal for the coming years is to maximise the expansion of the Alliance for Change in Aachen (see 1.1.3).

Urban society is to be involved in Aachen's climate protection process much more intensively and more bindingly via the Climate City Contract. The city administration will create and continuously develop the necessary framework conditions and formats.

The Climate City Contract is updated as a living document and submitted to the European Commission for review every two years.

Prioritisation regarding the implementation of climate protection strategies and measures is carried out by the Aachen City Council, the responsible committees and the Administrative Board. The responsible departments will draw up decision-making aids on climate protection-relevant topics for the Administrative Board and City Council, which will enable decision-making to take place in a comprehensible and transparent manner with clear guidelines.

The core activities of the Aachen Transition Team will be in the near future:

- Prioritisation of measures from the IKSK 2.0 for resolution by the City Council
- Implementation of the measures from IKSK 2020 and IKSK 2.0
- Introduction of multi-process management that keeps an eye on all processes
- Implementation of the new governance structure in the city administration
- Establishment of learning loops in order to readjust measures
- Introduction of a digital tool for comprehensive monitoring
- Visualisation of the progress of the measures and the GHG reduction
- Support and expansion of the network of CCC signatories
- Involving citizens in the Climate City Contract Establishment of a climate agency for climate, energy, circular economy and sustainability (CoLAB pilot project)
- Establishing positive and motivating climate communication
- Development of financing solutions / acquisition of funding
- Updating the CCC in 2026 / 2028 / 2030
- Strategy to strengthen political work at state, federal and EU level, including via stronGER cities

NET ZERO CITIES

EU MISSION PLATFORM | CLIMATE NEUTRAL AND SMART CITIES

Climate City Contract

2030 Climate Neutrality Commitments

City of Aachen

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Disclaimer

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List of abbreviations

IKSK	Integrated Climate Protection Concept (Integriertes Klimaschutzkonzept)

1 Introduction

The following chapter explains the motivation to join the EU Mission 100 Climate-Neutral and Smart Cities by 2030 and highlights the City of Aachen's present commitments to climate action.

Introduction

Aachen is motivated to tackle what is probably the biggest crisis of our time with determination. The City of Aachen's participation in the EU's 100 Climate-Neutral and Smart Cities mission is intrinsically motivated. On the one hand, as a regional centre and partner in the transformation of the Rhenish mining region, Aachen wants to be a driving force and a centre for the transfer of expertise in this area. On the other hand, Aachen is situated in a basin, which is increasingly leading to poor air quality and an increase in extreme weather events such as heavy rainfall and extreme heat islands caused by climate change.

Equally important is the fact that the City of Aachen has a very committed citizenry that is actively committed to climate and environmental protection. Examples include the Aachen citizens' initiative Runder Tisch Klimanotstand Aachen (Aachen climate emergency round table), which was formed with strong support from civil society and numerous members of associations in the fields of climate and environmental protection, energy, mobility and sustainability in response to a resolution on the climate emergency by Aachen City Council (June 2019). There is also a very active Fridays for Future scene, which has been joined by students (with around 60,000 students, almost every fourth resident of Aachen is a student) or groups such as Architects, Artists, Health workers, Parents, Psychologists or Scientists for Future.

Ultimately, however, the city of Aachen has always played a pioneering role and took on responsibility early to create a city worth living in. As early as 1992, at the same time as the ground-breaking UN Conference on Environment and Development in Rio de Janeiro, Aachen decided on the sustainable development of the city in a wide range of policy areas. The model project Ecological City of the Future (1992-2002) established structures for integrated cooperation within the administration and with external stakeholders, implemented measures and set a long-term, strategic course for sustainability.

In the 1990s, the focus was on strengthening sustainable mobility, expanding renewable energy and increasing energy efficiency as well as sustainable construction and housing. Lighthouse projects such as the model region for electromobility and the *altbau plus e.V.* support centre emerged from this long-standing tradition. In 2018, the City of Aachen was named one of the three most sustainable cities in Germany by the German Sustainability Award Foundation.

By joining the **European Climate Alliance** in 1992, the City of Aachen committed to ambitious reduction targets at an early stage and aligned its strategies and fields of action accordingly. In addition, Aachen has been a member of the **Covenant of Mayors** climate protection initiatives of European cities and **Mayors Adapt** of the EU Commission since 2015. In order to have its progress towards achieving its climate protection goals independently evaluated, the City of Aachen has been participating in the municipal management and certification system **European Energy Award** since 2009 and has been awarded the gold label ever since. The City of Aachen has drawn up an annual energy and carbon footprint since 2010. The balance is calculated using the ECORegion calculation tool recommended by the Climate Alliance on the basis of actual consumption and additional statistical data.

Aachen is also a true centre of innovation, combining expertise from academia, research, technology and business. Aachen also leads the way here and is part of a large number of model projects, e.g. in digitalisation as an enabler for a climate-neutral and intelligent city. Initiatives such as the digitalHub or the OcherLab are working together with the City of Aachen on concepts for technology transfer towards urban society as well as on participation formats that bring together urban social challenges – such as climate and environmental protection – with innovative solutions.

Politically, a number of strategic plans and resolutions have been initiated for the City of Aachen in recent years on the way to its application as one of the 100 Climate-Neutral and Smart Cities in 2030: the Climate Protection Plan (2010), the Noise Action Plan (2013), the Energy Policy Work Programme (EPA, 2015), the Local Transport Plan (2015), the Clean Air Plan (1st update, 2015), the Green City Master Plan (after the City of Aachen was sued by Deutsche Umwelthilfe regarding non-compliance with nitrogen dioxide limits, 2020), the Green City Master Plan (after the City of Aachen was sued by Deutsche Umwelthilfe regarding non-compliance with nitrogen dioxide limits, 2020). Update, 2015), the Green City Master Plan (after the City of Aachen was sued by Deutsche

Umwelthilfe for non-compliance with nitrogen dioxide limits in the city area, 2020), the Aachen 2030 Master Plan (land use plan, 2022) or transport development planning - as a process since 2012 towards a SUMP (Sustainable Urban Mobility Plan; winner of the Civitas Transformation Award 2021).

A decisive event on Aachen's path to climate neutrality dates back to June 2019, when Aachen City Council declared a climate **emergency** for the City of Aachen, which defines climate change and its existentially threatening consequences for humanity as the greatest and most important social task. This climate emergency was linked to the mandate given to the Climate and Environment Department (FB 36) to develop an **Integrated Climate Protection Concept** (Integriertes Klimaschutzkonzept, short: **IKSK 2020)** for the city. The aim of the IKSK 2020 was to halve Aachen's CO_2 emissions from 1990 levels by 2030. A total of around €181 million was made available for the implementation of the 2020 Integrated Climate Protection Concept, which was adopted by the city council in August 2020 (see attachment *IKSK 2020*), for the years 2021-2025. The climate protection targets for Aachen were tightened once again on 22 January 2020 when the city council decided that Aachen would be the first city in Germany to take into account its proportionate remaining greenhouse gas budget of 16.3 million tonnes of CO_2eq in order to keep global warming below two degrees celsius.

The still permissible CO_2 budget of the Federal Republic of Germany broken down to the City of Aachen (minus the polluters agriculture, industrial processes and waste management in the amount of approx. 5%) **thus amounts to 16.3 million tonnes** in absolute terms or approximately 7.5 years remaining, with CO_2 emissions of the City of Aachen of 2.139 million tonnes in 2018 as a reference value.

As a result, in May 2022, Aachen City Council adopted the Aachen Climate Neutral 2030 motion. This set the current target for the City of Aachen of achieving climate neutrality by 2030. The **council resolution on climate neutrality in 2030** instructed the city administration to update the existing IKSK with the goal of climate neutrality in 2030 and present it by the end of 2023 (**IKSK 2.0**). The new concept should include all of the city's direct and indirect options for reducing emissions. This update was carried out under the leadership of Department 36 with the support of GERTEC GmbH and the Wuppertal Institute in 2023. In September 2021, Aachen City Council created the new **Department VII Climate and Environment, City Operations and Buildings** and appointed Councillor Heiko Thomas as of 1 November 2021.

The ambitious goal of climate neutrality by 2030 not only requires new structures and measures within the city administration, but also represents a joint task for the entire urban society. It also requires strong and active support from local, national and EU policy-makers in order to align existing directives and laws with the goal of climate neutrality and to adopt new ones. Additional public funding and financial resources, which must be provided by the state and federal governments and the EU, are urgently required for the implementation of climate measures.

With this in mind, the City of Aachen decided in 2021 to take part in the **EU mission 100 Climate-Neutral and Smart Cities by 2030 (100 CNSC)**. By joining forces with other German mission cities, Aachen can address its needs and interests with greater vigour at state and federal level. The same applies to the strong network of all EU mission cities at EU level. In addition, the Net Zero Cities expert network can be used to answer new questions, for example on indicators, GHG monitoring or financing options. The exchange within the international network also provides many ideas for the path to climate neutrality through successful best practice measures from other mission cities.

Participation in the 100 CNSC, in particular the drafting of the Climate City Contract, has also led to a new level of communication between the city administration and the various stakeholders. The common goal of climate neutrality has triggered an unprecedented sense of togetherness in the entire urban community and strengthened mutual dialogue. With the start of the EU mission, more talks were held with representatives from business, academia and the public, in which problems as well as possible solutions were communicated and discussed extensively. People in all sectors and areas identify with climate protection and sustainability in Aachen. This is also reflected in the 134 commitments made by urban society up to the time of submission for the Climate City Contract (see Chapter 5, Signatories and Chapter 2, Figure C-3).

Another strong motivation for the City of Aachen to apply to the EU mission was to gain easier access to funding and loans by receiving the mission label. The mobilisation of private capital and third-party funding will be crucial for the full implementation of all action plans. The use of the Mission Cities Capital Hub, which has been set up exclusively for cities with the Mission Label, is also important.

2 Goal: Climate neutrality by 2030

This chapter summarises the goal of climate neutrality by 2030 as defined in the Expression of Interest (EoI) for participation in the EU mission. This includes the city-wide ambitions for the 2030 horizon as well as a description of any exclusion areas and a summary of how these areas will be addressed beyond 2030.

Goal

Aachen wants to be a role model for climate protection in Germany and Europe. With the acceptance of the residents' application of the Klimaentscheid Aachen by Aachen City Council in May 2022, the goal of climate neutrality in 2030 was politically decided. In order to achieve net-zero emissions in the city, greenhouse gas emissions are to be reduced to a minimum and remaining (unavoidable) emissions are to be compensated.

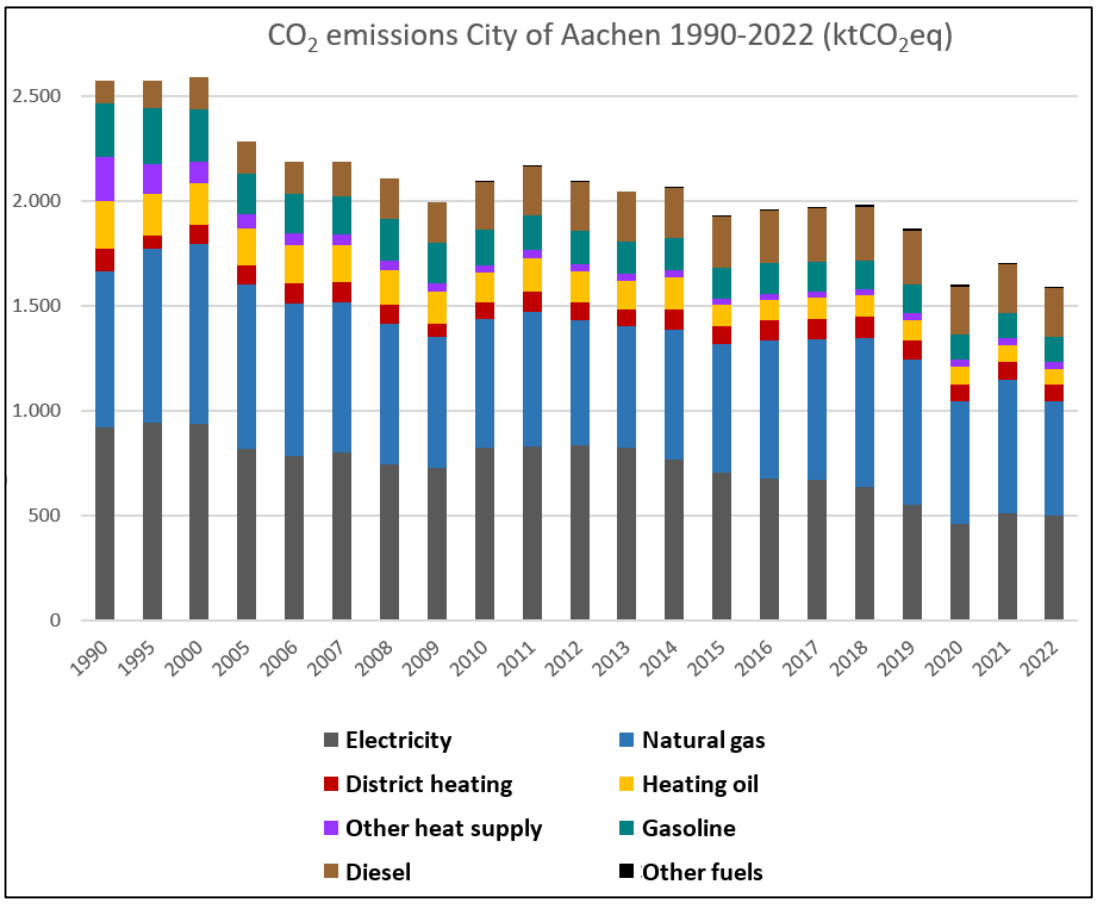


Figure C- 1 CO_2 emissions of the City of Aachen 1990-2022

Note: The calculations were carried out using the ECORegion balancing tool from Ecospeed AG (Switzerland) and differ slightly from those of the Economic Model (base year 2021: according to Ecospeed 1,706 $ktCO_2eq$ according to Economic Model 1,577 $ktCO_2eq$).

The CO_2eq emissions of 2,579 kt in 1990 were reduced by approx. 37 % to 1,626 kt by 2022.

The decision to make Aachen climate neutral by 2030 is in line with the definition of the Cities Mission and includes all territorial emissions within Aachen's geographical boundaries without exception. Aachen's urban area covers an area of 160.85 km^2, on which approx. 262,000 inhabitants live (as of January 2023), and has the following types of use: approx. 59.9% vegetation, approx. 29.7% settlement, approx. 9.9% traffic routes and approx. 0.5% water (for the distribution of population density across the urban area, see Figure AP-4).

In August 2020, the IKSK 2020 was adopted by Aachen City Council with the aim of halving the 1990 CO_2 emissions by 2030. A total of €120 million was made available for the years 2020-2025 to implement the necessary measures. With the update of the IKSK in 2023 to the goal of climate neutrality in 2030, the action plan for the city and city administration was significantly expanded. The attached action plan outlines Aachen's path to climate neutrality by 2030, while the investment plan describes the financial resources required to achieve

climate neutrality in Aachen by 2030. In the course of 2024, the integrated climate protection concept and the municipal budget will be updated with a view to 2030.

In order to fulfil the Climate City Contract and achieve climate neutrality by 2030, the City of Aachen has forged an alliance with relevant stakeholders. The ambitious climate targets can only be achieved if the city administration, business, academia and citizens work closely together. Partners such as municipal holdings, energy companies, grid operators, industry, investors, the construction industry, trades, commerce and universities are just as important as voluntary initiatives, educational and cultural institutions. At the time of submission, Aachen had received 134 commitments from the city society, demonstrating strong support and commitment from the urban community (see Figure C-3). Further partners will be added in the course of the mission.

In addition to achieving climate neutrality, this Climate City Contract also leads to a number of **additional benefits**. The energy, heating and mobility transition will create new employment opportunities in Aachen. The switch to renewable fuels and electricity will lead to a healthier environment with cleaner air and lower noise levels. Energy-saving technologies such as LED lighting or retrofitting buildings with intelligent technologies such as AI control of heating and ventilation will significantly reduce energy costs. Climate adaptation measures also offer additional benefits for citizens and the environment: rainwater management is optimised, the risk of urban heat islands is reduced and the city as a whole becomes greener. Everyone in Aachen will benefit from climate protection, both financially and in terms of health.

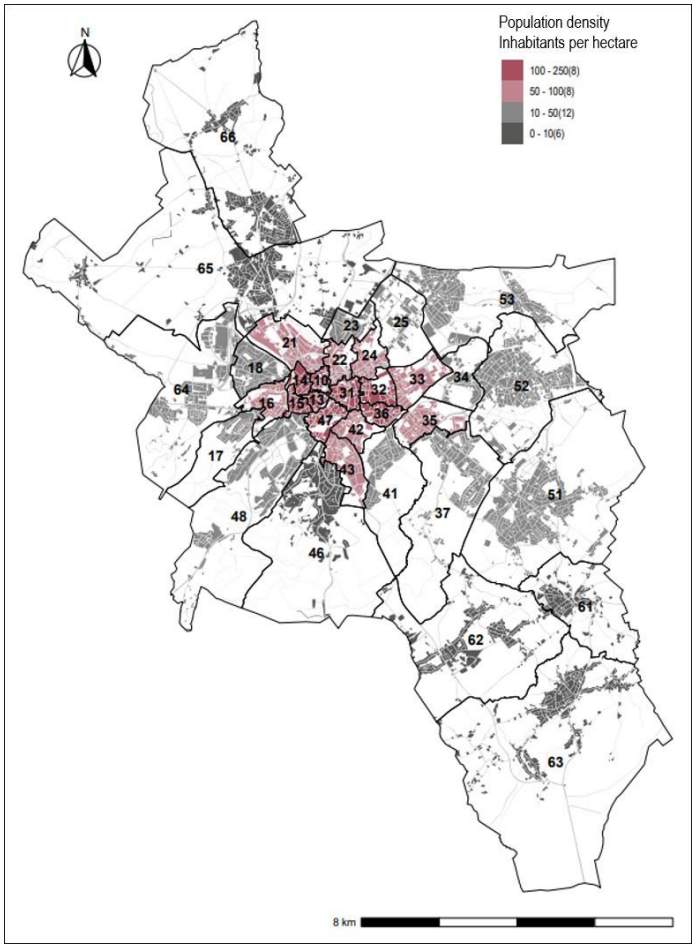


Figure C- 2 Population density in the Aachen city area 2021
Source: statistisches_jahrbuch_2020-2021.pdf (aachen.de)

Figure C- 3 Overview ot the 134 signatories to the CCC
See Figures C - 4 and C - 5 for an analysis of those expressing commitment.

3 Strategic priorities

This section summarises the strategic systemic priorities that need to be implemented in the city to become climate neutral by 2030.

Strategic priorities
Aachen is facing up to the major challenges associated with the goal of climate neutrality by 2030. Politicians and citizens have given the city administration a clear mandate and are calling for decisive and concerted action. The IKSK 2020 and the report "The path to climate neutrality 2030" (IKSK 2.0), which was completed at the end of 2023, set out the strategic priorities: • Buildings • Energy supply • Mobility • Economy • Social transformation Note: A distinction is made between the core measures of the IKSK 2020 and those of the IKSK 2.0.

Table C - 1 Central priorities of the city administration and municipal holdings for the transition to a climate-neutral city by sector.

Building	
Core measures IKSK 2020[1] until 2025	– Refurbishment of municipal residential and non-residential buildings – PV systems on all municipal buildings – Promotion of private energy-efficient refurbishments
Further core measures[2] by 2030	– Energy-efficient monument conservation – Redevelopment model area: eastern city centre – Climate campaign for leasehold properties in the city – Use of the city's own surplus wood for heat and energy generation
Energy supply	
Core measures IKSK 2020[1] until 2025	– Municipal heat planning for Aachen – Expansion of the district heating network – Expansion of wind power

	– Decentralised electrified heat supply
Further core measures[2] by 2030	– Climate-neutral electricity and heat supply for properties under municipal control – Photovoltaics on open urban spaces – Concept for the structurally optimised use of geothermal energy in Aachen
Mobility	
Core measures IKSK 2020[1] until 2025	– Expansion of the cycle path network – Expansion of the public transport network – Expansion of public transport services – Expansion of P+R facilities – Procurement of electric and hydrogen buses – Expansion of electromobility – Regiotram
Further core measures[2] by 2030	– Operational mobility management for the city administration – Conversion of the municipal fleet (incl. refuse collection vehicles) to climate-neutral drive train – Expansion of charging infrastructure – Zero-emission zone – City centre mobility concept
Economy	
Core measures IKSK 2020[1] until 2025	– Funding programmes for climate protection measures in companies – Climate-neutral industrial areas – Regenerative energy generation in industry – Development of hydrogen network
Further core measures[2] by 2030	– Circular economy in the construction industry – Sustainable transformation of retail and catering – Agroforestry – Development of a building yard of the future for Aachen's municipal operations – Strengthening organic farming in urban lease agreements – Conversion of processes to hydrogen technology
Social transformation	
Core measures IKSK 2020[1] until 2025	– *KlimaRegion* energy cooperative – Climate campaign "Climate protection. We. Now." – Sustainability competitions – Communication campaign (e.g. via the aachen.move app) – Increased citizen involvement – Incentives to change behaviour – Establishment of a climate agency
Further core measures[2] by 2030	– Training of volunteer climate trainers – Expansion of activities for education for sustainable development in schools – Unsealing of school and daycare centres

1: Politically decided and planned in the municipal budget, for a complete overview of measures, see IKSK 2020

2 From the report The path to climate neutrality in 2030, subject to political decision and financing, for a complete overview of measures, see The Contribution to Climate City Yield Volume 4 - Activities

The far-reaching transformation processes require the participation of many stakeholders in the city and urban society. Politicians and the city administration must lead by example through clear decisions and consistent action. This is the only way to convince urban society of the city's determination to achieve the ambitious goal of climate neutrality by 2030 and motivate it to act.

The greatest potential for saving emissions lies in the energy, heating and mobility sectors. Local energy suppliers, grid operators and mobility providers are therefore essential partners on the road to climate neutrality. Business and trade also have great savings potential and leverage. But ultimately, the commitment of every citizen is necessary for the transformation of society as a whole and climate neutrality to succeed.

In view of the shortage of skilled labour in climate-related professions throughout Germany and the need for innovation in the energy and heating sector, the importance of schools and universities is clear. Aachen is ideally positioned here with the university RWTH Aachen and the FH Aachen (university of applied sciences), as well as committed secondary schools and educational institutions. The commitments of the universities and educational institutions can be found in the table in Chapter 5 and Appendix 2.

In order to achieve the commitment of citizens, the first step was to involve voluntary environmental and climate protection initiatives in Aachen in the preparation of the report The Path to Climate Neutrality 2030. Some of them have made a commitment to the Climate City Contract with their own activities (see table in Chapter 5 and

Appendix 2). In addition, events on climate protection and sustainability were organised for citizens. Further events will follow in 2024. A climate campaign is also planned, which will provide information about existing and future offers and funding programmes, and give far-reaching tips on changing behaviour.

In order to increase the likelihood of measures from the urban community being implemented, a further participation and financing model is to be developed in line with the Climate Neutrality 2030 objective. This climate fund, which will particularly promote the implementation of measures in the area of the energy and heat transition, is also intended to give citizens and companies the opportunity to participate directly and, in this case, financially in shaping climate neutrality. An instrument is to be developed here that addresses not only the question of financing but also the question of active simple participation, in which the "donors" ultimately also decide which measure is to be implemented here as a priority, since the payments are, for example, linked to individual measures in terms of project and use. Aachen will ensure that all activities are socially equitable and include and consider all sections of the population. This is the only way to bring about change in society as a whole.

4 Process and principles

This section describes the systemic processes, key principles, and monitoring of the City of Aachen to achieve the climate neutrality target by 2030. Furthermore, the intention to update the Climate City Contract is expressed.

Process and principles

4.1 Building a strong mandate

The implementation of the Climate City Contract in Aachen is supported by a broad alliance. Local politicians, the city administration, and urban society collectively take responsibility for implementing specific and far-reaching measures to achieve the ambitious goal of climate neutrality by 2030. In addition, state and federal political actors are regularly addressed in order to hold all political levels accountable for achieving the climate target.

In June 2019, **Aachen City Council** declared a climate emergency for Aachen. The city administration was tasked with drawing up a climate protection strategy and an action plan for the years 2020-2025. This was to fulfil the goal of halving greenhouse gas emissions from 1990 levels by 2030. The result was the Integrated Climate Protection Concept, which was adopted by the city council on 26 August 2020. Funding of €120 million was allocated for the implementation of the outlined measures, including the appointment of 36 climate protection managers across all departments.

On 22 January 2020, the climate protection targets were adapted to the prevailing global circumstances through a resolution passed by the council. These targets are based on the resolution passed by the international community at the United Nations (UN) Climate Change Conference in Paris in 2015. With this resolution, the City of Aachen is the first city in Germany to take into account its proportionate remaining budget of greenhouse gases in order to keep global warming below two degrees, or 1.5 degrees if possible.

As a result, in May 2022, Aachen City Council adopted the "Aachen Climate Neutral 2030" motion. Klimaentscheid Aachen collected more than 11,000 signatures from citizens for this motion. The council resolution on climate neutrality in 2030 instructed the city administration to update the existing IKSK to include the goal of climate neutrality in 2030 and to present it by the end of 2023 (IKSK 2023). The new concept will include all of the city's direct and indirect options for reducing emissions, Implementation will start directly following its submission.

4.2 Participation in EU mission “100 Climate-Neutral and Smart Cities”

The EU mission is seen as a great opportunity to achieve the goal of climate neutrality by 2030 with greater acceleration and support. As early as November 2021, when the **Expression of Interest** for Aachen's application to become a Mission City was drawn up, there was cross-departmental collaboration within Aachen's city administration. The lead department, Department 36 Climate & Environment of Department VII Climate & Environment, City Operations and Buildings was actively supported in the application process by Department 60 Contract, Procurement and Funding Management of Department III Urban Development, Construction and Mobility and other departments and divisions of the city administration.

With the selection as an EU Mission City in April 2022, the internal administrative **transition team** was set up under the leadership of Councillor Heiko Thomas. The councillors of Departments III and VII, Frauke Burgdorff and Heiko Thomas, have jointly put together a team of representatives from different departments, which they manage together. In April 2023, the **Climate-Neutral Aachen 2030 office was** set up in the municipal association altbau plus e.V., which has a particular impact on urban society, as well as on the city administration via various communication channels. The activities of the "Climate Neutral Aachen 2030" office are regularly reported to the **Administrative Board.** This committee of department heads and the Lord Mayor serves as a source of ideas, sparring partner, and catalyst for the implementation of the Climate City Contract. In order to coordinate the work of the transition team, two closed meetings were held in March and August 2023, led by an external consultancy firm. This consultancy was also commissioned to support the formation of a new **governance structure** within the city administration. To this end, various interviews and workshops were conducted with employees of the city administration and the transition team in 2023.

The management and Strategic Projects Unit of Department 60 organised an **administrative tour.** During this tour, 12 departments from various divisions within the city administration were informed about the objectives of the EU mission and the Climate City Contract, and a sense of responsibility for the implementation of climate neutrality measures in the city administration was awakened.

In addition, various internal administrative bodies, such as the **climate protection conference,** were used to regularly inform department heads about the EU mission and the Climate City Contract. The advancement of each climate protection measure is reported and deliberated upon at the operational level during biweekly meetings of the designated climate protection team. The Climate Protection Conference and the Climate Protection Team are both led by Department 36.

With more than 6,000 employees, Aachen's city administration is the second largest employer in the region. It is organised into seven departments, 23 specialist areas, six district offices, and six municipal enterprises. The entire city administration was actively involved in drawing up the catalogue of measures for the report on Aachen's 2030 climate neutrality objective, aiming to foster widespread alignment with the overarching goal of climate neutrality within the city administration. In spring/summer 2023, four workshops were held with city employees to develop far-reaching measures that will lead to climate neutrality in 2030. The outcome comprised over 200 measures that Gertec prioritised based on their potential impact and speed of implementation. These measures were brought together in the **report "The path to climate neutrality 2030",** which was finalised in November 2023 and comprehensively describes Aachen's path to climate neutrality in 2030.

The report was presented and discussed in the following political committees:

- 05.12.2023: Planning and Property Committee
- 14.12.2023: Mobility Committee
- 18.01.2024: Planning committee
- 23.01.2024: Committee for Environmental and Climate Protection
- 06.02.2024: Committee for Labour, Economic and Regional Development

The Aachen City Council will vote on IKSK 2.0 in March 2024, the IKSK 2.0. The outcome of this meeting will be provided at a later time.

4.3 Stakeholder Engagement

A municipality can only achieve climate neutrality with the involvement of the entire **urban community**. Therefore, starting in 2023, various events were organised and existing formats utilised to provide information about the mission and the CCC. The aim was to unite as many people as possible behind the goal of climate neutrality by 2030 and to encourage them to make their own commitment to the Aachen Climate City Contract. These events were supplemented by company visits and individual speeches. It was important to reach all relevant stakeholders who are involved in the energy, heating, and mobility transition, for example, but also innovators and scientific institutions as solution providers. A list of the events and companies/institutions visited can be found in the Action Plan, Chapter 1 Introduction.

In order to standardise the contributions from urban society and make them comparable, a template was drawn up by the transition team and made available to the co-signatories for signature (see Appendix 1).

PREMIUM partners commit to drawing up their own climate protection concept with the aim of achieving climate neutrality by 2030 or 2025. FRAMEWORK partners implement individual measures that contribute to a reduction

in their greenhouse gas emissions. BASIS partners support the City of Aachen in achieving the goal of climate neutrality through projects or activities whose effect on greenhouse gas emissions is not directly measurable, but which, for example, help to activate civil society or pursue goals such as increasing biodiversity. LoI signatories will formulate their own measures for the next version of the Climate City Contract.

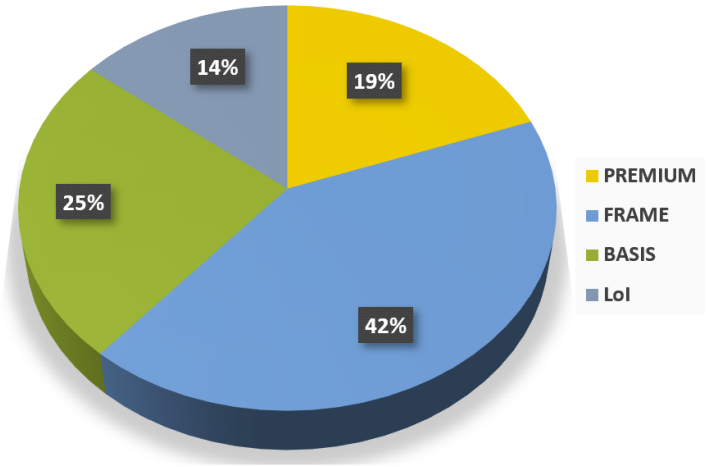


Figure C- 4 Distribution of partnership types (all 134)

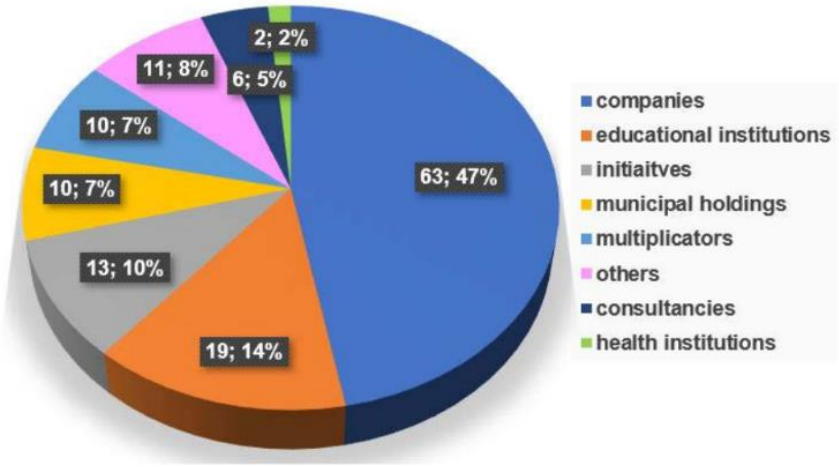


Figure C- 5 Distribution of the 133 commitments (excluding the City of Aachen) among different stakeholder groups. Absolute and percentage figures.

At the time of submission, 134 signatures have been collected in favour of the Aachen Climate City Contract (see Figure C-3 for an overview). An impulse and steering committee will be set up for the further development of the Climate City Contract and the implementation of further measures, in which the Lord Mayor, members of the administrative board, and representatives of all council parties will regularly exchange ideas with representatives of chambers, associations and PREMIUM partners of the Climate City Contract, as well as civil society. The aim is to incorporate the needs of the business community more strongly into the City of Aachen's climate protection policy and to prepare relevant political decisions (see also Action Plan Figure AP-11 and textual explanation).

The participation of Aachen's citizens is a central concern of the City of Aachen on the road to climate neutrality. The participation formats include low-threshold participation, which primarily aims to disseminate information and strengthen transparency around decisions to achieve climate neutrality through the mission. To this end, numerous events were organised during the development of the Climate City Contract, often in cooperation with the numerous climate initiatives that already exist in the City of Aachen (the we@Aachen project has identified 220 such initiatives). One successful example of this is the **"Sustainability Impulse Week",** which was organised in September 2023.

In addition, as part of the German pilot project **"CoLAB - Committed to Local Climate Action Building",** further strategies for citizen participation and innovative formats for citizen commitments to the Climate City Contract are to be developed together with the cities of Mannheim and Münster. In Aachen, preparations are underway within

CoLAB to establish a **climate agency** will consolidate offerings for citizens and companies regarding sustainability, energy and climate protection topics.

The City of Aachen is also distinguished by citizen participation formats that exhibit a high level of commitment. Above all, this serves to create a strong mandate together with the citizens. Examples include referendums, e.g. on the climate decision Climate-Neutral Aachen 2030 (see above, with almost 12,000 signatories; https://klimaentscheid-aachen.de/) or the cycling decision (in favour of improved cycling infrastructure in Aachen with more than 35,000 signatories; https://radentscheid-aachen.de/). As part of these referendums, regular meetings are held between the administration and the representatives of the climate and cycling referendums in order to compare the planned measures, e.g. the IKSK, for their conformity with the referendum. Aachen is also the first city in Germany to set up a permanent citizens' council ((https://buergerinnenrat.aachen.de/). In this Citizens' Council, Aacheners come together two to three times a year to discuss urban issues, including relevant topics from climate and environmental policy that are important for the mission of climate neutrality in Aachen. The results from the Citizens' Council are an important source of advice for politicians and the administration.

Aachen therefore also plays a pioneering role in the area of citizen participation. The city was awarded the federal "Cooperative City" prize by the Federal Ministry of the Interior, Building and Community in May 2021 for its efforts in the area of exemplary and creative cooperation ideas.

(https://www.aachen.de/de/stadt_buerger/gesellschaft_soziales/ehrenamt/17_Kooperative-Stadt/index.html).

A fundamental principle driving the City of Aachen's commitment to extensive citizen participation is to foster a socially equitable transformation. This means taking all citizens along on the path to a climate-friendly economy and way of life, leaving no one behind on this path. In pursuit of this objective, it is imperative to consider the interests of frequently marginalised or otherwise overlooked population groups, commonly referred to as "silent groups," throughout the decision-making process associated with the climate neutrality mission. This approach aims to minimise or alleviate any adverse effects on these groups resulting from activities to the greatest extent possible. In addition, measures from the Climate City Contract that improve the structural situation of disadvantaged groups should be swiftly initiated or prioritised. One concrete measure from the IKSK is the pilot project for the introduction of a municipal climate money. The City of Aachen is paying a municipal climate money into a fund, which will initially be paid out to 1,000 recipients of the Aachen Pass. The aim is to compensate for social hardship caused by rising CO2 prices by providing benefits in kind or financial support. As part of the pilot project, possible sources of income are to be identified and the payment mechanisms developed and tested. One example of further socially responsible funding under the IKSK is the cargo bike funding programme for families. Since 2022, the aim of this funding programme has been to make the purchase of cargo bikes more attractive and affordable for more families. An important new feature of the funding guideline is the social grading of the funding amounts (https://www.aachen.de/DE/stadt_buerger/verkehr_strasse/clevermobil/lara/index.html).

To facilitate such inclusive participation and establish participation on a broad basis, thereby engaging target groups that are typically hard to reach, it was important from the outset to obtain commitments from organisations that can act as multipliers for joint support from all social groups, such as trade unions or church congregations. The City of Aachen has obtained commitments from churches, Misereor, Missio and groups such as the carol singers and scouts. In addition, commitments from schools, kindergartens and clubs, and thus the use of established or familiar spaces for communication, are intended to create further opportunities for the participation of all social groups in the transformation process.

A key approach to strengthening multi-level governance is the merger of the nine German cities participating in the EU mission 100 Climate-Neutral and Smart Cities by 2030 to form the **stronGER Cities network** in order to jointly create favourable framework conditions for achieving climate neutrality at federal level. The German Mission Cities are also supported in this endeavour by the German Association of Cities. At federal level, a steering forum was set up in 2023 under the leadership of the BMWSB (Federal Ministry of Housing, Urban Development and Building) and the BMBF (Federal Ministry of Education and Research) with the participation of the BMWK (Federal Ministry of Economics and Climate Protection), which deals with climate protection issues in Germany. Representatives of stronGER Cities are permanent members of this steering forum and put the support needs of the Mission Cities on the agenda.

At state level, the three Mission Cities of Münster, Aachen and Dortmund have forged an alliance and jointly address the state government, which is very supportive of the process. The support of the higher level of government in NRW will strengthen and expand the scope for action at municipal level.

4.4 Monitor and update the CCC

With the adoption of the IKSK 2020 by Aachen City Council in May 2022, the implementation of the 70 measures named therein has begun. In the course of 2024, further measures from the 2023 report "The Path to Climate Neutrality 2030" will be adopted. Department 36 records the **implementation status of the municipal measures** annually. Department 36 also prepares an annual **balance sheet of CO_2 emissions** for the city. This balance sheet includes a final energy balance, primary energy balance (life cycle assessment method), and a CO2 emissions balance (LCA) to assess the development in terms of target achievement.

In the future, the monitoring of measures will also include those of the commitment donors. This task is the responsibility of the Climate-Neutral Aachen 2030 office. In addition, the balancing of CO_2 emissions in FB 36 is to be expanded to encompass emissions in the city area that are not caused by energy consumption. The network of the 100 EU Mission Cities and Net Zero Cities will be used to define and implement standardised and recognised indicators.

The focus of future work will be:

- Implementation of prioritised climate protection measures
- Development of a comprehensive monitoring and balancing system
- Obtaining external funding for measures outside the municipal budget
- Introducing political demands at state, federal and EU level
- Implementation of innovations to reduce/compensate emissions
- Strengthening cooperation between the players in Aachen
- Development of digital solutions to support climate work
- Activation of citizens to help shape the programme

This work will significantly strengthen climate commitment and climate protection measures in Aachen.

The continuation of the Climate City Contract is realised in parallel top-down and bottom-up strategies through the networking of municipal and civic measures and projects (Figure C-6). In the top-down approach, control options arise through the direct and indirect influence of the City of Aachen within the framework of local self-government. To this end, the implementation of the IKSK is regularly evaluated and expanded to include further possibilities with regard to measures and activities of the City of Aachen. The bottom-up approach focuses on obtaining further commitments and initiating and promoting projects and measures as citizen projects, as well as projects by companies and associations. These are integrated into the implementation strategy of the climate neutrality strategy as part of the Climate City Contract and thus form the engine for the continuous change process.

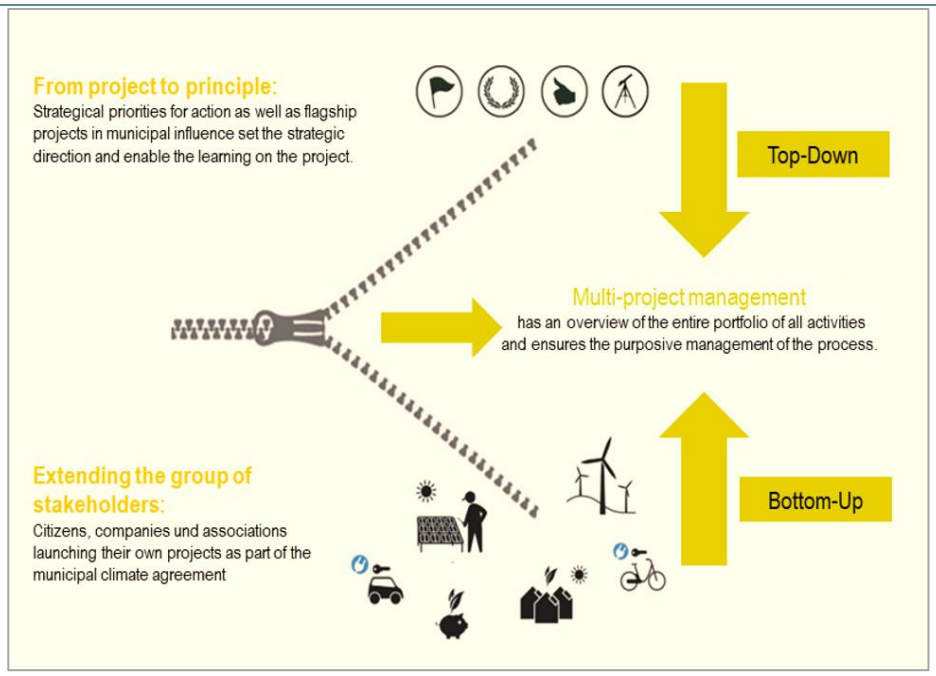


Figure C- 6 Top-down and bottom-up strategy for implementing and updating the CCC
Source : Gertec GmbH

The City of Aachen will update its Climate City Contract every two years. This serves to incorporate new strategies and plans that have been politically adopted. The update will also include a report on the implementation status of the measures and an updated list of co-signatories (commitments).

NET ZERO CITIES

EU MISSION PLATFORM | CLIMATE NEUTRAL AND SMART CITIES

Climate City Contract

Green House Gas Inventory 2022

City of Aachen

NetZeroCities has received funding from the H2020 Research and Innovation Programme under the grant agreement n°101036519.

Energy and CO_2 inventory of the city of Aachen for 2022

1 Explanations

A CO_2 balance sheet for the city of Aachen has been drawn up regularly since 1993 and annually since 2010. The international reference year 1990 was selected as the base year. The balance includes a final energy balance, primary energy balance (Life Cycle Assessment method, LCA) and a CO_2 emissions balance (LCA) to assess development in terms of target achievement. The calculations are carried out using the ECORegion balancing tool from Ecospeed AG (Switzerland).

The balancing is based on the data collected annually on energy fed into the municipal supply grids (Regionetz/Stadtwerke Aachen (STAWAG), consumption data from building management and municipal operations, chimney sweep data, data from city statistics (basic framework: Population, vehicle kilometres, labour statistics and federal statistics, as well as data provided by the state of NRW).

It records the final energy requirements and consumption within the City of Aachen balancing area, i.e. essentially the local electricity, gas, district heating, heating oil and fuel consumption. The primary energy balance (LCA) based on this also includes the so-called upstream chain shares of the respective final energy sources used, i.e. the effort required to extract or produce and transport the energy to the end consumer in Aachen. Finally, the CO_2 balance sheet is drawn up on the basis of the LCA balance sheet.

2 Adjustment of the "Mobility" balance sheet

For the year 2022, the transport sector was recognised for the first time according to the territorial principle instead of the polluter-pays model. This adjustment was necessary in order to fulfil the so-called "BISKO" (Bilanzierungs-Systematik Kommunal) standard preferred by most cities and municipalities today.

Previously, the emissions balance was calculated on the basis of vehicles registered in Aachen and national average values for kilometres driven, fuel consumption, etc. for the vehicle population. In contrast, when applying the territorial principle, only the emissions emitted by vehicles in the Aachen city area (through traffic, commuter traffic, traffic in Aachen) are included in the balance. Data from the ifeu Institute (Institut für Energie- und Umweltforschung Heidelberg gGmbH) is used as the data source. These are published annually for each municipality. The advantage of this for the balance sheet is that it uses data that is specific to the urban area and that local/regional mobility measures, such as increasing cycling or walking, are more visible in the balance sheet. The disadvantage is that the per capita emissions of CO_2 for the urban society are only incompletely recorded (without extra-urban journeys, air traffic).

In the interests of standardisation and comparability with regard to the savings rate achieved to date, the balance sheet was retroactively adjusted to the new BISKO system back to the reference year 1990. The territorial principle results in final energy consumption and emissions for the transport sector that are around 25 and 30 % lower than the previously used polluter-based balance. As a result, the city-wide CO_2 balance across all consumer sectors is also reduced by around 10 %.

NetZeroCities has received funding from the H2020 Research and Innovation Programme under the grant agreement n°101036519.

3 Final energy consumption of the city of Aachen by energy source

At 5,427 GWh (gigawatt hours), the final energy demand (not weather-adjusted) across all consumer sectors in 2022 is approx. 7.4 % below that of the previous year 2021 (5,859 GWh) and approx. 22 % below that of the base year 1990 (6,958 GWh).

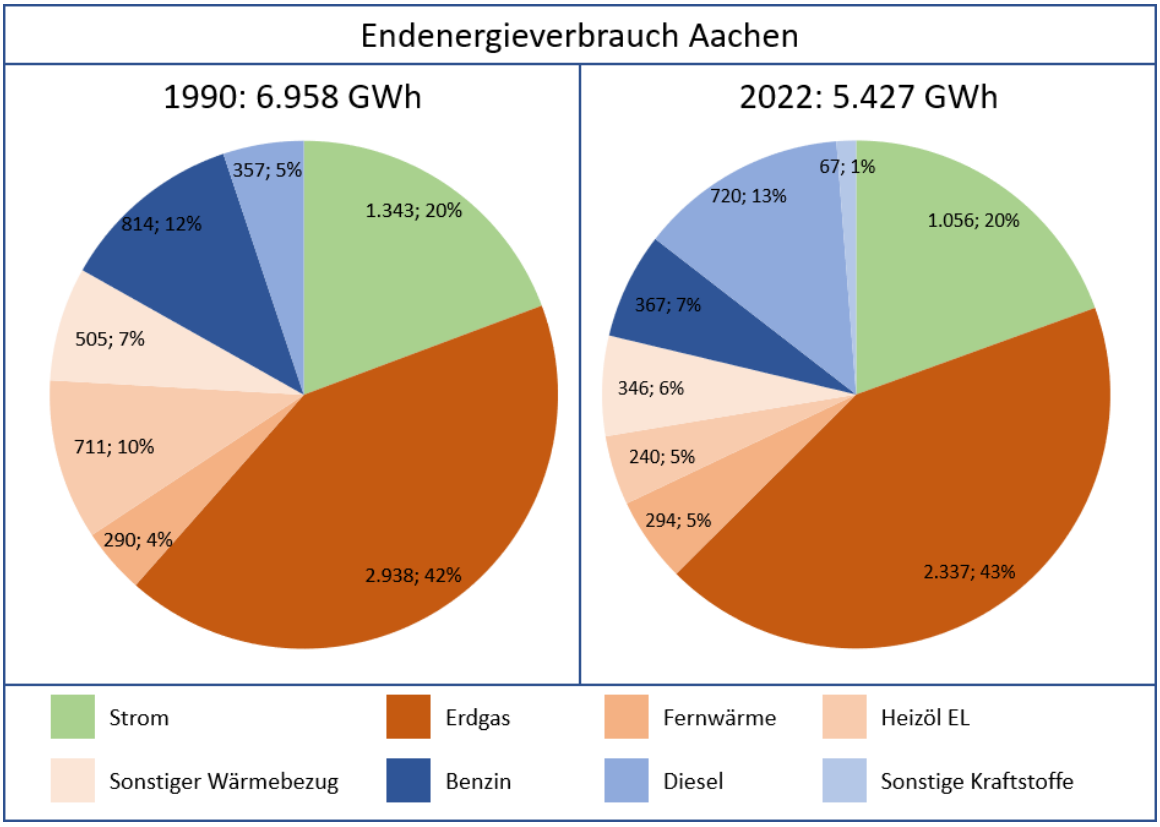


Figure 1 : Final energy consumption of the city of Aachen in 1990 and 2022 by energy source

Figure 1 shows the final energy consumption of the city of Aachen for the years 1900 and 2022 by energy source. Proportionally, diesel fuel (more), petrol (less) and heating oil (less) have changed significantly.

The final energy consumption in GWh by energy source for 2022 shows the following breakdown by energy source (see Figure 2) Heat incl. gas-based local electricity generation (orange):

The largest share of final energy consumption today is heat supply (approx. 59 %), which is provided by natural gas (2,337 GWh; 43 %), district heating (327 GWh; 5 %) and heating oil (266 GWh; 4 %).

The proportion of renewable heat generation (solar heat, environmental heat), summarised in the "Other heat procurement" area, is slightly above the level of heating oil and is growing continuously due to the addition of electricity-led heating systems in new and existing buildings. Solid fuels such as wood or coal no longer play a significant role in heat consumption today.

Compared to 1990, it is clearly recognisable that the demand for heating oil in particular has fallen significantly by around 2/3 by 2022. The overall lower heat demand can be explained by better insulated buildings and more efficient heat generation, but also by the significant decline in energy-intensive industry (Philipps/Glas, Continental/Tyres) in Aachen. In addition, less heat was purchased in 2022 due to higher energy prices as a result of the war in Ukraine.

Electricity (green):

The amount of electricity fed into Aachen's electricity grid has fallen significantly since 1990 and totalled 1,056 GWh in 2022. However, it can be assumed that an additional approx. 300 GWh of electricity is currently provided by in-house generation in industry and commerce and consumed directly there; due to a lack of precise key data, the gas requirements of in-house electricity generation are allocated to the heating sector (natural gas) in the balance sheet (see above). If gas-based electricity generation in Aachen is considered, Aachen's electricity demand has so far remained surprisingly stable at 1,300 to 1,400 GWh.

Of the total electricity feed-in, 153 GWh was generated by renewable energy sources in the Aachen city area and 903 GWh was transported to Aachen from the supra-regional electricity grid. The share of local renewable energies in the total electricity fed into the Aachen grid is growing slowly but steadily and is currently made up of 106.3 GWh of wind power (=10.1%), 23.4 GWh of solar power (=2.2%), 22.7 GWh of biomass power (=2.1%) and 0.7 GWh of hydropower (=0.07%).

Fuels (blue):

Local fuel consumption for vehicles accounted for 21% of the city's final energy demand in 2022. Diesel vehicles accounted for the largest share of this at 720 GWh and petrol vehicles at 367 GWh; the share of diesel has therefore increased significantly compared to 1990. Other fuels also include biodiesel and petrol. Aviation fuels are no longer shown in the balance due to territorial accounting.

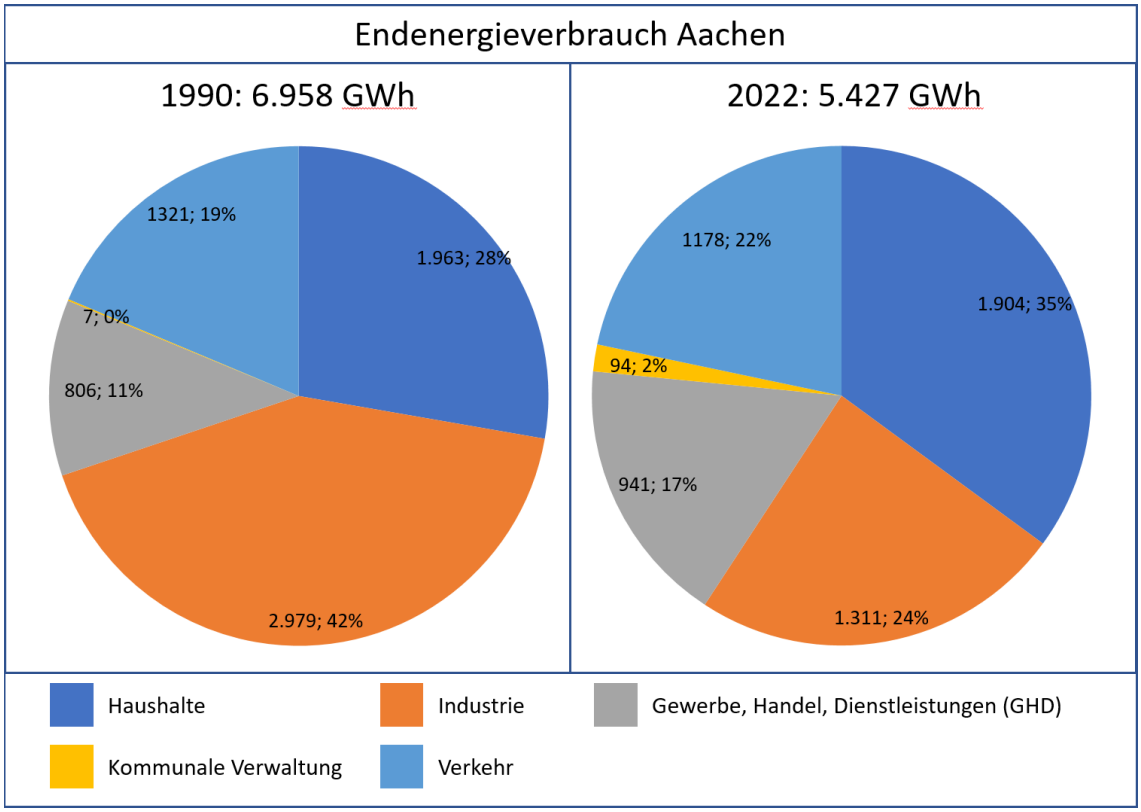


Figure 2 : Final energy consumption of the city of Aachen in 1990 and 2022 by consumption sector

Figure 2 shows the distribution of final energy consumption by consumer groups (sectors). Households (1,904 GWh, 35 %), industry (1,311 GWh, 24 %) and the transport sector (1,178 GWh, 22 %) dominate, followed by the trade, commerce and services sector (941 GWh, 17 %). The share of municipal administration is 94 GWh, 2 % (note: in 1990, there was no precise record of this. It has also not yet been possible to record the universities and state institutions separately, but this is likely to be in the region of 5 - 10 %.

The significantly lower final energy consumption of industry, both in relative and absolute terms, is also clearly recognisable.

4 CO_2 emissions of the city of Aachen

At 1,594 thousand tonnes of CO_2 (thousand tonnes of CO_2), the CO_2 emissions caused by the city of Aachen's primary energy consumption in 2022 are 38 % below those of the base year 1990 (2,579 thousand tonnes of CO_2).

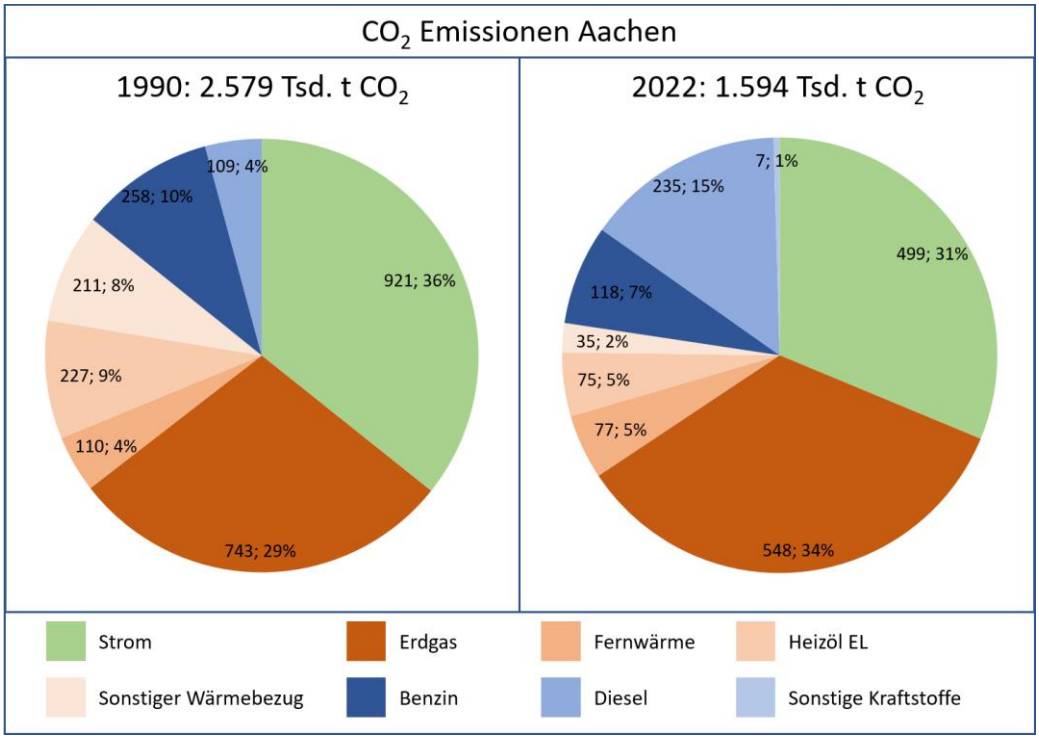


Figure 3 : CO_2 emissions of the city of Aachen in 1990 and 2022 by energy source

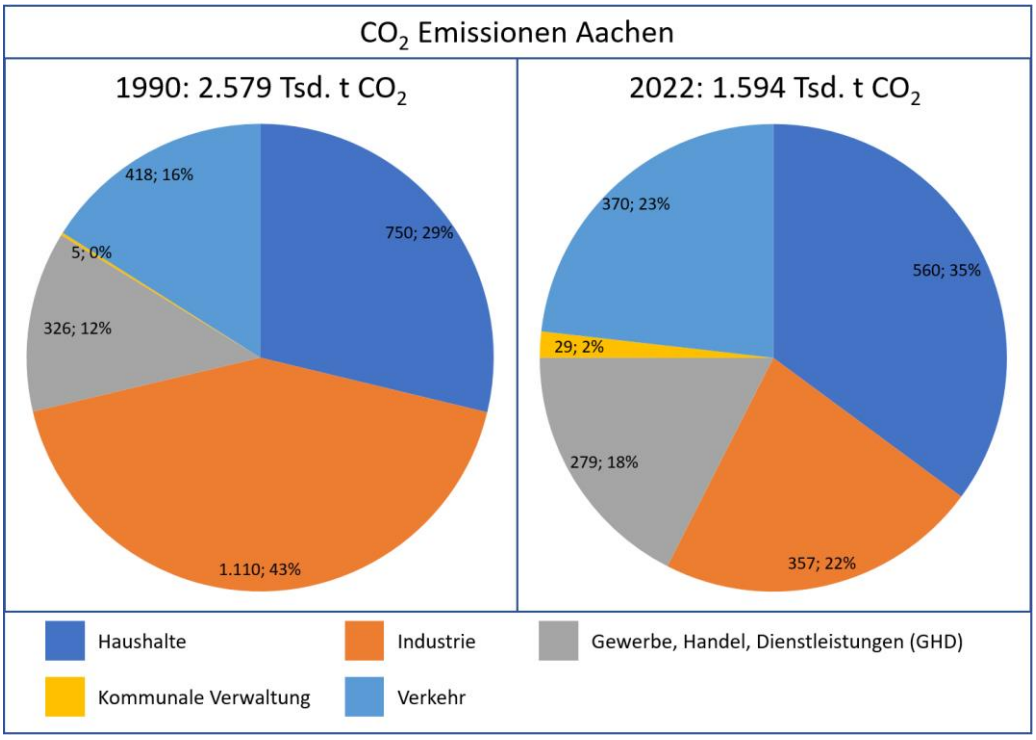


Figure 4 : CO_2 emissions of the city of Aachen in 2022 by consumption sector

Figure 3 and Figure 4 show the distribution of CO_2 emissions across the individual consumption sectors and energy sources. These show a largely analogous picture to the distribution of the final energy requirements of the individual sectors. Of the 1,594 thousand tonnes of CO_2 emissions for the city as a whole (100%), the local transport sector accounts for 370 thousand tonnes of CO_2, 23%, industry for 357 thousand tonnes of CO_2 , 22%, commerce for 279 thousand tonnes of CO_2 , 18% and households for 560 thousand tonnes of CO_2 , 35%. A further 29 thousand tonnes of CO_2, i.e. ~2 % of the city's total CO_2 emissions, are attributable to municipal buildings.

In addition, the Figure 3 shows a significant drop in emissions in the electricity sector (422 thousand tonnes of CO_2, 46 %). This is primarily due to the significantly improved CO_2 factor (decline in coal-fired power generation and expansion of renewables).

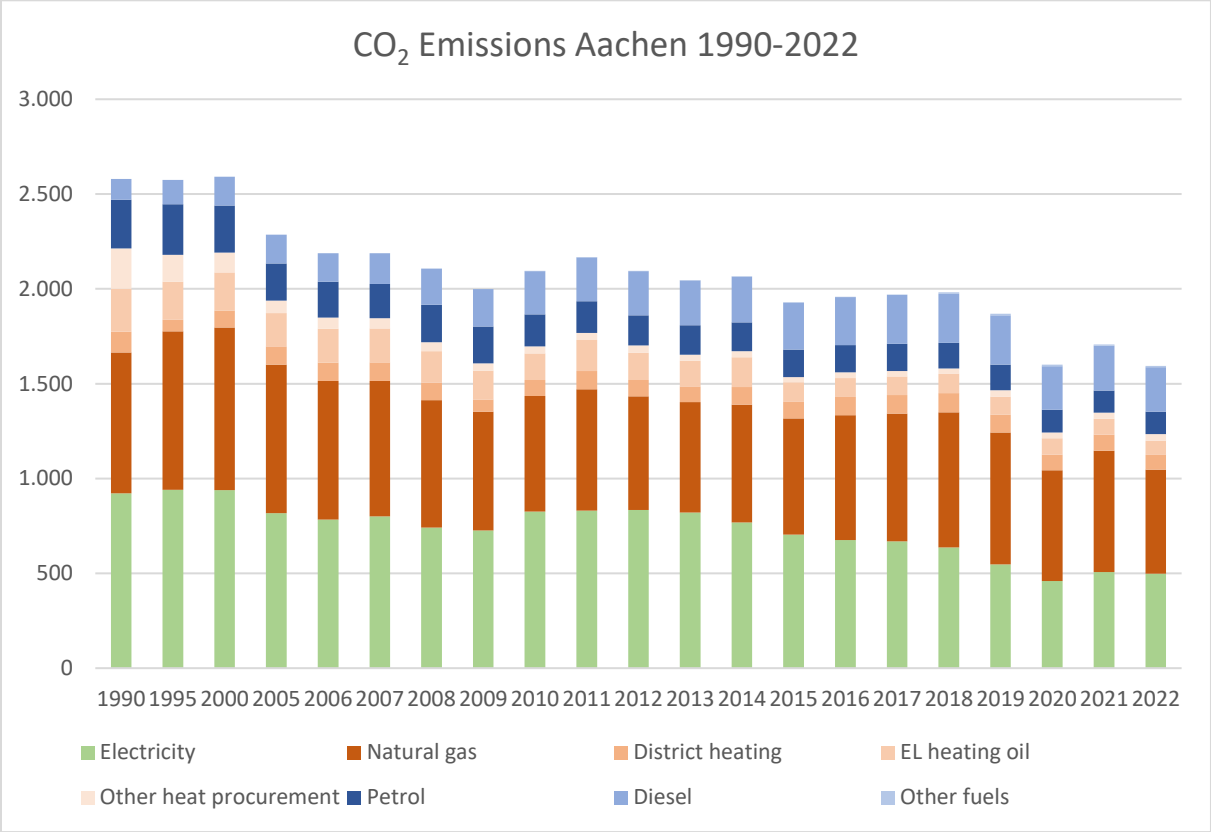


Figure 5 : CO_2 emissions trend since 1990

Figure 5 shows the development of CO_2 emissions since 1990. At 1,626,000 tonnes of CO_2 in 2022, these are around 118,000 tonnes of CO_2, which is 6.7% below the previous year's figure and 7,000 tonnes of CO_2 below the figure for the "coronavirus year 2020". Per capita CO_2 emissions in 2022 therefore amounted to around 6.1 tonnes of CO_2. This even corresponds to a 40 % reduction in per capita emissions since 1990 (then 10.2 t CO_2). The recent significant drop in heat consumption (especially natural gas) is strongly characterised by the effects of the war in Ukraine and the associated energy price developments.

In the heating sector alone, weather-adjusted emissions fell by 109 thousand tonnes of CO_2 (-12%) compared to the previous year. Emissions in the electricity and mobility sectors, on the other hand, remained at almost the same level.

5 Power generation from renewable energies

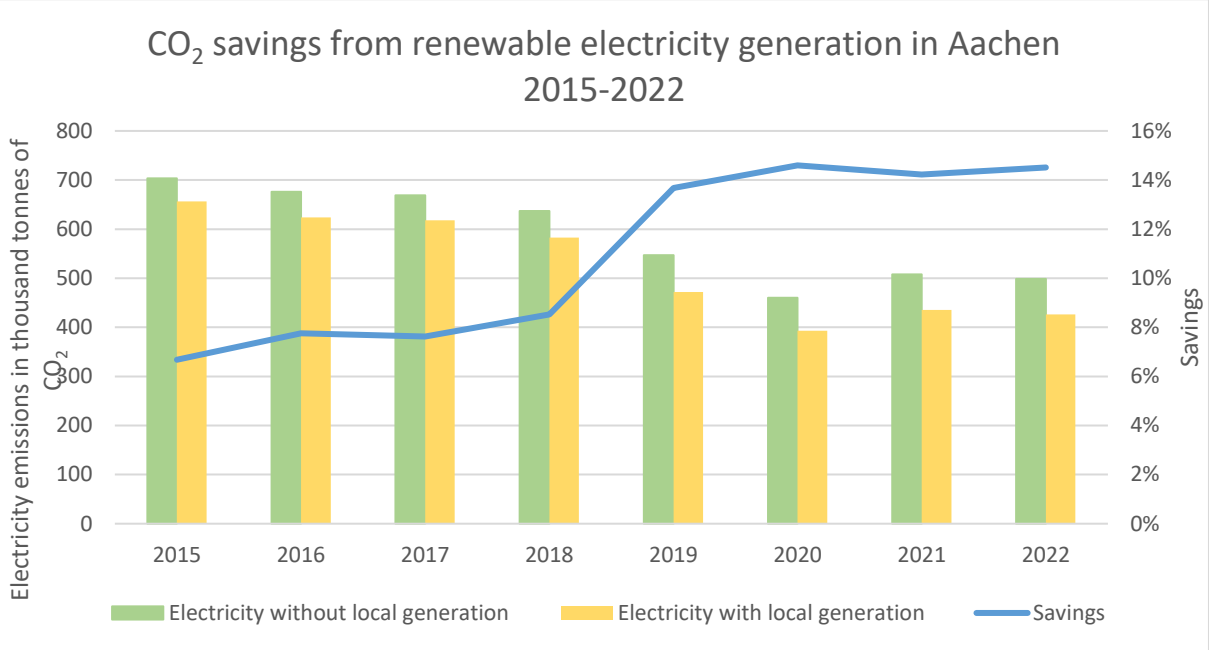


Figure 6 : Savings from renewable generation in Aachen

In Figure 6 shows the emissions in the electricity sector with and without the inclusion of renewable generation (wind energy, photovoltaics, hydropower, biogas) in the city of Aachen. The savings from local generation in Aachen currently reduce the city's overall balance by a significant 70 - 80,000 tonnes per year, corresponding to 4 %, and amount to approx. 15 % in relation to the local electricity sector.

6 Economic costs of Aachen's CO_2 emissions

The Federal Environment Agency calculates the current social follow-up costs for the environmental impact of CO_2 emissions at € 237 per tonne of CO_2 for the year 2022. With CO_2 emissions amounting to 1,594 thousand tonnes of CO_2 , this results in follow-up costs of € 378 million. This does not yet include the consequential costs that arise, for example, from air pollution during electricity generation or in the transport sector. The specific costs will tend to rise further, as the value of buildings and infrastructure facilities that are at risk from extreme weather will increase, for example. This shows that measures to further reduce emissions must be implemented quickly in order to sustainably reduce the annual social costs of CO_2 and other air pollutants.

7 Summary

a) The city's final energy consumption has fallen by 22% since 1990. In the heating and mobility sectors in particular, the great potential for efficiency and savings is only being realised slowly and to an insufficient extent.

b) Aachen's CO_2 emissions are continuing to fall, but are still noticeably below the agreed targets. Compared to the base year 1990, the saving today is 38 %. The average annual saving has noticeably increased to around 3% over the past four years; unforeseeable influences such as the coronavirus crisis, the war in Ukraine and the subsequent rise in gas and heating oil prices have played a particularly important role in this.

c) The absolute CO_2 saving compared to 2021 is 118 thousand tonnes of CO_2 and is therefore pleasingly high. However, the average CO_2 savings target of 77,000 tonnes of CO_2 per year anchored in the climate protection

concept (IKSK) was missed for the period 2019 - 2022; on average, only around 50,000 tonnes of CO2/year were achieved for the last 3 years, i.e. just under 2/3.

d) At 46 %, the highest absolute reduction in emissions since 1990 has been achieved in the electricity sector (savings: 422 thousand tonnes of CO_2), followed by the heating sector (savings: 556 thousand tonnes of CO_2). In contrast, the transport sector continues to lag behind in climate protection (savings: 6 thousand tonnes of CO_2), see Figure 7.

e) The share of renewable energies in local electricity generation will be 14.5% in 2022 - a good figure for a large city, but one that can still be significantly increased. Wind energy already makes the largest contribution today with 106 GWh.

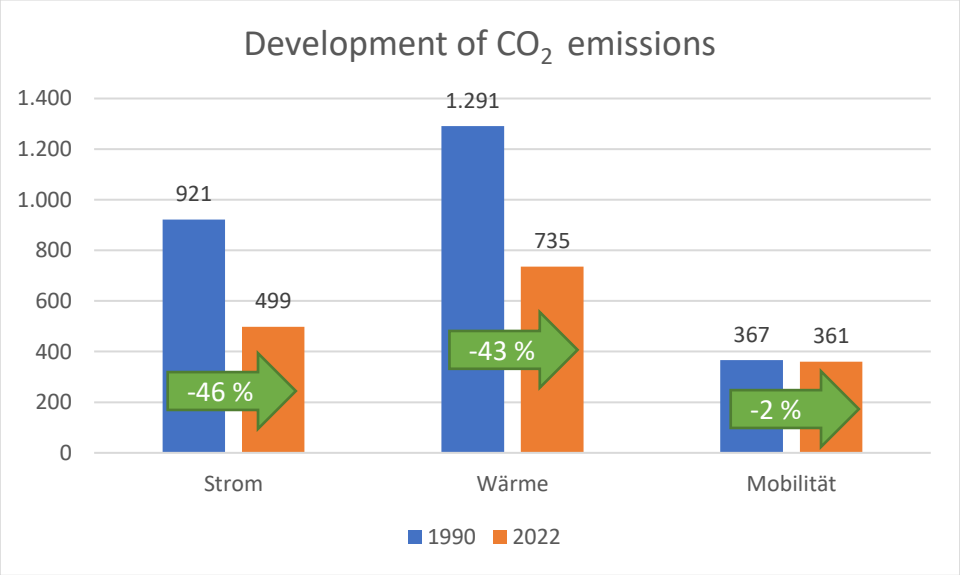


Figure 7 : Development of emissions by the electricity, heat and transport sectors

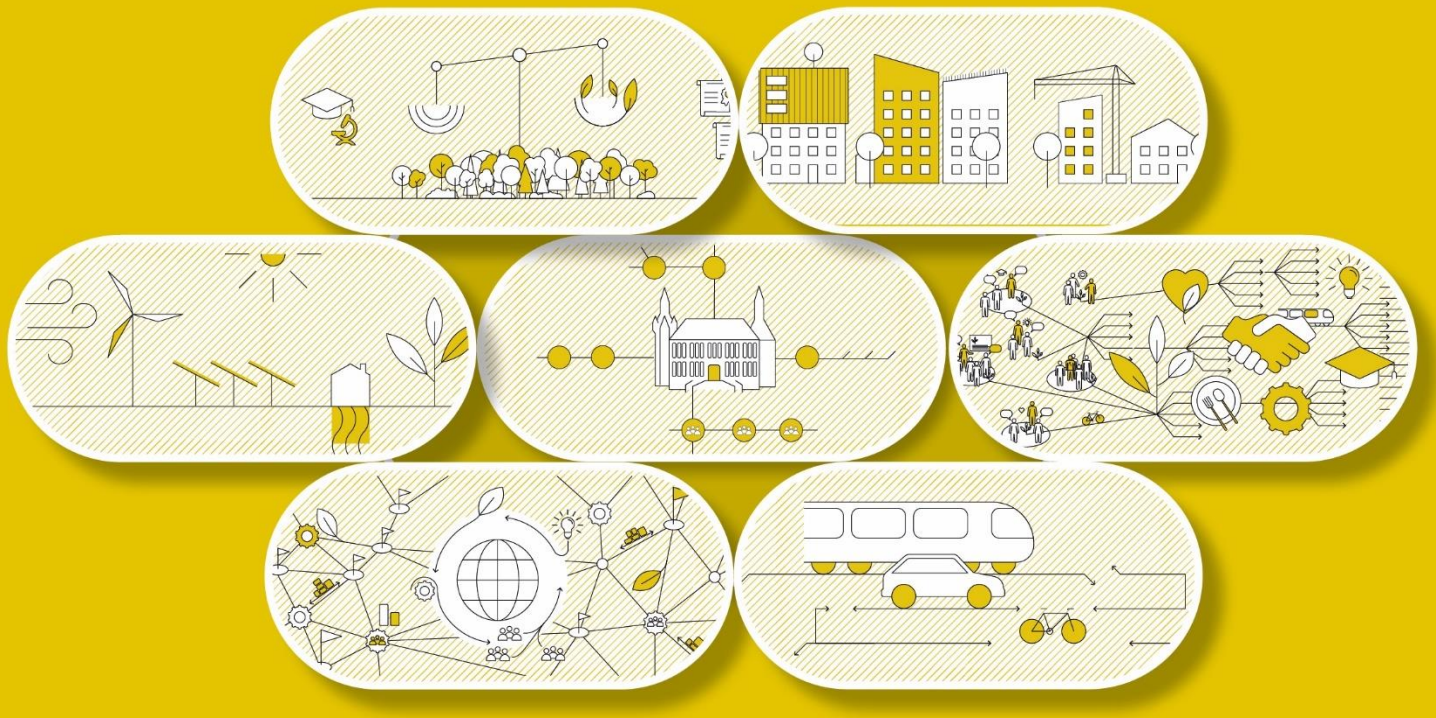
8 Conclusions

Climate protection is making further and faster progress in Aachen, but despite considerable efforts and a large number of important and necessary individual measures (including the ICSK), it is still lagging behind the ambitious targets that have been set.

The major challenges for the future, but also opportunities for Aachen on the path towards CO_2 neutrality (target: Aachen climate-neutral by 2030) lie in the rapid expansion of wind and solar energy, the "heat transition", the refurbishment of existing buildings and the transformation of the transport sector.

Der Weg
klimaneutral 2030

Band 1 – Die Strategie



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Foreword

Greeting from the Lord Mayor

Dear Aacheners,

As part of our participation in the EU's "100 climate-neutral and smart cities" mission, the city of Aachen has set itself ambitious goals.

We want to be a climate-neutral city by 2030 and thus make a significant contribution to climate protection and become a European role model.

In order to achieve this, it is essential that we develop a clear and effective strategy for the reorganisation of our existing Integrated Climate Protection Concept (IKSK). I am therefore delighted to present this report to you today.

This strategy paper is an important milestone on our path to climate neutrality. It provides us with a sound basis for stepping up our climate protection efforts and developing specific measures to reduce our CO_2 emissions. In addition to the reorganisation of the existing ICSK, structures are to be created for the continuous monitoring and adaptation of climate protection processes in order to enable more efficient and innovative solutions.

Our aim is to establish a Climate City Agreement as an instrument of our ambitions, to make it binding for all participating stakeholders in our city and to submit it to the EU Commission. With this agreement, we are promoting and encouraging close cooperation between the city administration, citizens, educational and research institutions, companies and other important partners. We need diverse expertise from a wide range of areas and interdisciplinary cooperation in order to be successful.

This report and the initial activities developed together provide us with valuable impetus and open up a wide range of potential.

It is a call for innovation and change that encourages us to position our city as a pioneer in climate protection.

The climate protection concept covers various areas, from the energy transition and sustainable mobility to the energy-efficient refurbishment of buildings. Innovative technologies and digital solutions will play an even more decisive role. I am convinced that together as a city, with the support of our citizens, we can realise the necessary transformation and create a sustainable future for Aachen.

I would like to thank everyone involved for their work and commitment in preparing this report.

I cordially invite you all to actively participate in the implementation of the report and the reorganisation of our ICSK. Your ideas, your expertise and your support are of great importance in achieving our goals.

We can develop effective measures to combat climate change and secure a future worth living for ourselves and future generations.

I am confident that we are taking a significant step in the right direction with the new climate protection concept. Climate protection is our shared mission. Let's make a personal commitment to a sustainable future!

Sibylle Keupen

Lord Mayor of the City of Aachen

Climate neutrality - what do we actually associate with it?

We equate the future of a climate-neutral Aachen with a liveable city, intergenerational justice, economic growth and stability. The path to climate neutrality offers a great opportunity for Aachen. At the same time, we also recognise the investments and changes that are already necessary. In all of this, a socially just organisation is immensely important to us.

There are many reasons why it is worthwhile for Aachen to lead the way and tackle this major challenge side by side with over a hundred other cities in the European Union and be among the first to do so. As part of the EU mission, we as the city administration are prepared to make the greatest possible contribution with other European pioneering cities, such as Copenhagen, Paris, but also Münster, Dortmund and other German cities, and to accept the risks in order to be among the winners. We are convinced that the opportunities for Aachen's development are worth this work.

Updating the "Integrated Climate Protection Concept" to achieve the goal of climate neutrality by 2030 is an important component of this. This report shows us as the city administration how we can make our contribution. In the coming months, we now need to prioritise and decide on the measures that will make the greatest possible contribution. In addition to Gertec, large parts of the administration were also very actively involved in drawing up the plan. Climate protection works when everyone does their bit.

However, we cannot achieve this goal as a city administration alone. We continue to need the strong and future-orientated research of the local universities. We need risk-taking and forward-looking companies that continue to invest in the future and climate neutrality. We need an agile and diverse civil society and, ultimately, we need citizens to join us in shaping the climate-neutral Aachen of tomorrow.

Let's shape and realise the "Climate-neutral Aachen 2030" mission together. It's worth it.

Heiko Thomas
Councillor for Climate and Environment, City Operations and Buildings

Frauke Burgdorff
Councillor for Urban Development, Construction and Mobility

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1. Aachen's path to climate neutrality in 2030

The climate crisis is the greatest challenge of our time. The consequences of the climate crisis have long been felt - even in Aachen

By ratifying the Paris Climate Agreement, the Federal Republic of Germany has made a binding commitment under international law to the climate targets set out therein. According to these targets, global warming is to be limited to well below 2 degrees compared to pre-industrial levels. The urgent recommendation is not to allow the rise to exceed 1.5 degrees if possible, as there is a risk of exceeding global tipping points from this point onwards.

The Federal Constitutional Court (4/2021) emphasised the urgency of consistent climate action with its groundbreaking ruling: "Climate protection targets must be aligned in such a way that the reduction of greenhouse gases is not postponed further and further into the future and the pressure on the entire younger generation will be so great that they will be massively restricted in their fundamental rights and freedoms."

Aachen is facing up to this responsibility and has set out to achieve climate neutrality by 2030.

The city of Aachen can look back on more than 30 years of experience in ambitious climate protection, which began with the establishment of an office for energy and climate protection (1991) and its accession to the European Climate Alliance in 1992. In 1993, the so-called Aachen model of a CO2 reduction concept for the period up to 2010. In the years up to 2003, Aachen's first wind farm with 9 large-scale wind turbines (Butterweiden), a solar housing estate with 43 energy-saving houses (passive houses) and 2 innovative office buildings were completed.

In the following years, valuable potential studies for wind, solar and biomass energy were carried out with the support of the state of North Rhine-Westphalia in order to better understand the future opportunities for an energy supply based on renewable energies. In 1998, the first

In 2009, the City of Aachen's Climate Protection / Energy Coordination Centre was set up and the "altbauplus" initiative was founded. Since 2009, the city of Aachen has also been a member of the "Covenant of Mayors" of the EU Commission and has been part of "Mayors Adapt" since 2014. The City of Aachen has also been participating in the "European Energy Award" certification programme since 2009 and was awarded gold in 2011, 2015 and 2019.[1] Since 2010, the City of Aachen has drawn up an annual energy and carbon footprint. In 2019, the City Council of Aachen declared a climate emergency. The Integrated Climate Protection Concept (IKSK) drawn up in 2020 describes how potential for greenhouse gas reduction can be leveraged in Aachen with the 2025 action programme. The measures described therein are already being implemented, so that a wide range of activities can be built on and existing structures can be used.[2] There are funding programmes and advisory services for the expansion of renewable energies and building refurbishment that have been running for several years and are gaining in popularity.[3] Since 2021, municipal funding in the area of solar and building refurbishment of over 7 million euros has been awarded. These have triggered an investment volume of almost 80 million euros.

[1] City of Aachen, status: 2019. Energy policy milestones. Available at: https://www.aachen.de/DE/stadt_buerger/energie/fotos_logos_pdf/2019_Energiepolitische-Meilensteine.pdf (accessed on: 30.08.2023).

[2] City of Aachen as at 30/08/2023. Objectives, strategies, concepts. Available at: https://www.aachen.de/de/stadt_buerger/energie/konzepte_veranstaltungen/index.html

[3] City of Aachen. Aachen climate-neutral 2030: Rough sketch for Aachen's path to 2030 p. 17; Committee for the Environment and Climate Protection (2023): FB 36/0239/WP18 Status 31.01.2023

Aachen sets an example in Europe

Continuing this long-standing commitment, the city of Aachen decided in 2021 to take part in the EU mission "100 Climate-Neutral and Smart Cities by 2030 (100 CNSC)". In recognition of its exceptional achievements, Aachen was then selected at the end of April 2022 to act as a role model for other European cities as part of the EU's "100 Climate-Neutral and Smart Cities by 2030" mission.

The ambitious goal of climate neutrality by 2030 not only requires new structures and measures from the city administration, but also represents a joint task for the entire urban society. It also requires strong and active support from local, national and EU policy-makers in order to align existing directives and laws with the goal of climate neutrality and to adopt new ones. The implementation of climate measures requires additional public funding and financing, which must be provided by the state, federal government and EU. It is also recognised by the EU Commission that the cities, including Aachen, cannot provide the necessary financial resources for this alone.

By joining forces with other mission cities, Aachen can address its needs and interests with even more vigour at state and federal level. The same applies to the strong network of all EU mission cities at EU level. In addition, the Net Zero Cities expert network can be used to answer new questions, for example on indicators, GHG monitoring or financing options. The exchange within the international network also provides many ideas for the path to climate neutrality through successful best practice measures from other mission cities.

Another strong motivation for the city of Aachen to apply for the EU mission was to become more independent in terms of energy, more liveable for its citizens and more crisis-resistant as a business location, combined with the prospect of privileged access to EU funding and subsidised loans from the European Investment Bank. Only with external funding will it be possible to successfully and fully implement the measures of the City of Aachen and the urban community that will lead to climate neutrality in 2030.

The IKSK 2023 "Aachen: The path to climate neutrality 2030" is the administration's contribution to the Climate City Contract

The integrated climate protection concept (IKSK) 2023 "Aachen: The way
climate-neutral 2030" is intended to provide an essential basis for the be a "Climate City Contract" and, by council resolution, become a strategic
paper for the period up to 2030.

It is to be understood as an expert opinion based on the IKSK 2020 and is intended to include an adjustment of the strategic orientation towards the goal of climate neutrality by 2030 through to concrete proposals for activities. The update also has the task of closing gaps in the City of Aachen's previous strategy. This includes, in particular, governance strategies, strategies for transformation in the

The focus is on the areas of lifestyles, consumption, nutrition and the circular economy, as well as the greater integration of issues relating to land use and mobility.

The IKSK 2023 consists of two volumes: Volume 1 describes a possible path to climate neutrality in 2030, while Volume 2 documents the results of the internal administrative participation process to develop a portfolio of activities and prioritises more than 50 individual activities across seven fields of action. The activities described therein, together with activities already underway, form a portfolio as a basis for further implementation planning. .

2. The key results at a glance

This IKSK 2030 describes a path to climate neutrality by 2030 and the municipal contribution to achieving this goal as part of the EU mission "100 Climate Neutral and Smart Cities by 2030". The City of Aachen's target is highly ambitious. The chapter summarises the results of the report and the fields of action.

Requirements for the municipal family:

What is needed is an effort by society as a whole. The municipal family, consisting of the core administration, municipal enterprises and holdings, has a maximum direct and indirect potential influence of around 50 % on the reduction of energy-related GHG emissions in the city as a whole. The market players in Aachen (private households, companies) must also make their contribution. It is also necessary for the EU, federal and state governments to set the appropriate framework conditions.

Link to the IKSK 2020

The Integrated Climate Protection Concept of 2020 provides a very good basis for the actions of the City of Aachen's administration. With the implementation of the 2020 ICSK, financial and human resources were made available and comprehensive climate protection measures were initiated. However, the GHG reduction measures and the resources provided are not sufficient to achieve the formulated goal of climate neutrality by 2030. From a technical point of view, a broader and more in-depth thematic focus is also required. This report continues the ICSK and adds the following focal points:

- The report introduces the new fields of action of governance, social transformation and compensation.
- It carries out in-depth technical analyses in the existing fields of action of the IKSK 2020 (buildings, energy, mobility, economy) and adapts the target and measure levels with their municipal activities.
- The report addresses important framework conditions for implementation. These include recommendations for process control and process monitoring, a more integrated view of the climate neutrality target as a cross-sectional task of urban development and climate justice as a basis for social acceptance. The ICSK update provides initial approaches in this regard.
- The update estimates the resources required for climate neutrality throughout the city and the associated benefits.
- The update creates transparency by identifying and quantifying activities to be implemented in the short term and combining these with the measures of the ICSK 2020 to create an overall portfolio of measures that can be updated.
- The update sets strategic guidelines for implementation by specifying fields of action, areas of activity and measures as well as formulating the respective objectives.

The most important findings for a climate-neutral Aachen 2030 are

The update of the ICSK is not a rigid plan, but describes a transformation process: in order to achieve the goal of climate neutrality by 2030, an understanding of transformation processes and fundamental changes in the municipal family and at a city-wide level are required. What is needed is the acceleration of implementation and the broadest possible anchoring of the goal of climate neutrality.

The path to climate neutrality requires rules and structures for cooperation: at the level of the municipal family, this requires above all clear, cross-sectional and transparent cooperation within the administration and with the municipal companies and municipal holdings. The update of the ICSK formulates organisational and procedural recommendations in this regard.

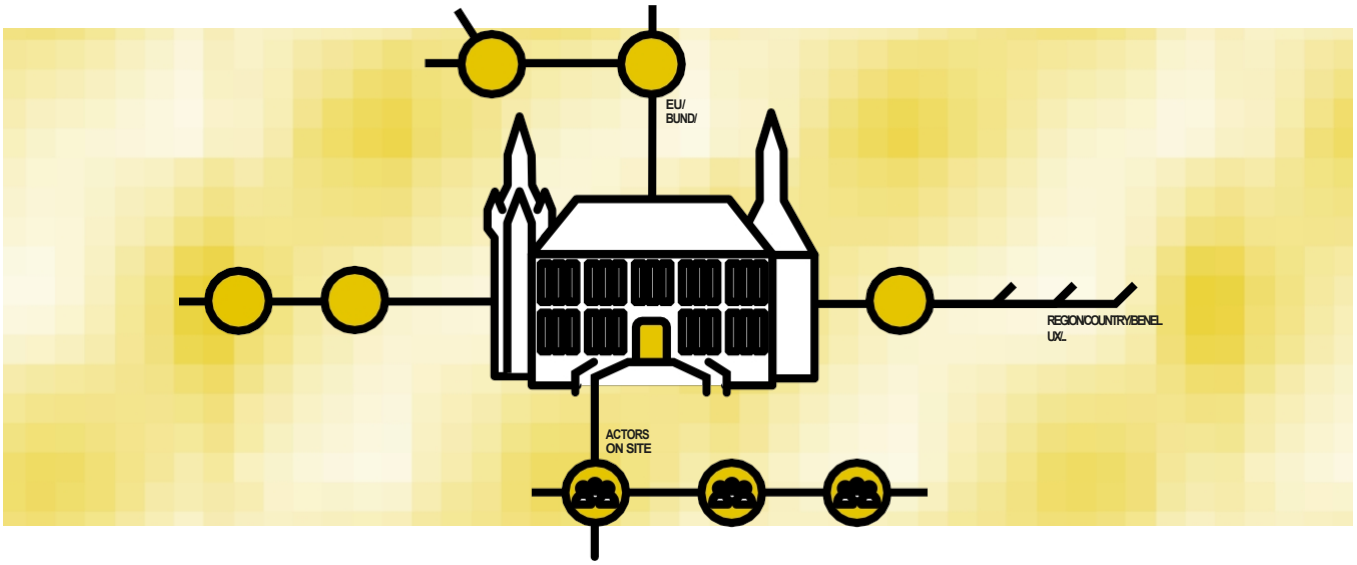
Climate neutrality pays off: investment costs of at least €7.2 billion are estimated by 2030. This will avoid a total of €254.7 million in environmental costs per year. In addition, demand-related costs totalling €417.5 million per year will be saved. Aachen citizens will be relieved of €67.7 million in electricity and heating costs per year. At the same time, sales of up to 95.1 million euros per year can be generated in the region.

Do better, do differently, use less, compensate: Efficiency, consistency, sufficiency and offsetting must be linked in equal measure. Climate neutrality can only be achieved if all potential is utilised. The switch to renewable energies has the largest share (61%).

A portfolio of activities in the fields of action ensures the implementation of the reduction strategies. The GHG reduction contribution of the portfolio of activities developed as part of the administrative participation is 9% of the overall reduction target.

Figure 1 The four forces for climate neutrality (Graphic: Bodo Wirtz, source Gertec)

2.1. Governance



The path to climate neutrality is a systemic task and an agile process in which the city, citizens and stakeholders such as companies, associations and interest groups must be equally involved.

Consistently utilising the influence of the urban family

The urban family can actively shape and influence the transformation for implementation. The ICSK identifies seven fields of action for achieving climate neutrality. The municipal family can act directly and indirectly in these fields of action. The municipal family can exert influence on four levels: regulation, supply and provision, advice and motivation, and consumption and role model. Appropriate, regular and targeted coordination should be institutionalised (see chapter 7.1).

Structural changes are necessary

Organisational brackets are needed to organise, communicate, steer and bring about decisions on the path to climate neutrality. This applies both internally, within the municipal family, and externally, in relation to civil society and the business landscape.

Thinking strategically about urban development and climate protection as a cross-sectional task

The planning and conceptual framework for these necessary developments is provided by integrated, climate-friendly and sustainable urban development. The city administration's actions always take into account the settlement areas for the city as a whole as well as potential land conflicts.

Adequate human and financial resources

In order to be able to implement the programme, the municipal family needs sufficient human and material resources, especially for staff development and retention.

Dealing with conflicting goals

Acceptance of a path to climate neutrality depends in particular on how conflicting goals are dealt with. Measures must fulfil social, ecological and economic criteria in equal measure.

Monitoring and readjusting the process

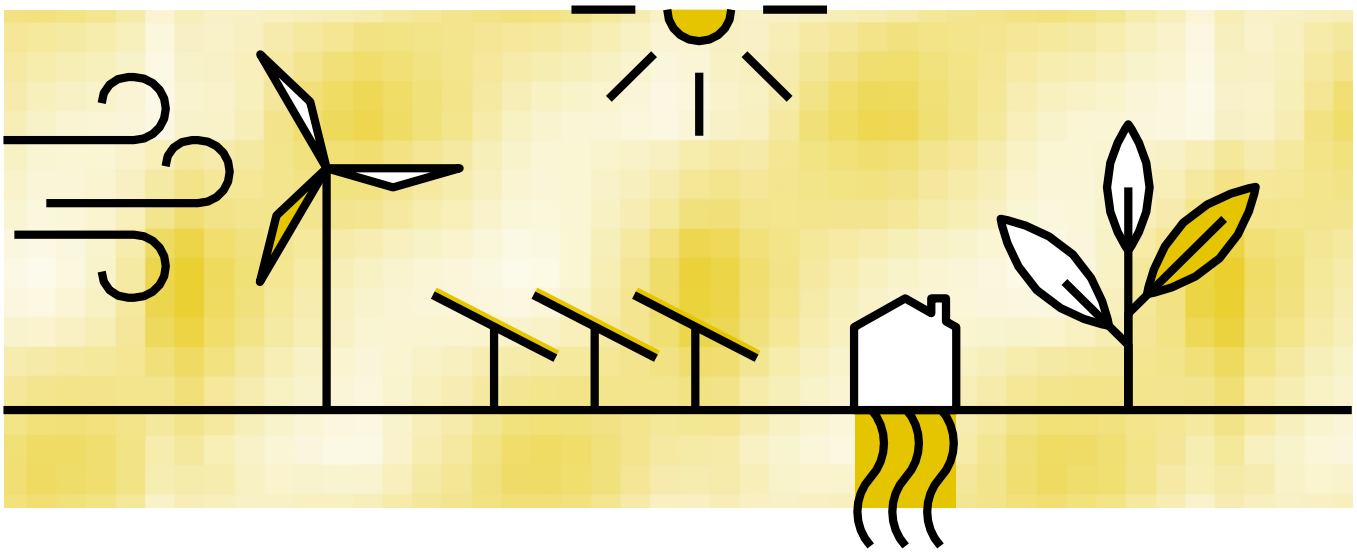
The $CO2_{budget}$ for each area of action must not be burdened beyond a target value. Controlling and monitoring of the process is required to check, evaluate and readjust compliance with the development path as well as a binding mechanism for follow-up control. The possibilities for monitoring the city administration's budget and the business plans of the municipal enterprises and companies are an important source for the ability to steer towards climate neutrality. These should be utilised extensively to achieve the target.

The targeted strategic development of innovation spaces and participation programmes

A critical mass of people is required for change to be initiated and accelerated.

Process-accompanying citizen participation in climate protection and Climate adaptation processes, the active promotion of civil society processes and the creation of innovation spaces form a framework for transformation.

2.2. Energy



The energy transition is going electric: the goal of climate neutrality can only be achieved if fossil fuels are completely replaced by renewable energies using cross-sectoral approaches. Today, almost 1.2 million tonnes of CO2eq are emitted annually through electricity and heat generation in Aachen. More than 60 % of this can already be saved by switching energy sources.

The energy transition goes electric

The increased use of electricity from renewable energies for heat generation and mobility will increase electricity consumption by a factor of 1.3. The expansion of renewable electricity generation from wind and solar power, the expansion of cross-sector supply concepts and the system integration of renewable energies are therefore key tasks for the City of Aachen's climate neutrality strategy. Around 70 % of the increased electricity demand must be generated locally by tapping into the available potential and importing the rest from renewable sources. This requires an increase in photovoltaic capacity of approx. 150 $_{MWp}$ and an expansion of wind power to a total of approx. 93 MW.

Infrastructure modernisation to secure supply is a priority task

A secure supply of renewable energies is a key prerequisite. The expansion of sector coupling requires the joint optimisation of electricity, gas and heating grids.

So-called hybrid grids enable the consumption, storage and transport of energy in its current form or the conversion into another form of energy that can also be consumed, stored or transported. This means that, for example, in the event of an oversupply of electricity from renewable sources, this can be utilised flexibly or other forms of energy can be used for reconversion if there is an undersupply.

Heat supply becomes climate-neutral

The challenge of providing a climate-friendly supply of space heating and hot water as well as process heat in industry is particularly high in the area of heat supply. The federal and state governments have already reacted and set the framework for cities and municipalities with the laws on municipal heat planning. This means that large cities such as Aachen have until 31 December 2025 to submit a municipal heating plan that shows how a climate-neutral heating supply can be achieved. One core task is to expand green district heating: 17,500 households are already connected to district heating today. Decarbonisation and the expansion of district heating is a lever with which the climate-neutral conversion in the districts and neighbourhoods can also succeed in terms of a social and sustainable urban development strategy. Waste heat and geothermal energy provide a high potential of around 500 GWh/a of heat for centralised heat supply. Heat pumps are the preferred technology for decentralised supply solutions.

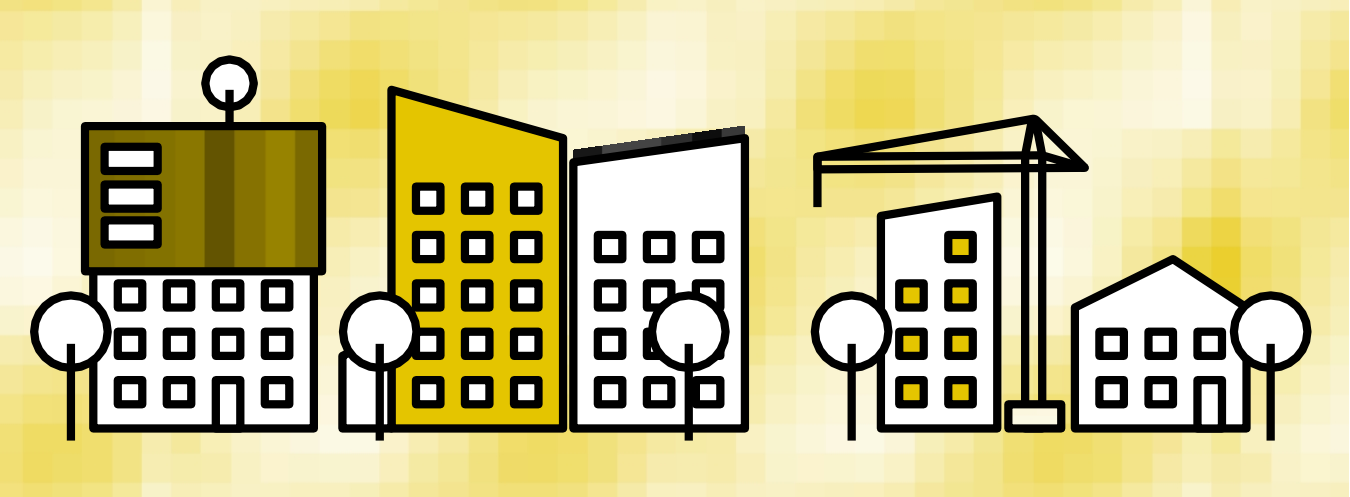
Public participation and new operator models strengthen acceptance

The generation of electricity from renewable energies by citizens is already an important pillar of the energy transition. Citizens' energy cooperatives, tenant electricity models and neighbourhood networks for heat supply promote acceptance through individual benefits and regional value creation.

Hydrogen is a rare commodity in the energy transition

Hydrogen from renewable energies is a scarce and expensive energy source. Nevertheless, it will be required for industrial processes in particular. Hydrogen is therefore an indispensable part of the energy supply strategy in the future.

2.3. Building



The main task lies in existing buildings: the aim is to refurbish more than a third of existing buildings to a high standard of thermal insulation by 2030. This requires a reduction in heat consumption of around 25 % compared to 2021.

Increase in the refurbishment rate

The renovation rate must be increased to 4% annually in order to achieve climate neutrality by 2030. Remaining energy requirements for space heating, hot water and electricity must be covered by 100% renewable energies. The reduction in energy consumption must also be responded to with customised energy infrastructure and energy services. Further energy savings can be achieved through the behaviour of residents as building users, which creates additional points of contact with the Social Transformation field of action.

Promoting sustainable urban neighbourhoods

In order to leverage the potential in existing buildings, an integrated approach at neighbourhood level is required. The neighbourhood level also makes it possible to examine property-independent, residential value-enhancing factors with an indirect influence on energy-efficient refurbishment (residential environment, local amenities, mobility options) in an integrated manner.

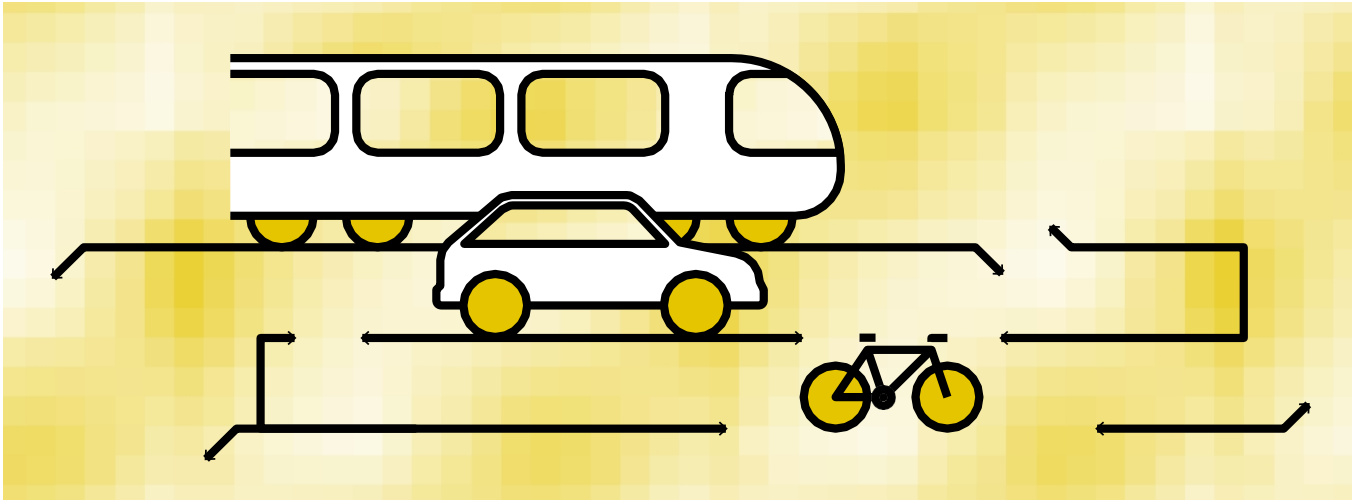
New construction must not place an additional burden on the CO_2 budget

This results in the need to introduce nationwide efficiency standards for buildings that are at least greenhouse gas-neutral. In this context, the selection of sustainable building materials and the establishment of innovative forms of housing that are implemented in a way that conserves space and resources are also crucial.

The city of Aachen leads by example

The city of Aachen is forging ahead with the energy-efficient refurbishment of its own building stock and is endeavouring to make its non-residential and residential building stock climate-neutral.

2.4. Mobility



In the mobility sector, approx. 330 kt CO_{2eq}. must be saved or avoided, among other things by strengthening the environmental network and by changing drive systems. It is necessary for up to 90 % of the remaining journeys made by motorised private transport to be electric.

The city of short distances

The city of Aachen is pursuing the strategy of a city of short distances. Schools and kindergartens as well as facilities for daily needs are close to where people live, and the routes to education and work are easily accessible with alternatives to the car.

This shortens distances and avoids car journeys, thus reducing the environmental impact of motorised private transport.

Avoid, relocate and reorganise

The mobility field of action includes all measures that support the path already taken by the city of Aachen on the way to a climate-neutral mobility system and avoid motorised transport, shift to climate-friendly means of transport or switch to climate-friendly drive systems. The city is already actively involved in mobility management for companies and promotes the implementation of climate-friendly mobility concepts. For motorised transport that cannot be avoided or shifted to more climate-friendly means of transport, the aim is to reduce energy consumption and the resulting emissions as far as possible and to substitute fossil fuels (efficiency and consistency).

Transport planning and mobility concepts

The city of Aachen has already launched numerous strategies and projects on behalf of politicians to enable and establish sustainable mobility. The most recent

Milestones on this path were the adoption of the 2019 cycling decision, the resolution of the Mobility Strategy 2030 targets and the integrated climate protection concept with the goal of halving CO_2 emissions by 2030, both from 2020. Every two years, the city administration of Aachen publishes a mobility status report, which uses quantified target indicators to show the progress of the mobility transition. Additional financial and human resources were also created for implementation as part of Aachen's cycling decision.

Cooperation in the region

Aachen is well placed to benefit from the close cooperation between the city and neighbouring municipalities in the StädteRegion Aachen.

"Netzwerk Mobilitätswende Region Aachen" (NEMORA) is cleverly organised. Four working groups are coordinating the expansion of public transport, mobile stations, regional cycling and financing issues. A memorandum of understanding was also signed by all mayors in spring 2023. A coordinated transport model is available as a planning basis for sustainable mobility in the city region. Successful projects include the Cambio car sharing service and the Velocity Aachen pedelec sharing system. The structural and organisational framework conditions in the mobility sector can therefore be considered to be quite target-oriented with regard to future challenges.

Expand public transport

In terms of infrastructure, numerous improvements have been made in recent years in the areas of walking, cycling and public transport. The Euregiobahn is a successful model for the reactivation of railway lines and has been or will be further expanded in the Aachen region. The planned expansion of the RegioTram from Baesweiler to Aachen is an important planning project. There are good public transport connections within Aachen. The addition of express buses and

On-demand services with alternative drive systems are being developed by 2027. By 2030, 95% of public transport journeys are to be electric or hydrogen-powered. In the future, autonomous shuttle buses could be operated economically on routes that are currently not covered by public transport.

Increase the share of cycling and walking

At 30%, the share of walking in the modal split in Aachen is above the national average. The creation of comfortable and barrier-free routes is seen as a central task. The flagship project is the "premium footpaths". The steadily growing number of environmentally friendly transport options shows that the conditions for a city of short distances are in place. Where everyday tasks cannot be carried out within walking distance, additional services need to be created and successfully established. Since the 2019 cycling referendum, the interests of cycling have become more important in road planning on main roads. With priority cycle routes, the city of Aachen is creating attractive cycle routes from all districts to the city centre. A main cycle network was adopted in 2023, which serves as a new basis for decisions on cycling measures.

Expanding combined mobility

A close-knit network of mobility stations, bicycle parking, repair and rental facilities, e-scooter parking zones and car-sharing services, supplemented by neighbourhood car parks, forms the backbone of a car-saving mobility organisation.

The physical offers are supported by attractive mobility packages in conjunction with a significant reduction in public transport ticket prices. A campaign that fits in with the challenges of the mobility transition, which explains the project and supports the voluntary switch, helps to increase acceptance.

Converting fleets to climate-neutral drive systems

The municipal family is leading by example and gradually converting its own vehicle fleet to climate-neutral drive systems. The conversion of the entire fleet in the city of Aachen is being actively supported. ASEAG's bus fleet is being converted to battery buses and hydrogen buses.

Expanding the charging infrastructure

The rapid expansion of the charging infrastructure for electric cars and pedelecs is within the sphere of influence of the City of Aachen and the market players. This is crucial for the success of the drive transition. For people who live and work in inner-city neighbourhoods and do not have parking spaces on the premises of their homes or businesses, neighbourhood car parks could be built to meet demand. These neighbourhood car parks should be operated on a cost-covering basis and also offer charging facilities for all electric cars.

Converting commercial and freight transport to be climate-friendly

In the area of road-based commercial and freight transport, the aim is to promote a shift to rail or a switch to climate-friendly drive systems wherever possible, for example by promoting the reactivation of disused railway sidings or the development of a range of microhubs for more climate-friendly handling of courier, express and parcel transport, which has grown significantly in the recent past. The Freight Transport Round Table has been established as a cooperation body and serves to promote the transition to climate-friendly urban transport.

2.5. Economy

A significant part of the transformation task lies with market players. Around 122 thousand tonnes of annual greenhouse gas emissions must be reduced in the business sector by 2030 in order to achieve climate neutrality. Key activities include reducing current electricity and heating energy requirements and transforming the transport of goods and personnel. Modernisation measures in thermal production must reduce consumption for the provision of process heat in industry by around 20 % by 2030, to less than 550 GWh/a.

Climate neutrality as a factor in business promotion and location development

The transformation of the existing economy (trade, commerce and industry) towards climate neutrality and the establishment of climate-neutral and sustainable companies in Aachen is one of the tasks of economic development and location development. Economic development is increasingly taking on the systematic promotion of co-operative and sustainable forms of business.

Climate neutrality as an economic policy model

Climate change harbours a variety of risks for business locations. As a result of climate change, supply routes can be disrupted and the supply of raw materials, as well as intermediate production or the transport of goods, can be impaired. The security of supply of electricity from renewable energies is becoming a location factor. Companies are increasingly facing up to their social responsibility and fulfilling the demands of their customers, employees, investors and partners for more climate protection and climate action.

Sustainability. Eco-efficient (better production) and eco-effective (cradle-to-cradle) product development offers opportunities for positioning on the market. Such ideas, processes and actions should be bundled and launched as part of the Round Table on Sustainable Agriculture and Food.

Circular economy conserves resources and protects the climate

The limits of resource consumption have already been reached in many cases in view of the ecological limits.
Sustainable production and consumption patterns must therefore be promoted and the demand for resources reduced. In Aachen, the growth in consumption should therefore be decoupled from the consumption of non-renewable raw materials by establishing a consistent circular economy. Aachen's municipal utility and the municipal waste, or rather recycling, management have a special task. The process that has already begun of recognising the municipal enterprise as an integrated partner in new value chains should be intensified, as it can also provide new impetus for the economy and science.

Promoting regional trade structures

Regional trade structures promote regional value creation and minimise greenhouse gas emissions through short distances.

The city of Aachen has a direct influence on the agricultural use of urban agricultural land in terms of food supplies by regulating the use of urban agricultural land.

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Leasing. The city of Aachen can influence the proportion of regional and sustainable production by utilising its own demand potential in the context of municipal communal catering and indirect influence in supporting sustainable production and trade processes.
Finally, the city can influence consumer behaviour by advising, activating and qualifying citizens

2.6. Social transformation

Societal transformation is a systemic task: although individual, smaller changes in behaviour do their part to protect the climate, a societal transformation needs support in order to bring about a broader, more fundamental change. Furthermore, the responsibility for transformation does not lie solely with the individual, but also with other actors such as the municipality or market players. Considering and taking into account the effects from and on social situations is a fundamental prerequisite for the success of the transformation to climate neutrality. Greenhouse gas savings can be achieved across all sectors through sufficiency, i.e. savings through reduced use or consumption due to changes in behaviour. Private households offer the greatest potential for sufficiency - particularly with regard to electricity consumption - with approx. 79 kt $CO_{2eq/a}$.

Responsibility Structural changes

This creates the framework conditions in such a way that the individual has the opportunity or even the incentive to make climate-friendly decisions. Framework conditions can be understood to include legal requirements as well as offers from the city of Aachen. Similarly, existing activities should be analysed for their impact on the climate and discontinued if necessary.

Climate protection needs a rethink

Climate-friendly behaviour must become the new routine so that it can be implemented in everyday life by a large proportion of the population. It is therefore not a discussion about values, but the benefits of climate-friendly solutions must be emphasised.

Promote and stabilise change

It is crucial that climate-friendly behaviour is enabled and promoted equally in all parts of society.

Observe social polarisation

On the one hand, there is growing environmental awareness in society, but on the other hand, the pressure to change is generating resistance, particularly due to the perceived loss of control. Climate protection needs a new
"Framing" that emphasises the benefits and enrichment, deals with challenges in a practical and transparent manner and thus reduces reservations and fears.

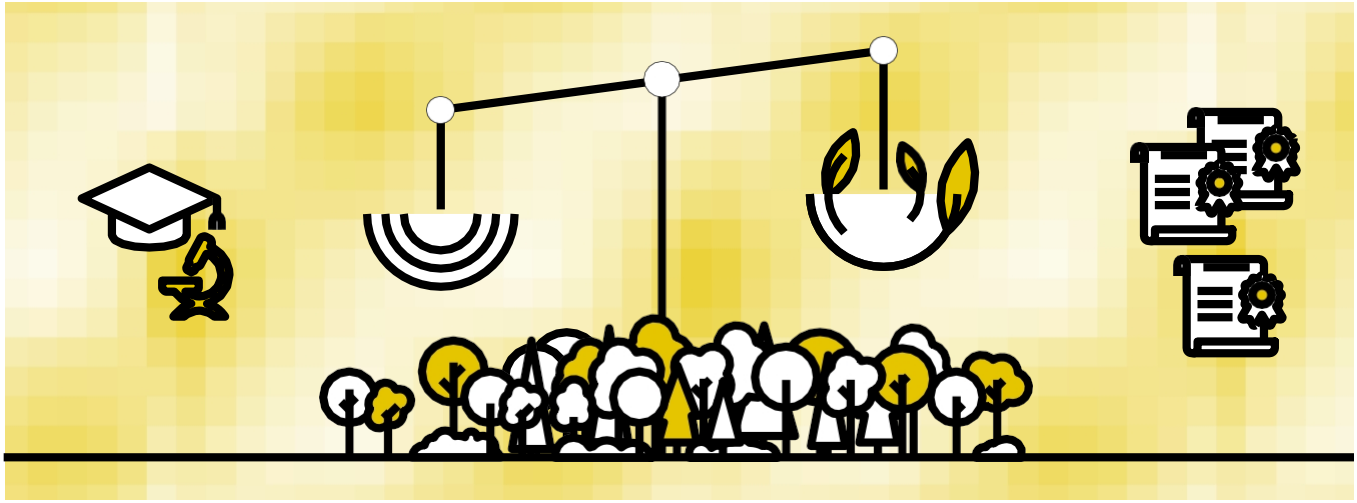
Social change begins with innovation

Social change takes place gradually in the sense of a diffusion model. Innovations and opportunities for practical everyday experience have a special role to play: innovators and pioneers of change form the nuclei for new lifestyles and alternative behaviour.

Taking the social dimension seriously

The relationship between climate neutrality measures and the impact on the city's various social neighbourhoods is not always free of conflict. Disadvantaged social locations are often particularly negatively affected by the consequences of climate change and other environmental influences (noise, heat, etc.). It is therefore important to pay particular attention to this area of conflict. It is important to better understand the effects and, where possible, to take greater account of them when implementing measures (for example in the areas of rents and energy/heating).

2.7. Compensation



As a Mission City, the city of Aachen is in a special position - it can offset unavoidable emissions through emissions trading, expansion of its natural greenhouse gas sinks and technical solutions such as carbon capture and storage and offset them directly against its territorial balance. The latter is not open to other cities.

Compensation - when all other options have been exhausted

Offsetting $CO_{2\ emissions}$ should only be seen as the final, unavoidable step at the end of a process whose primary aim must be to avoid the emissions caused altogether or at least reduce them. The ICSK describes strategies for offsetting the amount of greenhouse gases required to achieve climate neutrality without undermining the success of emissions reduction.

Special framework conditions for Aachen as a "Mission City"

As a "Mission City", the city of Aachen must fulfil the criteria set by the EU for offsetting unavoidable greenhouse gas emissions. The emissions to be offset should not exceed 20 % of the city's greenhouse gas balance.

Green infrastructure as carbon sinks

Natural sequestration by expanding and strengthening the natural sinks in Aachen, such as the Aachen forest, trees and green spaces within the city limits, conserves the GHG budget.

Technical solutions as carbon sinks

Technical solutions offer opportunities to remove GHG emissions from the atmosphere and store them ("carbon capture and storage"). Possible technical processes include biomass CCS (BECCS), direct air carbon capture and storage (DACCS) or the material binding of CO_2 in green polymers (green naphtha). The first pilot plants are already being used in Aachen.

Participation in the voluntary offsetting market

Carbon credits - certified according to international standards and by independent auditors - are suitable instruments for offsetting unavoidable GHG emissions in Aachen.

Excursus Synergies through integrated climate adaptation and climate protection

In addition to the need to halt the progression of climate change as far as possible, it is essential to adapt to the existing and worsening consequences of climate change. However, the clever combination of measures to combat climate change and measures to adapt to its consequences also offers great opportunities.

The sixth IPCC Assessment Report (AR6) estimates that the effects of climate change will also continue to increase in Europe. The consequences of climate change in the form of heat, drought, heavy rainfall, flooding, storms, etc. cause damage ranging from impairment of quality of life and health to immense damage to property and personal injury. In order to limit these and the resulting costs, municipalities must adapt to the changed and still changing climatic conditions. Existing precautionary measures must be expanded and new risks taken into account.

Climate adaptation is the adaptation to existing and predicted consequences of climate change that cannot be averted in the future. On the other hand, there is climate protection, the aim of which is to minimise climate change itself and thus keep its effects as low as possible. Climate adaptation and climate protection are therefore not contradictory or separate issues. We need both strategies to ensure a future worth living. However, climate protection and limiting global warming to a minimum should take priority, as life, and therefore we too, can only adapt to the climate changes we are facing in the relatively near future to a very limited extent.

In summer 2023, the federal government passed the first nationwide Climate Adaptation Act, which for the first time creates a framework for adapting to climate change at all administrative levels. The federal government is committed to taking precautions and pursuing measurable goals. Climate adaptation concepts are to be developed across the board in local authorities. The law also includes a requirement to take climate protection and climate adaptation into account in urban land-use planning, as already exists in Section 1a (5) BauGB, for example: The goal of climate adaptation must be taken into account in planning and decisions.

The city-wide concept for adapting to the consequences of climate change was published in Aachen back in 2018. This sets the strategic focus on measures against the dangers of heavy rainfall, measures against the effects of heat, environmental assessment, B planning and project-related planning as well as green planning. Aachen's climate adaptation concept is therefore divided into the following six categories:

- Hazard analysis and derivation of measures against heavy rainfall
- General water-sensitive planning
- Safeguarding fresh and cold air corridors
- General measures against heating
- Environmental assessment, binding urban land-use planning
- Green planning

The topic of climate adaptation has been included in urban planning, action plans and statutes in the past and will continue to be. Important milestones include

- 2012 Masterplan Aachen* 2030, including climate adaptation field of action
- 2014 Adaptation concept to the consequences of climate change in the Aachen basin
- 2014 Overall urban climate map, including cold air map
- 2017 Green and design statutes
- 2018 City-wide concept for adapting to the consequences of climate change
- 2020 FNP Aachen*2030, including a protected area and ventilation paths for the urban climate
- 2021 Climate checklist "Climate protection and climate adaptation in Aachen - checklist for urban development designs and development plans"

In general, climate adaptation measures can be categorised into four types of measures.

1. Green measures, e.g. green spaces, trees, green roofs and façades, which provide evaporation cooling and infiltration during heavy rainfall, act as pollutant filters and promote biodiversity and quality of life.

2. Blue measures, e.g. stream reclamation, renaturalisation of bodies of water and the creation of retention areas, which create evaporation cooling and mitigate flooding caused by heavy rainfall and high water and improve the quality of life.

3. Grey measures in the form of technical infrastructure or construction measures, e.g. cold air corridors, rainwater retention basins, building insulation, which provide protection against heat and heavy rainfall.

4. Soft measures, e.g. information, monetary relief, incentives for stakeholders.

Climate adaptation cannot be viewed independently of climate protection. On the one hand, successful climate protection contributes to less pronounced consequences of climate change globally and on large time scales, thus reducing the need to adapt to certain extreme events. On the other hand, the climate is changing and we must now adapt the city to existing consequences that can no longer be averted. There are both synergies and conflicts. There are measures that contribute to both climate protection and climate adaptation, as well as measures in which the two objectives are in competition with each other.

There are synergies between the two topics, particularly in the green area. In terms of climate adaptation, urban greenery provides rain retention during heavy rainfall events and shade and evaporative cooling in hot weather. Green roofs and façades, for example, also serve as summer heat insulation and winter thermal insulation. From a climate protection perspective, plants contribute to the reduction of CO2 by binding carbon dioxide, whereby the type of greenery - whether a lawn or a 100-year-old tree - plays a decisive role in how much CO_2 is bound. But even with trees, the proportion of CO_2 storage capacity is low. A mature tree binds only single-digit tonnes of CO_2 in its entire lifetime. This means that it can just about compensate for the annual emissions of a single car. Another example is the conversion of forests into mixed forests. These are more resilient in the long term and can therefore make a longer and more sustainable contribution to cold air and CO_2 reduction.

There are further synergies in the area of building refurbishment, e.g. better thermal insulation leads to savings in heating energy and thus to lower CO_2 emissions. In addition, interiors are kept cooler on hot days.

Conflicts between the implementation of climate protection and climate adaptation measures arise primarily due to competing land use requirements. For example, the looser building style with a high proportion of open space, fresh air corridors and a low degree of sealing, which prevents the formation of heat islands, for example, is at odds with the compact settlement style, which optimises traffic and reduces energy consumption and better meets climate protection requirements.

Many climate adaptation measures, such as rainwater retention basins, infiltration systems, renaturalisation and opening up of bodies of water, fresh air corridors and unpaved green spaces and swales, require a lot of space. The upper and lower road space in particular is already in short supply and is needed for traffic and pipes for the supply of energy, heat and water/wastewater.

There are further conflicts in the energy sector, e.g. air conditioning systems are effective as a climate adaptation measure, but are harmful to the climate due to their high energy consumption.

When considering climate protection and climate adaptation, it is therefore necessary to take the other area into account, to find positive links and to recognise and minimise negative influences.

3. The common path: Project organisation and networking

The EU's "100 climate-neutral cities" mission provided an opportunity to develop this Integrated Climate Protection Concept (ICPCC) in close cooperation with the city administration of Aachen. It builds on the ICSK from 2020, develops it further and supplements it. The process of creating this document itself already represents a contribution on the path to a climate-neutral city of Aachen by 2030, which is due to the intensive cooperation of various stakeholder groups in the city administration.

In this context, the following chapter takes a detailed look at the ICSK of 2019 and examines the relationships and roles of the stakeholder groups involved within the city administration of Aachen in the creation of this document and the continuation of the measures and activities.

3.1. The "IKSK 2020"

Where did we start from? - The "old" IKSK

On 19 June 2019, the Aachen City Council adopted the climate emergency and at the same time commissioned the development of the Integrated Climate Protection Concept (IKSK) for the city of Aachen. The concept is based on an inventory that analyses the successes and failures to date and takes into account activities such as participation in the European Energy Award (EEA) with its strategic recommendations and proposed measures.

What is the IKSK?

The city of Aachen's integrated climate protection concept was developed in a year-long process together with a large number of stakeholders from politics and administration as well as civil society. Many of the suggestions made during the participation processes were directly incorporated into the planning of measures. In total, the participation process resulted in around 70 measures for the 2025 action plan. The 2030 Strategy and the 2025 action plan both aim to halve the city of Aachen's emissions by 50 % by 2030 compared to 1990 emission levels.

What is its focus?

The programme of action, including the concept's profiles of measures, is scheduled until 2025 and also includes a strategy concept until 2030. The plan of measures until 2025 comprises the following fields of action:

- Urban planning
- Municipal buildings
- Energy supply
- Mobility
- Building refurbishment (private, commercial, non-municipal)
- Communication
- Economy

The mobility field of action is divided into three key areas: Reduction of car traffic in urban transport, reduction of car traffic in regional transport and reduction of vehicle emissions. Parts of the catalogue of measures will be taken up again in Aachen's path to climate neutrality in 2030.
This was supported by a communication and participation concept and strategic recommendations for decarbonisation by 2030.

How many activities does the IKSK 2020 have?

The action programme with an overview of measures for 2025 comprises over 200 measures spread across various sub-concepts. The energy policy work programme within the EEA contains the majority of these measures.

How large is the financial volume?

The costs of the 2025 action plan amount to 35 million euros per year for the urban measures, of which 15 million euros are attributable to the mobility sector and 20 million euros to the energy/RE, building refurbishment and business sectors.

How many staff positions will it create?

The personnel costs for the IKSK amount to 49 full-time positions, the majority of which are to be newly created, for example three new positions for the #AachenMooVe!3 project or 10 new staff positions for the expansion of traffic area monitoring.

How much greenhouse gas is saved?

A linear reduction trend over 10 years is assumed. Together with other concepts of the City of Aachen (e.g. energy policy work programme), the entire 2025 action plan achieves a reduction effect of 45,430 tCO2eq /a.

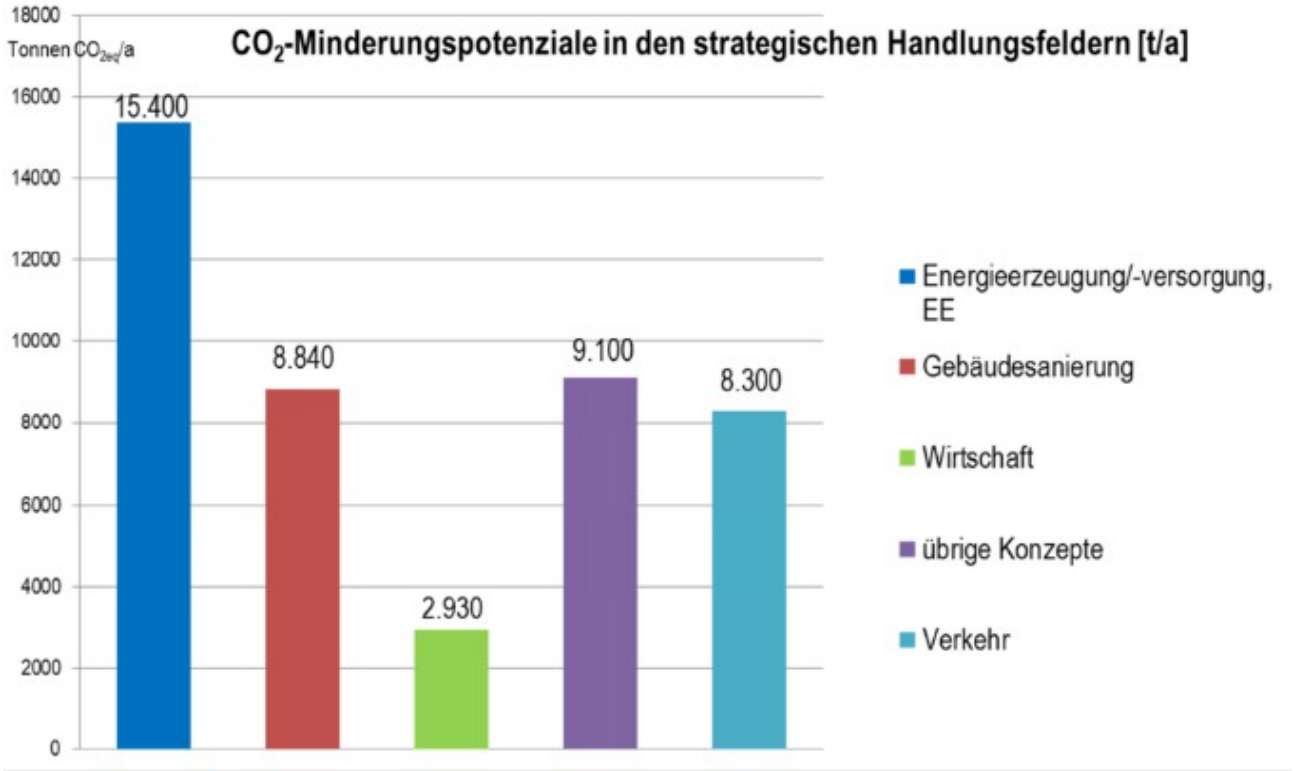


Figure 2 Illustration of the CO_2 reduction potential of the strategic fields of action of the IKSK 2020 (Graphic: Gertec GmbH)

3.2. Control and networking: The project team of the city of Aachen

The ICSK 2023 was developed in close cooperation with various stakeholder groups in the municipal family. The interaction between the stakeholder groups is shown in Figure 3.

The ICSK 2023 was developed with the involvement of all departments and municipal companies. The departments were represented by the ICSK team (see Figure 4.) The coordination of the process is the responsibility of Department 36 with the support of external service providers.

The VEP Steering Group and the municipal stakeholders were involved in specific technical issues, in particular mobility and energy supply issues. At a strategic level, the process was anchored in the administration via the climate protection conference.

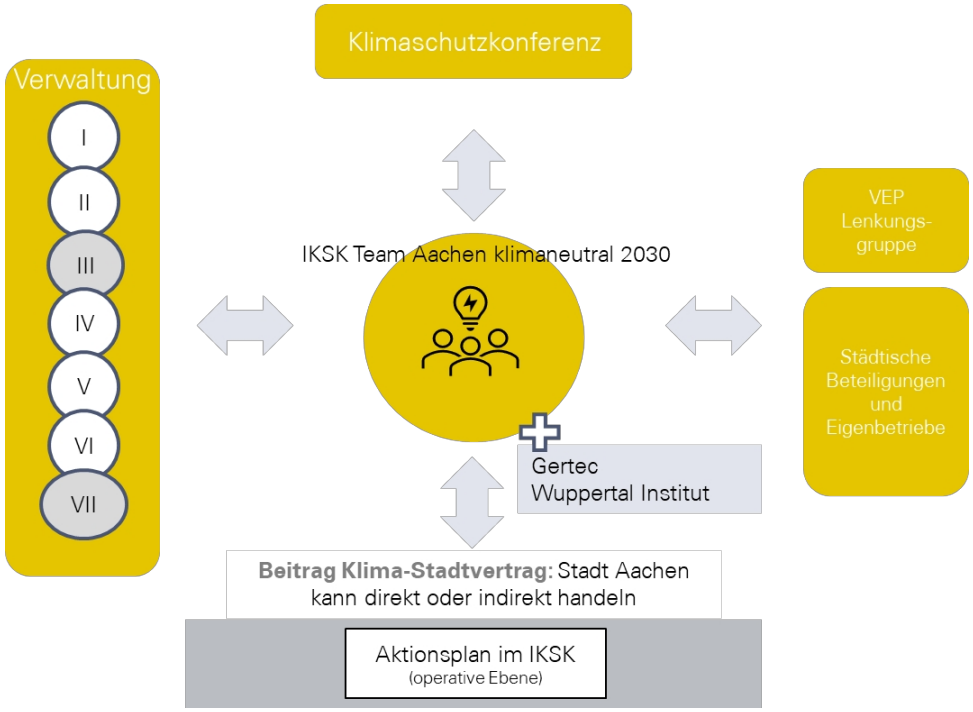


Figure 3 The stakeholder group in the ICSK process. (Graphic: Gertec GmbH)

3.3. Shaping and activating: The IKSK team

The technical centrepiece of the ICSK creation was a participation process with the ICSK team. The ICSK team involved all departments with the relevant specialist areas and municipal companies in the development of the ICSK as a contribution to the Climate City Contract.

Thanks to this broad involvement, all fields of action of the ICSK 2023 could be professionally mapped. Figure 4 shows the composition of the ICSK team based on the departments and specialist areas involved. The participation process consisted of four face-to-face meetings and one online participation meeting.

Below is an overview of the dates:

- Kick-off 10 May 2023: Opportunities and challenges on the path to climate neutrality, search for solutions
- Workshop 20.6.2023: Setting anchor points, searching for solutions (templates for activity profiles)
- Workshop 9.8.2032: Setting anchor points, searching for solutions (templates for activity fact sheets)
- Workshop 19.09.2023: Review of the activity profiles, identify and fill gaps

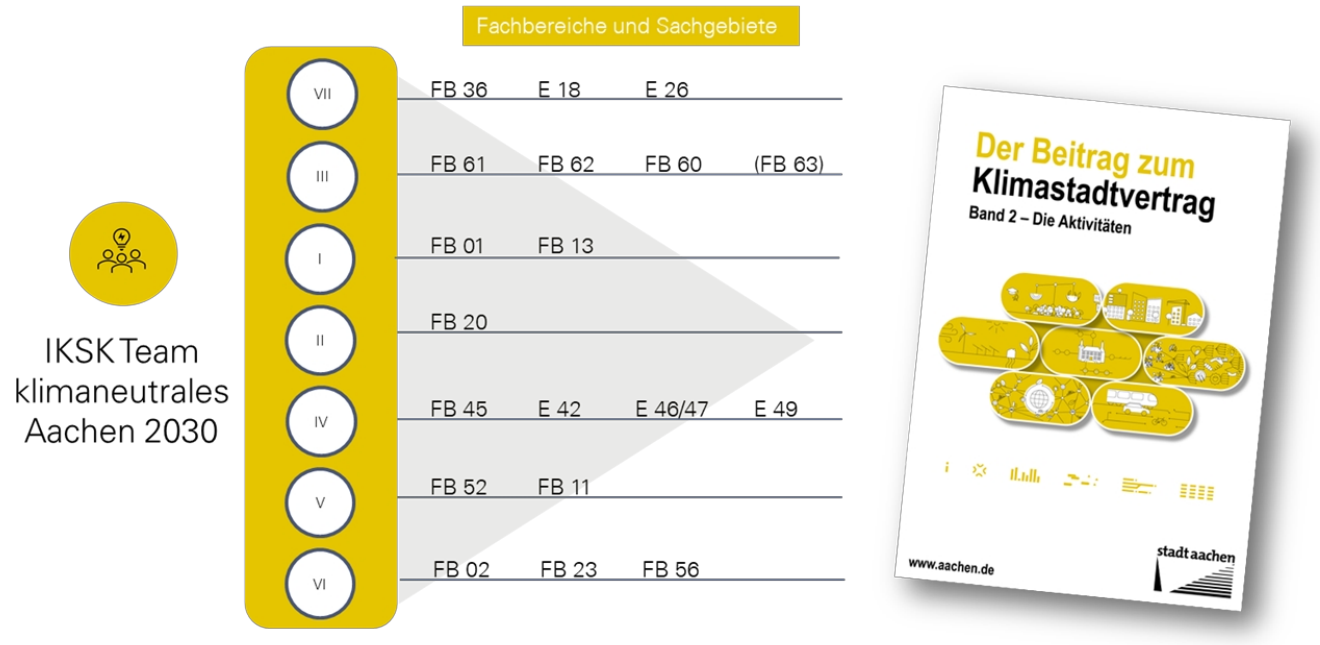


Figure 4 Overview IKSK Team (Graphic: Gertec GmbH)

3.4. Understanding and anchoring: climate protection conference, climate council and political participation

The chapter describes the involvement of the Climate Change Conference, the Climate Council and policy participation within the framework of the EU mission

As part of the ICSK development process, the Climate Protection Conference and the Administrative Board were involved at the strategic level. Participation took place at key milestones along the process. Political participation was ensured through information and consultation. With the City of Aachen's Climate Council as an advisory body,

The exchange also took place at important milestones. The technical and strategic coordination between the ICSK process and the process for the EU mission took place through integrated cooperation in the teams. Political participation was ensured through a meeting in the AUC and an intergroup information event.

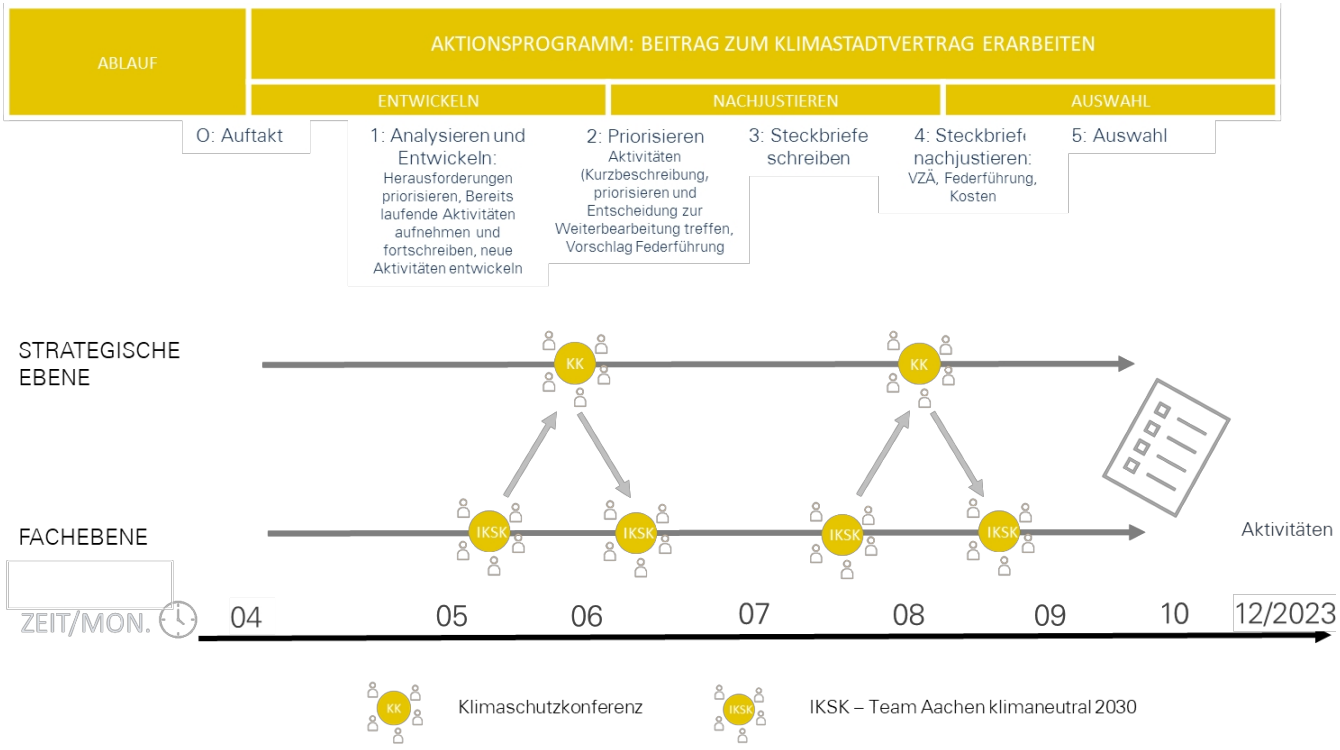


Figure 5 Schematic representation of the investment process (Graphic: Gertec GmbH)

4. This is our starting point

In order to successfully shape the path to climate neutrality in the city of Aachen, it is essential to know the current position. By clarifying the current situation, an effective path can be developed and flanked with appropriate measures and activities as part of the strategy.

The following chapter provides an overview of the most important features of Aachen as a business location. These include the geographical location and connections to the region, the socio-demographic structure, the composition of the city's built fabric and the transport, economic and energy structure.

4.1. Aachen - location and integration into the region

Aachen is an independent city in North Rhine-Westphalia. Aachen's urban area is divided into seven districts: Brand, Eilendorf, Haaren, Kornelimünster/Walheim, Laurensberg, Mitte and Richterich.

Due to the close proximity to both Belgium and the Netherlands, there is a close connection and cooperation with both countries. In addition, the merger with the neighbouring municipalities to form the Aachen city region means that there is also a close exchange here. The municipalities of Alsdorf, Baesweiler, Eschweiler, Herzogenrath, Monschau, Roetgen, Simmerath, Stolberg and Würselen belong to the Aachen city region. Aachen is also part of the

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so-called Rhenish mining district. The Rhenish mining area is characterised by lignite mining in the Hambach, Garzweiler and Inden opencast mines. The city region of Aachen, the districts of Düren, Euskirchen, Heinsberg, the Rhine-Erft district and the Rhine district of Neuss as well as the city of Mönchengladbach have joined forces for the strategic structural change of the region in the course of the end of lignite mining

Aachen's spatial structure

Figure 6 Spatial structures of the city of Aachen (Graphic: Gertec GmbH).

4.2. Socio-demographics

Aachen's socio-demographic structure is crucial for the implementation of the implementation of the Climate City Contract.

In 2022, 262,040 people lived in Aachen according to the city's statistics centre (Figure 7). The largest increase can be seen in the 18 to 25 age group.[4] Only in this age group is the city's net migration positive. This is due to the influx of first-year students at Aachen's universities. In the 2019/20 winter semester, a total of 61,362 students were enrolled at Aachen's universities.[5] This corresponds to almost a quarter of Aachen's population. These demographic characteristics are also reflected in in the household structure, although not all students also live in Aachen. Of a total of 152,163 households in 2020, 86,341 were single-person households. Together with people over the age of 60, 20 to 30-year-olds make up the largest proportion of the total population at 23% each (Figure 8). Children under the age of 10 and people aged 10 to under 20 account for the smallest share, at 8% each. Aachen's population is therefore relatively young, although the birth rate has been falling since 2019.

.[6]

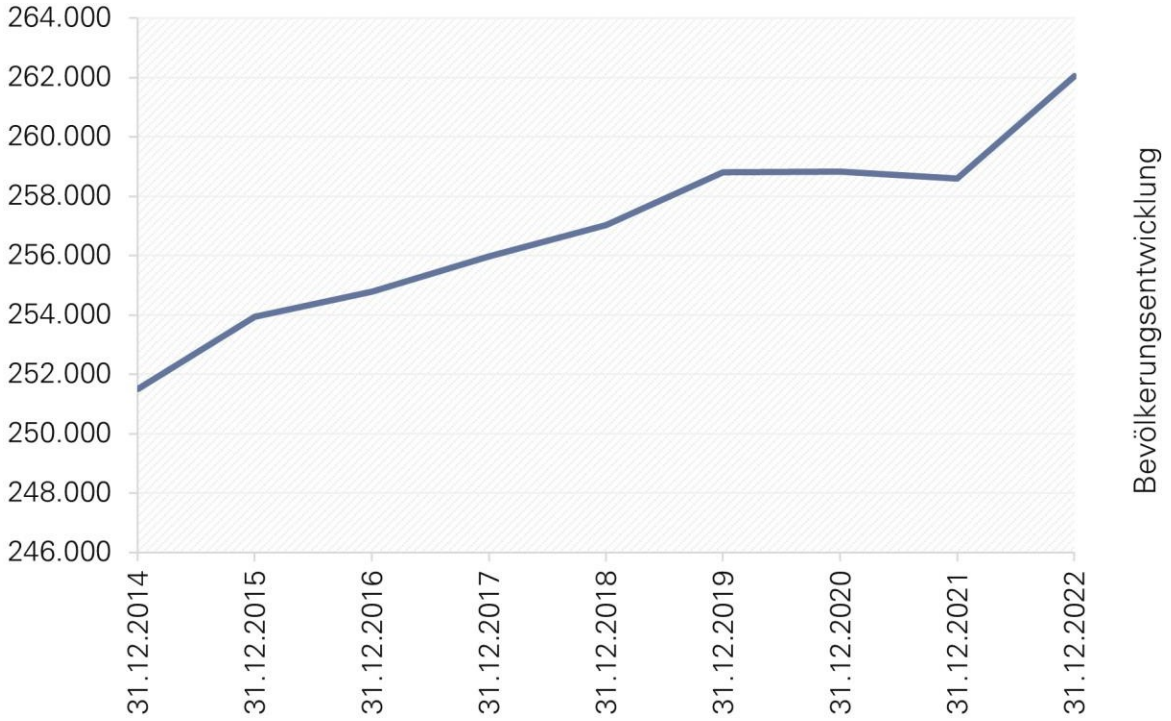

Figure 7 Development of the population in Aachen[7]. (Source: City of Aachen, Graphic: Gertec GmbH)

[4] City of Aachen. Statistical yearbook 2021-2022. p. 9

[5] City of Aachen. Statistical yearbook 2021-2022. p. 52

[6] City of Aachen. Statistical yearbook 2021-2022. p. 33

[7] City of Aachen. Statistical yearbook 2021-2022. p. 10

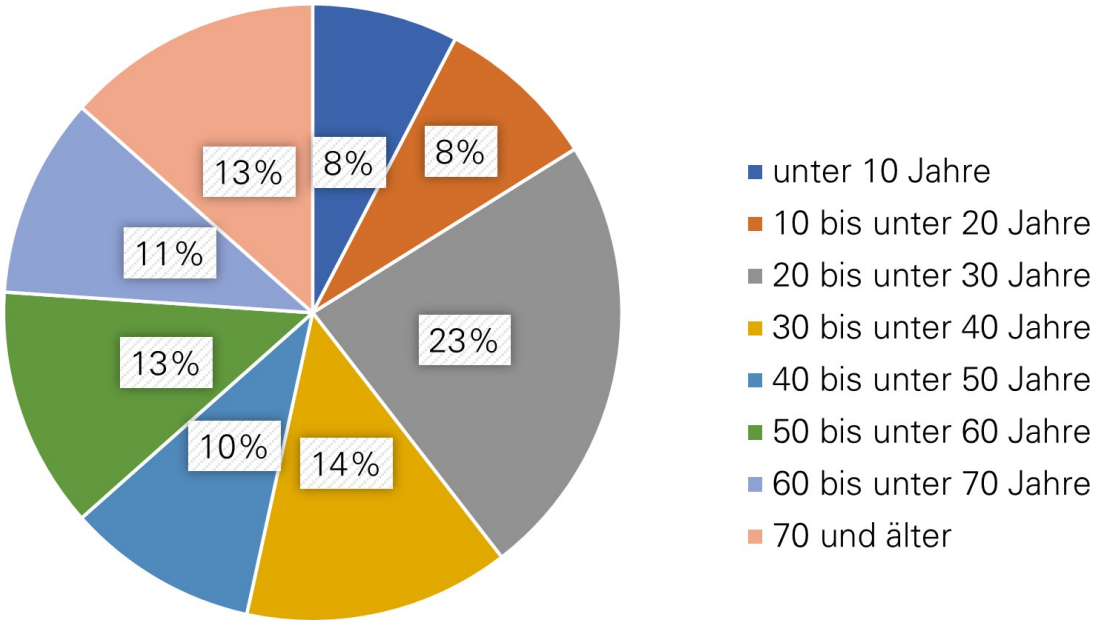

Figure 8 Population by age group in Aachen[8]. (Source: City of Aachen; Graphic: Gertec GmbH)

[8] City of Aachen. Statistical yearbook 2021-2022. p. 34 - 35

4.3. Spatial structure and building stock

As a large city, Aachen has an above-average population density. With an average of 1,548.5 inhabitants per square kilometre, it is well above all other municipalities in the city region (787.5 inhabitants/km2) and the state (525.5 inhabitants/km2).[9]

Nevertheless, the settlement area only accounts for just under 30% of the total area of 160.85 km2 in the urban area. At 21 km², residential areas account for the largest share of the settlement area. The industrial and commercial area accounts for around one sixth of the settlement area and is therefore roughly the same size as the area for sport, leisure and recreation. Vegetation accounts for the largest proportion of land at almost 60 %, of which almost two thirds is agricultural land and around one third is woodland. Most of the forests are located in the south and west of the urban area.[10]

Around 60 % of Aachen's buildings are residential. The remainder of the building stock is divided between commercial or industrial buildings, buildings for public purposes and other buildings. The majority of Aachen's building stock was constructed between 1949 and 1978. Many buildings from the period before 1919 and the period from 1919 to 1948 still exist. However, significantly fewer new buildings have been constructed since 1978. Two thirds of the building stock in Aachen consists of detached houses, the other third are apartment blocks. A quarter of the buildings in Aachen are owner-occupied.

BAK (year of construction)	Number of buildings	Share of the building stock
A/B (until 1919)	5.239	13,1 %
C (1919-1948)	4.840	12,1 %
D/E/F (1949-1978)	19.487	48,6 %
G (1979-1986)	3.639	9,1 %
H (1987-1995)	1.624	7,6 %
I (1996-2000)	1.624	4,0 %
J (2001-2008)	1.813	4,5 %
K (from 2009)	459	1,1 %
total	38.743	

Table 1 Aachen's building stock according to building age classes (source: City of Aachen).

[9] IT.NRW, state database, as of 29 March 2023. municipal profile Aachen, district city. Available at: https://www.it.nrw/sites/default/files/kommunalprofile/l05334002.pdf

[10] City of Aachen. Statistical yearbook 2018-2019. p. 17

4.4. Transport structure

The mobility sector currently accounts for around 25 % of CO_2eq emissions within the city limits, of which motorised private transport makes up the largest share.

According to the Mobility Report 2021, walking accounts for 30% of the modal split in the city of Aachen as of 2017, while 11% is accounted for by cycling and 13% by public transport. Private motorised transport has a total share of 46% of the modal split, consisting of 34% as drivers and 12% as passengers. The car density in 2020 was around 446 cars per 1,000 inhabitants, which compares favourably with NRW with a figure of 556 (2016). However, it should be noted that car registrations in Aachen have increased by 30 % over the past 30 years, although the population has only increased by 3.1 % over the same period. Accordingly, there is still a major challenge in reducing car density in order to achieve a successful mobility transition in Aachen.

In addition to good connections to three federal motorways, Aachen is connected to the trans-European rail network and is therefore part of important international passenger and freight transport routes such as the Montzen route. There are also several ICE and regional train connections from Aachen's main railway station. The Aachener Verkehrsverbund (AVV) operates the Euregiobahn and express buses to other European countries, while the city's public transport is operated by ASEAG with over 100 bus routes. Aachen has a long-standing membership in the Arbeitsgemeinschaft fußgänger- und fahrradfreundlicher Städte, Gemeinden und Kreise in NRW e.V. The transport infrastructure is shown in Figure 10.

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The commuter flows in the city of Aachen recorded an average of 170,751 daily commuter movements in 2022, of which 31,687 were outbound commuters, 72,448 inbound commuters and 66,616 inbound commuters[11]. The daily population in the city of Aachen thus increased by almost 40,000 people, of which around 3,810 commuter movements from Belgium and a further 1,880 from the Netherlands also took place in 2019.[12] The commuter flows are shown in Figure 9.

According to the Agora Verkehrswende city profile (as of 2020), 41% of journeys to work in Aachen were made by car, a further 3% as a passenger in a private car, 19% by public transport, 23% by bike and 15% on foot. Compared to other cities of a similar size, public transport is less popular with Aachen residents, with only around 44% of those surveyed for the study enjoying or very much enjoying travelling by public transport. According to the ADFC bicycle climate test, satisfaction with the cycling infrastructure is also slightly below average, although around 73% of households own at least one bicycle. With regard to car-sharing use, data is only available for the entire Aachen city region. These indicate that, at 11% of households, an above-average number of people have a car-sharing membership.

[11] Commuter Atlas.NRW, 2022.

[12] Agora Verkehrswende (2020): Cities on the move. Figures, data and facts on mobility in 35 German cities

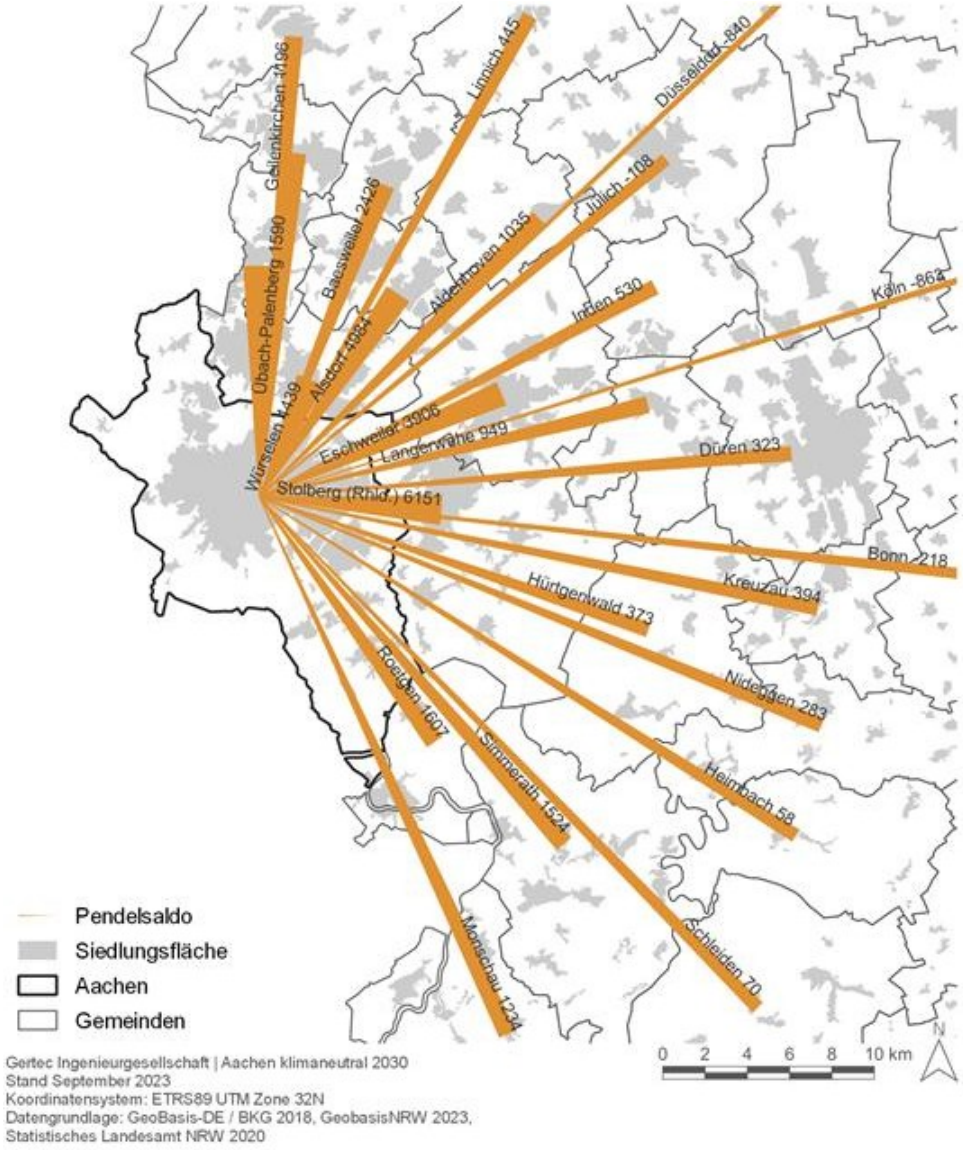

Figure 9 Commuter structures from Germany to Aachen. (Graphic: Gertec GmbH).

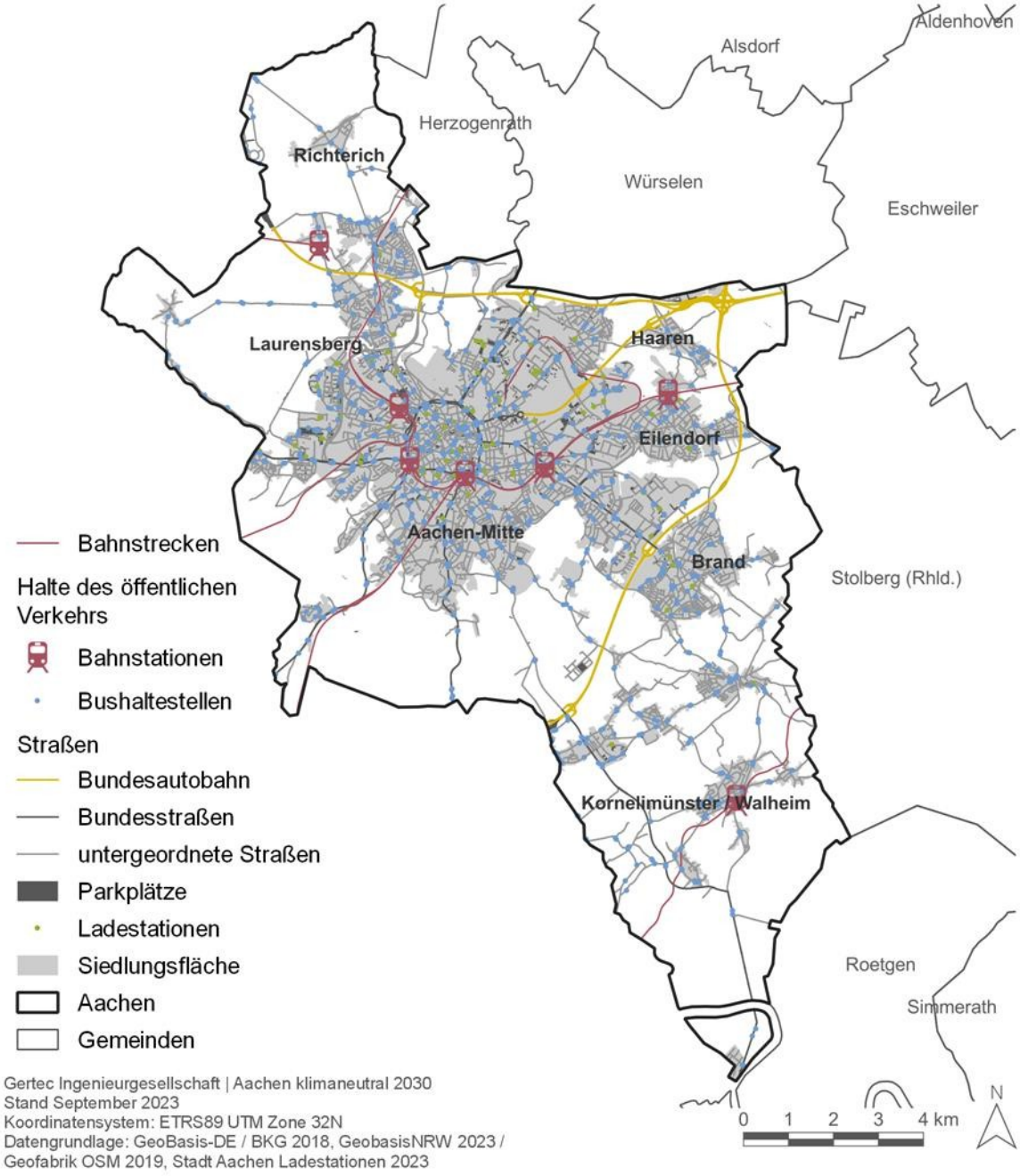

Figure 10 Overview of the mobility infrastructure in the city of Aachen (graphic: Gertec GmbH).

4.5. Economic structure

Aachen is a dynamic science and business location and the regional centre for the Aachen city region.

Aachen has a heterogeneous economic structure, with around 67% of employees subject to social insurance contributions working in the service sector, a further 17% in trade, catering, transport and warehousing, followed by around 15% in the manufacturing industry, in particular mechanical engineering and confectionery production.

The most important employer is RHTH Aachen University, followed by the city of Aachen and the administration of the Aachen city region.

The food industry is strongly represented by Zentis GmbH & Co KG, Lambertz GmbH and Lindt & Sprüngli GmbH. In the automotive technology sector, the Ford Research Centre and FEV GmbH, as a development service provider, are worth mentioning. In the medical and healthcare sector, the University Hospital Aachen and the pharmaceutical company Grünenthal GmbH are examples. Sparkasse Aachen is the largest employer in the financial sector, while Generali Deutschland AG is a strong representative of the insurance industry.

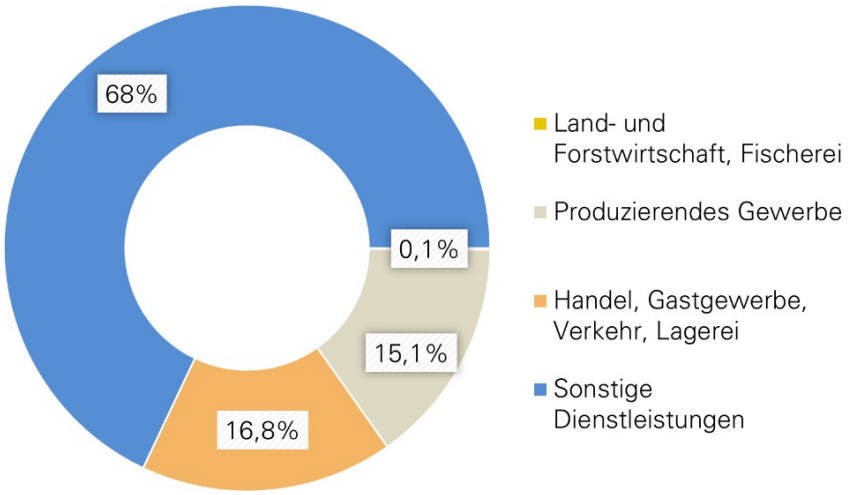

Figure 11 Employees by economic sector in Aachen. (Source: IT:NRW, 2022. Graphic: Gertec GmbH).

4.6. Energetic structure

With the Aachen model, the city of Aachen was an early best-practice example of how the energy transition can succeed. However, in order to fulfil the Climate City Agreement, the entire energy infrastructure and supply in the city area must be decarbonised.

The city of Aachen has a final energy demand of 5,797 GWh[13]. Natural gas accounts for the largest share at 43%. Natural gas is mainly used for heat supply and in second place for combined heat and power supply (CHP) in industry, hospitals, at RWTH Aachen University and in other public buildings (cumulatively around 8 %). In addition, a small proportion of heating oil (5%) is used in Aachen. District heating has a share of 6 %. The heat supply therefore accounts for around 60 % of the total final energy demand. At 22 %, fuels for vehicles account for the second largest share of final energy demand. Electricity consumption accounts for 19 % of final energy demand. When analysed by sector, private households account for the largest share of final energy consumption at 30 %. The trade, commerce and services sector follows with a difference of only three percentage points. The transport sector accounts for 22 % and industry for 19 %. Municipal administration has the smallest share of final energy consumption at just under 2 %. Renewable energy generation in the city has so far been able to cover 15.7 % of Aachen's electricity requirements. Wind turbines account for the largest share of this at 129 GWh per year. Photovoltaics with 17.5 GWh and biomass with 26 GWh, on the other hand, only account for a small proportion.[14]

Aachen already has a district heating network totalling 277 GWh, which already supplies 17,500 households. The district heating network is currently mainly fed with waste heat from the Weisweiler lignite-fired power plant, which is due to be decommissioned in 2029. Two combined heat and power (CHP) plants with 10 and 22 MW are currently available as alternatives[15]. In addition, numerous feasibility studies on solar thermal supply and the utilisation of warm mine water for heat supply are already underway.
Test drilling for deep geothermal energy is also planned. The realisation of a cold local heating network is planned for the West Campus.[16]

In terms of (energy) supply structures, the city of Aachen can build on a good foundation. Stadtwerke Aachen Aktiengesellschaft (STAWAG) is the majority shareholder in the grid operator Regionetz GmbH and thus combines grid operation, management, construction and asset management. /meter management in the areas of electricity, gas, heat and water networks in the city of Aachen, the Aachen city region and parts of the districts of Heinsberg and Düren.[17] By 2032, the aim is to
Around 30,000 smart metering systems will be installed[18], which will also facilitate the demand-led control of the feed-in of renewable energies.

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[13] The total and distribution of final energy demand by sector and energy source for 2021 are derived from the data stored in the ECOSPEED balancing tool. The data set used was retrieved in May 2023.

[14] City of Aachen. Aachen climate-neutral 2030. Rough sketch for the Aachen path to 2030. p. 37

[15] City of Aachen. Aachen climate-neutral 2030. Rough outline of the Aachen path to 2030. p. 45

[16] City of Aachen. Aachen heat transition: Cornerstones for a climate-neutral energy supply in 2030 p. 46, 50

[17] Regionnetz GmbH. https://www.regionetz.de/

[18] Regionanetz GmbH. https://www.regionetz.de/privatkunden/messstellenbetrieb/smart-meter-

rollout/

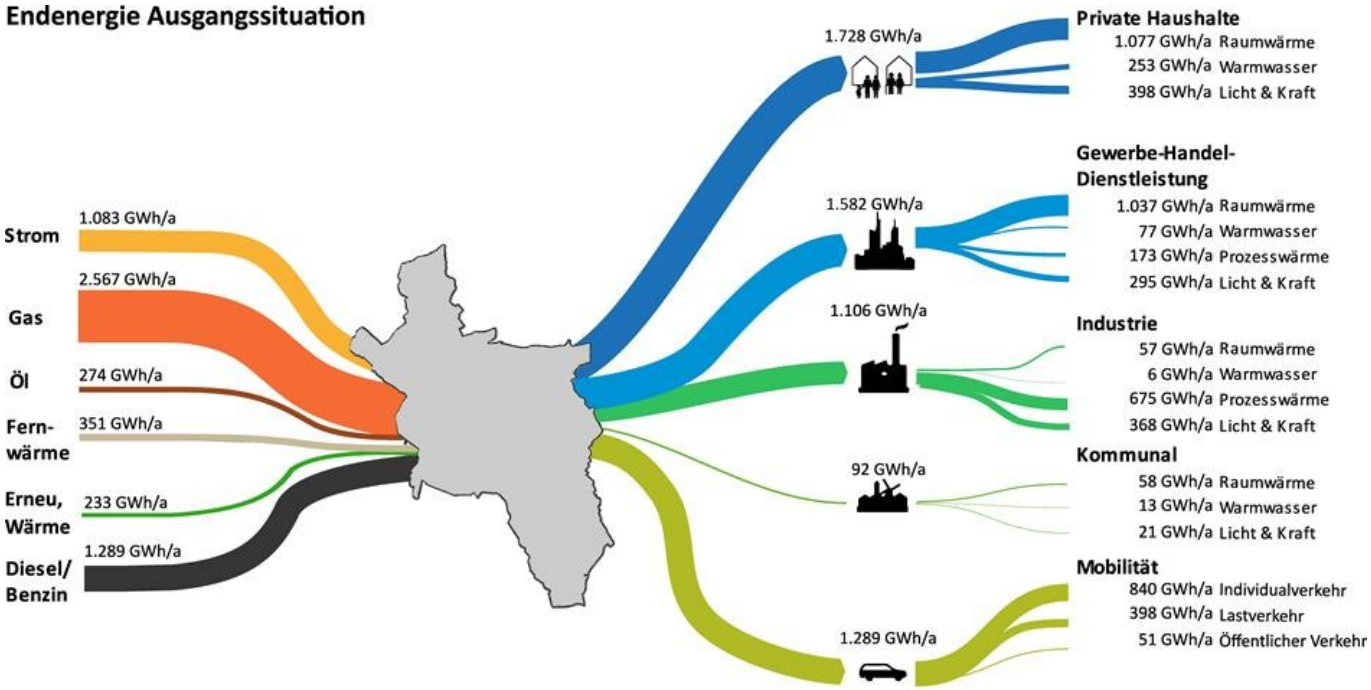

Figure 12 Final energy consumption and energy sources (initial situation) (Graphic: Gertec GmbH)

5. Focus on the transformation

The transformation towards climate neutrality is an ambitious and holistic task. It encompasses not only technical and infrastructural aspects, but also extends to the process and social level.

Various tasks need to be mastered in the process. These include the creation of governance structures to manage and coordinate the transformation and at the same time accelerate processes. In addition, the urban population must be mobilised and involved in the process. On the other hand, there are the challenges of acting within the framework of social responsibility and respecting the natural limits of land and resources.

The aim of this chapter is to introduce the concept of transformation and explain, based on theory, where changes occur. Following on from this, the central tasks and challenges of transformation are addressed and the benefits of transformation - the creation of structures for the provision of services of general interest in harmony with climate protection - are presented.

5.1. Where do we want to go?

This IKSK 2030 is intended to show what a path to climate-neutral Aachen could look like by 2030. This path requires comprehensive transformations in technology and infrastructure, society and the economy as well as in the use of land and resources.

In 1989, a cost-covering feed-in tariff for solar installations was introduced in Aachen for the first time. The so-called
In the years that followed, the "Aachen Model" was copied by many others and became a key basis for the Renewable Energy Sources Act (EEG). The Aachen Model is an example of how transformation can succeed: Innovations are tested in the niche, found to be good, grow and ultimately change the previously prevailing structures.

New ways of steering, participation and political instruments are required - in other words, a culture of governance that connects and actively promotes the search for solutions. The climate crisis also requires swift action. Nevertheless lack suitable framework conditions that support climate protection: There is often a lack of people, funding and broad acceptance for change. In this respect, this chapter focusses on the task of transformation for Aachen: What does transformation mean and what role can the municipal family play? What are the key transformation tasks? What challenges need to be overcome? What benefits for the future of the city of Aachen and the region are associated with the transformation? The chapter deliberately sets priorities and provides an overview. Where feasible and necessary, it refers to more detailed chapters in this ICSK 2030.

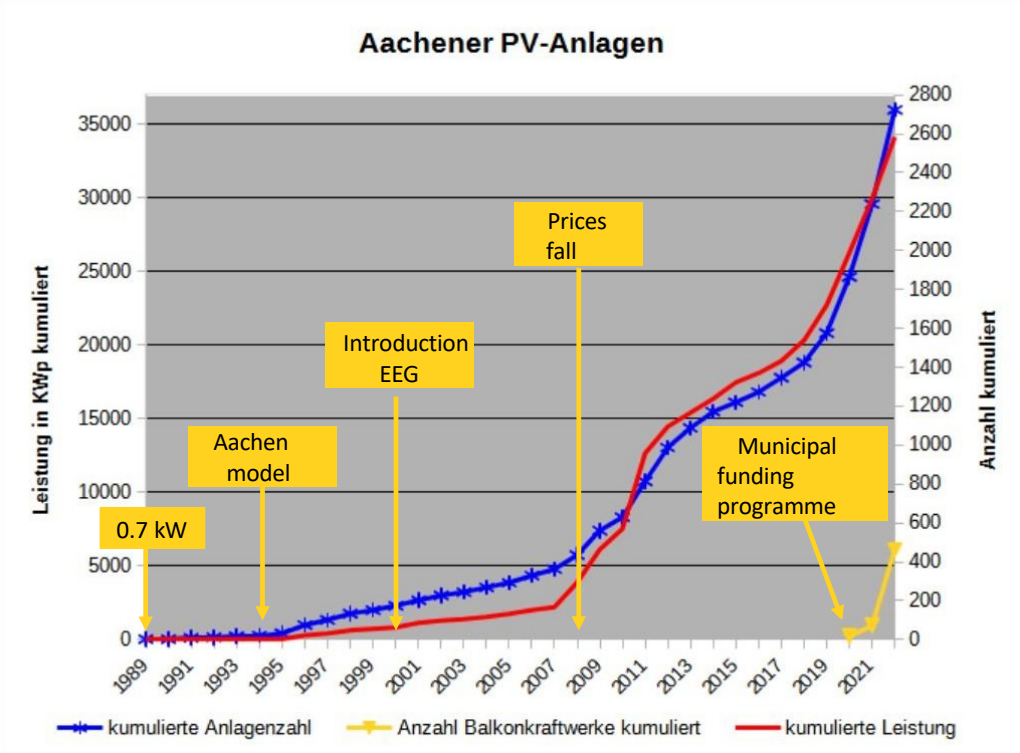

Figure 13 Development of PV systems in Aachen from 1989 to 2021 (Graphic Aachen hat Energie e.[V19].)

[19] https://www.aachen-hat-energie.de/sonne/entwicklung.php (Last call: 07.11.2023, 15:04)

5.2. What do we mean by transformation?

Transformation means a fundamental change. It describes changes in the political, economic or technological relationships of a society. It is accompanied by long-term processes and is only finalised when new system structures have become permanently established.

Change by design or change by disaster?

A key question is what triggers the transition to a climate-neutral society. Is the necessary change the result of proactive, risk-minimising behaviour and decisions or is the change reactive - i.e. the result of the greater impact of climate change.

On the road to climate neutrality, the ICSK 2030 assumes a proactive approach at three decision-making levels. Specific decisions are made at these levels and the framework for action is determined. The decisions have an inhibiting or promoting effect at the respective levels. Each level is necessary, none can replace the others and the goal of climate neutrality can only be achieved through interaction.

A distinction is made between three levels of decision-making

State/federal government/EU, market players (suppliers and consumers), urban family Aachen.

From a municipal perspective, the laws are set by EU, federal and state actors. Through their economic activities, market players create an environment with and in which municipalities operate. At the same time, there are interactions through municipal regulatory options. These relationships can set limits to the municipal sphere of influence, but can also expand it through cooperation and conscious control (Chapter 7) (Figure 14).

Figure 14 Multi-level view of the players (Graphic: Bodo Wirtz).

In this context, transformation means that fundamental principles and values as well as laws, processes and structures are revised in order to achieve a new goal.

Changes in one stakeholder group and another are mutually dependent. This happens across all sectors.

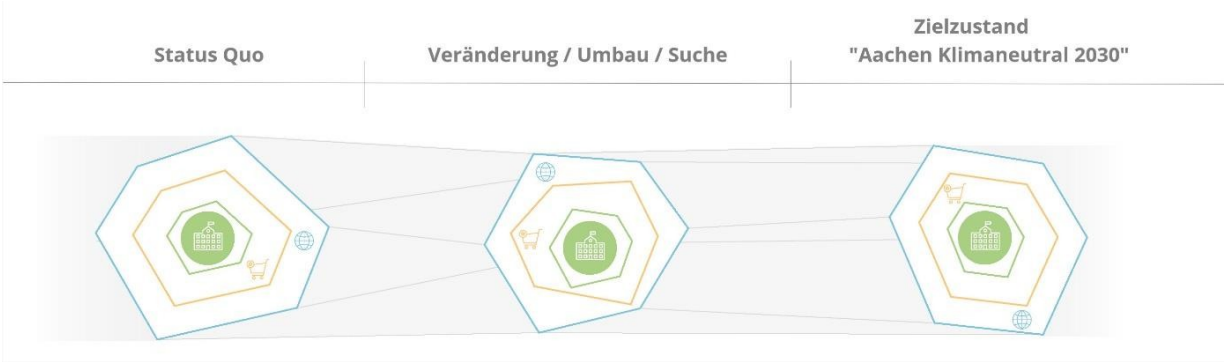

Figure 15 Change and mutual influence of the areas of impact between actors within the transformation to a climate-neutral society (Figure Bodo Wirtz)

Change occurs in niches

As the example of the Aachen model for cost-covering feed-in remuneration shows, change occurs in niches. Transformation science supports this realisation that changes that have the power to establish new principles, values, laws, processes and structures in the long term are developed in smaller niches. These so-called niches are to be understood as dynamic relationships between a small circle of actors in which new impulses are developed, promoted, tested, adapted or even dropped.

can become. They are like new threads that are woven into the developments in the structures between actors.

In order to enable such processes, governance is required that helps to accelerate processes, facilitate the implementation of activities and spread implementation across the board. The following sub-chapters provide an introduction to the transformation tasks.

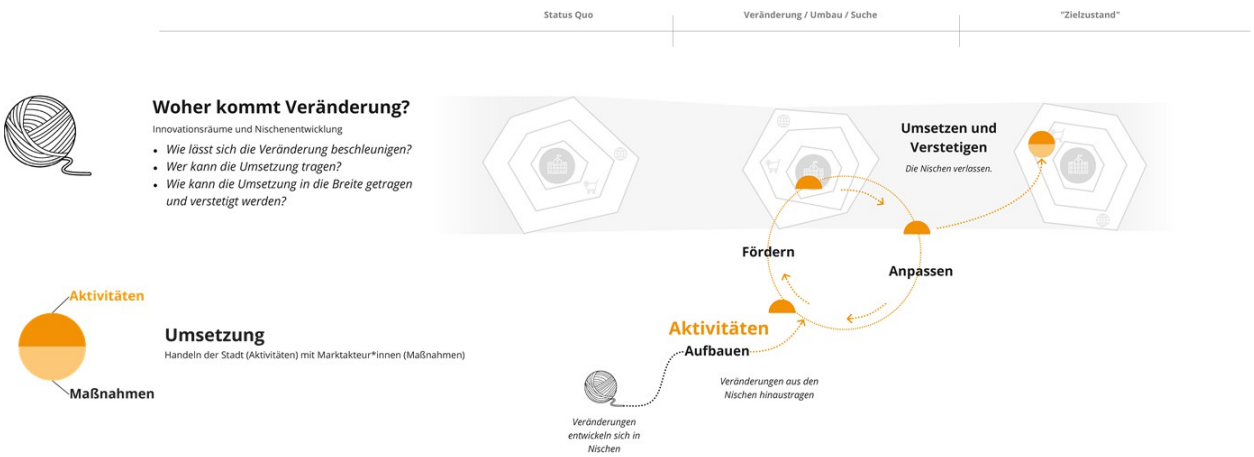

Figure 16 Where does change come from? (Graphic Bodo Wirtz)

5.3. Transformation task: Creating governance structures

The path to climate neutrality is a systemic task and an agile process in which the city, citizens and stakeholders such as companies, associations and interest groups are equally involved.

Governance explained

Aachen's path to climate neutrality by 2030 is a collective task for society as a whole that cannot be solved through top-down processes. The transformation process of urban society towards climate neutrality can be actively shaped and accelerated by the core administration, but it cannot be controlled in its entirety. This requires mechanisms to coordinate the stakeholders.

Governance attempts to summarise these mechanisms. The term is not clearly defined and is described differently depending on the context. For the ICSK, the term is used in two main ways:

- On the one hand, this refers to the rules and models that are required for coordination within the municipal family and are therefore of a more formal nature. It is about the concrete possibilities for the municipal family to influence the process towards climate neutrality and the processes and organisational structures for anchoring the climate neutrality goals in the municipal family and managing them.
- Governance is also used in the ICSK as a collective term to describe the interface between municipal and social action and the negotiation of a common path to climate neutrality. This is primarily about informal, network-like structures and the joint initiation and initiation of projects.

The issue of governance is of particular importance in the ICSK. This document devotes three chapters to the topic of governance:

This chapter 5.3 begins by describing the fundamental tasks involved in creating governance structures in the transformation process.

Chapter 9.4 formulates the necessary focal points for action, objectives and measures for establishing governance structures within the municipal family and at a city-wide level.

Finally, Chapter 11 formulates specific recommendations for the introduction of a control and coordination system for process management, with the aim of creating transparency, managing the use of resources in a targeted manner and promoting and integrating innovations and projects from urban society.

The fundamental transformation task of governance is described below.

The influence of the municipal family (Aachen Group)

The municipal family, with influential members such as STAWAG, ASEAG, GEWOGE and Sparkasse, can actively shape and tangibly influence its own transformation and that of the city as a whole. The IKSK identifies seven fields of action for achieving climate neutrality. In these fields of action, the municipal family can directly and indirectly act. Chapter 9 describes the necessary key areas of action and measures in detail. The municipal family acts on four levels: Regulating, providing and offering, advising and motivating, and consuming and setting an example. The instruments in this toolbox are described in Chapter 7.

Figure 17 Schematic representation of the organisational levels involved and the toolbox (Graphic: Gertec GmbH).

Structural changes are necessary

The requirements for the transformation process towards climate neutrality were formulated in a series of interviews conducted in June and July 2023 with department heads, heads of office and employees in the specialist departments.

The results were transferred to an organisational analysis. This revealed the following strategic goals for organisational development.

1. Increased speed in the implementation of measures to generate greater effectiveness.
2. Increased adaptability of processes within the city of Aachen and on the border with external organisations Actors in the identification of changed framework conditions.
3. Creating a framework for the necessary courageous decisions within a legally secure framework.
4. Creating a broad commitment and a high level of engagement for the goal of "climate neutrality 2030" in the city administration and in the entire municipal family.
5. Ensuring the contribution of the transformation envisaged by the EU in the city administration and for the city of Aachen by creating a positive radiance through the working methods of the actors in favour of climate neutrality.

Six principles set the framework for steering as a municipal management task

Organisational bracket

Every transformation process encompasses an organisation at the factual and personal level. The factual level becomes clear in the basic logic of administration through the anchoring of a topic in the organisation chart. The impact of the transformation is created by people who stand for these topics and give them a face both externally and internally. This requires people with strong communication skills, good networking and responsible leaders. Organisational brackets are required to organise, communicate, steer and bring about decisions on the path to climate neutrality. This applies both internally, within the municipal family, and externally, in relation to civil society and the corporate landscape (Chapter 11.2).

Transparency

The progress made under the IKSK 2020 and the associated successes in the area of climate neutrality are often not transparent. They are described in a traffic light system that merely indicates whether a measure has already been started or not yet started. This form of reporting is very vague. The presentation of activity statuses should therefore be more differentiated: How many milestones are there? Which milestones have been reached? How far along are the measures in detail? What is to be done in the next step? By when will measurable success be achieved? In order to create this transparency, digitally supported success monitoring is required at the activity implementation level (see Chapter 11). This enables the targeted management of activities and the use of resources to be planned. Transparency is also important for internal and external communication: which activities are currently underway and are part of the climate neutrality mission?

Clear decision-making system

In addition to the organisational framework for climate neutrality, a clear decision-making system is required. In the overall view of political mandates, it is necessary to balance resources; sustainable decisions must be made, especially when budgets are becoming tighter. For the City of Aachen, this means staffing the Climate Protection Conference in such a way that it is generally capable of making decisions - in close coordination with the Administrative Board - or that it can prepare decisions as recommendations for policymakers (cf. Chapter 11.3).

The Climate Protection Conference should clearly prioritise topics, especially for measures that require investment.

Communication that strengthens commitment

A large proportion of employees in the City of Aachen - as the interviews show - are convinced that climate neutrality is a necessary concern. However, there is a lack of conviction that all the necessary steps can be realised with the available resources - and that the political decision on climate neutrality will hold. A central task must therefore be to strengthen and promote the existing motivation of many individuals (see chapter 11.4).

Cross-functional co-operation:

The successes of the IKSK 2020 to date have been achieved thanks to the great personal commitment of individuals. In order to stabilise the topic of climate neutrality, stable structures need to be created for the future. The basic idea of ambidexterity helps to understand what is meant: on the one hand - and with one hand - central structures must be created. On the other hand - and with the other hand - the idea of the network and cross-functional cooperation in the city of Aachen must be strengthened. To what extent can the topics of sustainability, climate protection, climate neutrality and climate impact adaptation be bundled? Where does a demarcation make sense? (see chapter 11.5).

Tangibility

For many city administration stakeholders, the topic of climate neutrality is not sufficiently tangible. Although they are aware of the partial successes in climate protection, there is sometimes a lack of concrete anchoring in processes, regulations and principles in the city administration. In addition to awareness-raising communication about the City of Aachen's strategic goal, the pioneering role it has already taken on and the many individual activities, there is also a need to anchor this in official directives and regulations. How can climate protection be integrated into day-to-day administrative action, what contribution can everyone make in their own area? What tasks and responsibilities must be taken into account in the future, including in the job profiles of managers with regard to climate neutrality and sustainability? (see chapter 11.6)

5.4. Transformation task: accelerate processes

Climate neutrality requires a considerable acceleration of planning and implementation processes. During workshop meetings with the IKSK team, approaches were developed to promote the acceleration of decision-making and implementation processes. The approaches are taken up in the ICSK and taken into account conceptually and at the level of municipal activities.

The key aspects are briefly explained below and the link to the ICSK is presented as an example:

- Common goals and strategies: A shared vision and goals are important. It is necessary to create low-threshold entry points and to make successes visible quickly.
- Introduce transparent process management and controlling: It is necessary to set up portfolio management and digital controlling (smart and digital solutions). Data availability and data transparency must be ensured and accessible (open data, open governance).
- Leadership task - promoting responsibility for solutions: Act as a role model: Cross-sectional, fast decisions ("case management") promote the speed of implementation. Through networking, e.g. in Peer to peer networks promote learning from each other and the exchange of implementation knowledge and increase the speed of implementation.
- Take long-term action - promote perseverance with a culture of follow-up: Ensure financing with a sufficient time perspective.
- Use push and pull factors (promotion, regulatory means)
- Networking and training stakeholders: Imparting knowledge about one's own options for action, promoting knowledge transfer at all levels and thus achieving faster decisions, passing on information in networks and promoting technology transfer.
- Provide sufficient implementation resources: Promote training of specialised personnel, equip planning processes with sufficient personnel cf.

5.5. Transformation task: Carrying out the implementation

The realisation of climate protection tasks is a particular challenge when financial and human resources are scarce. Cities in particular bear the burden of implementing climate protection measures locally.

The cities' room for manoeuvre

They invest in the renovation of their own buildings, rebuild the local infrastructure, ensure the framework conditions for land use within the framework of self-administration sovereignty and accelerate social change through information, promotion and knowledge transfer. One basic problem here is the unclear legal situation. Climate protection is not a statutory duty for cities. However, the question arises as to whether voluntary action is still appropriate in light of the climate crisis and the negative impact on services of general interest. The climate protection requirement formulated in the climate ruling of the Federal Constitutional Court [20] is also filtering down to the municipalities and goes beyond the mere role model function [21]. Against this background, it is logical that tasks such as municipal heat planning are regulated by law as a mandatory task for municipalities. In this respect, the fundamental question arises: Which tasks are mandatory, which tasks can the city of Aachen implement voluntarily and where does the money for their implementation come from?

The IKSK 2030 shows which tasks must be taken on by the city of Aachen in order to make a significant contribution to climate neutrality.

These are described in detail in Chapter 9 for each field of action and are listed in detail in Volume 2. This includes a determination of the required investments at a city-wide level and the associated benefits in Chapter 10.

In the course of workshop meetings with the ICSK team, approaches were also developed to ensure implementation from a practical perspective. These include

- Sharing on different shoulders: City, companies, citizens work hand in hand (marketplace model), private companies and public companies work together (PPP), civic projects (citizen energy cooperatives), volunteer work
- New ways of financing: municipal climate protection funds for profitable and non-profitable projects, public-private partnerships (PPP), financing and funding landscape, funding management, new financing models.
- City of Aachen stabilises the initiation and implementation of measures and projects by market players, e.g. by promoting projects and innovation spaces, supporting "pioneers of change" and including projects in the portfolio of measures.

[20] BVerfG, decision of 24 March 2021, ref. 1 BvR 2656/18 et al.

[21] Dr Roda Verheyen et al, Municipal climate protection in the area of conflict between task and

Figure 18 Climate funds as sources of project financing (Graphic: Gertec GmbH)

Figure 19 Schematic representation of the integration of market players in the Aachen Way (Graphic: Gertec GmbH)

5.6. Transformation task: urban society Spreading the change

A critical mass of people is required for change to be initiated and accelerated. This section describes how this quantity can be achieved.

During workshop meetings with the IKSK team, approaches were developed to spread the change in urban society across the board

- Multipliers, volunteer work as a pillar of change: Social transformation processes begin with people who are willing to change as pioneers of change and role models. Promoting and supporting associations, providers of climate-friendly offers and services as well as multipliers in civil society as pioneers of change is a key lever that can be triggered by urban activities (cf. Chapter 7.5.).

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Associations are multipliers for disseminating information quickly and effectively. One example is the interactive map of sustainable commitment in Aachen.[22].

- Acceptance through benefit-orientation: benefit-orientation for infrastructures and services, participation opportunities e.g. B to citizen energy cooperatives.
- Anchoring climate neutrality across the board - even in the face of resistance:
- Climate neutrality - the new normal: Promote self-reinforcing processes, e.g.: good visibility of sustainable products increases their purchase, more and more companies are also trying to offer sustainable products (see chapter 5.6.).

[22] One World Forum Aachen: Sustainable commitment in Aachen: https://we-at-aachen.de/Initiativen/ (Last call: 26.10.2023, 13:40)

5.7. Transformation challenge: limits to the use of space and Resource consumption

A range of activities and measures are required to achieve climate neutrality. In particular, those activities and measures that contribute to energy saving and efficiency measures face the challenge of additional land and resource consumption.

Avoid the rebound effect

This is because the so-called rebound effect describes a situation in which in which the planned energy savings through efficiency measures or technological improvements are partially or even fully offset by increased consumption. This happens in particular when a measure is economically viable. Particularly with regard to energy supply and urban development, resources can be conserved by pooling resources, implementing sufficiency measures in the urban family and utilising existing potential.

Approaches are:

- Intelligent use of space: Commercial areas are being developed upwards in order to save space, there is an increase in flat swaps so that people can once again use living space that meets their needs, surveys of existing buildings identify unused buildings so that they can be used in the future, office space can be greatly reduced due to increasing digitalisation and mobile working, intelligent parking systems help to reduce public parking spaces.

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- Re-use land and reduce consumption: largely avoid new development, multiple use (PV on car parks), redesign road space to make room for bicycles and public transport.
- Reduce resource consumption: Recycling, sharing, upcycling etc. help to reduce resource consumption.
- Adapt utilisation: Intelligent parking systems help to reduce public parking spaces, spaces are used several times by different people, at different times and for different purposes, street space is extensively redesigned to make room for bicycles and public transport.

5.8. Transformation challenge: acting with social responsibility

When it comes to climate change, it is an open secret that groups of people who structurally contribute little to emissions due to their own limited resources will often be the hardest hit by the consequences. At the same time, their limited resources prevent these groups from actively participating in the transformation process with resounding force. They are therefore structurally trapped on two levels. This results in a social responsibility for all those actively shaping the transformation.

The requirements profile is changing

The ICSK requires a proactive approach to the transformation towards climate neutrality. Proactive action goes hand in hand with various decision-making processes that have direct and indirect effects on uninvolved stakeholders. There are various approaches here to consider the inherent social responsibility that goes hand in hand with the decision-making processes, to take this into account and to implement it in measures that contribute to climate neutrality and at the same time improve the living conditions of stakeholders. This means

- Weighing up: Taking the interests of unrepresented population groups into account during the decision-making process and avoiding or mitigating the negative consequences of activities as far as possible.
- Accepting responsibility: This means initiating measures and activities swiftly and at the same time prioritise those that improve the structural situation of people.
- Addressing citizens from different socio-economic backgrounds and involving them in processes (see chapter 2.1)
- Pilot project "Introduction of a municipal climate money": As part of a pilot project, the city of Aachen is introducing a "Municipal Climate Money", which will initially be paid out to 1,000 recipients of the Aachen Pass. The aim is to compensate for social hardship caused by the rising $CO_{2\ price}$ through non-cash or financial benefits. As part of the pilot project, possible sources of income are to be identified and the payment mechanisms developed and tested (see Chapter 9).

5.9. Transformation benefits: Climate protection and services of general interest

Although the transformation towards a climate-neutral society faces enormous challenges, these must be assessed against the overall benefits.

A successful transformation assumes that a social structure is found between the actors and their behaviour that is in harmony with the natural resources of the environment and does not have a negative impact on them. This means that traditional public service tasks and the way they are performed will change. In the desired state, mandatory municipal tasks such as urban development, supply and disposal and infrastructure provision will contribute to the successful mitigation of climate impacts and thus protect vulnerable groups. The aim is to interweave tasks of general interest with a holistic understanding of climate protection to create a liveable city of Aachen. The IKSK addresses this with the following measures:

- Expansion of a decentralised energy structure: A decentralised structure of renewable energies secures the regional energy supply.
- Climate neutrality as a guide to action: Anchoring climate neutrality in the administration as a normative guideline that also enables new structures (see chapter 9)
- Supplementing traditional tasks of public services: The expansion and revision of traditional urban planning tasks via neighbourhood management, the orientation of construction activities towards climate neutrality and the consideration of climate-neutral transport (Chapter 9).

6. Clearly describe climate neutrality

In order to derive a concrete CO_2 budget to achieve climate neutrality for Aachen, a standardised understanding of the terms is first necessary. The Federal Environment Agency categorises the term "climate neutrality" within a more precise climate science framework. For the municipal context, it recommends using the term "greenhouse gas neutrality". Greenhouse gas neutrality is achieved when all technically avoidable greenhouse gas emissions have been completely avoided and the unavoidable greenhouse gas emissions have been neutralised through compensation measures.

On this basis, an energy and greenhouse gas balance was drawn up for Aachen in accordance with the BISKO standard, supplemented by secondary balances on the compensation options for green infrastructure. The CO_2 budget for Aachen was derived on this basis. For the city of Aachen, there is a budget of around 12,454 tonnes per person (energy-related share) as part of the 1.5-degree target.

In the following chapter, the methodical derivation of the per capita budget is carried out and Aachen's possibility of offsetting in accordance with the requirements of the EU's "100 climate-neutral cities" mission is described.

6.1. The goal of climate neutrality

The terms 'climate neutrality' and 'greenhouse gas neutrality' are used synonymously both in the Paris Climate Agreement and at EU level. However, at national level, particularly through the Climate Protection Act and the Federal Environment Agency, a more differentiated approach is taken to these terms. The Federal Environment Agency's definition is particularly relevant for the specific municipal context.

'Climate neutrality' - The UBA definition

The Federal Environment Agency categorises the term 'climate neutrality' within a more precise climate science framework. According to this, 'climate neutrality' refers to a state in which human activities have no net effect on the climate system[23]. These activities include both climate-relevant emissions and measures to remove greenhouse gases from the atmosphere, as well as human activities with regional or local biogeophysical effects, such as changes in surface albedo.

This definition requires a policy that aims for climate neutrality to be more ambitious, as it takes into account not only greenhouse gas emissions but also all other climate-related effects of human activity.

For the municipal context, the Federal Environment Agency therefore recommends using the term 'greenhouse gas neutrality', taking into account the following criteria:

- Greenhouse gas neutrality is achieved when all technically avoidable greenhouse gas emissions have been completely avoided and the unavoidable greenhouse gas emissions have been neutralised through offsetting measures.
- The BISKO standard (municipal accounting system) serves as the central point of reference for recording energy-related greenhouse gas emissions.

[23] Federal Environment Agency, 2021 Factsheet - Greenhouse gas neutrality in municipalities. [online] Available at: https://www.umweltbundesamt.de/sites/default/files/medien/376/publikationen/2021-03-24_factsheet_treibhausgasneutralitaet_in_kommunen.pdf (last accessed: 21.11.2023, 11:34).

6.2. Determine the balance sheet limits

A fundamental distinction is made between two accounting principles: consumption accounting (domestic principle) and source accounting (territorial principle). These two approaches allow different perspectives on the recording of GHG emissions.

Establish comparability

The consumption balance takes into account GHG emissions caused by a polluter (e.g. a company), regardless of its location. The source balance takes into account GHG emissions that occur within the territorial boundaries of Aachen. This approach enables a detailed recording of the actual emissions within the urban area. Another advantage is the principle of addability: as the emissions can be allocated to specific territories, they can be added together and easily compared with each other

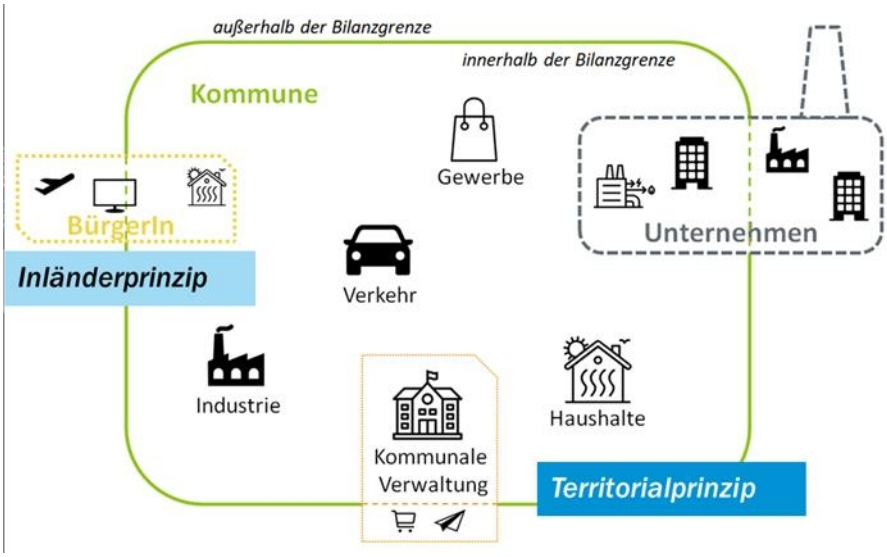

Figure 20 Accounting principles (ifeu Heidelberg, Jung Stadtkonzepte Cologne)

In relation to these accounting principles, there are various accounting standards that are used to carry out the accounting. For example, companies use the Greenhouse Gas Protocol and DIN ISO 14064-1 for their accounting.

Accounting. The BISKO standard based on the territorial principle has become established for municipalities and districts. This standard is used for the city of Aachen.

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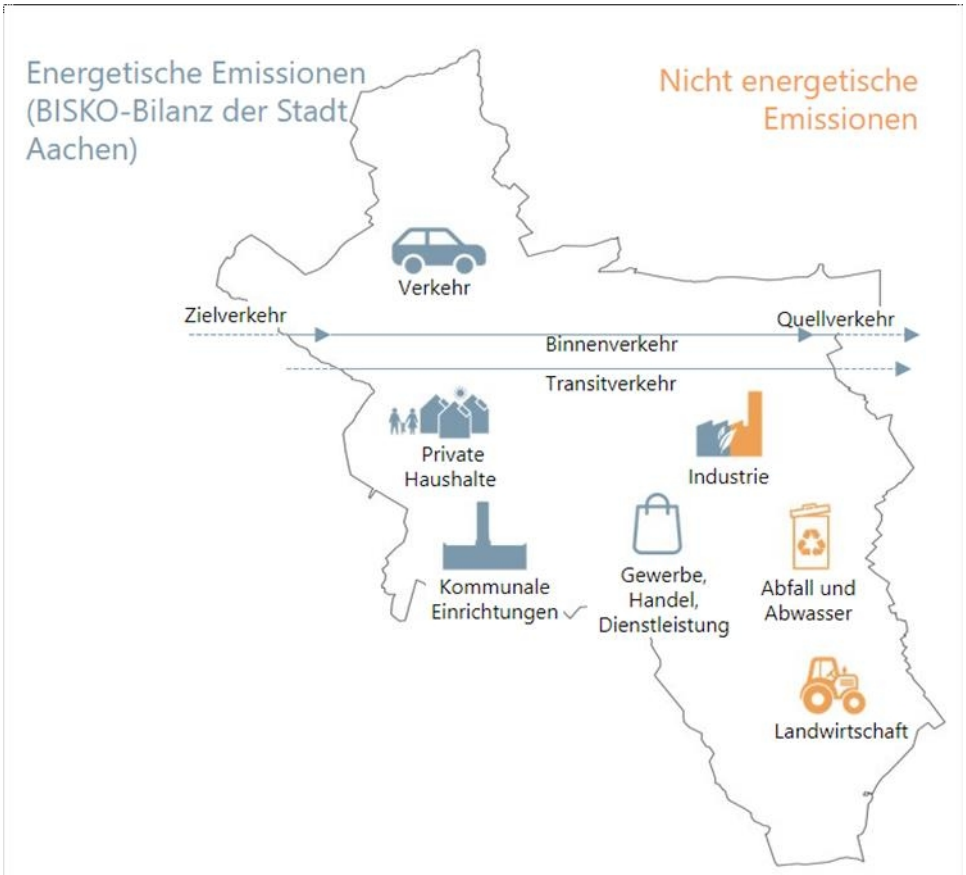

Figure 21 Balance sheet boundaries of the city of Aachen according to the territorial principle. (Graphic: Gertec GmbH)

The limits of the BISKO standard

The BISKO standard makes a fundamental distinction between energy and non-energy emissions. Non-energy emissions include climate-impacting gases from industrial processes, agriculture, waste and wastewater. The share of non-energy emissions in agriculture, for example, amounts to approx. 8.2 % of total emissions in Germany.

The main elements of the BISKO balance sheet are

- Final energy-based territorial approach: All energy-related emissions within the city limits of Aachen are analysed.
- Federal electricity mix: The federal mix is used as a reference when assessing electricity in the Aachen balance sheet prepared in accordance with the BISKO standard.
- Consideration of upstream chains and $CO_{2\,equivalents}$: The balance takes into account not only the direct emissions, but also the emissions generated during extraction, processing and transport of the energy sources used. In addition, the greenhouse gases methane (CH_4) and nitrous oxide (N_2O) are recorded as $CO_{2\,equivalents}$. For this reason, we will refer to greenhouse gas or GHG emissions and balances rather than CO_2.
- Exergetic allocation: In electricity and heat generation from CHP processes, emissions are allocated on the basis of their exergetic value.
- No weather correction: The calculated energy consumption is not adjusted for weather conditions due to harmonisation processes in the BISKO standardisation. When the BISKO standard was developed, this was justified by the fact that a balance sheet should reflect the status quo and any effects for changes are better explained for information purposes. This approach is also used at other levels (federal states, federal government).

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6.3. The initial balance sheet

The key results of the BISKO assessment for the city of Aachen and recommendations for expanding the assessment procedures are formulated below.

Final energy balance

The basis for the energy-related GHG balance listed in section 6.3 is the city-wide final energy balance for the city of Aachen. Figure 23 shows the balance for 2020, broken down by sector and energy source. The local data shown was taken from the EcoRegion online balancing tool for Aachen.

In 2020, the city's total final energy consumption was around 5,797 GWh.

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Of this total volume, around 30 % (approx. 1,728 GWh) was attributable to the private household sector, around 27 % (approx. 1,582 GWh) to the tertiary sector, around 22 % (approx. 1,289 GWh) to the transport sector and around 19 % (approx. 1,105 GWh) to the industrial sector. The buildings and properties managed by the municipal building management, referred to below as "municipal buildings", contributed around 2% (approx. 92 GWh) to the total volume.

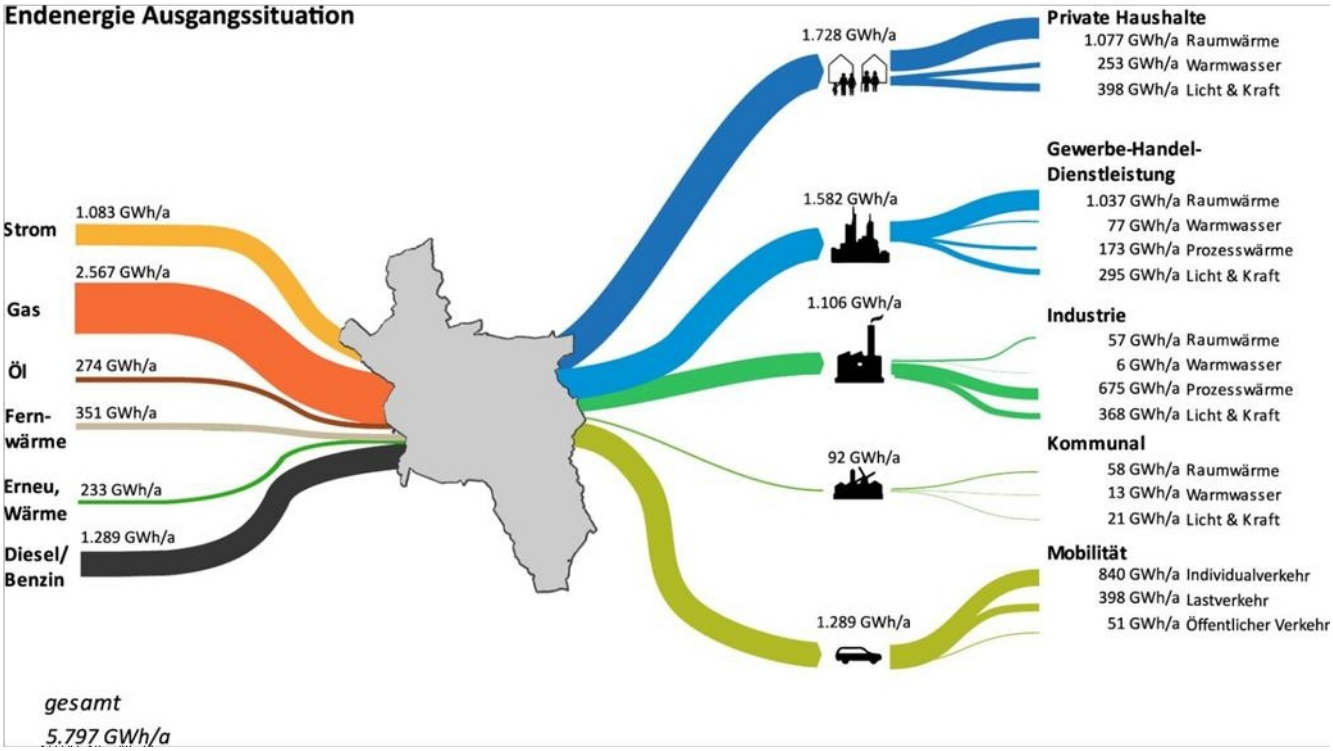

Figure 22 Final energy balance by energy source and area of application, 2020 (Graphic: Gertec GmbH)

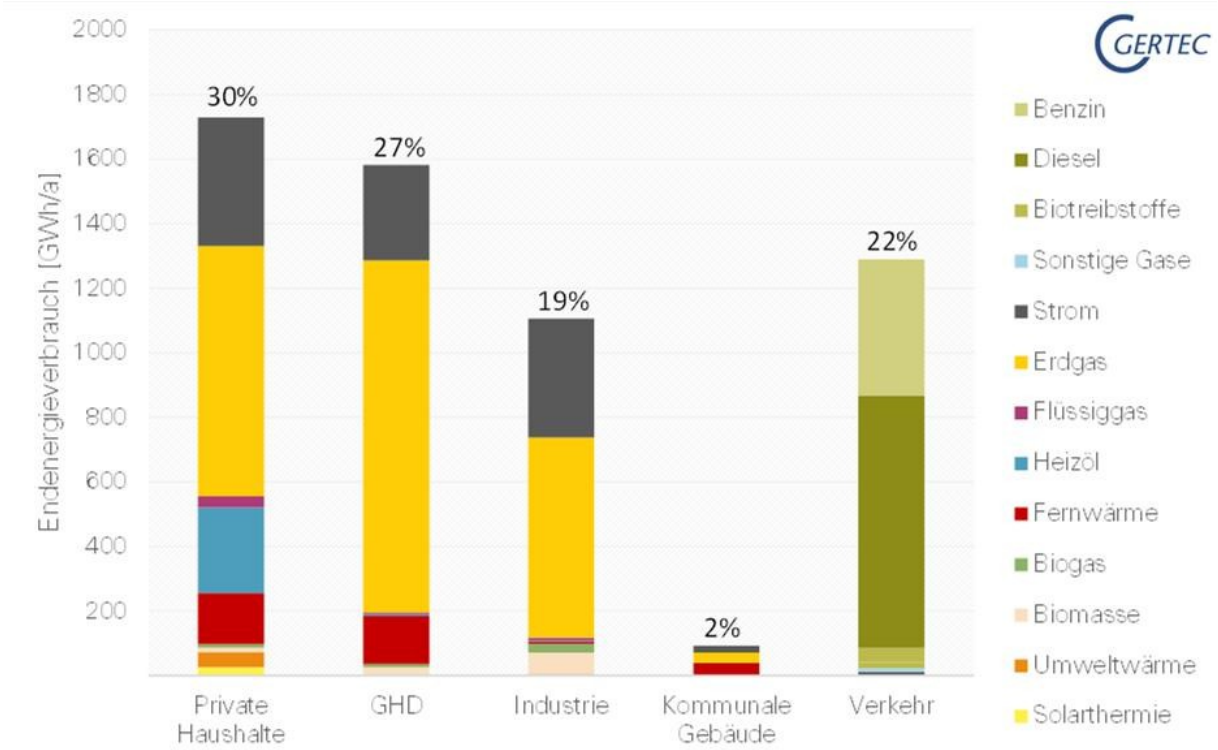

Figure 23 Final energy consumption in Aachen in 2020, broken down by sector and energy source (Graphic: Gertec GmbH)

In terms of energy sources, natural gas dominated with around 43% (approx. 2,519 GWh) in all stationary consumption sectors, followed by fuel with around 22% (approx. 1,278 GWh) and electricity with around 19% (approx. 1,083 GWh). District heating accounted for around 6 % (approx. 351 GWh), while heating oil accounted for around 5% (approx. 274 GWh) of total consumption. Other energy sources played a smaller role here, totalling around 5 %.

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Energetic GHG balance

The GHG balance for 2020 was prepared on the basis of the total final energy consumption of the various energy sources and the specific emission factors.

As illustrated in Figure 24, GHG emissions amounted to around 1.6 million tonnes or around 6.6 tonnes of GHG per inhabitant.

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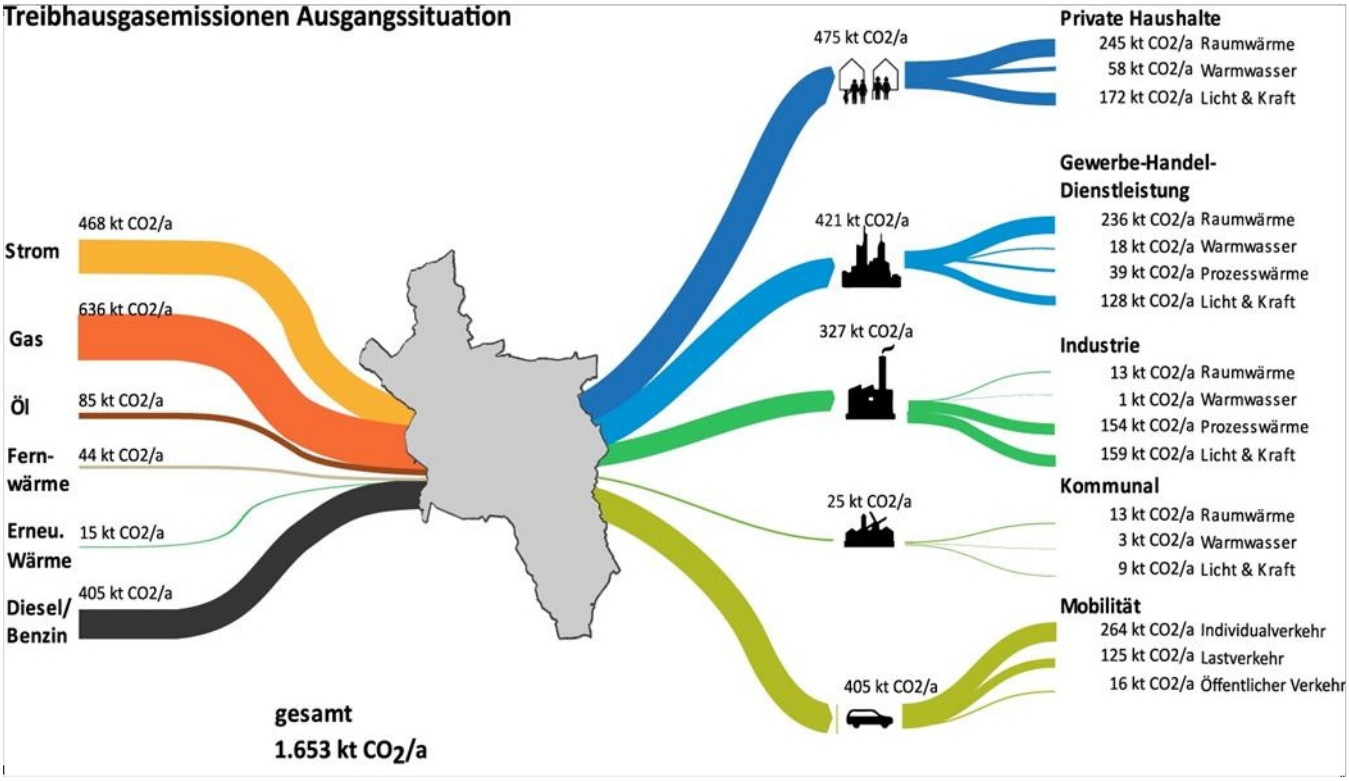

Figure 24 Greenhouse gas emissions in the baseline situation (2020). (Graphic: Gertec GmbH)

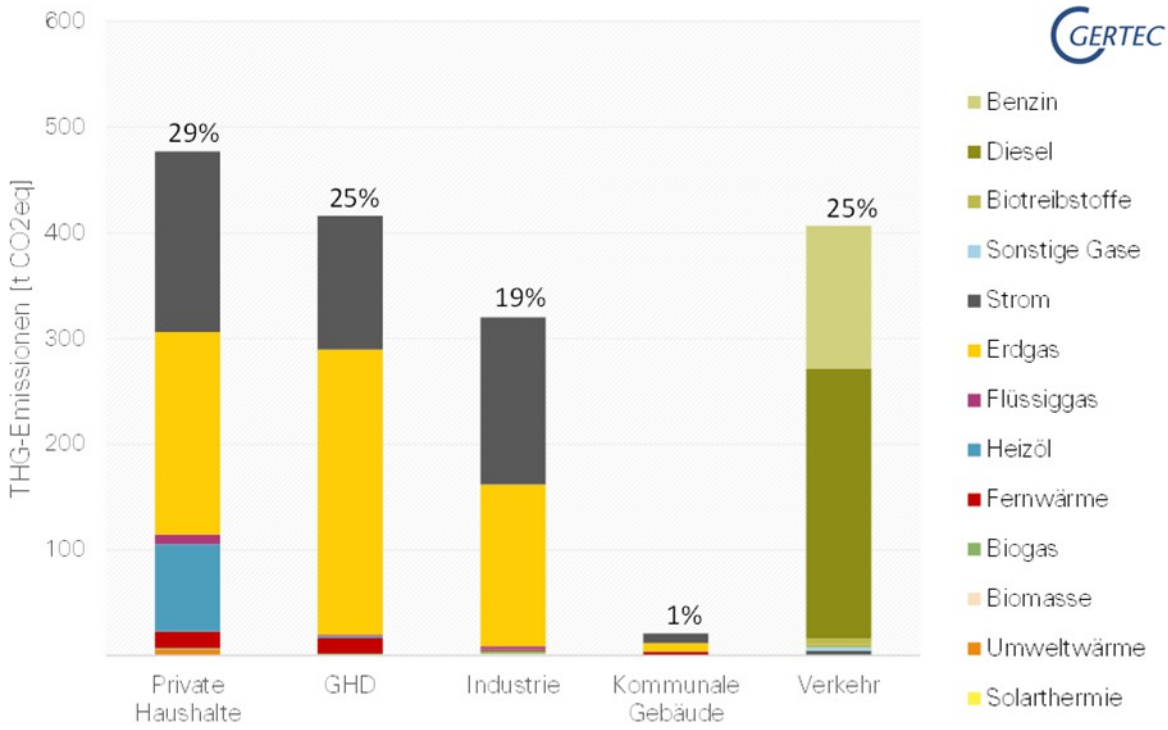

Figure 25 GHG emissions 2020 in Aachen broken down by sector and energy source (Graphic: Gertec GmbH)

Due to the comparatively high emission factor for electricity, the share of emissions within the sectors for this energy source increases compared to the final energy balance. The shares of the private households, trade, commerce and services and municipal buildings sectors in the city's overall GHG emissions are lower than the corresponding shares in final energy consumption. The use of district heating with a lower emission factor can contribute to this.

Due to its high proportion of fossil fuels, the transport sector contributed a larger share of 406,747 tonnes of GHG or 25 % of total emissions. At around 477,146 tonnes of GHG, private households caused around 29 % of total emissions, while the tertiary sector emitted around 416,135 tonnes of GHG (25 %). Municipal buildings caused the lowest GHG emissions at around 20,846 tonnes or 1%.

The distribution of emissions across the various energy sources shows that natural gas consumption caused the most GHG emissions among the energy sources at around 38% or around 622,077 tonnes. Electricity and fuels also contributed around 469,198 tonnes of GHG (29%) and 399,499 tonnes of GHG (24%) respectively.

contributed to emissions to a greater extent. Emissions from heating oil amounted to around 85,236 tonnes of GHG, which corresponds to around 5% of total emissions. District heating and other energy sources accounted for a total of 62,237 tonnes of GHG, or just under 4 % of total emissions.

The city-wide GHG balance (see Figure 25) was prepared in accordance with the BISKO standard using the national emission factor for electricity (federal electricity mix). This method takes into account the quality of locally generated electricity (from combined heat and power plants, renewable energies, etc.) in the calculation of the federal electricity mix by including the amount of electricity fed into the German electricity grid. This approach avoids significant fluctuations in future balances, enables an inter-municipal comparison and focusses on final energy consumption as well as progress in energy saving and efficiency.

If local electricity feed-ins are included directly in the emission factor for electricity (local electricity mix), the municipal GHG balance would be around 65,146 tonnes or just under 4 % lower than if the federal electricity mix were used.

Excursus: Secondary balance - consumption and nutrition

In addition to the GHG emissions considered in Chapter 6.3, which result from stationary energy consumption (in private households and the economy) and energy consumption in the transport sector, every person contributes to the emission of greenhouse gases into the atmosphere through their individual behaviour (consumer behaviour and diet). The production, processing and transport of food as well as purchasing decisions all play a role here.

On average, 4.48 tonnes per capita are accounted for by consumption and nutrition

The personal CO_2 balance (CO_2 footprint) is a measure of the total amount of greenhouse gas emissions caused indirectly and directly by lifestyle. The average German CO_2 footprint is 10.34 tonnes per year[24]. The average emissions for nutrition are on average 1.75 tonnes CO2eq per capita, the emissions for consumption are 2.73 tonnes CO2eq per capita. This includes 2.1 tonnes of CO2eq as a "consumption rucksack" for basic materials (glass/ceramics), preliminary products (chemicals) and public infrastructure, over which there is no individual influence.

Observe different accounting methods

Greenhouse gas emissions in the area of consumption and nutrition are accounted for according to the polluter-pays principle, the so-called consumption balance. This means that the emissions caused by a polluter (e.g. a company) are analysed, regardless of its location. This principle differs from the territorial principle used in the ICSK. In this respect, GHG emissions from the area of consumption and nutrition, which are recorded as a consumption balance, cannot simply be compared with the values of the territorial balance sheet. There is currently no synchronisation of the balance sheet types with regard to consumption and nutrition. Quantification in the sense of a balance sheet is therefore dispensed with in the ICSK.

Consumption decisions have a steering effect

Nevertheless, it is of central importance to also have a steering effect through changes in consumer behaviour. By consciously purchasing climate-friendly products, long-life products or eating predominantly regionally produced food, relevant contributions can be made to the transformation and greenhouse gas savings.

The urban family has market power.

The municipal family can exert a relevant influence through the procurement of goods and services. The municipal family would like to exert this influence through changes in the procurement system (see activity 5.1.1.1. in Volume 2).

Development of a methodology for the preparation of a subsidiary balance sheet

To ensure that the effects of changes in consumer behaviour can be quantified in future and monitored and controlled, the introduction of a secondary balance sheet for non-energy emissions in the area of consumption and nutrition is recommended. The development of a method and the creation of a database to derive a carbon footprint for the citizens of Aachen to quantify social commitment and sensitise the population is also recommended.

[24] ClimateActive

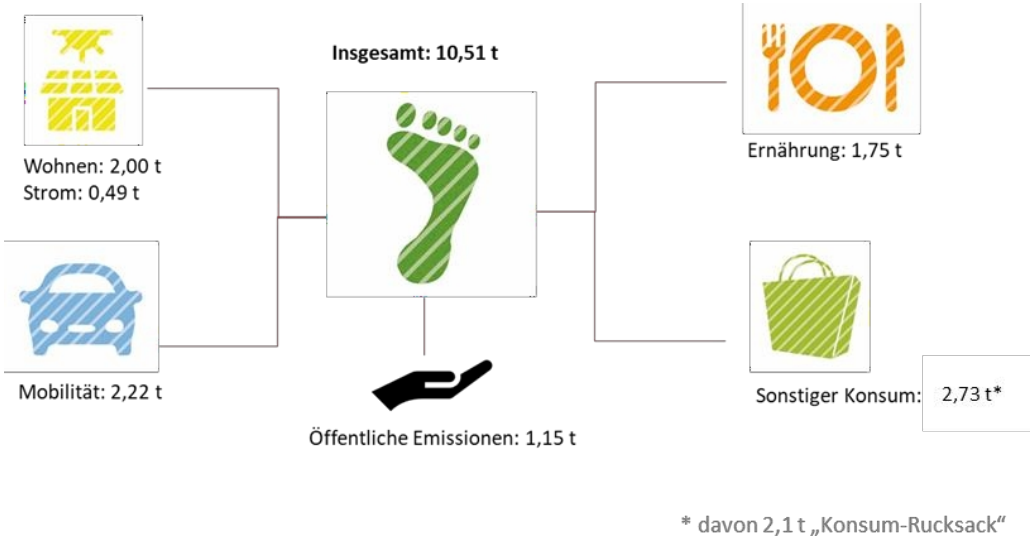

Figure 26 Average emissions per inhabitant in Germany (source UBA, graphic Gertec).

Excursus: Non-energy GHG balance and offsetting potential

Definition of "compensation" for Mission Cities

In order to ensure that the mission cities reduce the emissions attributed to them as far as possible in accordance with the territorial balance principle, it is recommended that a maximum of 20 % of the baseline balance remains in the target year 2030 (residual emissions). Although compensation through natural or technical storage (carbon sinks) or emissions trading (carbon credits) is possible from then on, the mission cities are encouraged to consider compensation only for unavoidable emissions. The aim is to reduce or balance the amount of emissions emitted on the territory of the city to "net zero" by 2030. Cities have the following two options for the combination:

a) Drift house sinks, e.g. sequestration through natural or technical solutions within the city limits
b) Certified carbon credits (emissions certificate trading) from outside the city limits that have undergone a third-party certified audit

The mission cities are obliged to draw up a strategy for their emissions certificate trading and to report gross and net emissions separately in their reports in order to maximise transparency with regard to offset emissions25.

Non-energy-related greenhouse gas balance

As explained in Chapter 6.2, the BISKO standard reaches its limits where no final energy consumption can be attributed to processes within the area under consideration. These processes include, for example, the production of food, but also the further processing of goods within a production chain. In addition, energy consumption only accounts for part of the emissions in agricultural processes.

The diesel used in the maize harvest, for example, can be balanced. Fertilisers, pesticides, fungicides or herbicides that are applied via the

The energy sources used during the growth phase and which were not produced within the municipal boundary account for a large proportion of the GHG emissions of the end product, but are not a classic energy source whose energy - over and above that used in the production process and transport - can be included in BISKO. They also have an impact on the environment at the place of use, for example by being discharged into surface waters when it rains. Emissions from livestock farming and storage, such as methane from stables and barns, are also not included in the balance.

[25] European Commission, 2021. EU Mission 100 Climate Neutral and Smart Cities by 2030 -Info Kit. Subsection 3.2, p. 13. [online] Available at: https://commission.europa.eu/system/files/2021-11/ec_rtd_eu-mission-climate-neutral-cities-infokit.pdf (last accessed: 20 October 2023, 15:34).

slurry silos. This is partly due to a lack of data availability, as the collection of emissions data in the agricultural sector has not been a high priority at federal and state level to date and the Thünen Institute has only been able to provide country-specific emissions values for the LULUCF (Land Use, Land Use Change and Forestry[26]) sector and the AFOLU sector. In order to enable differentiated reporting of non-energy greenhouse gas emissions in the future, interfaces between the municipal and state levels should be expanded and the survey methodology standardised.

In addition, there is another challenge, namely the dual function of emission source and sink that agriculture and forestry represent. According to the IPCC, a quarter of global net anthropogenic greenhouse gas emissions can be attributed to the Agriculture, Forestry and Other Land-Uses (AFOLU) sector. The emissions are caused by deforestation, soil cultivation, fertilisation and livestock farming, among other things.

Many forms of land use are both natural greenhouse gas sinks and sources. How they are included in the calculation depends on several factors. Basically, a sink (sequestration) is created by the growth of biomass that stores carbon in vegetation, soil and wood over the long term. If the growth of this biomass is disturbed by utilisation, emissions are released. Two examples:

- Natural - means largely unaltered by humans
  - Peatlands are a natural net GHG sink due to the protection of organic material from oxygen. Peatlands that
  z. For example, areas that are drained for peat extraction emit greenhouse gases from the decomposition of the organic material.
- Grassland is able to fix nitrogen in the soil. However, this is released again when the land is ploughed up, which is why permanent pastureland emits more GHGs.
  "than a one-year fallow area.

Whether an area functions as a net sink or source therefore depends on a) how the area is managed and b) over what period of time this form of management is continuously maintained. Consequently, mainly intact forests and peatlands are considered to be greenhouse gas sinks. Since management or natural disasters such as forest fires can change the sink capacity of an area within comparatively short periods of time, not every economically utilised agricultural or forestry area can be considered a GHG sink per se.

The special position of Aachen as a Mission City

In order to avoid double counting of the sink performance of areas in a local and the national greenhouse gas balance, the Federal Republic of Germany claims all sink functions of e.g. forests for the national greenhouse gas balance. For this reason, no CO_2 compensation projects certified according to the international Gold Standard can be offered in domestic forests. As a "Mission City", however, the city of Aachen is required to present the so-called AFAOLU sector in its balance sheet (Module A- 1 Greenhouse Gas Emissions Baseline Inventory) and to set up a monitoring system for "negative emissions" through the expansion and improvement of natural sinks within its urban area, which takes into account all changes in sink capacity, e.g. release due to forest fires.

Model calculation of emissions from agriculture and forestry for the city of Aachen

In order to make a qualitative assessment of city-related emissions for agriculture and forestry and thus fulfil the desire of local stakeholders for a greenhouse gas balance for the agriculture and forestry sector, a guideline for balancing GHG emissions and sink effects was used.

The guideline is based on GHG emission calculations from the LULUCF (Land Use, Land Use Change and Forestry) sector of the Thünen Institute at national level, which can be broken down with data on land use to obtain a comparable emission value per hectare of land ($CO_{2eq/ha}$). Figure 27 provides a schematic overview of the procedure.

[26] Land use, land-use change and forestry. The titles illustrate the overlap between the LULUCF and AFOLU sectors due to anthropogenic and biological processes on the same area for a period of time x.

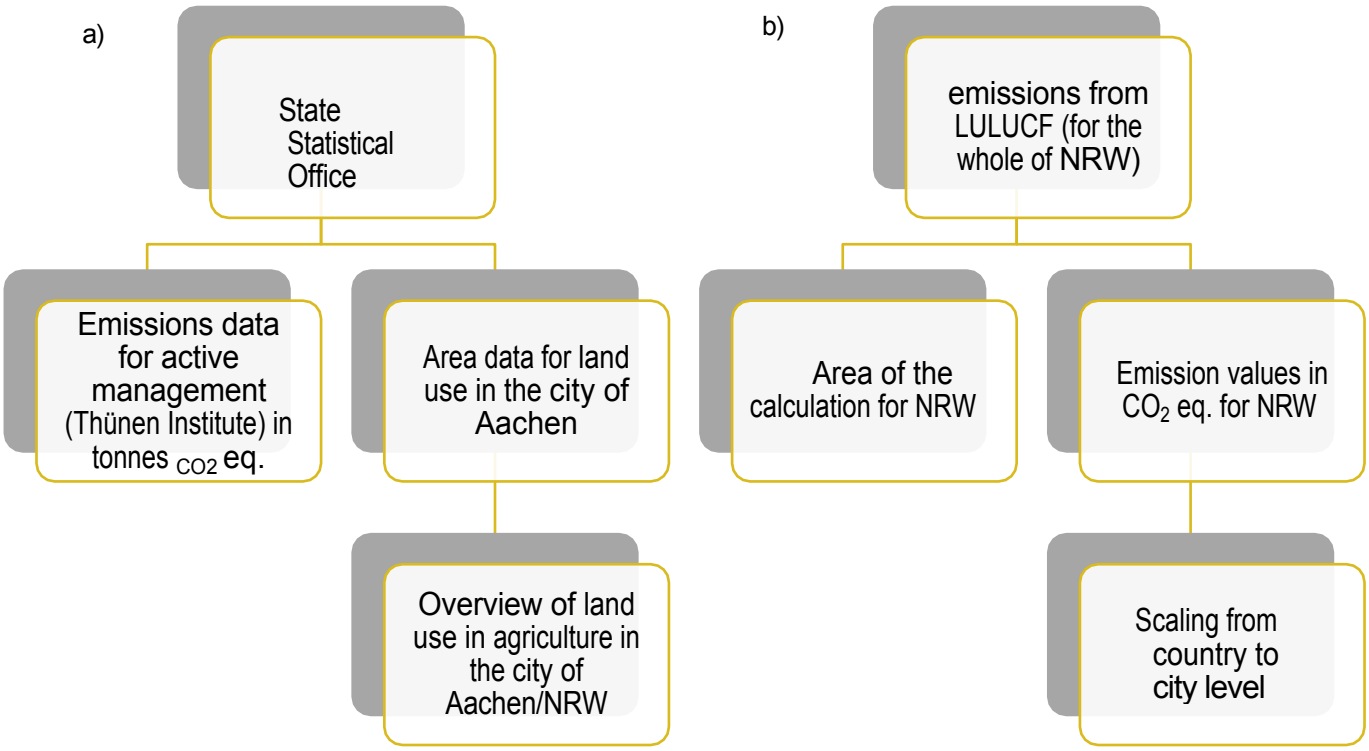

Figure 27 Diagram of the steps involved in GHG accounting for the agriculture and forestry sector a) Comparison between land use in NRW and the city of Aachen b) Calculation of scaled emission values from NRW to city level. (Source: Thünen Institute, 2023; Graphic: Gertec GmbH)

By scaling down the emission values in $CO_{2eq/ha}$ to the city level with the help of city-specific land use data, the absolute emission values are obtained, from which the total footprint for agriculture and forestry is calculated. It should be noted here that only relatively rough land use categories could be surveyed for the city of Aachen, as no more precise data was available from, for example, the 2020 agricultural structure survey at the State Statistical Office[27].

Figure 28 shows the development of emissions from agriculture in the city of Aachen from 1990 to 2020 in tonnes of CO_{2eq} per year. A total decrease of 2,305 tonnes of CO_{2eq}. can be observed, from approx. 48,115 tonnes of CO_{2eq}. in 1990 to approx. 29,044 tonnes CO_{2eq} in 2020. The emission values for potent greenhouse gases such as nitrous oxide (N_2O) or ammonia (NH_3), which are mainly emitted by livestock farming and fertiliser storage and application, have fallen steadily from 15,736 t CO_{2eq}. in 1990 to 9,155 t CO_{2eq}. in 2021, with a somewhat more pronounced decline between 2008 and 2010 in particular. The situation is similar with methane (CH_4), a highly climate-impacting gas that is also produced in animal husbandry and the treatment and storage of fermentation residues. Here, too, a step-like decline can be observed between 2008 and 2010 in an otherwise slowly declining emissions volume, from 30,620 tonnes of CO_2 in 1990 to 17,134 tonnes of CO_{2eq}. in 2021. This suggests a common source and should be investigated further. Only the direct CO_2 emissions in Aachen are subject to relatively small fluctuations.

[27] The last comprehensive survey by the State Statistical Office dates back to 2010. Many thanks at this point to the Chamber of Agriculture of North Rhine-Westphalia, Aachen-Düren-

Euskirchen district offices, for their support.

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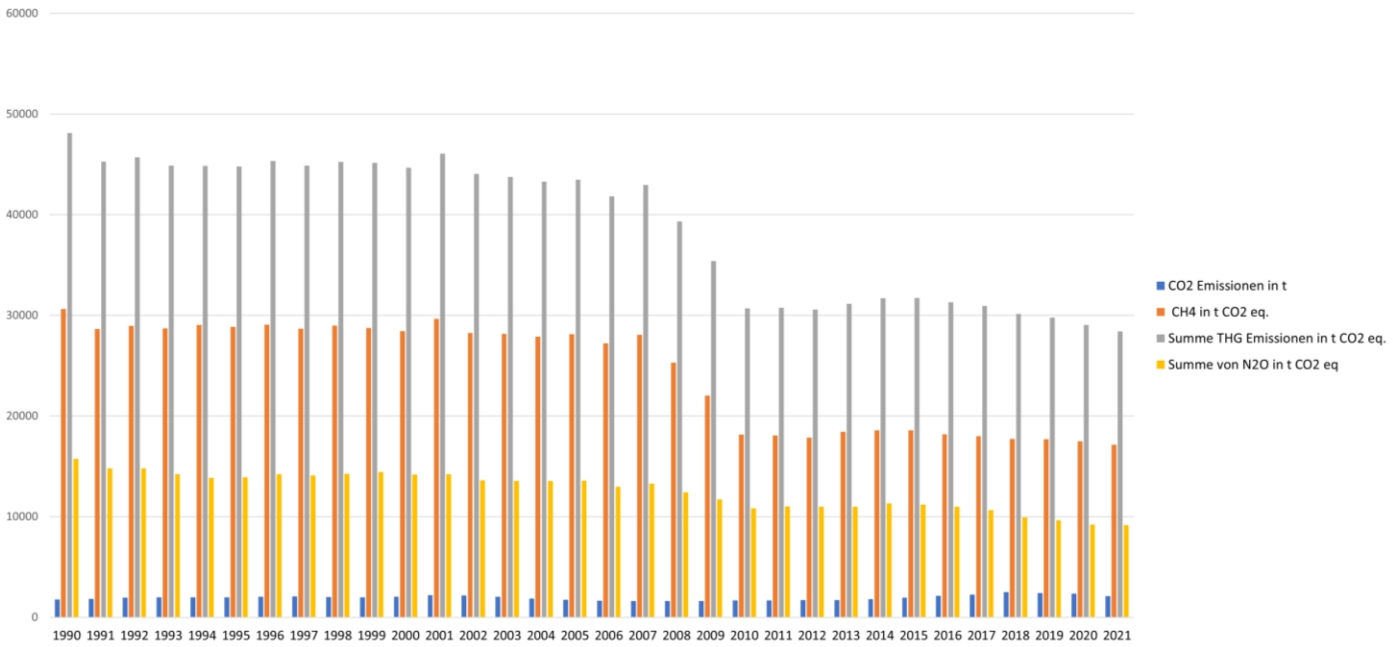

Figure 28 Development of GHG emissions from agriculture in Aachen in tonnes $CO_{2eq.}$/a between 1990 and 2022 (Source: Thünen Institute, 2023. Graphic: Gertec GmbH).

In order to visualise the sources and sinks per sector for the city, the LULUCF data from the Thünen Institute were offset against land use data at state and city level (Figure 29) for the following categories:

- Total utilised agricultural area
- Arable land
- Permanent grassland (incl. bushy grassland and hedges)
- Permanent crops such as fruit trees
- Forest (especially the municipal forest)

The values calculated in this way provide an overview of the source and sink effects of the individual emission groups, e.g. permanent grassland and arable farming in Aachen (see Figure 30).
Figure 31 shows a comparison of the sources of the sink effect of agriculture and forestry in Aachen.

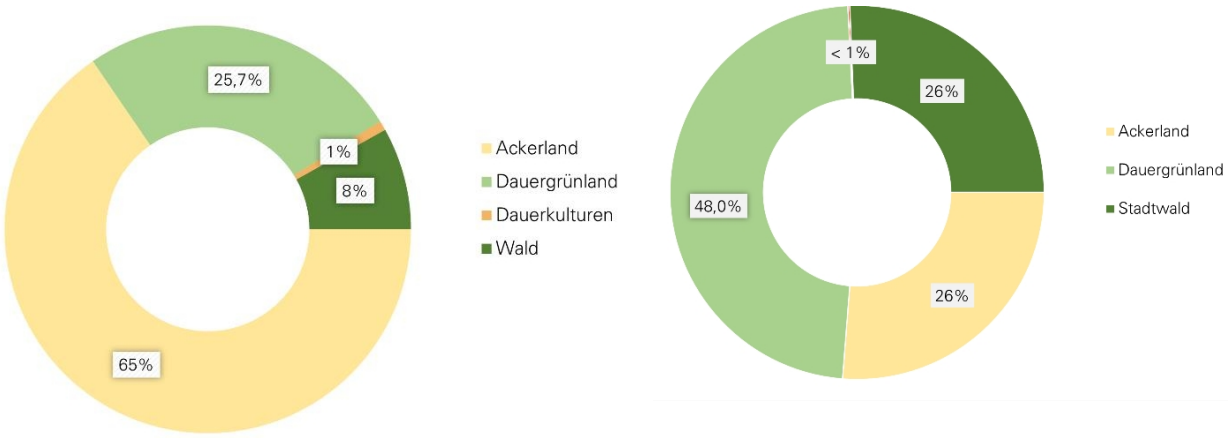

Figure 29 Comparison of land use categories in ha between the state of North Rhine-Westphalia[28] (left) and the city of Aachen (right). Around 15 ha of permanent crops are registered in the city of Aachen (as of 2020). (Source: State Statistical Office, graphic: Gertec GmbH)

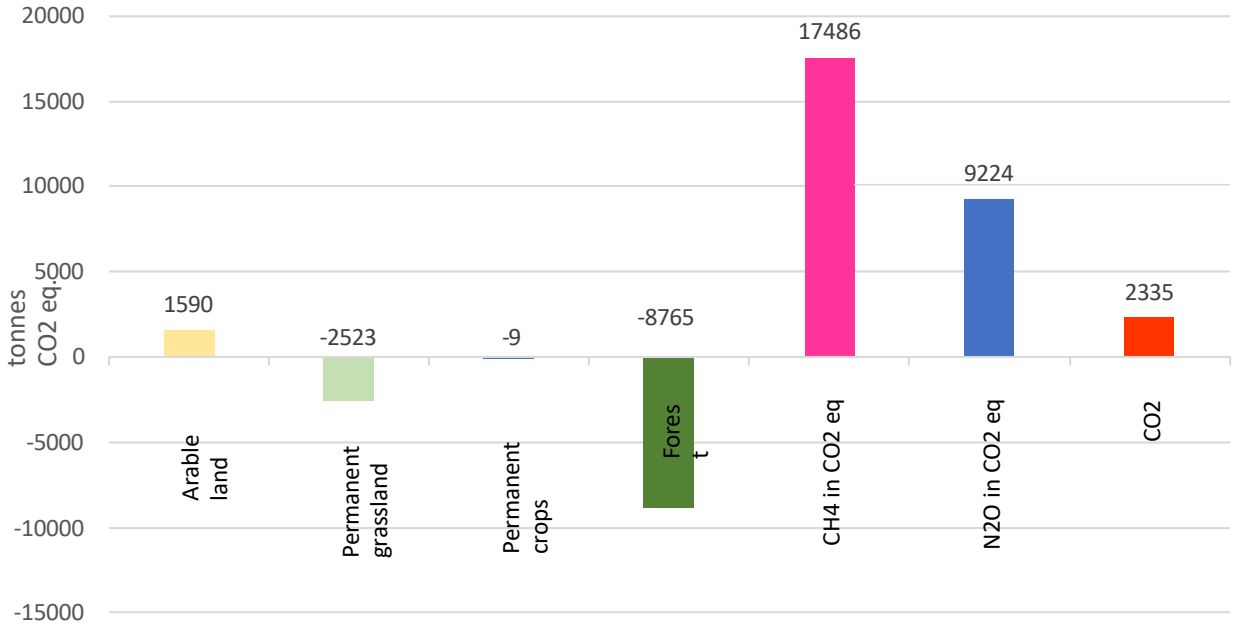

Figure 30 Emissions of the LULUCF sectors and GHG emissions of Aachen's agriculture in t $_{CO2eq}$. in 2020 by land use and GHG groups (Source: Thünen Institute, 2023, Graphic: Gertec GmbH)

[28] Note: With regard to the forest areas, there are sometimes large deviations in the area data between the agricultural structure survey used here, ALKIS-based land use data and data from the local forestry office.

Figure 31 Overview of the sources and sink functions of land use types per hectare. Data: LULUCF data from the Thünen Institute, 2023 (Graphic: Gertec GmbH).

The CO2eq $_{values}$ include particulate matter, volatile organic compounds (NMVOCs), as well as the main greenhouse gases $_{CO2}$, $_{N2O}$, $_{CH4}$ and their related molecules ($_{NH3}$, NO). Emissions from livestock farming are accounted for indirectly via methane emissions, for example. As stables are often registered via the owner's or keeper's place of residence, this prevents distortion of the available emissions data. The emissions of the greenhouse gas inventory, broken down into greenhouse gases, were then aggregated and offset against the absolute values of the LULUCF for agricultural land.
This includes arable land, fruit, tree nurseries and permanent grassland. The calculations are shown in Table 2.

Currently, this methodology calculates a theoretical sink effect of 11,298 tonnes $_{CO2eq/ha}$ for the LULUCF sectors of the city of Aachen for 2020. The largest share of this in 2020, at -8,765 tonnes CO2eq, was accounted for by forest areas, although it is unclear to what extent their sink effect was reduced by the prolonged drought and corresponding forest ^{damage}[29]. This contrasts with arable land, which - in addition to cultivation emissions - was the cumulative source of emissions of

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approx. 30,635 tonnes $_{CO2eq/ha}$, whereby the proportion of the city's total agricultural land must also be taken into account. 2,530 ha of urban woodland make up around 26 % of the agricultural area, compared to 2,407 ha of arable land. The distribution of land use categories according to their effect as an emission source or sink in the city is shown in more detail in Figure 31. The graph shows the clear sink effect of forest areas as well as permanent grassland and permanent crops and thus illustrates how important the duration of an uninterrupted growth phase of biomass is for the sequestration of CO2 $_{equivalents.}$ At the same time, it fulfils the objective of reducing emissions from the agricultural sector, which cannot be reduced without affecting food production.

Figure 32 provides an overview of the total greenhouse gas emissions of the agriculture sector in the city of Aachen (orange column) in comparison to the emissions incl.
LULUCF sector (blue column) and its sink function (green column) and illustrates the influence of active management (such as manure or livestock farming) on the climate and environment.

[29] This calculation takes into account the NRW Forest Condition Report for 2022, which can, however, only provide limited information on local health conditions. A discussion with the municipal forestry office revealed that, depending on the location, spruces and some older beeches and oaks have been exposed to drought stress, but the actual effects will probably not become apparent until 2024.

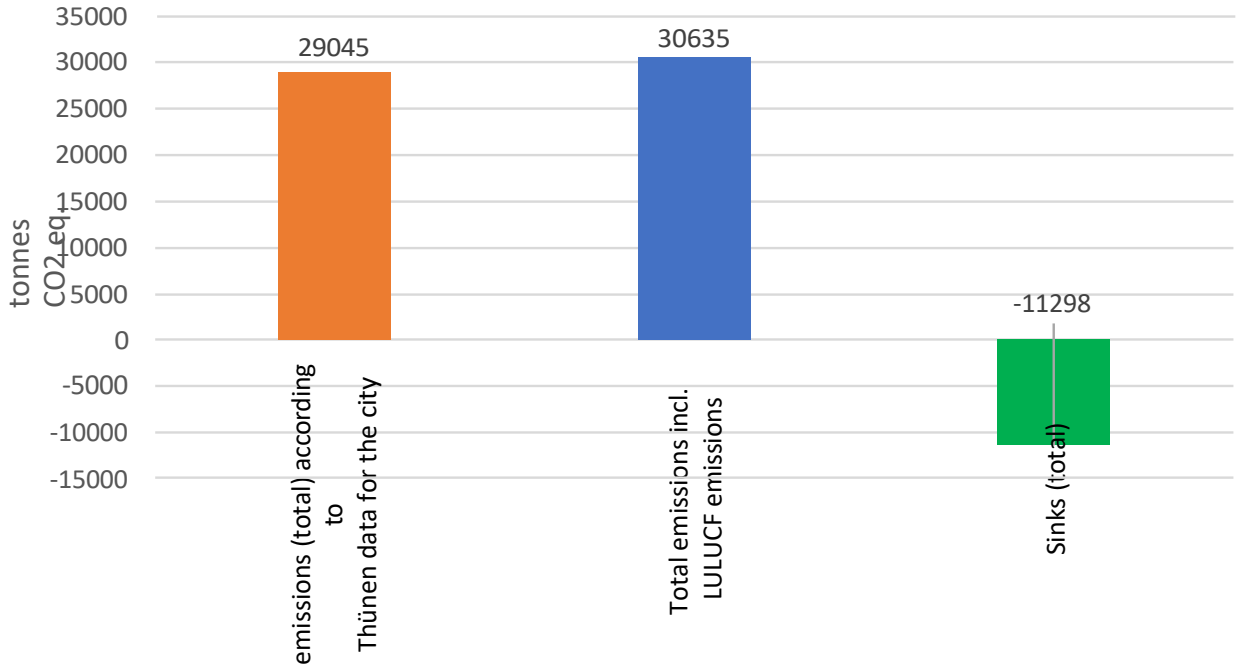

Figure 32 Comparison of all greenhouse gas emissions and sink functions for agriculture and forestry in the city of Aachen (Source: Thünen Institute, 2023; Graphic: Gertec GmbH)

It is particularly important to emphasise that this accounting method does not take into account the efficiency of agricultural production - the yield - and thus to a certain extent ignores the main function of agricultural production; the production of sufficient, affordable, nutritious and balanced food. This means that the accounting of emissions from agriculture, as presented here, is merely a documentary overview that should make it easier for climate protection managers to recognise dynamics in the agriculture and forestry sector in the future. In the medium term However, the LULUCF and AFOLU[30] sectors should also be included in the national greenhouse gas balance. Their sink capacity should be prioritised for offsetting the unavoidable emissions from agriculture, as food and animal feed production cannot be saved. Accordingly, only a small proportion of the natural offsetting potential - if any - is available to the other sectors.

The EU's "Fit for 55 Climate Package (ff55)" envisages that all member states will introduce binding targets for increasing net CO2 reduction in the area of land use and forestry from 2026. As a "Mission City", the city of Aachen is starting to monitor and expand the natural sink capacities in the urban area, which could provide important empirical values for local implementation.

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[30] AFOLU = Agriculture, Forestry and Other Land Uses.

data	LULUCF - emissions and sinks according to Thünen Institute, 2020				LWS emissions according to Thünen Institute, 2020		
Area categories	Arable land	DGL incl. hedges & shrubs	Permanent cultures	Forest	CH_4 as CO2eq	NH_3 and N2O as CO2eq	CO_2
Calculated emissions in CO_{2eq}. (Aachen)	1.590 t CO2eq	-2.523 t CO2eq	-9 tonnes CO2eq	-8.765 t CO2eq	17.486 t CO2eq	9.224 t CO2eq	2.335 t CO2eq

Table 2 Overview of GHG emissions from agriculture and the LULUCF sector in the city of Aachen in 2020 in tonnes of CO_{2eq}. (Source: Thünen Institute, 2023; Graphic: Gertec GmbH). .

The available figures and graphs should therefore by no means imply a blanket restriction of agricultural activities in Aachen. Rather, the city should strive for a more differentiated data basis for the cultivation of its land, as well as a localisation of animal husbandry, in order to develop measures in dialogue with farmers and foresters to reduce these abrupt increases as far as possible. With regard to its own forestry stocks and green infrastructure (street trees, green corridors and watercourses), however, it can already start taking measures to adapt to climate change in order to maintain their sink capacity. This includes, for example, the systematic reforestation of existing areas with the aim of achieving a mix of species that is as climate-resilient as possible, not only on calamity and extraction areas, counselling services for private forest owners and the merging of smaller green plots into larger green corridors, where compatible with nature conservation and landscape planning. The latter also has an impact on the quality of life and amenity in the city as well as synergies with climate change adaptation.

A positive aspect is the existing expertise of the municipal forestry office of the city of Aachen, which has been managing part of the city's forest areas according to FSC criteria since 1993 and is transferring its findings to the remaining stands. The communication of the forest's ecosystem services to the public by the municipal forestry office is also very positive and can form a basis for further strengthening the green infrastructure in the city of Aachen.

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6.4. Objectives of the Paris Climate agreement transferred to Aachen

In order to limit global warming to well below 2 °C compared to pre-industrial levels, percentage emission reduction targets alone are not a sufficient contribution. To achieve the goals of the Paris Climate Agreement, it is also necessary to limit total greenhouse gas emissions in absolute terms. The German Advisory Council on the Environment (SRU) recommends setting a German CO_2 budget per capita (per capita principle) that is compatible with the Paris Climate Agreement and tightening the climate targets accordingly. The CO_2 budget should serve as an overarching assessment basis for achieving the targets

The CO_2 budget for Aachen

To date, there are no binding methodological guidelines for local authorities on how to manage their carbon budget. By adopting the recommendation of the German Advisory Council on the Environment to use the population principle, this report follows a methodology that takes into account the issue of fairness in the sense of a balanced approach. This is a plausible, viable option for calculating the budget in this way. However, this is not the end of the technical discussion. If more standardised rules on the methodology of budget calculation for local authorities are defined in the future, it is recommended that the present analysis be reviewed accordingly and adapted if necessary.

However, the budget described by the SRU refers to energy and non-energy CO_2 emissions, but only takes into account CO_2 as a greenhouse gas.
Methane and nitrous oxide/nitrous oxide are not taken into account. The greenhouse gas balance of the city of Aachen currently only considers energy-related emissions, but includes all greenhouse gases as CO_2 equivalents. The following assumptions were therefore made in order to transfer the CO_2 budget to the balance limits of Aachen:

- According to the National Inventory Report on the German Greenhouse Gas Inventory, around 93 % of emissions (CO_2, methane and nitrous oxide) are attributable to energy consumption.
- In the budget analysis, 93 % are considered energy-related emissions, while 7 % are considered non-energy-related emissions.
- In order to check compliance with the remaining budget, the annual emissions of the City of Aachen are deducted from the budget.
- As soon as this sum becomes negative, the budget of the City of Aachen is exhausted and the respective temperature limitation target from a municipal perspective is missed.
- As the BISKO balance includes not only CO_2 but also CO_2 equivalents, this is a conservative approach. This means that more emissions are deducted from the budget than is actually required according to the budget definition.

If the national CO_2 budget is transferred within Germany according to the population principle, this results in a budget of around 48 tonnes per person (energy share) for the city of Aachen with 262,040 inhabitants (2022) as part of the 1.5-degree target. With regard to the 1.75-degree target, this figure rises to around 74 tonnes per person (energy share).

In order to achieve the goals of the Paris Agreement and become greenhouse gas neutral, the budget for the 1.75 degree target should at least be adhered to.

Definition of the term climate neutral

Against this backdrop and the participation in the EU mission "100 Climate-Neutral Smart Cities by 2030", "climate neutrality" is becoming increasingly important for the

City of Aachen as follows:

Climate neutrality is achieved when the sum of positive and negative greenhouse gas emissions equals zero. Other

important guidelines are

- Climate neutrality means greenhouse gas neutrality.
- Avoiding greenhouse gas emissions takes priority in line with the precautionary principle.
- The top priority is to comply with a Paris-compliant $CO_{2\,budget}$.
- Energy-related GHG emissions are largely avoided through technical and behavioural measures.
- Unavoidable GHG emissions (e.g. from agriculture or wastewater) are offset regionally where possible. Compensation measures are reported separately in each balance sheet.

7. The limits of action and Identifying the city of Aachen's room for manoeuvre

In the transformation to climate neutrality, a multi-level approach is used to describe the relationships between the municipal family and other decision-making levels. At these decision-making levels, the actors must work together and coordinate their decisions. The specific decisions of the actors influence, inhibit or promote each other. The chapter first explains these relationships and then looks at the municipality's specific room for manoeuvre:
"Consumption and role model", "Supply and provision", "Regulation" and "Advise and motivate".

The following chapter examines this room for manoeuvre and provides an assessment and quantification of this room for manoeuvre in Aachen.

7.1. The municipal Describe room for manoeuvre

Comprehensive transformations are required to achieve climate neutrality while meeting the 1.5 degree target. The potential influence of the Aachen municipal family will not be enough to achieve climate neutrality on its own. This requires joint action by all stakeholder groups in Aachen as well as optimal framework conditions for action. But how much influence can the city be expected to have?

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A project by the Federal Environment Agency (UBA) with the involvement of ifeu, Heidelberg, provides the basis for this. The study defines four areas of influence: "Consume and set an example", "Supply and offer", "Regulate" and "Advise and motivate".

The levels of influence and decision-making are briefly described and the City of Aachen's options for action are identified.

The multi-level view

Figure 33 Schematic representation of the different impact areas, actors and organisational levels in the transformation process.

When considering the municipal sphere of influence, three different decision-making levels with their respective spheres of influence on achieving climate neutrality must be taken into account - the so-called multi-level approach.

The three decision-making levels are:

1. The European Union, federal and state governments set important legal and economic framework conditions at the higher decision-making level and have the largest sphere of influence.

2. Citizens and companies together form the market players; their sphere of influence is characterised by their decision-making behaviour with regard to consumption, investments and participation in campaigns and offers.

3. The City of Aachen acts both directly and indirectly through its administration and municipal holdings.

In principle, the multi-level approach is not a clear-cut division, but an interactive framework whose levels influence each other. However, urban climate neutrality can only be achieved if all decision-making levels utilise their influence and provide the necessary framework conditions.

Neither the administration nor the municipal holdings can achieve this goal through direct and indirect action if it is done in isolation.

Nevertheless, the sphere of influence of Aachen City Council and the municipal holdings should not be underestimated, as will be explained in the following sections. The term "Aachen municipal family" or "City of Aachen" is used in the context of the measure level with direct options for action. In addition to the city administration, it also includes the city's own companies and holdings. The scope for action of the municipal family are described in more detail in sections 7.2 to 7.5.

Another prerequisite for achieving urban climate neutrality is a comprehensive transformation of urban society, which must be understood as both a systematic task and an agile process. The transformation is triggered by activities within the spheres of influence and in turn informs the decisions of the stakeholders in the multi-level view, as the Aachen municipal family, citizens and companies alike play a central role in the transformation.

7.2. Room for manoeuvre Consumption and role model

In the area of influence "Consumption and role model", the City of Aachen has full direct influence on the reduction of GHG emissions. This includes, for example, street lighting, the optimisation of procurement or the renovation of its own buildings.

The instruments and areas of influence are listed below:

Instrument/topic area	Possibilities of influence (examples)
Municipal energy management	• Energy consumption control • Conceptual principles for reducing energy consumption
Municipal property management	• Energy-efficient building modernisation • Efficiency measures • Expansion of photovoltaics • Conversion of street lighting to LED (incl. intelligent control system)
Property management of municipal residential buildings	• Energy-efficient building modernisation • Conversion of the heat supply to renewable energies
Strategic procurement management	• Compliance with efficiency standards • Bundling of orders • Observance of quality seals
Drinking water and wastewater disposal	• Increasing the efficiency of systems for the production and treatment of drinking water or in sewage treatment plants, for example
Municipal mobility management	• Avoidance of business trips • Choice of mode of transport for business trips
Fleet management	• Choice of drive types for the vehicle fleet (incl. public transport)

Table 3 Instruments and opportunities to exert influence in the area of "Consumption and role model"

7.3. Room for manoeuvre Supply and offer

The City of Aachen, together with its municipal enterprises and municipal holdings, provides important infrastructures with direct or indirect potential for influence.

Instruments and possibilities of influence are:

Instrument/topic area	Possibilities of influence (examples)
Municipal property management	• Installation of PV systems
Municipal heat planning	• Decarbonising the energy supply by switching energy sources • Strategic basis for the conversion of the heat supply structure
Strategic procurement management	• Increase and standardise the availability of regional and sustainable food in public canteens
Cycling concept	• Modernisation and expansion of cycling infrastructure
Pedestrian traffic concept	• Improving the pedestrian transport infrastructure
Local transport planning	• Modernisation and expansion of public transport services

Table 4 Instruments and opportunities to exert influence in the area of "Supplies and offerings"

7.4. Regulating room for manoeuvre

Within the framework of local self-government, the City of Aachen has the opportunity to exert influence through its planning and decision-making authority.

Instruments and possibilities of influence are:

Instrument/topic area	Possibilities of influence (examples)
Land use plan	• Site planning of new construction areas, e.g. consideration of solar radiation possible • Definition of traffic areas, open spaces, areas for restricted use, etc. • Definition of areas for the use of renewable energies (e.g. ground-mounted PV systems) • Definition of wind power areas in land use planning
Development plan	Determination for residential and non-residential buildings, e.g. • Construction method • Compactness or A/V ratio • Roof shape • Building orientation • Shading (restriction of planting to increase the solar yield) • Height and spacing with regard to solar yields • PV obligation • Labelling of statutes on the obligation to connect and use
Urban development contract	Building standard for residential and non-residential buildings, e.g. • Thermal insulation standard • Energy requirement/ energy standard, e.g. low-energy construction • Energetic quality • Utilisation of renewable energies, including PV • Obligation to connect district heating • Heating and cooling supply • Creation of energy concepts and implementation of the variants described therein Obligation for mobility measures
Property purchase agreement (purchase agreement)	Building standard for residential and non-residential buildings e.g. • Thermal insulation standard • Energy requirement/ energy standard, e.g. low-energy construction • Energetic quality • Utilisation of renewable energies, including PV Financial influence options, e.g: • Linking property prices to energy efficiency and sustainability Building standards

	• Additional costs for higher energy standards and sustainable building materials can be offset proportionately to reduce the price
Articles of Association	• Compulsory connection and use of "decarbonised" district heating • Green and design statutes
Car park management	• Reduction of parking spaces in public areas • Parking space obligation • Car park management • Parking space regulations • Special utilisation statutes

Table 5 Instruments and options for exerting influence in the area of "Regulation"

7.5. Room for manoeuvre Advise and motivate

The City of Aachen has an indirect influence on all market players through counselling and motivation activities. Co-operations, e.g. with business associations, are one way of joining forces.

Instruments and possibilities of influence are:

Instrument/Topic area	Possibilities of influence (examples)
Information and counselling services, participation	Activating participation Possible topics for citizens and companies • Energy-efficient building modernisation • Heating replacement (switch to renewable energies) • Mobility behaviour
Municipal funding programme	Possible topics • Energy-efficient building modernisation • PV expansion (in particular preparatory studies) • Promotion of cargo bikes • Courtyard and façade design • Attic conversion

Table 6 Instruments and opportunities to influence in the area of "counselling and motivation"

7.6. Evaluation of the Room for manoeuvre

Assessment and quantification of the impact on the reduction of greenhouse gas emissions

The assessment and quantification of the city administration's sphere of influence is carried out in relation to the system and action potential, divided into an ambitious-realistic and a maximum variant. The categorisation differs in the assumed probability of implementation by the City of Aachen. The quantification of both variants is based on the results of a project by the Federal Environment Agency (UBA) and the ifeu Institute in Heidelberg and supplemented by an expert assessment, which also takes into account the ICSK participation of the municipal family.

In addition to quantifying the city administration's sphere of influence across all fields of action, a

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Quantification based on the trend scenarios of the GHG reduction targets for the following fields of action:

- Building
- Energy supply
- Mobility
- Economy
- Social transformation

No reduction targets were calculated for the "Governance" fields of action, as these describe the transformation process in urban society, in which only indirect savings can usually be achieved. The same applies to the "Compensation" field of action, which must be understood as last-resort.

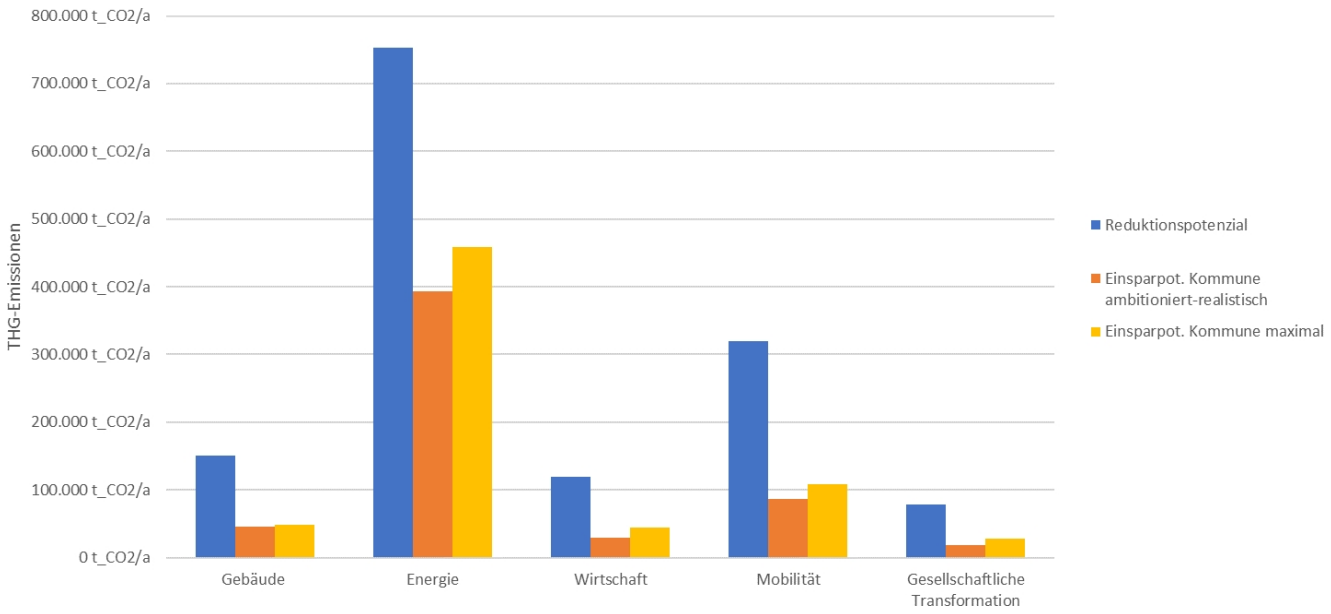

Figure 34 Overview of the savings potential that can be influenced by local authorities in relation to the reduction potential per area of action (source: Gertec Ingenieurgesellschaft).

Figure 34 shows the total savings potential in gigatonnes (thousand tonnes) of CO_{2eq} (blue columns) that can be influenced by the municipality for each area of action, as well as a comparison of the maximum (yellow column) and the ambitious-realistic savings potential (orange column) for the city of Aachen.

For the maximum consideration, this results in a municipal sphere of influence of approx. 44 % (approx. 686,500 t CO_{2eq}), whereby it is assumed that all the necessary framework conditions for successful implementation at scale and in good time are in place.

The calculation of the municipal sphere of influence in the ambitious-realistic variant is correspondingly lower, approx. 37% (approx. 574,100 tonnes of CO_{2eq}), as it is not assumed here that the necessary framework conditions are fully available at the right time. An example of appropriate timing

The framework conditions at scale are the availability of sufficient quantities of hydrogen including a distribution system and a sufficiently large supra-regional vehicle fleet within the period 2025-2030 in order to completely decarbonise freight transport in the city of Aachen.

Broken down into the individual fields of action, it is clear that a large proportion (53%) of the total reduction potential can be realised in the field of energy (see Figure 35), followed by the fields of mobility (22%) and buildings (11%). Figure b) shows the assessment of the municipal savings potential according to the ambitious - realistic variant, in which it is not assumed that all the necessary framework conditions and resources will be available in time.

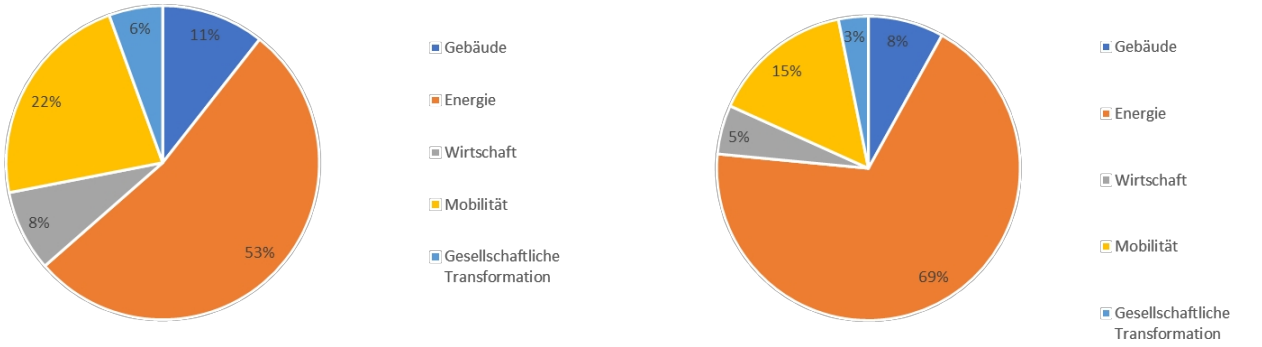

Figure 35 a) Percentage shares of the fields of action in the total reduction potential; b) Municipal savings potential per field of action in the ambitious-realistic variant

Both figures illustrate that the municipal family can exert its influence particularly in the energy sector. However, by decarbonising the energy supply in the form of electricity and heating energy, the municipal family can also indirectly influence all other fields of action, in

where energy is used. However, the other fields of action are more strongly characterised by the decisions of market players, which is why the municipal influence is smaller here.

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8. Thinking from the goal - Climate-neutral Aachen 2030 scenario

Scenarios are not forecasts. They describe a possible development, taking into account the assumptions made. The climate-neutral Aachen 2030 scenario describes "from the goal" what a path to climate neutrality in 2030 could look like and what measures would be necessary to achieve this.

The following chapter is dedicated to the methodical derivation of the "climate-neutral Aachen 2030" scenario in comparison to the trend scenario - i.e. the expected development of greenhouse gas reductions without increased action. The scenarios are based on the balance of energy-related emissions for the territory of the city of Aachen.

Strategic recommendations for the implementation strategy are derived on the basis of the possible development paths. The key recommendations include firmly integrating the goal of "climate neutrality" into overarching urban development, increasing the refurbishment rate, expanding green district heating on the basis of municipal heating planning and stepping up strategic activities to strengthen cycling and the electrification of motorised private transport.

Describing the path to climate neutrality

In order to describe the path to climate neutrality, possible development paths in the consumption and energy sectors are discussed along the four main strategies of efficiency, consistency, sufficiency and compensation:

Efficiency (doing better): Achieving the same benefits while reducing energy and resource consumption to avoid greenhouse gas emissions.

Sufficiency (using less): Saving energy and resources by changing behaviour and consumption patterns.

Consistency (doing things differently): Achieving the desired benefits with a climate-friendly use of energy and resources.

Compensation (offsetting): The compensation of unavoidable greenhouse gas emissions or the removal of greenhouse gases from the atmosphere.

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Two scenarios were analysed as part of this report:

- Trend scenario
- "Climate-neutral Aachen 2030" scenario (in compliance with the 1.5-degree target)

The "Climate-neutral Aachen 2030" scenario describes a development trajectory that leads to climate neutrality by 2030 and fulfils the 1.5-degree target. The trend scenario continues the previous development of greenhouse gas emissions in the city of Aachen and primarily serves as a means of comparison.

In order to take into account local effects due to changes in the electricity mix, the electricity was assessed using a local electricity mix, taking into account all plants feeding electricity into the grid.

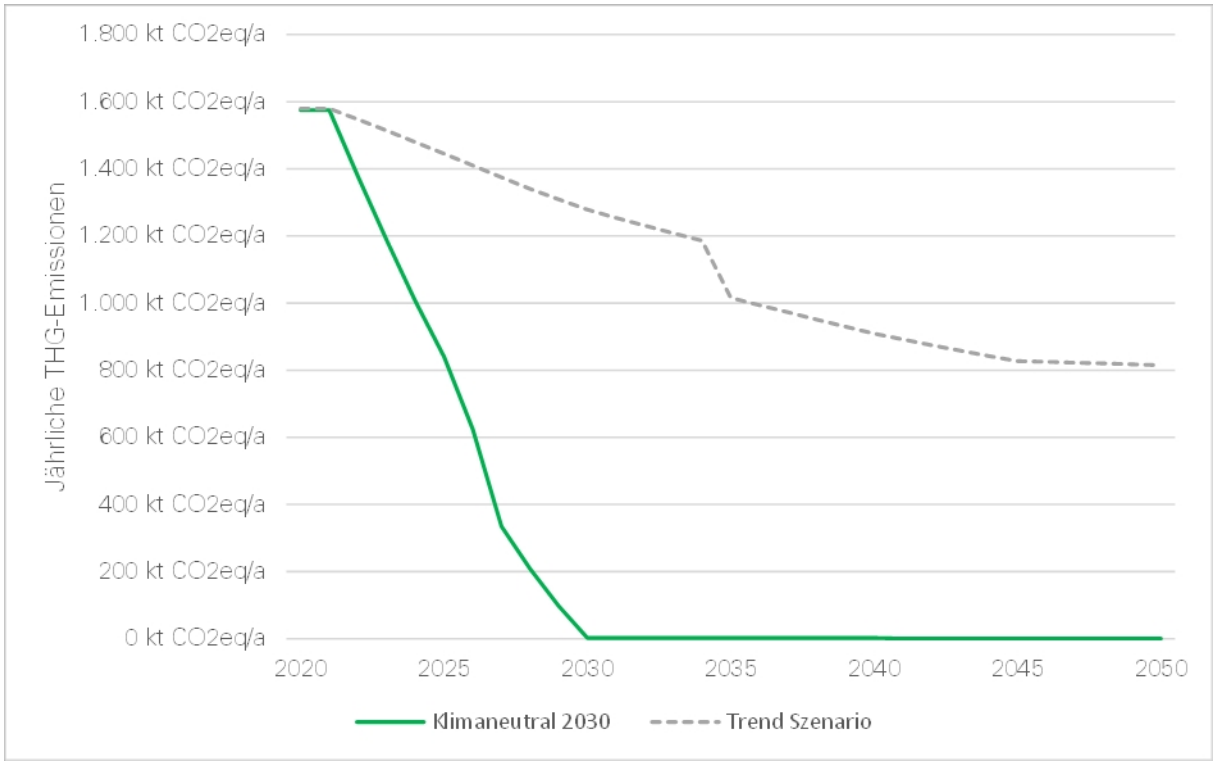

Figure 36 Scenario comparison trend scenario and climate-neutral 2030

Table 7 below summarises all the assumptions made and parameters taken into account in the scenario calculation.

Sector	Differentiation	Specification		Conversion until
Private households	Space heating	Modernisation rate	4,0 %	2030
		Depth of modernisation (savings per system)	70 %	
	Hot water	Modernisation rate	4,0 %	2030
		Depth of modernisation (savings per system)	70 %	
	Light and power	Modernisation rate	2,7 %	2035
		Depth of modernisation (savings per system	17 %	
GHD	Space heating	Modernisation rate	4,0 %	2030
		Depth of modernisation (savings per system)	70 %	
	Hot water	Modernisation rate	4.0 %	2030
		Depth of modernisation (savings per system)	70 %	
	Light and power	Modernisation rate	2,7 %	2030
		Depth of modernisation (savings per system)	49 %	
	Process heat	Modernisation rate	4,0 %	2030
		Depth of modernisation (savings per system)	55 %	
Industry	Space heating	Modernisation rate	4,0 %	2030
		Depth of modernisation (savings per system)	70 %	

	Hot water	Modernisation rate	4,0 %	2030
		Depth of modernisation (savings per system)	70 %	
	Light and power	Modernisation rate	2,7 %	2030
		Depth of modernisation (savings per system)	49 %	
	Process heat	Modernisation rate	4,0 %	2030
		Depth of modernisation (savings per system)	55 %	
Sufficiency	Sufficiency - stationary sectors	9-30 % sufficiency potential PHH, 10 % sufficiency potential economic sectors		2030
	Natural gas		0 %	2030
	District heating		27 %	2030
	Heating current		0 %	2030
Heat supply	Heating oil		0 %	2025
	Solar thermal energy		10 %	2030
	Heat pump		53 %	2030
	Biomass		10 %	2030
Power supply	Photovoltaics	Target level performance	176 MW	2030
	Wind energy	Target level performance	93 MW	2030
	MIV	Avoidance of driving per year [% / a]	5.56 %	2030
		Shift in mileage per year [% / a]	4.24 %	2030
		Efficiency gain per year [% / a]	0,67 %	
	PUBLIC TRANSPORT	Avoidance of driving per year [% / a]	0,00 %	2030
		Shift in mileage per year [% / a]	-7,47 %	
Mobility		Efficiency gain per year [% / a]	0,67 %	
	Freight transport	Avoidance of driving per year [% / a]	-1,96 %	2030
		Shift in mileage per year [% / a]	0,00 %	
		Efficiency gains per year [% / a]	0,67 %	
	Drive change	Electrification + P2L final state - passenger cars	90 % / 5 %	2030
		Electrification + P2L final state - public transport	70 % / 25 %	2030
		Electrification + P2L final state - freight transport	83 % / 14 %	2030
Compensation		Assumption: 5 % of 1990 emissions are unavoidable		From 2027

Table 7 Assumptions made and parameters in the "Climate-neutral Aachen 2030" scenario

8.1. The development path to climate neutrality

A Paris-compliant development pathway for Aachen towards climate neutrality by 2030 in compliance with the 1.5-degree target is outlined below.

The basics

Future assumptions from the DENA flagship study (2020) "Towards climate neutrality" were adopted for the development path presented. For the commercial and non-commercial building stock, the study assumes modernisation rates of 2.4 % per year by 2045 as an ambitious target. For the Aachen case of climate neutrality by 2030, however, an acceleration must be taken into account here, so that refurbishment rates of 4.0 % per year are required, which were set for the course of the development path.

Within the study used, the distinction between space heating and hot water demand is not taken into account. However, as the hot water demand is included in the heating demand, the assumptions in this scenario are used for both areas. In addition, the thermal insulation standard to be achieved is increased from KfW55 to KfW40 in order to meet the 1.5°C target. Based on an average heat requirement per square metre of around 132 kWh/(m²*a), this corresponds to a saving of around 70 % for each refurbishment carried out. The assumptions for the municipal building stock are also based on these values.

The DENA lead study also provides information on the development of electricity demand in the residential building sector, with a total savings potential of around 4 % based on the status quo. This may seem low at first, but is due to increasing electrification, meaning that the increase in efficiency and savings due to the increase in the number of appliances used partially offset each other. With an assumed modernisation rate of 2.7 % per year for electrical appliances and lighting, this corresponds to a saving of around 17 % per modernisation by 2030. This will achieve a city-wide modernisation level of 24 % by the target year.

With regard to process heat, the DENA pilot study forecasts a savings potential of 19.8 % for the commercial sector by 2045. In order to achieve this target by 2030, an average reduction of around 55 % per modernisation is required, assuming a modernisation rate of 4 % per year. This reduction can be achieved through innovative, energy-efficient processes and the increased use of electricity in the processes. Across the city, a modernisation rate of 36% of the relevant facilities can be achieved by 2030.

In addition to the technical energy savings that lead to the energy efficiency effects described above, it is also necessary to consider the potential for behaviour-related energy savings. This potential can be exploited in particular through changes in user behaviour and measures to promote sufficient behaviour. The sufficiency potential estimated here is based on our own calculations based on Lehmann et al. (2015). "Stromeinspareffekte durch Energieeffizienz und Energiesuffizienz im Haushalt" and information from the study by the Federal Environment Agency (2018) "Mit Suffizienz mehr Klimaschutz modellieren". Depending on the area of application, they vary from 9 % to 30 % in private households and around 10 % in the economic sectors.

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Preserving the $CO_{2\,budget}$

Achieving climate neutrality means that the current energy-related GHG emissions of around 1.6 million tonnes of CO_2 are to be reduced by 93% to around 151,000 tonnes by 2030. In addition, a compensation share of around 9% of emissions will be taken into account from 2027. This will ensure that all emissions occurring in the city of Aachen are offset.

energy-related residual GHG emissions can be offset naturally or through targeted measures.

Under this assumption, the $CO_{2\,budget}$ available to meet the 1.5 degree target by 2030 is reduced from around 12,454 kilotonnes to around 5,228 kilotonnes of CO_2 (Figure 37).

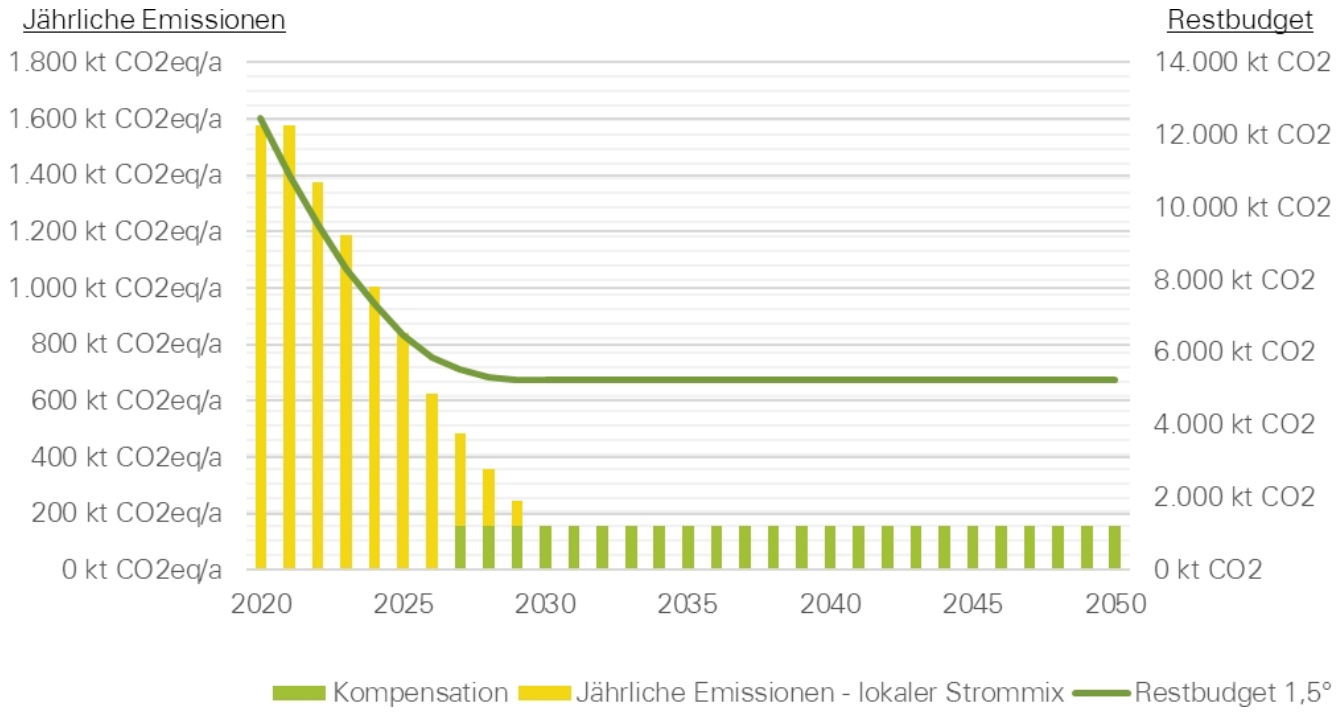

Figure 37 Development of the $CO_{2\,budget}$ in the climate-neutral 2030 scenario (Graphic: Gertec GmbH)

Reduce quickly - acceleration has top priority

In order to achieve the goal of climate neutrality, it is a top priority to accelerate the reduction of greenhouse gas emissions. The step-by-step plan in Figure 38 sets out the annual reduction targets that should be implemented to meet this goal. At the beginning of the process, the annual reduction is around 12% (based on 2021) and will then be will gradually decrease over the period up to 2030. From 2026, the increased implementation of behaviour-related potential will lead to a significant increase in the reduction. In 2027, offsetting will be included in the calculations for the first time, which will lead to a further increase in reductions at this point.

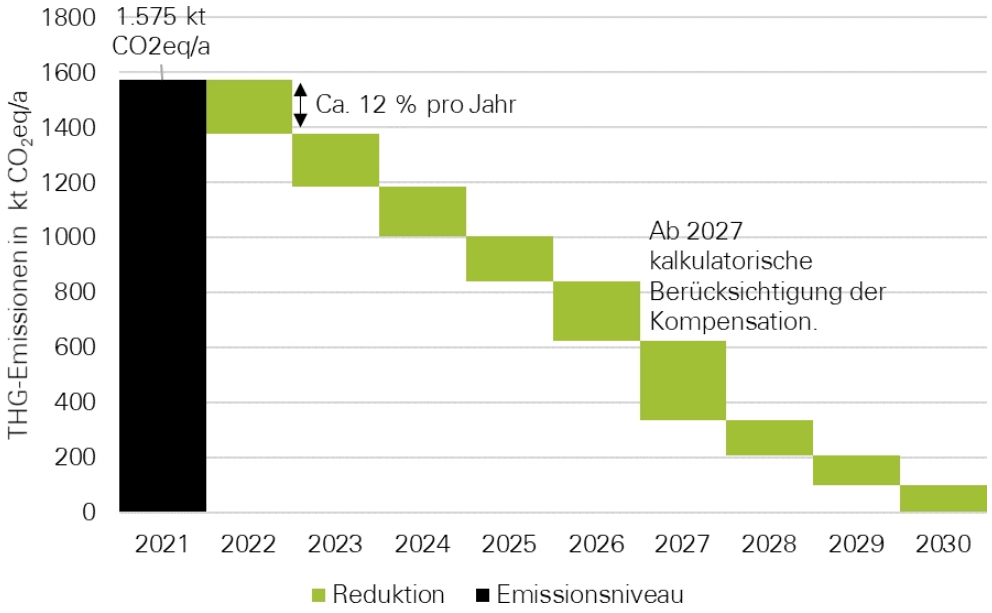

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Figure 38 Step-by-step plan for annual GHG reduction by 2030 (Graphic: Gertec GmbH)

8.2. Development paths in the consumption sectors

The development paths in the various consumption sectors outline targets for both final energy consumption and greenhouse gas emissions. These sectors include private households, economic sectors such as trade, commerce and services (TCS) and industry, as well as municipal facilities and transport.

Figure 39 and Table 8 show the development of final energy consumption in the individual sectors over time from 2021 to 2050. In the private household sector, final energy consumption will fall by around 34 % by 2030 compared to 2021. Final energy consumption in the tertiary sector will decrease by reduced by around 31 %. The municipal facilities sector has a similar reduction potential of 30 %. In the industrial sector, there is still a reduction of 21 %. The most significant percentage reduction in final energy consumption by 2030 can be achieved in the transport sector at around 81 %

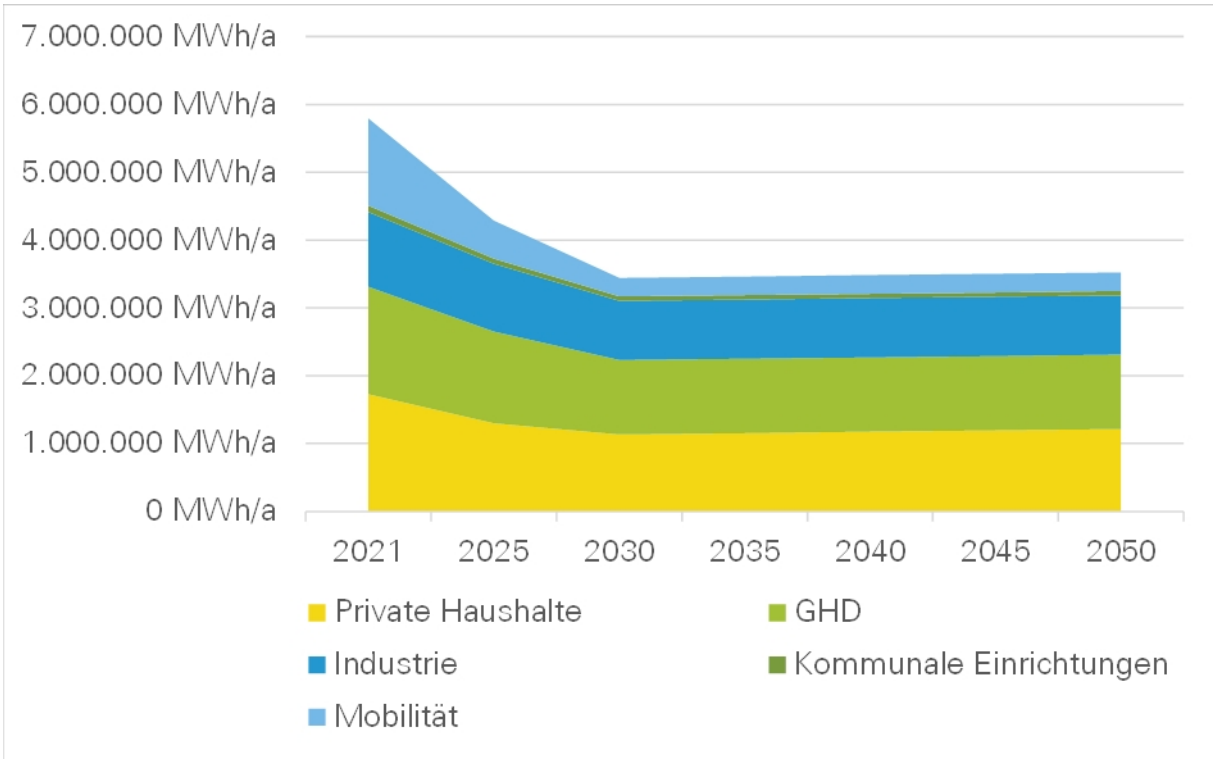

Figure 39 Development path of final energy consumption broken down by consumption sector

Energy consumption in GWh/a	2021	2025	2030	2035	2040	2045	2050
Private households	1.728	1.299	1.134	1.154	1.173	1.193	1.213
GHD	1.582	1.351	1.092	1.092	1.092	1.092	1.092
Industry	1.105	995	870	870	870	870	870
Municipal facilities	92	75	64	64	64	64	64
Mobility	1.289	522	244	245	246	247	284

Table 8 Final energy consumption by consumption sector

The development path of GHG emissions broken down by consumption sector is shown in Figure 40 and Table 9. The local electricity mix is used as a basis here. It can be seen that GHG emissions in the private households and tertiary sectors will be reduced by around 90 % by 2030. With

A reduction of 89 % is recognisable in the municipal facilities and 87 % in the industrial sector. The most significant percentage reduction, equivalent to the final energy consumption, can also be found in the transport sector. 94 % of the emissions from 2021 can be reduced here by 2030.

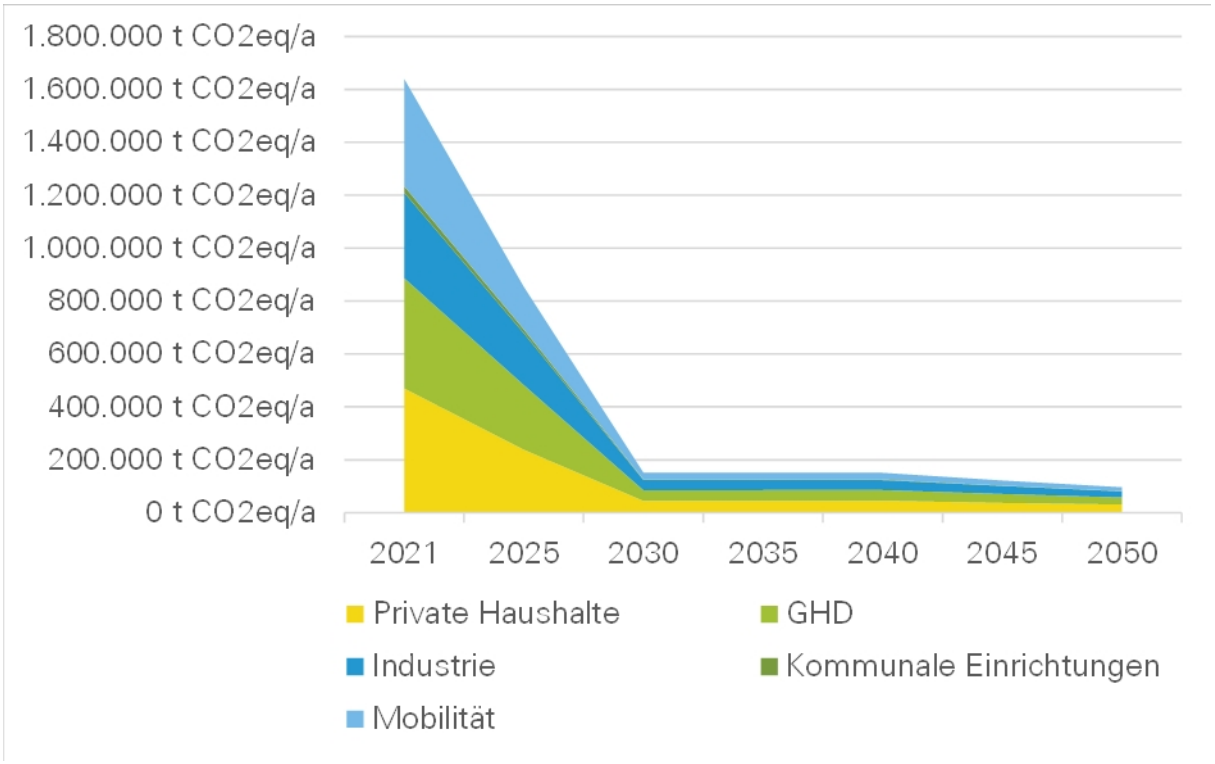

Figure 40 Development path of GHG emissions broken down by consumption sector (local electricity mix taken into account)

GHG emissions in tonnes CO2eq/a	2021	2025	2030	2035	2040	2045	2050
Private households	445.994	233.262	44.073	44.583	45.086	42.661	40.092
GHD	398.149	240.371	40.769	40.538	40.308	37.576	34.813
Industry	301.668	192.106	38.520	38.280	38.040	35.201	32.323
Municipal facilities	23.714	13.800	2.641	2.625	2.609	2.422	2.232
Mobility	405.330	160.793	24.924	24.874	24.823	23.057	21-248

Table 9 GHG emissions broken down by consumption sector (local electricity mix).

When analysing the areas of application for energy within the individual sectors, it becomes clear that the heating sector accounts for the largest share of energy consumption at 59 % (2021) (Figure 41 and Table 10).

Light, power and mobility account for 19 % and 22 % respectively. In absolute terms, the reduction in consumption is similar within the heating and mobility sectors by 2030 (1,072 GWh/a and 1,045 GWh/a respectively), despite major differences in the shares of total energy consumption.

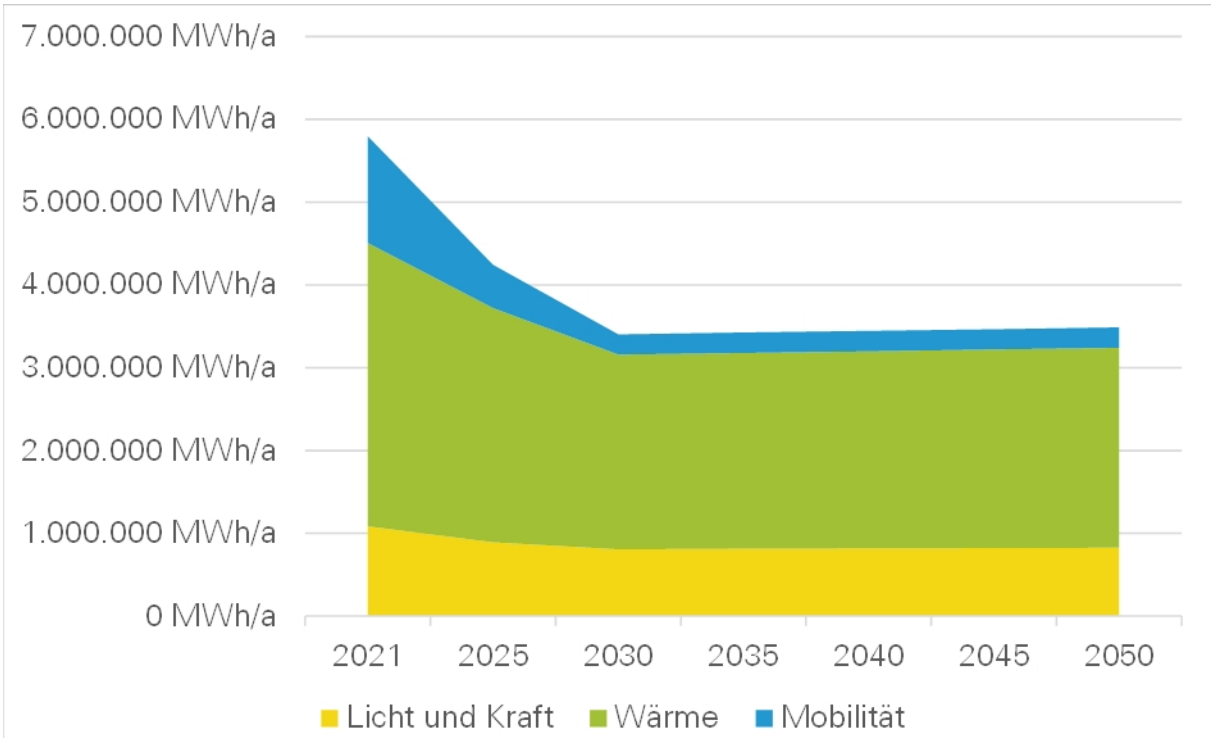

Figure 41 Development path of energy consumption broken down by application area.

Final energy consumption in GWH/a	2021	2025	2030	2035	2040	2045	2050
Light and power	1.083	890	807	812	817	821	826
Heat	3.425	2.831	2.353	2.368	2.383	2.398	2.414
Mobility	1.289	522	244	245	246	247	248

Table 10 Final energy consumption by application area

Figure 42 Table 11 shows the development path of GHG emissions by application area.

In percentage terms, the most significant reduction (92 % and 94 % respectively) can be seen in the areas of heating and mobility.

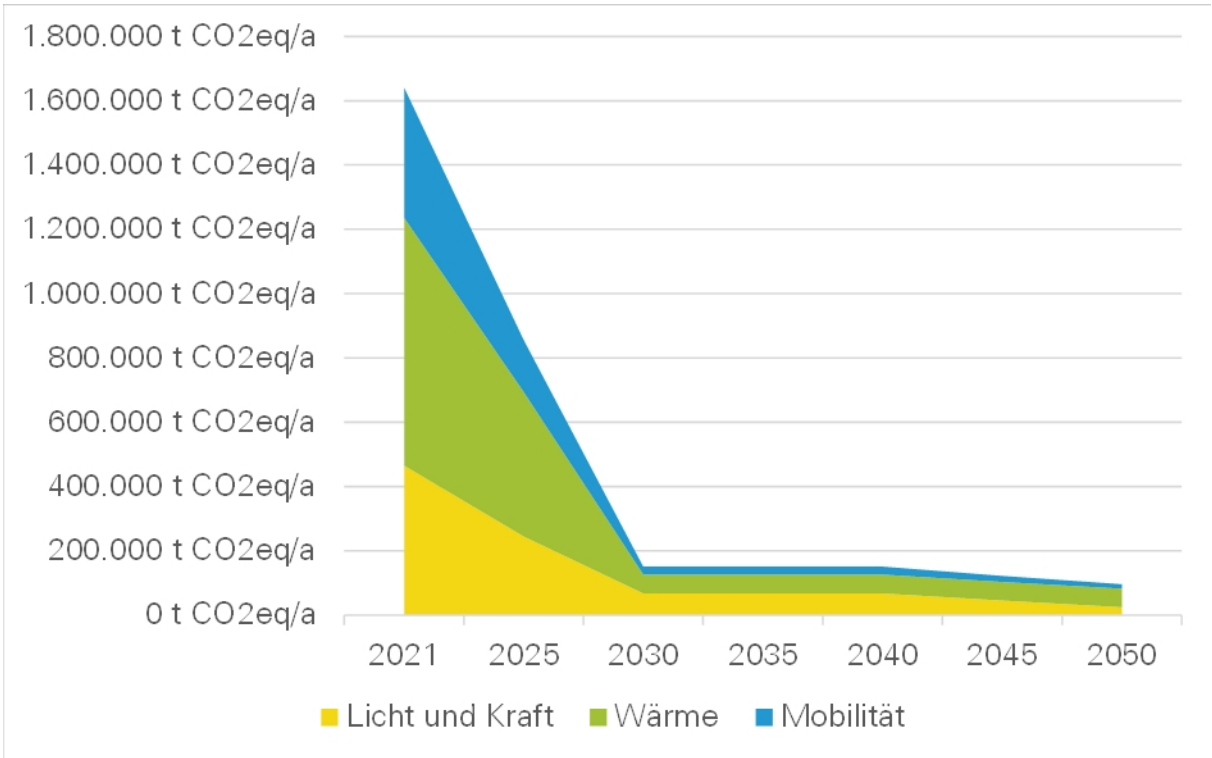

Figure 42 Development path of GHG emissions broken down by application areas (local electricity mix taken into account). (Graphic: Gertec GmbH)

GHG emissions in tonnes CO2eq/a	2021	2025	2030	2035	2040	2045	2050
Light and power	399.974	237.698	67.183	67.056	66.927	61.128	55.149
Heat	769.551	441.841	58.821	58.970	59.116	56.731	54.311
Mobility	405.330	160.793	24.924	24.874	24.823	23.057	21.248

Table 11 GHG emissions broken down by application area (local electricity mix taken into account)

8.3. Recommendation for a Derive implementation strategy

Strategic recommendations are derived from the scenarios, on which the strategy for the ICSK 2023 is based.

Strategic recommendations

- Climate neutrality should be anchored and strategically planned as a fundamental goal of urban development. This requires a holistic approach that reconciles energy-efficient refurbishment, behavioural changes, resource efficiency, cost optimisation and the use of renewable energies. Such an integrated approach requires an interdisciplinary planning culture, space for innovative ideas and solutions with impact.
- Immediate increase in the refurbishment rate in existing buildings to 4% per year with consistent implementation of high energy standards in existing buildings with average energy savings of 70
  %. The highest energy standards must be consistently implemented in new builds.
- District heating plays a crucial role in the process of decarbonising the heat supply. One of the top priorities is to utilise the existing infrastructure and transform it in the direction of decarbonised "green district heating", taking into account the necessary change in technology, including the use of waste heat and carbon capture, for example. This requires the implementation of comprehensive municipal heat planning.
- Around 50% of journeys by private motorised transport, which corresponds to journeys of less than 5 km, must be avoided by 2030 in order to achieve a reduction in emissions. Promoting and expanding cycling infrastructure and making local public transport more attractive will make a significant contribution to achieving this goal.
- The city of Aachen should take strategic measures to actively contribute to the transformation of drive technology in motorised private transport (MIT) and local public transport (LPT). By 2030, e-mobility rates of 90 % (motorised private transport) and 70 % (public transport) are to be achieved in the city of Aachen.

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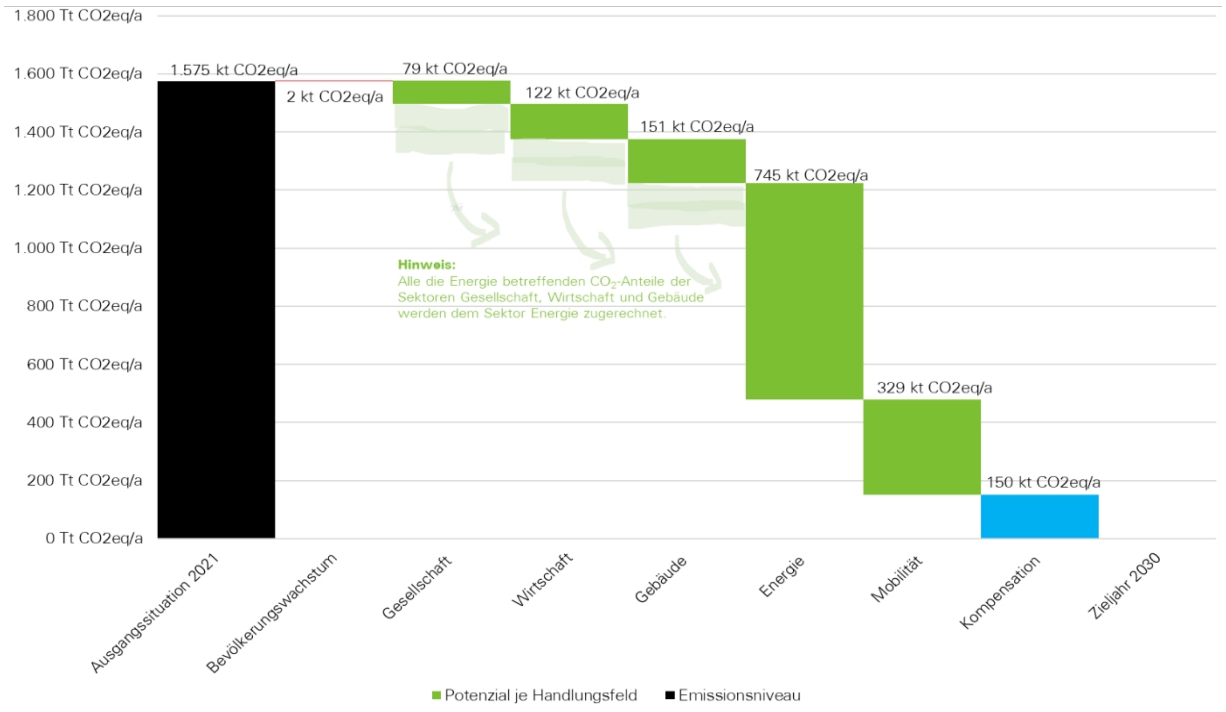

Figure 43 GHG reduction targets by field of action. (Graphic: Bodo Wirtz)

9. The IKSK 2023 Aachen's path to climate neutrality

Volume 1 of the IKSK 2023: "Aachen's path to climate neutrality" lays the starting point for the creation of a city-wide operationalisable strategy by recording the current energy and GHG balances and deriving the 2030 target scenario. From the strategic goal to the concrete project, a coordinated process is required that can serve as a reference for the various stakeholders involved.
Accordingly, the following chapter summarises the findings to date and projects the strategic objectives onto the municipal scope for action.

An overview of the fields of action, key areas of action and measures is provided, these are described in detail and qualitative and quantitative targets are formulated. The level of activities, as a concrete operationalisation of the strategy for the municipality, is described in detail in Volume 2 "The contribution to the Climate City Contract: Activities in the IKSK 2030".

9.1. Structure of the strategy

A strategy describes the path to achieving a goal. The city of Aachen has set itself the goal of achieving climate neutrality by 2030. Climate neutrality here means that no more GHG emissions are emitted than can be offset by natural or technical sinks. The premise here is compliance with the Paris-compliant budget for the 1.5 degree target. This strategy for the city of Aachen is not a rigid plan, but represents an ongoing process.

Figure 44 The structure of Strategy 2030 (Graphic: Bodo Wirtz)

The four levels of strategy

The climate neutrality strategy for the city of Aachen as a whole covers the first three levels, while the administration's activities as a contribution to the Climate City Contract are described by the fourth level:

Level 1 - Fields of action: The fields of action describe at an overarching level what needs to happen in order to achieve climate neutrality: Who can act, how can action be taken and by when must overarching goals be achieved? The fields of action formulate guidelines for greenhouse gas reduction.

Level 2 - Priorities for action: The action priorities concretise and describe what needs to be done. To this end, they formulate strategic goals and name the main actors and target groups involved in the key areas of action.

Level 3 - Measures: Measures specify who must act and by when.

Level 4 - Activities: Activities formulate direct and indirect options for action by the core administration of the City of Aachen. These are described as profiles (see Volume 2 "The contribution to the Climate City Contract: Activities in the IKSK 2030"). Among other things, they describe specifically who is responsible for the implementation, which actors need to be involved in the implementation and the greenhouse gas savings, costs and time required.

Report in two volumes

The strategy for the climate-neutral city of Aachen is documented in two volumes:

- "Volume 1: "Aachen: The path to climate neutrality 2030" describes the climate neutrality strategy 2030 for the entire city of Aachen. This includes in particular the descriptions of levels 1 to 3.
- "Volume 2: "The contribution to the Climate City Contract: The activities" describes the contribution of the city administration to the Climate City Contract.

- It contains the profiles of the proposed activities (level 4), sorted according to fields of action and key areas of action.

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Note: Levels 1 to 3 describe the climate neutrality strategy for the city of Aachen as a whole. Not all of the strategy's key areas of action and measures have the potential to influence the city of Aachen. There are therefore measures for which no activities have yet been formulated.

Figure 45 Section of portfolio plan with magnifying glass view of levels 1-4 (Graphic: Gertec GmbH)

9.2. Portfolio plan at a glance (levels 1 and 2)

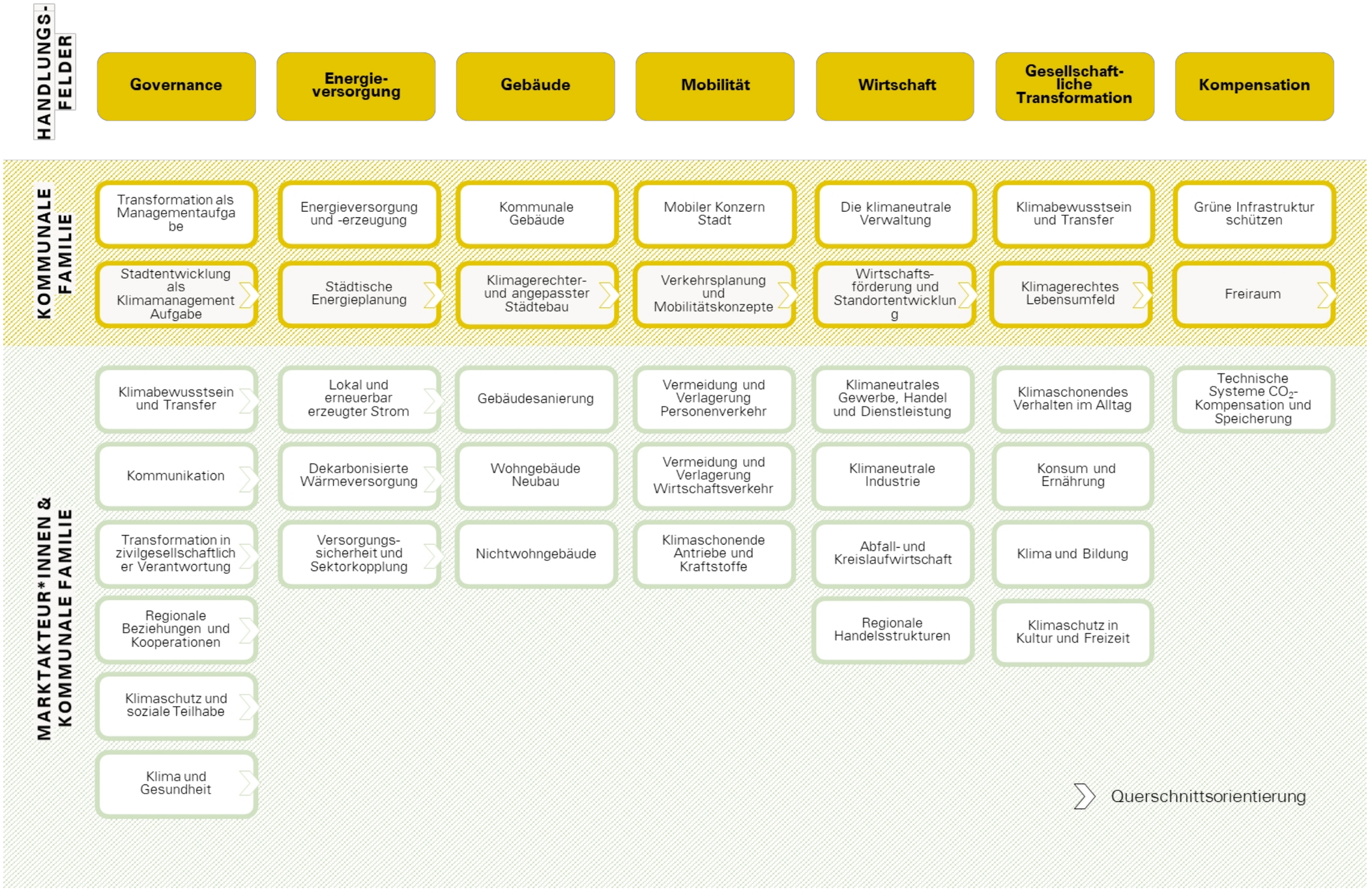


Figure 46 Portfolio plan (source Gertec, graphic created by BWG)

Aachen Klimaneutral 2030 - Portfolioplan
Vorabzug, Stand 23.11.2023

1. Governance

1.1. Stadt als Vorbild: Transformation als Managementaufgabe

1.1.1. Maßnahme: Multiprojektmanagement mit Monitoring und Controlling einrichten

- 1.1.1.1. Multiprojektmanagement einführen und verankern
- 1.1.1.2. Dashboard: Monitoring & Controlling mit Stianz
- 1.1.1.3. Transformationsstrategie Klimaneutralität - Praxistürmen für die Umsetzung

1.1.2. Maßnahme: Übergreifend Instrumente zur Finanzsteuerung und Initierung von Projekten

- 1.1.2.1. kontextbindung von Klimarelevanzprüfung zur Priorisierung von klimarelevanten Beschlüssen
- 1.1.2.2. Einführung von Klimafonds
- 1.1.2.3. Übergreifendes Fördermittelmanagement
- 1.1.2.4. Lenkungsgruppe VEP als Koordinationsorgan für Klimaneutrale Mobilität
- 1.1.2.5. Innovationsraummanagement für ein Klimaneutrales Aachen 2030

1.1.3. Maßnahme: Integration des Ziels der Klimaneutralität in die Struktur der Kommunalen Familie

- 1.1.3.1. Klimakoordinator*innen in allen Dezernaten einführen
- 1.1.3.2. Klimaschutz in und weitere Anpassung der Infrastruktur bei Feuerwehr und Rettungsdienst sowie dem Stadtbetrieb
- 1.1.3.4. Agentur für Klima, Energie und Nachhaltigkeit
- 1.1.3.4. Einrichtung eines Klimabeirat
- 1.1.3.5. Klimacation als Format zur Förderung des querschnittsorientierten Austausches und der Vernetzung in der Verwaltung
- 1.1.3.6. Richtlinie "Klimaneutral" für alle städtischen Publikationen und Dienstanweisungen

1.1.4. Maßnahme: Regionale und überregionale Kooperationen und Netzwerke

- 1.1.4.1. Pilotprojekt CoLab
- 1.1.4.2. Klimaregion

1.1.5. Maßnahme: Politische Einflussnahme für Klimaschutz- und Nachhaltigkeit

- 1.1.5.1. Think Tank Aachen Klimaneutral 2030: Interessenvertretung auf Ebene EU und Bund

1.2. Stadtentwicklung als Klimamanagementaufgabe

1.2.1. Maßnahme: Rahmenbedingungen für eine klimangepasste Stadtentwicklung

- 1.2.1.1. Gründung einer AG Urbane Daten - Ausschreibung einer Stelle neher urbaner Daten Koordinator*in zur Koordinierung und Analyse urbaner Daten
- 1.2.1.2. Klimaschutzmanagement für integrierte Stadtentwicklungskonzepte und Projekte zur Umgestaltung des öffentlichen Raums
- 1.2.1.3. Stadtentwicklung als Aufgabe des Klimamanagements
- 1.2.1.4. Nachhaltigkeitskriterien / -vorgaben für die Vergabe städtischer Flächen
- 1.2.1.5. Zentrales Klimaschutzmanagement zur Ideensammlung & Weiterentwicklung

1.3. Kommunikation

1.3.1. Maßnahme: Externe Kommunikationskampagnen für Öffentlichkeit und Wirtschaft

- 1.3.1.1. "Ocher Solardach" Allianz & Kompagne
- 1.3.1.2. Kommunikationsstrategie

1.3.2. Maßnahme: Interne Kommunikationsstrategie erarbeiten und durchführen

- 1.3.2.3. Mitarbeiterfortbildung "Kommunikationstraining Thema Klimaneutralität" Schulungskonzept

1.4. Transformation in zur gesellschaftlicher Verantwortung

1.4.1. Maßnahmen: Bürgerbeteiligung intensivieren und dauerhaft stellen

- 1.4.1.1. Bürgerbeteiligungsformate zur Klimaneutralität
- 1.4.2. Bürgerschaft ist gelegene Initiativen und Netzwerke aktiv einbinden

- 1.4.2.1. Zentrales Kundenbeziehungsmanagement
- 1.4.2.2. Klimaschutz + Karneval
- 1.4.2.3. Klimaschutz + Sport

1.5. Klimaschutz und soziale Teilhabe

1.5.1. Maßnahme: Förderung zur sozialer Ausgleichungen im Bereich Wohnen und Energie

- 1.5.1.1. Einführung eines kommunalen Klimageldes

1.5.2. Maßnahme: Unterstützung der Gemeinwohlökonomie

1.5.3. Maßnahme: Unterstützung und Förderung sozialer Infrastrukturen bei der Klimatransformation

1.6. Klima und Gesundheit

1.6.1. Maßnahmen: Forschungskooperation Gesundheit und Klima RWTH Aachen

1.6.2. Maßnahmen: Organisationsinternen Beschlussprozesschutz

2. Energieversorgung

2.1. Stadt als Vorbild: Energieversorgung und -erzeugung

2.1.1. Maßnahme: Diskriminierung der Strom- und Wärmeversorgung in der städtischen Familie

- 2.1.1.1. Klimaneutrale Strom- und Wärmeversorgung der Liegenschaften im kommunalen Einfluss

2.1.2. Maßnahme: Ausbau der erneuerbaren Stromerzeugung in der städtischen Familie

- 2.1.2.1. PV Hinflächen auf städtischen Hächen
- 2.1.2.2. PV Anlagen auf kommunalen Gebäudene

2.2. Städtische Energieplanung

2.2.1. Maßnahme: Integrierte Wärme- und Energieplanung

- 2.2.1.1. Masterplan - integrierte, umfassende Energieplanung
- 2.2.1.2. Wärmeplanung
- 2.2.1.3. Prüfung des Ausbaus von Photovoltaik im Stadtgebiet (Freiland- Anlagen, S1 Anlikis u.a.

2.3. Lokal und erneuerbar erzeugter Strom

2.3.1. Maßnahme: Bebe- gungs- und Beteiligungsmodelle fördern

- 2.3.1.1. Energie in Bürgerhand

2.3.2. Maßnahme: Windkraftpotenziale erschl- eßen

- 2.3.2.1. Sicherung/Ausbau der Windenergie
- 2.3.2.2. Anwendung einer App zur Darstellung der Auswirkungen von Windkraftanlagen

2.3.3. Maßnahme: Ausbau der Photovoltaik auf Wohn- und Nichtwohngebäuden

- 2.3.3.1. Solareffizienz auf allen geeigneten Dachflächen

2.3.4. Maßnahme: Freiflächenphotovoltaik ausbauen

- 2.3.4.1. Konzepterstellung: Ermittlung und Nutzung PV-Freiflächenpotenziale

2.4. Dekarbonisierte Wärmeversorgung

2.4.1. Maßnahme: System- und Anlagenoptimierung der bestehenden Fernwärme

2.4.2. Maßnahme: Ausbau und Dekarbonisierung der Fernwärme

- 2.4.2.1. Konzept zur siedlungsstrukturell optimierten Nutzung der Geothermie in Aachen
- 2.4.2.2. Geothermische Versuchsanlagen
- 2.4.2.3. Inspektion in Baugruben
- 2.4.2.4. Abwärmenutzung im Bereich Campus-West)
- 2.4.2.5. Dezentrale Wärmeversorgung, Fernwärmenetz, Einzellösungen
- 2.4.2.6. Städtische Vorhaltung von Kohlekontrakten
- 2.4.2.7. Kalte Nah- und Fernwärmenetze

2.4.3. Maßnahme: Effiziente dezentrale Heizungen mit erneuerbarer Energien fördern

- 2.4.3.1. Maßnahme: Aufbau eines zukünften Wärmeversorgung (PV + WP + Electrolyse)
- 2.4.3.2. Beratung zu Hr Wärme/ Heizung
- 2.4.3.3. Ausbau der Beratung zu Hr Wärme/ Heizung

2.5. Versorgungssicherheit und Sektorkopplung

2.5.1. Maßnahme: Netzinfr für die Sektorkopplung machen

- 2.5.1.1. Verknüpfung von Energie- und Mobilitätsverende

2.5.2. Maßnahme: Ausbau Energiespeicher

- 2.5.2.1. Dezentrale Stromspeicherung

2.5.3. Maßnahme: Steuerung und Speicherung volatiler Stromerzeugung, netztechnische Energieinfra und Betriebsmodelle

- 2.5.3.1. Digitalisierung vorantreiben

2.5.4. Maßnahme: Import und Export von erneuerbarem Strom bedarfsgerecht sicherstellen

2.5.5. Maßnahme: Erhaltung und Weiterentwicklung Wasserstoff, synthetische Gase und Kraftstoffe, Infrastrukturentwicklung

2.5.6. Maßnahme: Erhöhung der Umsetzungsgeschwindigkeit

- 2.5.6.1. Aufbau eines stadtweiten Handwerkerpools sowie einer Plattform inkl. Schulungsmöglichkeiten

3. Gebäude

3.1. Stadt als Vorbild: Kommunale Gebäude und Anlagen

3.1.1. Maßnahme: Errichtung eines klimaneutralen und klimaangepassten Gebäudestandard der Nicht-Wohngebäude

- 3.1.1.1. Sanierungsfahrplan städtischer Nicht-Wohngebäude
- 3.1.1.2. Begrünung kommunaler Gebäude
- 3.1.1.3. Verbesserte Daten_Nr-Wohngebäude-Monitoring
- 3.1.1.4. Anreiz: Wiedereinführung von Boni an Schulen

3.1.2. Maßnahme: Errichtung eines klimaneutralen und klimangepassten Gebäudestandard des der Wohngebäude

- 3.1.2.1. Handlungskonzept Energetische Sanierung städtischer Wohngebäude
- 3.1.2.2. Energetische Sanierung GrWOKW- Gebäude

3.1.3. Maßnahme: Klimaneutrale Neubau

- 3.1.3.1. Klimaneutrale Neubauten

3.1.4. Maßnahme: Energiemanagementsysteme

- 4.1.4.1. Energie- Management auf den ganzen Kontinn Stadt ausweiten

3.2. Klimagerechter und angepasster Städtebau

3.2.1. Maßnahme: Aktivierung von Baulücken/Flächenmanagement

- 3.2.1.1. Neue Wege gehen - Zusätzliche Wohneinheiten im Gebäudebestand und Entwicklung von alternativen, lebenszyklus-anpassungsfähigen Wohngebäuden
- 3.2.1.2. Fortführung Projekt Flächenmanagement

3.2.2. Maßnahme: Klimagerechte Stadtplanung

- 3.2.2.1. Energieeffiziente Denkmalpflege
- 3.2.2.2. Forderung von Grün im Stadtraum
- 3.2.2.3. Klimaneutrale Neubauten (B, v. Grundstücksverkaufsverträgen, stadtbauliche Vorlagen
- 3.2.2.4. Checkliste für städtebauliche Entwürfe, K Pläne
- 3.2.2.5. Energiekonzepte bei größeren Bauvorhaben, B-Pläne
- 3.2.2.6. Mobilitätskonzepte bei größeren Bauvorhaben (B-Pläne)
- 3.2.2.7. Vorgaben zum kompakten Bauen / Verzicht von DTH
- 3.2.2.8. Aachener Neu- und Umbaustandards
- 3.2.2.9. Klimaoptimierte für entspechtgrundstücke der Stadt

3.3. Wohngebäude Bestand

3.3.1. Maßnahme: Modernisierung des Gebäudebestandes

- 3.3.1.1. Beratung und Förderprogramm Altbausanierung
- 3.3.1.2. Strategie zum Umgang mit Gebäudeeigentümern

3.3.2. Maßnahme: Modernisierung des Mehrfamilienhausbestandes privat und gewerblich vermietet, Eigentümergemeinschaften

- 3.3.2.1. Kreativ-gutachten: Energieoptimierte Modernisierung des Mehrfamilienhausbestands in Zeitraf und gewerblich vermietet, Eigentümergemeinschaften

3.3.3. Maßnahme: Energetische Quartiersentwicklung

- 3.3.3.1. Sanierungs- Modellgebiet Örtliche Innenstadt
- 3.3.3.2. Energetische Quartierssanierung (KfW 432)
- 3.3.3.3. Quartiersperspektive Sanierungsberatung
- 3.3.3.4. Fortführung Quartierskonzept Aachen- Brand
- 3.3.3.5. Ressourcenschonende Bestandssanierung
- 3.3.3.6. Wohnungs- und Hausbesitzvermittlung

3.4. Wohngebäude Neubau

3.4.1. Maßnahme: Ausbau von klimaneutralen Einfamilienhäusern

- 3.4.1.1. Klimaneutrale Musteriedlung

3.4.2. Maßnahme: Ausbau von klimaneutralen Mehrfamilienhäusern

3.5. Nichtwohngebäude

3.5.1. Maßnahme: Potenziale der Gewerbeimmobilien heben

- 3.5.1.1. Beratung von Gewerbetreibenden
- 3.5.1.2. Modernisierung Gewerbeimmobilien

4. Mobilität

4.1. Stadt als Vorbild: Mobiler Konzern Stadt

4.1.1. Maßnahme: Betriebliches Mobilitätsmanagement

- 4.1.1.1. BMM bei der Stadtverwaltung Aachen und den städtischen Beteiligungsgesellschaften
- 4.1.1.2. Kommune als Vorbild: Fahrradinfrastruktur
- 4.1.1.3. Kostenloses Deutschlandticket/Jobticket auch für Landesbedienstete

4.1.2. Maßnahme: Klimaneutraler Fahrzeugpark

- 4.1.2.1. Beschaffungsunterstützung E-Busse bei der ASEAG
- 4.1.2.2. Elektrifizierung städtischer Fahrzeuge

4.2. Verkehrsplanung und Mob- ilitätsmanagement

4.2.1. Maßnahme: Strukturelle Rahmenbedingungen

- 4.2.1.1. Verbindliche Mobilitätskonzepte für Bauprojekte und Veranstaltungen
- 4.2.1.2. Bilanzierung und Wirkungsabschätzung der Mobilitätsmaßnahmen im IKSK
- 4.2.1.3. Wissensmatrix/die Regierung Mobilitätswende
- 4.2.1.4. Innerstadtmobilität für morgen
- 4.2.1.5. Netzwerk Mobilitätswende Region Aachen (NM:MOKA)
- 4.2.1.6. Null-Emissionszone
- 4.2.1.7. Klimaschonender Bau von Verkehrsinfrastruktur
- 4.2.1.8. Markierung von Kfz-Spuren in Zeiten oder mehr Personen
- 4.2.1.9. Sonderrechte für Autos mit Zwei oder mehr Personen
- 4.2.1.10. Klimaschonender Straßenbau

4.3. Vermeidung und Verlagerung Personenverkehr

4.3.1. Maßnahme: Ausbau ÖPNV/ Angebot

- 4.3.1.1. Starke ÖPNV-Achsen (Busspuren, Hälteseiten) . Stadtbahn
- 4.3.1.2. 10% Mehrleistung der ASEAG
- 4.3.1.3. starker Ausbau Schnellbusangebote
- 4.3.1.4. RegioTram
- 4.3.1.5. Ausbau Flexibilität im ÖPNV
- 4.3.1.6. Kostenloser ÖPNV im Stadtgebiet
- 4.3.1.7. Verkehrsberuhigung der Ruhrtotte

4.3.2. Maßnahme: Radverkehrsinfrastruktur & Fußverkehr

- 4.3.2.1. Ausbau Radverkehr gemäß Radentscheid
- 4.3.2.2. Premiumwege und Plätze
- 4.3.2.3. qualitativer und quantitativer Ausbau der Wegeinfrastruktur
- 4.3.2.4. Verbesserte Fahrradparken
- 4.3.2.5. Umwidmung von Verkehrsflächen des PKWs
- 4.3.2.6. Velocity Stationen an Pendlerparkplätzen (insb. P&R)

4.3.3. Maßnahme: Multimodale Mobilität

- 4.3.3.1. Förderung von Sharing und Multimodalität

4.3.4. Maßnahme: Parkraum Management

- 4.3.4.1. Verlagerung bewohnerparkplätze i Mobility -Hubs: elektrifizierte Quartiersparkhäuser
- 4.3.4.2. Ausbau Verkehrsraumkontrolle
- 4.3.4.3. Mobilitätsmanagement für Besucher
- 4.3.4.4. Parkkonzept Individualverkehr (Tarife, Parkhäuser)
- 4.3.4.5. PHUMobility -Hubs an allen Einfallstraßen

4.3.5. Maßnahme: Anreize für den Umstieg schaffen

- 4.3.5.1. Halbierung der Tarife ab 2025
- 4.3.5.2. Kampagne und Förderprogramm Mobilitätswende (2.000 Lastenpedelec mit 1000 pr Lastenrad)
- 4.3.5.3. City Maut und Finanzierungsmodelle
- 4.3.5.4. Anreizkatalog zur Vereinigerung des MIV schaffen
- 4.3.5.5. Tempo 30 für alle
- 4.3.5.6. Autofreie Innenstadt
- 4.3.5.7. Zufahrtsbeschränkungen für Fahrzeuge mit hohem Schadstoffausstoß
- 4.3.5.8. Abbau der Privilegien des PKWs

4.4. Vermeidung und Verlagerung Wirtschaftsverkehr

4.4.1. Maßnahme: klimaschonender Wirtschaftsverkehr und betriebliche Mobilität

- 4.4.1.1. Fortführung BMM-Programm
- 4.4.1.2. Emissionsreduktion Lieferverkehr
- 4.4.1.6. Ausbau Wirtschftsmanagement und digitale Grundlagen
- 4.4.1.4. Förderung Elektrifizierung betrieblicher Mobilität

4.4.2. Maßnahme: Betriebliches Mobilitätsmanagement Unternehmen

4.4.3. Maßnahme: Strategien für die letzte Meile

- 4.4.3.1. Förderprogramm Z.000 Lastenfahrräder

4.5. Klimaschonende Antriebe und Kraftstoffe

4.5.1. Maßnahme: Angebote und Infrastruktur zur Förderung der E-Mobilität

- 4.5.1.1. Ausbau Ladeinfrastruktur
- 4.5.1.2. Elektromobilitätsprogramm
- 4.5.1.3. Beratung von Unternehmen und Privatpersonen

4.5.2. Maßnahme: Angebote und Infrastruktur synthetische Kraftstoffe für Event-, Landwirtschaft sowie Sonderfahrzeuge

5. Wirtschaft

5.1. Stadt als Vorbild: Die Klimaneutrale Verwaltung

5.1.1. Maßnahme: Klimaneutrale Ausstattung und Beschaffung

- 5.1.1.1. Nachhaltige Kreativität
- 5.1.1.2. Sharing Economy

5.1.2. Maßnahme: Klimaneutrale IT - Infrastruktur

- 5.1.2.1. Cloud-System (ähnlich WeTransfer) zur Reduktion von Datenmüll
- 5.1.2.2. Green Coding für die Verwaltung & Aachener Unternehmen

5.1.3. Maßnahme: Verhaltensbezogene Einsparpotenziale heben

- 5.1.3.1. Realisiere "Klimafreundlich handeln am Arbeitsplatz" - Mitarbeiterinnen Aktivierung und Qualifizierung, Ausbildung von Multiplikator*innen

5.1.4. Maßnahme: Klimagerechter städtischer Bau & Bausteilen

5.2. Wirtschaftsförderung und Standortentwicklung

5.2.1. Maßnahme: Wirtschaftsförderung 4.0

- 5.2.1.1. Förderkultur "Nachhaltige und effiziente Wirtschaft"
- 5.2.1.2. Klima-Hub: Beratung für Start-Ups im Klima- und Nachhaltigkeitsbranchen, Transformationsberatung für bestehende Unternehmen

5.2.2. Maßnahmen: Standortentwicklung und Infrastrukturmaßnahmen zur Sektorkopplung in Gewerbegebieten

- 5.2.2.1. IT-Fahrzeuge fördern
- 5.2.2.2. Digitalisierung, Flexibilisierung Energieversorger
- 5.2.2.3. Digitalisierung als Unterstützung bei der Transformation
- 5.2.2.4. Wasserstoff als Energieträger
- 5.2.2.5. Integrierte Industrieparkentwicklung
- 5.2.2.6. Nachhaltige Standortentwicklung (Gewerbegebiete)
- 5.2.2.7. Klimaneutralwerke in den Gewerbegebieten
- 5.2.2.8. Interkommunale Zusammenschluss im Gewerbegrund
- 5.2.2.9. Marktorientierte Modelle - Gewerblisches Contracting
- 5.2.2.10. Gewerbehof der Zukunft

5.3. Klimaneutrales Gewerbe, Handel und Dienstleistung

5.3.1. Maßnahme: Beratung zur Energieversorgung und Energieeinsparung

- 5.3.1.1. Unterstützungsangebote zur Steigerung der Energieeffizienz
- 5.3.1.2. Fördermittelberatung
- 5.3.1.3. Ökoprofit

5.3.2. Maßnahme: Förderung der Klimaschutzmanagement am Arbeitsplatz

5.4. Klimaneutrale Industrie

5.4.1. Maßnahme: Nachhaltige Produktion mit erneuerbaren Energien

- 5.4.1.1. Unterstützung von Unternehmen bei der Bewertung der Umsetzung auf Wasserstofftechnologien, Bereitstellung von Informationen, Kennung und Vernetzung
- 5.4.1.2. Veranstaltungsreihe "Energieeffiziente Betriebe"

5.4.2. Maßnahme: Förderung klimaschutzrelevanten Arbeitsplatz

5.5. Abfall- und Kreislaufwirtschaft

5.5.1. Maßnahme: Recycling von Produkten und Materialien fördern

- 5.5.1.1. Kreislaufwirtschaft konkret: Entwicklung eines Bauhofs der Zukunft für die Aachener Stadtbetrieb
- 5.5.1.2. Ressourcenrecycling vorantreiben

5.5.2. Maßnahme: Notstelle des Baustoffs in die Verbindung bringen

5.5.3. Maßnahme: Abfallvermeidung fördern

5.5.4. Maßnahme: Kreislaufwirtschaft in Industrie und GHD aus- und ausbauen

- 5.5.4.1. Kreislauffähige Prozesse in der Industrie implementieren
- 5.5.4.2. Klimaneutrale Abfallsammlung

5.5.5. Kreislaufwirtschaft im Baugewerbe

- 5.5.5.1. Bauteil- und Ressourcenlager
- 5.5.5.2. Kreislaufwirtschaft im Bauzyklus
- 5.5.5.3. Kriterien für klimaneutrale Baustellen entwickeln

5.6. Landwirtschaft, Ernährungswirtschaft und regionale Handelsstrukturen

5.6.1. Maßnahme: Regional Einkaufen: Produkten und Vermarktung im Bereich nachhaltige Ernährung fördern

- 5.6.1.1. Regionaler Kochbuch - Nachhaltige Lebensmittelproduktion und - Vermarktung
- 5.6.1.2. Stärkung des lokalen Einzelhandels und nachhaltige Transformation der Gastronomie

5.6.2. Maßnahme: Ausbau der nachhaltig bewirtschafteten Landwirtschaft

- 5.6.2.1. Pachtverträge der Stadt Aachen werden für die Stärkung der ökologischen Landwirtschaft genutzt
- 5.6.2.2. Pilotprojekte in der Agroforstwirtschaft
- 5.6.2.3. Ackerflächen werden regional bewirtschaftet
- 5.6.2.4. Fortführen des Runden Tisches "Nachhaltige Landwirtschaft und Ernährung"

6. Gesellschaftliche Transformation

6.1. Klimabewusstsein und Teilhabe

6.1.1. Maßnahme: Planung des Wandels fördern und Innovations- und Erfahrungsräume öffnen

- 6.1.1.1. Klimaneutralitäts erfahrbar und Best Practice sichtbar machen

6.2. Klimagerechtes Lebensumfeld

6.2.1. Maßnahme: Klimaschutz in den Lebensraum Stadt integrieren

- 6.2.1.1. Ocher trinken Ocher Wasser (Trinkwasserbrunnen im öffentlichen Raum)

6.2.2. Maßnahme: Klimaschonendes Verhalten im Alltag

- 6.2.2.1. Pilotprojekte zur Entsiegelung von Schul- und Kitageländen

6.2.1. Maßnahme: Klimaschonendes Verhalten im Alltag

6.2.1.1. Maßnahme: Klimamaßnahmen zur Aktivierung und Qualifizierung der Aachener Bürger*innen

- 6.2.1.1. Klimaschutzkampagne mit einem städtischen Klimaticket*innen
- 6.2.1.2. "Turdesing" der Nutzung regenerativer Energien

6.2.2. Maßnahme: Regionale und saisonale Ernährung fördern

6.2.3. Maßnahme: Initiierung der Lebensmittelverwertung umsetzen und überwachen

- 6.2.3.1. Gesunde und nachhaltige Gemeinschaftsverpflegung

6.4. Klima und Bildung

6.4.1. Maßnahme: Erfahrungs- und prozessbasierte Umweltbildung für Klimaschutz und Nachhaltigkeit

- 6.4.1.1. Begleitung und Unterstützung von Klima- und Nachhaltigkeitsaktivitäten an Schulen zur strukturellen Verankerung
- 6.4.1.2. Konzepte zu Klimabildung entwickeln und umsetzen

6.5. Klimaschutz in Kultur und Freizeit

6.5.1. Maßnahme: Anbieter von Freizeitorschtungen als Multiplikatoren für Klimaschutz und Nachhaltigkeit fördern

- 6.5.1.1. Strukturelle Veränderungen mit dem Handabdruck: Workshops und Begleitung der Umsetzung innerhalb der Verwaltung und mit Multiplikator*innen in Vereinen und Initiativen

6.5.2. Maßnahme: Kulturschaffende als Multiplikatoren für Klimaschutz und Nachhaltigkeit fördern

7. Kompensation

7.1. Grüne Infrastruktur zur CO2- Bindung

7.1.1. Maßnahme: Aachener Wald im Wandel

7.1.2. Maßnahme: Entwicklung und Schutz von natürlicher CO2-Senken

- 7.1.2.1. Anzahl Grundfachen und Baumpflanzungen erhöhen (natürliche Senken von CO2)

7.1.3. Maßnahme: Schutz der Böden

7.2. Kompensation auf Unternehmensebene

7.2.1. Maßnahme: Einheitliche Kauf- und Reportingstandards für Emissionszertifikate festlegen

- 7.2.1.1. Beratungsangebote für Aachener Unternehmen zu Kompensationsmöglichkeiten

7.3. Technische Systeme CO2-Kompensation und Speicherung

7.3.1. Maßnahme: Potenziale zur technischen Kompensation und CO2-Speicherung identifizieren

- 7.3.1.1. Potenzialstudie technische CO2- Kompensation

Legende

- Steckbrief
- Kurzbeschreibung
- Speicher

Figure 47 Portfolio plan (Graphic: Gertec GmbH)

9.3. Savings targets, areas of influence of the municipal family and contribution of the ICSK at a glance

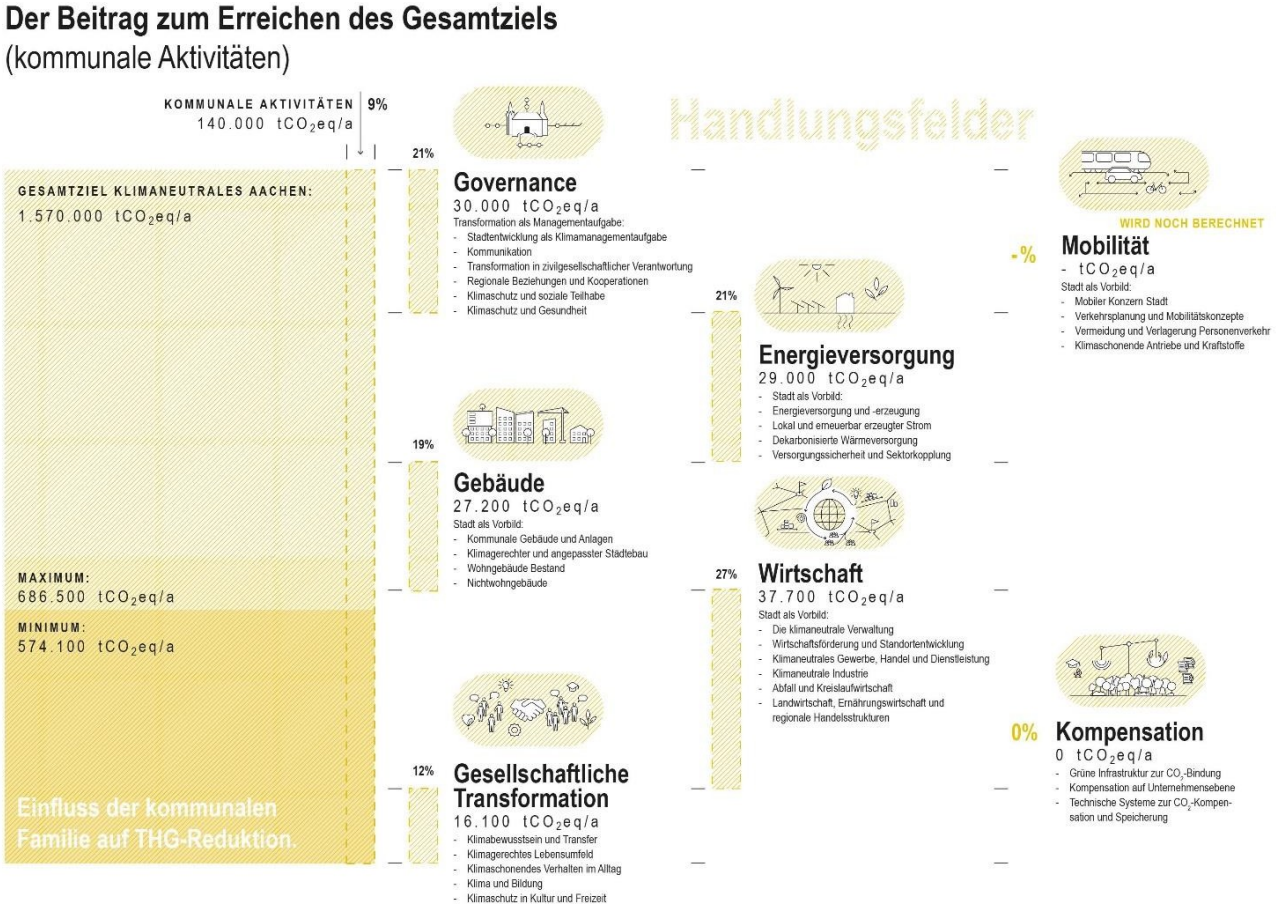
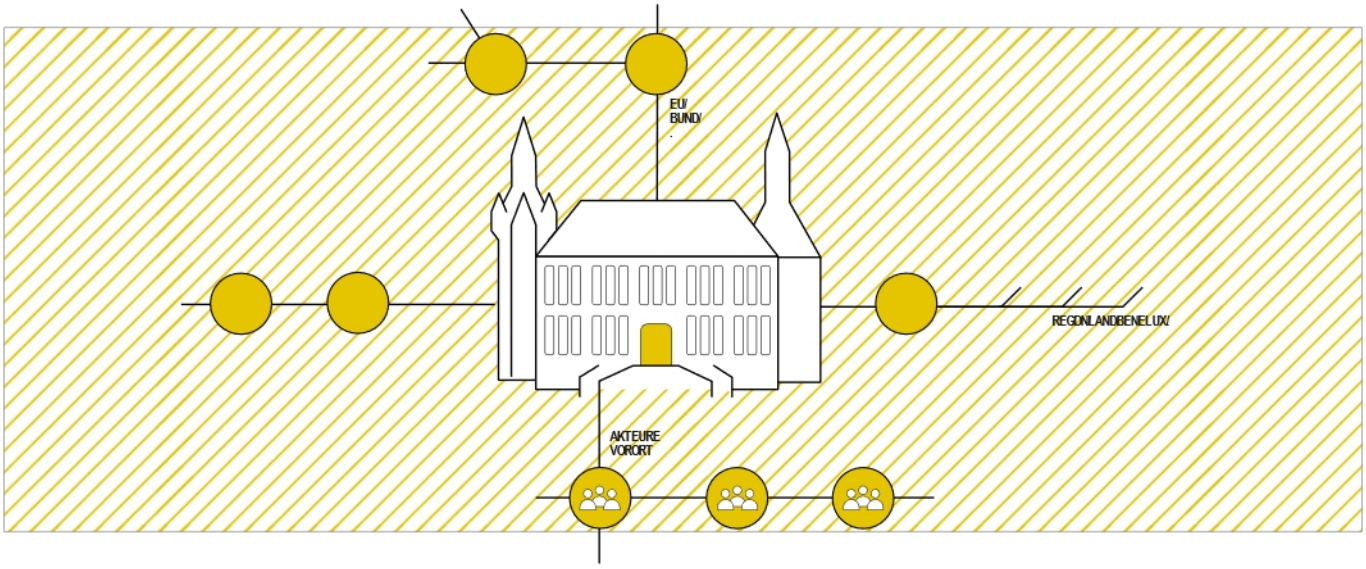


Figure 48 Schematic representation of the theoretical reduction potential of the ICSK 2023 per field of action. (Source: Ifeu, calculation: Gertec GmbH, graphic: Bodo Wirtz)[31]

[31] The city administration of Aachen is currently in the tendering process for the expansion and adaptation of the accounting methodology for $CO_{2\ emissions}$ in the mobility sector (see Volume 2 Activity 4.2.1.2. Accounting and impact assessment of mobility measures in the ICSK). This forms an important basis for estimating GHG savings in the mobility sector more accurately and taking into account interactions between different proposed activities.

9.4. Governance



The path to climate neutrality is a systemic task and an agile process in which the city, citizens and stakeholders such as companies, associations and interest groups must be equally involved. The field of action aims to translate the insights gained by the administration (see chapter "Focus on the transformation") into strong structures.

What is this about?

Transformation as a management task

Administration translates climate neutrality into an action-oriented idea; begins to build up new processes within itself, restructure old processes, reorganise. The $CO_{2\,budget}$ for each field of action must not exceed a target value. Controlling and monitoring of the process is required to check, evaluate and readjust compliance with the development path as well as a binding mechanism for follow-up control.

Urban development as a climate management task

The planning and conceptual framework for these necessary developments is provided by integrated, climate-friendly and sustainable urban development. The city administration's actions always take into account the settlement areas for the city as a whole as well as potential land conflicts.

Communication

Change processes require active communication in order to deal with resistance and increase acceptance.
Through the type of mediation and communication, education, the The transformation can be actively shaped by creating incentives for action and decision-making impulses and by taking behavioural characteristics into account. Good internal administrative communication and networking form the basis for accelerated and consistent implementation of the process towards climate neutrality. This includes clarity about the communication and decision-making channels for the implementation of climate protection measures, interdisciplinary exchange across departments and learning from each other. External communication creates a basis on which the Climate City Contract can be implemented together with the city's population.

Transformation in civil society responsibility

In order to achieve the goal of climate neutrality by 2030, strong participation of the urban community is required. New ideas and projects are initiated and further developed in direct dialogue with citizens, and the implementation of projects, measures and activities is accompanied and supported.
Community action promotes social cohesion. Initiatives run open workshops, neighbourhood centres, online platforms for swapping, lending and co-creation.

Citizen participation should be organised on an ongoing basis. A hybrid approach that combines both analogue (e.g. project workshops, focus groups, citizens' councils) and digital formats (e.g. citizens' panels) makes sense.

Regional relations and cooperation

Administration needs strong contacts and stakeholders outside the administration; this requires networks and alliances between which paths can be established

Climate protection and social participation

Climate protection must go hand in hand with greater social justice. The fight against the climate crisis also means standing up for social and intergenerational change. Life satisfaction depends on the opportunity to participate. Strong

Communities build up social capital and are stable in crisis and change situations. Major differences and perceived injustices hinder transformation and lead to resistance. Combating inequality and strengthening the community is therefore a success factor.

Climate protection and health

The quality of life of Aachen's citizens is closely linked to the protection of health and the climate. From the prevention of heat stress to protection against the spread of pathogens. Climate change can have direct or indirect effects on the physiological and mental state of Aachen's citizens. In this respect, a city-wide strategy and targeted management of measures across various fields of action are required.

What are important influences and framework conditions?

Adequate human and financial resources:

In order to be able to implement the programme, the municipal family requires sufficient human and material resources, particularly for staff development and retention.

Knowing the municipal sphere of influence

The interdisciplinary and coordinated use of municipal control instruments within the framework of local self-government creates a framework for implementation. This includes, in particular, the integrated and cross-sectional use of formal and informal participation and planning instruments.

Accelerating the implementation

Governance for the transformation process requires organisational and regulatory structures to accelerate planning and decision-making processes.

Dealing with conflicting goals

Acceptance of a path to climate neutrality depends in particular on how conflicting goals are dealt with. Measures must fulfil social, ecological and economic criteria in equal measure.

Create the targeted strategic development of innovation spaces and participation programmes across all fields of action

Good framework conditions for process-accompanying citizen participation in climate protection and climate adaptation processes, means of actively promoting transformation through civil society processes.

What is the potential?

Utilising municipal control options

Control options arise from the direct and indirect influence options described in chapter 7 within the framework of local self-government.

- Direct influence refers to the city's ability to have a direct and immediate impact on greenhouse gas emissions.
- Indirect influence refers to opportunities for municipal action that have an indirect effect. They harbour a probability of reducing greenhouse gas emissions, but this depends on the degree of involvement of third parties (companies, private households, etc.).

Transparency and knowledge transfer

By creating transparency, an overview of current and past activities is created within the municipal family and across the city as a whole. This makes it possible to organise knowledge management of the experience gained. Data, information and knowledge are kept up to date in this way.

Strategic project initiation and development

Change often begins in the niche. Innovations that prove themselves in the niche have a system-changing effect and have the potential to accelerate the transformation. Active innovation and niche management, particularly at the interface with urban development, aspects of climate justice and healthcare, therefore offer potential for control

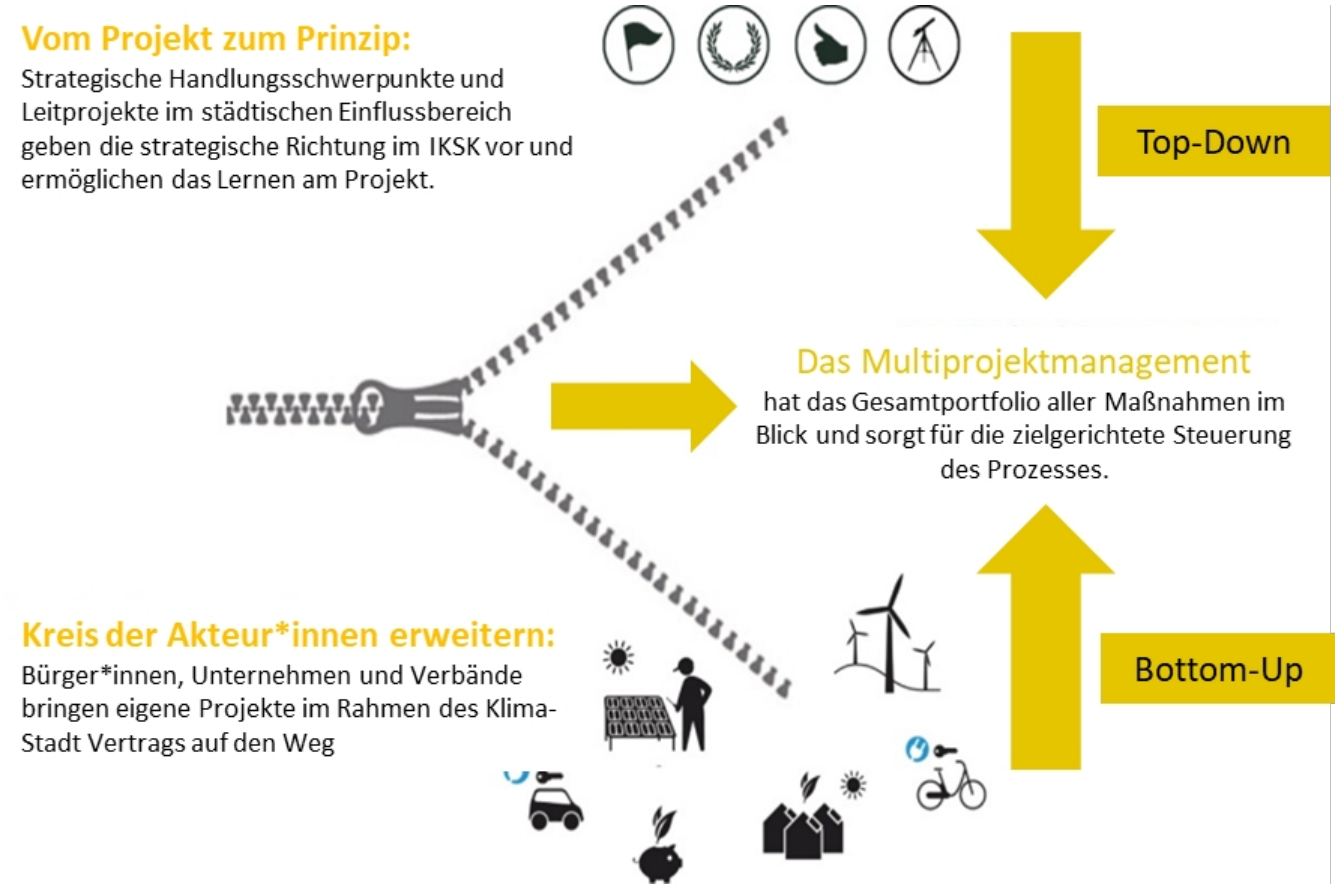


Figure 49 Change through projects: Control through strategic project development. (Graphic Bodo Wirtz, Icons Jung Stadtkonzepte)

Idea management

Ideas management promotes new ideas for measures and projects through targeted offers and formats and accompanies the path from idea to measure.

Parallel top-down and bottom-up strategy

The portfolio of measures and activities forms the backbone for managing the process. There is potential in a parallel top-down and bottom-up strategy through the networking of municipal and civic measures and projects. In the top-down approach, control options arise from the direct and indirect influence of the City of Aachen within the framework of local self-government. The direct and indirect control options are bundled in measures and activities of the City of Aachen.

The bottom-up approach focuses on initiating and promoting projects and measures as citizen projects, projects by companies and associations. These are integrated into the implementation strategy of the climate neutrality strategy as part of the climate city contract and thus form the driving force behind the change process. Central questions that clarify the principles of action can be:

- Does the project serve to reduce greenhouse gases?
- Does the project create economic added value in terms of regional value creation?
- Does the project help to improve the quality of life for citizens in Aachen?
- Does the project have innovative power and appeal?

Promote implementation

In order to adhere to the target path, the city can use legal, planning and financial means to shape the framework conditions for the implementation of measures. Important tasks of implementation control are

- Coordination and management of resources: Required resources are identified and their deployment planned as part of strategic planning. This includes human resources, but also funds to promote innovation and investment for projects under the responsibility of civil society.
- Promotion of cross-sectional cooperation: Cross-sectional cooperation promotes the exchange of expertise, enables integrated and interdisciplinary solutions and helps to reduce resources. Internal training and further education is the basis for cross-sectional work.
- Communication that strengthens commitment: Internal and external communication promotes mutual understanding and thus acceptance for implementation. Working in networks is the basis for co-operative solutions and the exchange of knowledge and experience.
- Funding management: Funding programmes for the acquisition of funding are recorded across the board and advice is provided within the municipal family on the acquisition of funding.

Monitoring and controlling in Aachen become digital, transparent and flexible

Monitoring and controlling records and evaluates the progress of the process using specific indicators to determine whether the key objectives in the fields of action are being met. It is consistently designed and implemented as a digital system with open data interfaces. Chapter 11.6 describes the principles of monitoring and controlling.

- Evaluation and success monitoring: Multi-project management uses a standardised data structure that supports users in generating, storing and retrieving data, information and knowledge in a targeted manner thanks to its transparency.
- Balancing: Regular GHG balancing is carried out and the data is analysed and interpreted.
- Climate relevance assessment: This includes the preparation of decision papers for policymakers and the formulation of recommendations for prioritisation in the committees.

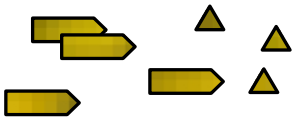
Recommendations for the binding anchoring of the control processes

For the management of the climate protection process within the city administration of Aachen, the introduction of a binding follow-up mechanism is recommended if the city's targets are not met.

- Annual balancing according to the BISKO method and determination of the previous year's emissions data.
- Target/actual value comparison for the sector-specific $CO2_{emission}$ and budget targets (annual).
- Case 1: Maximum annual emission volumes complied with = no need for readjustment
- Case 2: Annual emission volumes exceeded in one or more sectors => need for readjustment
- Consideration and recommendation for readjustment
- Departments and municipal holdings (half-yearly) weigh up and present activities for subsequent control with direct or indirect influence.

The measures and activities must be communicated transparently to the Aachen City Council and, if necessary, approved. This mechanism can be gradually extended to the investments in the Group. This procedure requires a binding anchoring of the climate protection targets in the individual departments as well as interfaces to the holdings.

These are the 2030 guidelines



The urban transformation process towards climate neutrality is being actively shaped by the municipal family of the city of Aachen. Favourable framework conditions for innovation and change have been created.

A monitoring and controlling system has been introduced to measure CO_2 emissions and for subsequent control.

Climate protection as a cross-cutting issue is anchored as a binding task and objective in all relevant levels of the administration and the municipal holdings and is equipped with suitable structures and resources.

The municipal instruments for influencing the climate neutrality process have been identified and are being integrated and used in a targeted manner.

Planning and approval procedures have been accelerated with a view to achieving climate neutrality by 2030. All potential for speeding up procedures has been identified and measures implemented.

Climate neutrality is anchored as a cross-sectional strategic goal of urban development and economic development.

The management of the process takes social issues into account in all measures.

The management of the process takes into account aspects of health promotion and prevention, insofar as these are influenced by aspects of climate change and climate adaptation requirements.

These are the main areas of action and measures at a glance

Transformation as a management task

The municipal management task is not interpreted solely as classic project management with clearly quantifiable objectives, but rather as process-orientated change management. The core administration plays an important coordinating role here. The strategic planning of the transformation process and the introduction of appropriate monitoring and controlling with multi-project management are at the centre of the focus of action.

Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
Dec. VII and FB 36 with: Agency for Climate, Energy and Sustainability, EU Mission Core administration, Dec. V, FB 13, FB 14, E26 Investments and municipal companies, Private sector companies, civil society organisations Fire brigade, rescue services, THW if necessary	Transformation is actively pursued by creating favourable conditions for change. The urban instruments for influencing the climate neutrality process are identified and used in a targeted manner Promotion of innovations under social, economic and ecological criteria.	Set up multi-project management with monitoring and controlling Comprehensive instruments for process control and project initiation Integrating the goal of climate neutrality into the structure of the municipal family Regional and supra-regional co-operations and networks Political influence at federal and EU level for climate protection and sustainability	Introducing and anchoring multi-project management Dashboard: Monitoring & controlling with balance sheet Climate neutrality transformation strategy - Practical solutions for implementation Updating the climate relevance assessment to prioritise climate-relevant decisions Introduction of climate funds Comprehensive subsidy management Introduce climate coordinators in all departments Climate protection in and further adaptation of fire and rescue service infrastructure and city operations Climate, Energy and Sustainability Agency CoLab pilot project

Urban development as a climate management task

Climate neutrality is a central goal of urban development in Aachen. The City of Aachen promotes this goal within the framework of municipal self-administration and the associated planning sovereignty. To this end, urban development sets the cross-sectional planning framework for land development and land use in all fields of action of the ICSK and creates the informal and formal planning basis for implementation. This creates favourable framework conditions for achieving the energy and greenhouse gas reduction targets. One task is therefore also to initiate internal processes for the development of urban planning standards with regard to the goal of climate neutrality, to accelerate procedures and decision-making processes and to anchor the climate protection goals in the informal and formal planning processes.

Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
FB 61/100, statistics centre, FB 02/200 with core administration FB 61 with FB 56, FB 36 with citizens	Work intensively and interdisciplinarily on strategic interfaces between urban development and other areas of the municipal family in relation to climate protection Integration and binding anchoring of the goal of climate neutrality in informal and formal planning processes Acceleration of planning and implementation periods for climate protection measures	Framework conditions for climate-adapted urban development	Establishment of an urban data working group - advertisement for the position of an urban data coordinator to pool and analyse urban data Climate protection management for integrated urban development concepts and projects to redesign public spaces

Communication

Change processes require active communication, both internally and externally, in order to deal with resistance and increase acceptance. In external communication, the transformation can be actively shaped through the type of mediation and communication, education, the creation of incentives for action and decision-making impulses as well as the consideration of target group-specific behavioural characteristics. Good internal communication and networking within the municipal family forms the basis for an accelerated and consistent implementation of the process towards climate neutrality. This includes clarity about the communication and decision-making channels for the implementation of climate protection measures, interdisciplinary dialogue and learning from one another

Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
Dec VII with VB13	Activation and qualification of citizenship and the development of an identity-forming effect Increasing self-efficacy, actively addressing resistance Promoting internal administrative communication and networking Create transparency and understanding of internal dependencies Accelerate decision-making processes	External communication campaign for the public and business Offer and conduct internal communication training	Communication strategy

Transformation in civil society responsibility

Civic engagement is an important social resource and an expression of a strong civil society. Civic engagement refers to individual, voluntary, unpaid, public and community activities beyond the family. Civil society organisations are an important pillar in achieving the goal of climate neutrality. The spectrum ranges from large charities such as Caritas or Diakonie to environmental organisations, such as Radentscheid Aachen or the Climate Emergency Round Table, to small local associations. In addition, there is civil society involvement in non-formalised or only slightly formalised associations. This engagement tends to take place spontaneously in everyday life, is generally limited in terms of time and space and is usually linked to people - for example, to the neighbourhood or circle of acquaintances. The focus of action bundles measures and activities to promote civil society involvement on Aachen's path to climate neutrality.

Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
FB 01 Citizens' dialogue, district offices with citizens, associations and initiatives	Public participation is a natural part of opinion-forming and decision-making in the climate protection process and is evaluated on the basis of clearly formulated quality criteria. Organised and non-organised civic engagement on the path to climate neutrality is actively promoted and integrated. An infrastructure for participation is being implemented without wanting to control civic engagement and civil society organisations. A framework is created to support civic projects and initiatives in their development and implementation. implementation.	Intensify and permanently promote citizen participation Actively involve civic initiatives and networks	Citizen participation formats for climate neutrality

Climate protection and social participation

The fight against the climate crisis also means standing up for social and intergenerational change. Life satisfaction depends on the opportunity to participate. Strong communities build social capital and are stable in situations of crisis and change. Major differences and perceived injustices hinder transformation and lead to resistance. Combating inequality and strengthening the community is therefore a success factor.

The climate crisis primarily affects vulnerable and weaker people in society. For these people in particular, the right to access and participation is a fundamental good. There is therefore also an obligation to create the basic conditions for social participation. This priority area summarises measures and activities to actively involve vulnerable groups and promote social structures to support them.

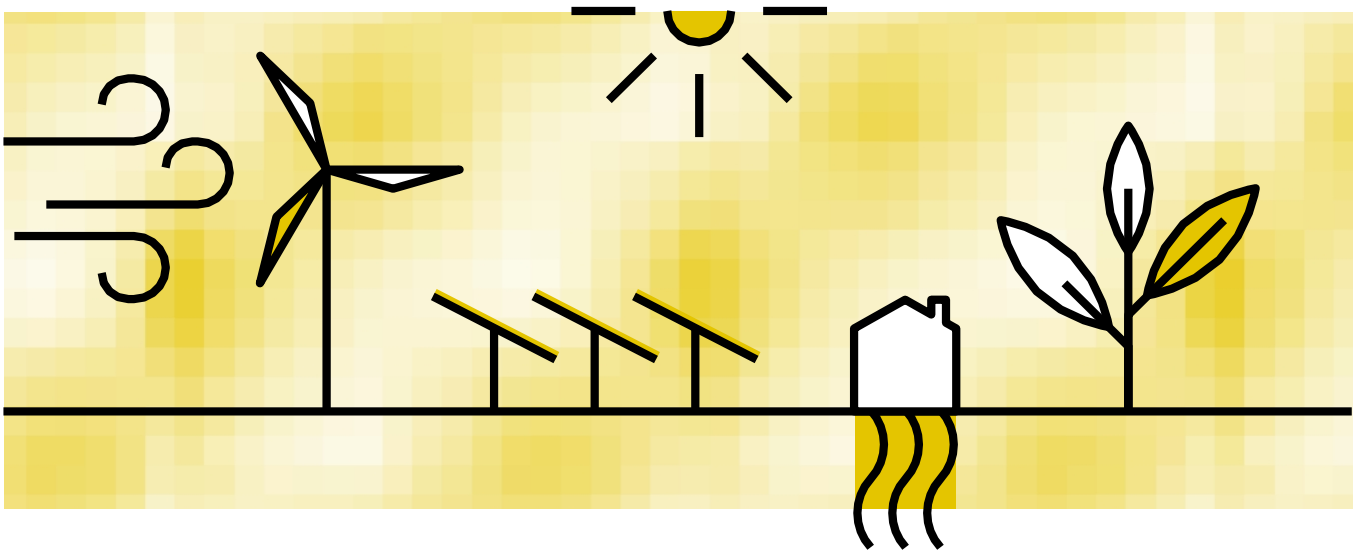
Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
FB 20 and Citizens' Service with citizens and companies	Promoting processes and initiatives for social and intergenerational change Ensuring social participation for vulnerable and weaker people in the process Securing the social infrastructure in the process towards climate neutrality Creating acceptance by strengthening the community - combating inequality	Promotion of vulnerable groups in the area of housing and energy Support for the economy for the common good Support and promotion of social infrastructures for climate transformation	Introduction of a municipal climate fee

Climate and health

Climate change has direct and indirect consequences for physiological and mental health. For example, rising temperatures have a direct impact on health. The city of Aachen is responding to this by drawing up a heat action plan. The climatic developments in Aachen are currently being analysed as part of a preliminary study. Indirect consequences arise, for example, from the spread of pathogens or the spread of allergens. Preventive health care is therefore a cross-sectional task that must be actively managed with regard to increasing risks and catastrophes. The focus of action on climate and health will therefore be worked on intensively in the future.

Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
n.n.	Minimise direct and indirect risks to the physiological and mental health of Aachen's citizens as a result of climate change.	Research Co-operation Health and Climate RWTH Aachen University Set up organisational unit for civil protection	-

9.5. Energy supply



A climate-neutral energy supply requires a fundamental reorganisation of energy generation, storage and distribution of electricity and heat from renewable energies.

What is this about?

City as a role model: energy supply and generation

In terms of setting an example, the aim is to decarbonise the electricity and heat supply of municipal buildings and facilities. In the heating sector, this is primarily achieved by converting the heating systems. In terms of electricity supply, the focus is on meeting demand with renewable energies, which are generated by the company's own plants wherever possible.

Locally and renewably generated electricity

The energy transition is going electric: the goal of climate neutrality can only be achieved if fossil fuels are completely replaced by renewable energies using cross-sectoral approaches. The increased use of electricity from renewable energies for heat generation and mobility will increase electricity consumption by a factor of 1.3. The expansion of renewable electricity generation from wind and solar power, the expansion of cross-sector supply concepts and the system integration of renewable energies are therefore key tasks for the City of Aachen's climate neutrality strategy.

Decarbonised heat supply

Heat supply becomes climate-neutral: The challenge of a climate-friendly supply of space heating and hot water as well as process heat in industry is particularly great in the area of heat supply. The federal and state governments have already reacted and set the framework for cities and municipalities with the laws on municipal heat planning. This means that large cities such as Aachen have until 31 December 2025 to submit a municipal heating plan that shows how a climate-neutral heating supply can be achieved. One core task is the expansion of green district heating: 17,500 households are already connected to district heating today. The aim is to significantly increase the use of district heating and provide heat without emitting greenhouse gases. As part of the necessary technological change in heat generation, the utilisation of waste heat and carbon capture, i.e. the separation of CO_2 emissions, are seen as important technologies for achieving the target.
Decarbonisation and the expansion of district heating is a lever with which the climate-neutral conversion of urban districts and neighbourhoods can also succeed in terms of a social and sustainable urban development strategy.

Security of supply and sector coupling

Infrastructure modernisation to secure supply is a priority task. The expansion of sector coupling requires the joint optimisation of electricity, gas and heating grids. So-called hybrid grids enable the consumption, storage and transport of energy in its current form or the conversion to another form of energy that can also be consumed, stored or transported. This means that, for example, in the event of an oversupply of electricity from renewable sources, this can be utilised flexibly or other forms of energy can be used for reconversion if there is an undersupply.

Hydrogen is a rare commodity in the energy transition. Nevertheless, it will be required for industrial processes in particular.
Hydrogen is therefore an indispensable part of the energy supply strategy in the future.

What are the most important influences and framework conditions?

The framework conditions are primarily set by the EU, the federal government and the state of NRW:

Green Deal:

The European Union's European Green Deal, for example, stipulates that around 49% renewable energy should be used in buildings by 2030 and that the share of renewables in the heating and cooling supply should be increased by 1.1% per year. A further resolution by the EU Parliament provides for emissions trading to be extended to the transport and building sectors from 2027. This also harbours the opportunity for the city of Aachen to achieve urban sector targets more quickly due to the additional incentive.

CSR Reporting Guideline:

Sustainability reporting obligations for companies in accordance with the CSR Reporting Directive can help to accelerate the success of the energy transition in the economy. Further impetus comes from the federal government and the NRW state government with various strategies and action plans, which aim to decarbonise the economy and industry, among other things, and therefore form an important interface with the economic field of action.

National hydrogen strategy:

In this context, the city of Aachen has opportunities through the use of green hydrogen in energy-intensive industries. It is also easy to store and can compensate for volatile electricity generation from renewables. The City of Aachen already has a "Hydrogen for Aachen" guideline from 2022, which sets out future visions and recommendations for action. It is also involved in numerous networks and research projects to prepare for the ramp-up of hydrogen.

Expansion of renewable energies:

A comprehensive legal framework has been created at federal level to support the expansion of renewable energies. This includes municipal heat planning, the Renewable Energy Sources Act and the Energy Industry Act. The Renewable Energy Sources Act (EEG) 2023 of the

The German government has formulated the goal of a consistent and significantly accelerated expansion of renewable energies in order to achieve an 80% share of gross electricity consumption by 2030. In the area of wind energy expansion, the Wind an Land Act and the Wind Energy Area Requirements Act provide the framework. For the city of Aachen, opportunities arise from the abolition of distance regulations in NRW by 2025 as well as the abolition of distance regulations for repowering existing turbines. Organisational structures have been established, including with the German Energy Agency (dena) at federal level and with the state company NRW.ENERGY4CLIMATE, which support stakeholders in the municipalities during the transformation. There is also a dynamic funding framework for the expansion of renewable energies, which is financed by the state of NRW and the federal government. In addition to companies, private individuals and non-profit organisations, municipalities can also benefit from the funding.

Renewable energies and monument protection:

The state of North Rhine-Westphalia has responded to conflicting objectives in the area of monument protection with the "Decree on the Simplification of Approval Decisions under Monument Protection Law". The decree from November 2022 serves as a decision-making aid for the lower and higher monument protection authorities in NRW with regard to the use of renewable energies - in particular photovoltaic systems. This decision-making guideline creates transparency for both the owners and the authorities as to the conditions under which the installation of a solar system on, on or near monuments is possible.

Climate-damaging subsidies are hampering the conversion:

At national level, there are still numerous climate-damaging subsidies that are hampering the energy transition. According to calculations by the German Environment Agency, these subsidies account for around 39% of the energy supply.[32] The city of Aachen could try to influence this as part of the EU mission.

[32] Federal Environment Agency, 2021. press release no. 44/2021 [online]. Available at: https://www.umweltbundesamt.de/presse/pressemitteilungen/umweltschaedliche-subventionen-fast-die-haelfte (Last accessed: 22/11/2023, 13:00)

and to work towards the reduction of climate-damaging subsidies.

Making grids fit for climate neutrality:

With the 2037/2045 Grid Development Plan, the federal government is working towards making the electricity grids fit for the future requirements as part of the planned expansion of renewable energies.
"climate neutrality grid". Without this expansion, the energy transition cannot succeed, but the expansion can only be realised slowly due to lengthy planning procedures. The city of Aachen has no influence here, but it can drive forward the expansion of renewables and the upgrading of the distribution grids in its own city area together with STAWAG.

National Action Plan for Energy Efficiency (NAPE):

The federal government is endeavouring to significantly increase energy efficiency with the help of the National Action Plan on Energy Efficiency (NAPE).

Amendment of state building regulations:

The amendment to the NRW state building regulations will gradually introduce a solar obligation for new builds and renovations. The city of Aachen can take action here and incentivise roof renovations in order to accelerate the expansion.

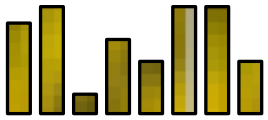
Obstacles and opportunities for market players:

In addition to the legal requirements, numerous other factors at the level of market players have an impact on the development of the energy supply in the city of Aachen. For example, conflicting goals between roof statics (especially for large flat roofs) and the expansion of roof-top photovoltaics as well as trees and photovoltaics on and around buildings have an inhibiting effect. Furthermore, the shortage of raw materials and skilled labour is significantly slowing down the expansion of renewable energies. The expansion of intelligent metering systems (smart meters), among other things, offers opportunities, as the digitalisation of grids enables better control of volatile energy generation and energy demand. By 2032, Regionetz GmbH plans to have around
30,000 meters to be converted to smart metering systems.

Public participation and new operator models strengthen acceptance:

The generation of electricity from renewable energies by citizens is already an important pillar of the energy transition. Citizens' energy cooperatives, tenant electricity models and neighbourhood networks for heat supply promote acceptance through individual benefits and regional value creation.

What is the potential?



For the city of Aachen, the greatest potential for renewable electricity generation lies in the areas of wind and solar energy.

Wind energy potential:

According to the NRW wind energy area analysis by the LANUV from March 2023, an area potential of 403 ha is indicated for the city of Aachen. Additional potential in areas for the protection of nature (BSN) amounts to 50 ha. The City of Aachen has already initiated the designation of 19 wind energy areas, which the administration considers to be particularly suitable, by amending the AACHEN*2030 land use plan - wind energy areas. The size of the areas is around 422 ha for variant A of the plan and 405 ha for variant B, which roughly corresponds to the information provided by the LANUV. Based on this potential, up to 57 MW could be installed[33].

Photovoltaic potential:

According to LANUV calculations, there is potential for generating electricity from solar energy of 645 MWp on open spaces and 680 MWp on roof surfaces. Currently, only a fraction of the available potential is being utilised in Aachen with an installed capacity of around 40 MWp. The expansion should be massively driven forward and also include solutions for tenants such as balcony systems. In addition to renewable electricity production, the import of renewable electricity will also be necessary in future to cover demand.

Potential of deep geothermal energy:

According to the NRW potential study and the city's cornerstone paper, Aachen has a theoretical potential for energy from deep geothermal energy of several 100 MW. Test drillings to determine the potential are planned, and STWAWAG signed a cooperation agreement with the Fraunhofer Institute in 2021. Another goal is the construction of a deep geothermal power plant in the Aachen area by 2029[34].

In addition, heat generation using disused mining pits in Richterich is being considered and a corresponding feasibility study is currently being prepared.

[33] Basic assumption: Potential is based on turbines with a nominal capacity of 5.3 MW and an installation grid of 790m x 474m, in accordance with the latest LANUV wind energy potential study (2023), https://www.lanuv.nrw.de/fileadmin/lanuvpubl/3_fachberichte/Potenzialstudie-Windenergie-NRW.pdf (last accessed: 09.10.2023, 10:33).

[34] https://www.fraunhofer.de/de/forschung/aktuelles-aus-der-forschung/wir-haben-die-energy/geothermal.html

Potential of heat pumps in buildings:

According to the FFE's potential survey, around 40 % to 59 % of residential buildings in Aachen are suitable for the use of heat pumps (excluding groundwater heat pumps, whose potential was not considered)[35]. 90 % of single and two-family houses in Aachen are estimated to be suitable, and 87 % of smaller apartment blocks.

Potential of green district heating:

As part of municipal heat planning, the requirements and potential for fossil-free heat supply will be presented in possible development scenarios for the entire city. The city of Aachen has already presented the cornerstones for a climate-neutral energy supply in 2030 in its paper "Wärmewende Aachen". From the perspective of the City of Aachen and STAWAG, combined heat and power, deep geothermal energy and the Weisweiler waste incineration plant are seen as the most significant potential for converting and expanding district heating. The city of Aachen has set itself the target of connecting a further 6,500 households to district heating by 2030 and providing a further 100 GWh of energy[36].

Hydrogen potential:

The city of Aachen co-founded the Hydrogen Hub Aachen in 2021 and is to be connected to the Eynatten-Hürth pipeline in the medium term via the international "H2ercules Project". The Hydrogen Hub Aachen advises companies on decarbonisation and communicates potential hydrogen requirements to network operators in order to drive forward the expansion of the necessary infrastructure.

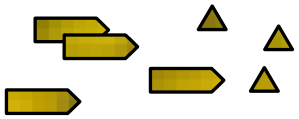
Potential of citizen and operator models:

The expansion of renewable energies can be significantly accelerated through the involvement of citizen energy cooperatives. In this way, considerable investment sums can be generated and the acceptance of citizens can be increased. The City of Aachen can provide advice and support here.

[35] https://waermepumpen-ampel.ffe.de/karte (last call: 28/09/2023, 15:53)

[36] City of Aachen (2022): Aachen heat transition: Cornerstones for a climate-neutral energy supply in 2030 p. 45

These are the 2030 guidelines



Saving energy takes precedence over switching to renewable energies. Efficiency and sufficiency potential is therefore prioritised. These are addressed in particular in the areas of action of buildings, mobility and social transformation.

The following guidelines apply to the energy supply field of action:

- The city of Aachen's electricity consumption will be covered 100% by renewable energies by 2030.
  The remaining requirements are generated regionally wherever possible or covered by imports of green electricity.
- The heat supply will be largely decarbonised by 2030, meaning that around 94% of households and businesses will have a fossil-free supply.
- The share of district heating in the heating mix increases from approx. 10 % to 27 %.
- Geothermal energy, waste heat and (waste) disposal will make a significant contribution of 77% to the heat supply in the grid-based heating network in 2030. The share of natural gas is only 23 %.
- The decentralised heat supply will be largely (approx. 73%) covered by heat pumps in 2030. The remainder is evenly split between biomass and solar thermal energy.
- The existing potential for renewable electricity and heat generation in the city must be utilised as effectively as possible. This requires strategic energy planning in order to avoid competition for space and provide sufficient areas for conversion.
- The necessary generation plants and infrastructure for distribution and storage must be expanded accordingly. Security of supply is guaranteed at all times.

Electricity demand through sector coupling

Due to the increased share of electricity in the heating sector in the future and the integration of electromobility in the sector, local renewable electricity generation is also increasingly taking centre stage. Figure 50 shows an increase in electricity demand of 28 % by 2030 due to the use of electricity in the heating and mobility sectors.

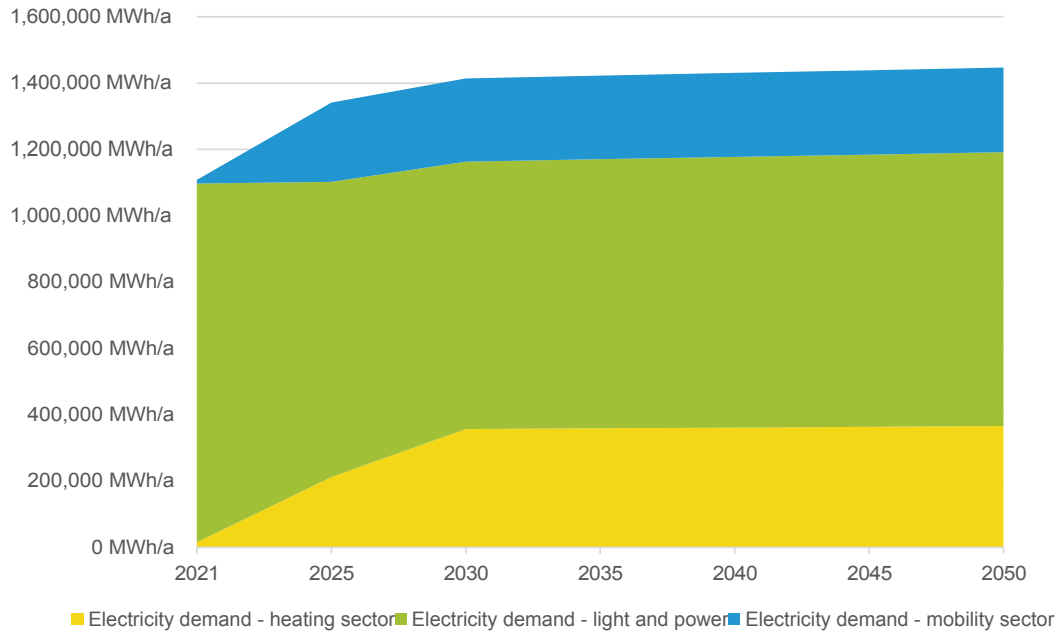


Figure 50. Development of electricity demand by area of application. (Graphic: Gertec GmbH)

Power generation development path

Based on the LANUV potential study and information from the status report "Freiflächen Solarenergie und Agri-PV" by the Climate and Environment Department of the City of Aachen, the scenario assumes an expansion of photovoltaics from the current 27 MW to 176 MW. The figures include photovoltaic systems on roof surfaces (140 MW) and ground-mounted photovoltaic systems
(36 MW). For wind energy, information from the IKSK of the City of Aachen, which envisages a target level of around 93 MW in this area. The Aachen Regional Energy Plan also states an expansion potential of around 65 MW of installed electrical CHP capacity in 2030, which was also taken into account in local energy generation.
The temporal course of the renewable electricity generated on site in Aachen is shown in Figure 51Figure 51.

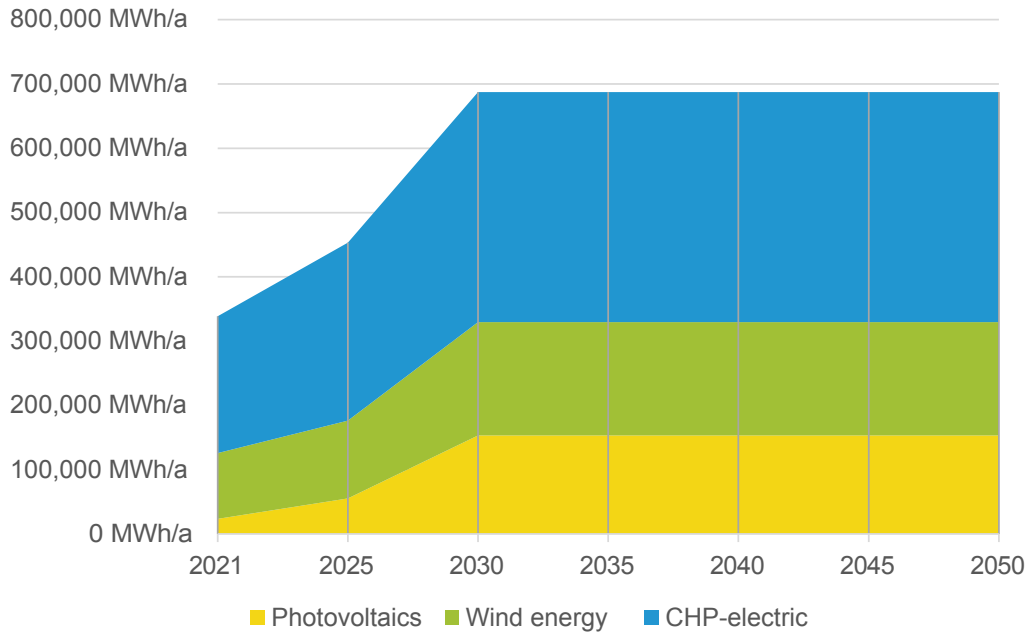


Figure 51 Development of locally generated electricity in Aachen. (Graphic: Gertec GmbH)

As not all of Aachen's electricity needs can be met from these regional sources, it is necessary to "import" additional amounts of energy. In 2030, imported electricity will account for around 30 % of total electricity demand. electricity requirements of Aachen (Figure 52Figure 52). At this point, the scenario assumes that the imported electricity has a comparable composition to the locally generated electricity and is obtained from green electricity sources.

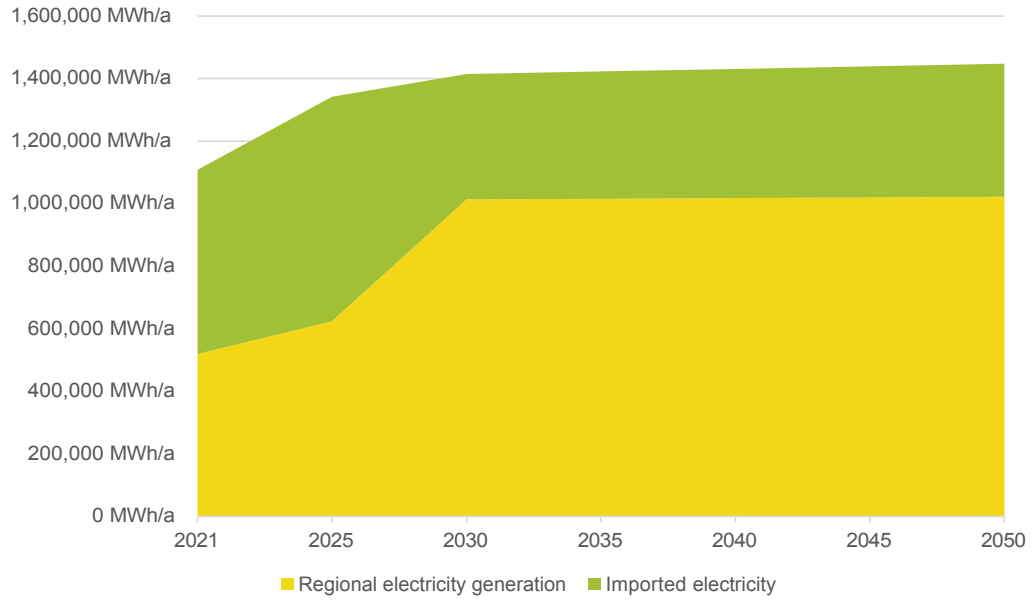


Figure 52 Development of electricity demand by origin. (Graphic: Gertec GmbH)

Heat supply development path

In order to achieve the ambitious targets of greenhouse gas neutrality by 2030, it is essential not only to reduce energy consumption, but also to drive forward the decarbonisation of the energy sources used. The city of Aachen's goal therefore requires a strategic combination of lower energy demand and the use of almost climate-neutral energy generation sources.

The development of the heating supply mix for this scenario is based on the BDI study "Climate Paths 2.0". The study assumes that heating oil will be displaced by 2030. In this case, however, it is assumed that this process will be accelerated in Aachen, which means that the displacement of heating oil will be completed by 2025. This accelerated timeline is crucial to realising the goal of climate neutrality in Aachen by 2030.

In this scenario, the share of district heating in the heat supply almost triples to around 27% between 2021 and 2030. The majority of heat generation, around 53 %, will also be generated using heat pumps by 2030. The remaining heat will be generated from a mix of solar thermal energy and biomass. The share of solar thermal energy increases from 1 % to 10 % and that of biomass from 3 % to 10 % in the period under review. The development of the heat energy mix in Aachen over time in the context of this scenario is shown in Figure 53.

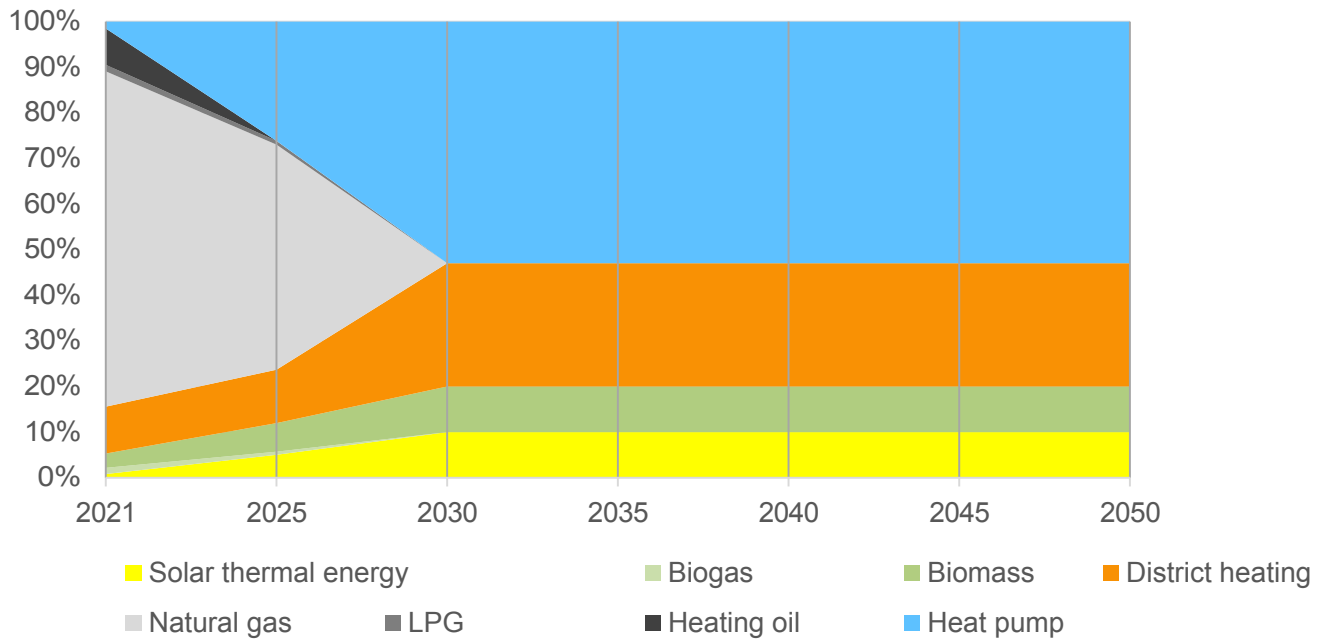


Figure 53 Development of the thermal energy mix in Aachen. (Graphic: Gertec GmbH)

Figure 54 also shows the development path of the district heating generation mix. The district heating development in this scenario is geared towards significantly reducing the share of natural gas by 2030 and replacing it with district heating generation from geothermal energy and waste heat from the Weisweiler waste incineration plant.

substitute. Overall, the majority of district heating (around 77 %) is therefore supplied by geothermal energy or waste heat.

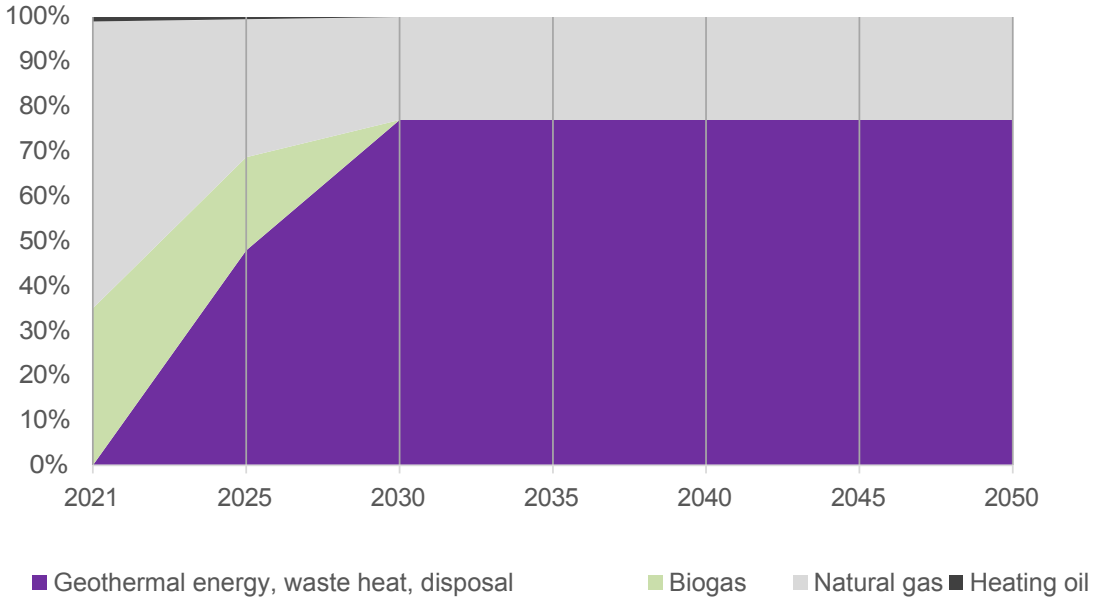


Figure 54 Development of the district heating generation mix in Aachen. (Graphic: Gertec GmbH)

These are the main areas of action and measures

City as a role model: energy supply and generation

The city has direct potential for action. It acts as a role model for citizens, companies and other stakeholder groups. It can create good examples and motivate others to follow suit. Municipal buildings can serve as anchors for heating networks as part of municipal heat planning/heat transition.

Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
City administration (building management, treasury, climate protection management, investment management) incl. Associated companies with energy suppliers, solar installers, service providers, caretakers	The energy supply (electricity and heat) for municipal facilities of the City of Aachen Group will be climate-neutral by 2030 The decarbonisation of the electricity and heat supply will significantly reduce energy-related GHG emissions by 2030 The goal of climate neutrality is integrated into the development of strategies and firmly anchored as an objective within the City Group	Decarbonisation of the electricity and heat supply in the urban family Expansion of renewable electricity generation in the urban family	Climate-neutral heat supply for properties in municipal ownership Ground-mounted PV systems on urban areas

Urban energy planning

Climate-friendly energy planning creates an important strategic basis for a successful energy transition in the city of Aachen and can also help to accelerate it. The focus here is on an integrated approach to energy planning for electricity and heat.

Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
City administration, politicians, energy suppliers, grid operators, external experts, planners	Creation of a reliable planning and investment basis for the energy transition in the city of Aachen	Integrated heat and energy planning	Masterplan (concept plan) integrated, comprehensive energy planning Heat planning

Locally and renewably generated electricity

Sufficient electricity from renewable energies is a key prerequisite for the energy transition. This is the only way to stop the consumption of fossil fuels across all sectors and reduce dependence on imports. Price stability and regional value creation are increased. Local generation allows citizens to participate locally, which increases acceptance and strengthens local structures.

Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
City administration, politics with energy suppliers, citizen energy cooperatives, banks, companies, private households, operators of renewable energy systems, associations such as NABU/BUND	Participation models, especially for citizens, are being expanded; these strengthen the acceptance and positive perception of the topic Photovoltaic systems will be mandatory for new buildings in future Where possible, rooftop PV is realised in combination with green roofs The PV potential on roofs and open spaces is maximised as much as possible Tenant electricity models and balcony power plants are being brought into widespread use The expansion of wind power is being rapidly implemented	Promoting participation and operator models Tapping wind power potential Expansion of photovoltaics on residential and non-residential buildings Expanding ground-mounted photovoltaics	Energy in the hands of citizens Safeguarding/expansion of wind energy (private/STAWAG) Solar on all suitable roof surfaces Concept development: Identification and utilisation of PV open space potential

Decarbonised heat supply

A large proportion of emissions are caused by heating requirements (space heating, hot water, process heat), so there is a high GHG reduction potential. Dependence on fossil fuel imports is reduced and ultimately ended. Increased security of supply. By utilising local potential, long transport routes for fossil fuels, which cause additional emissions, are eliminated.

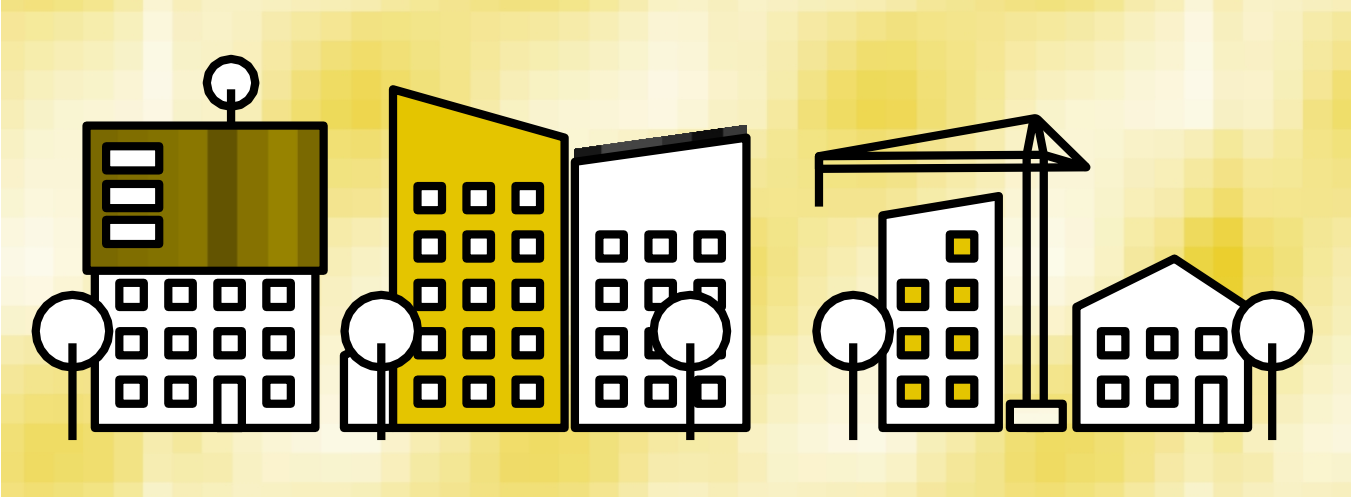
Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
City administration (FB 61 Urban development, -planning and mobility infrastructure, Department 36 Climate and Environment, possibly others) with politicians, energy suppliers, service providers, private households, companies	With its municipal heating planning, the city of Aachen is creating the strategic basis for the reorganisation of the heating supply and the further expansion of pipeline-based green heating Existing waste heat potentials, including from industry, are integrated into the heating networks in the best possible way Renewable energies are primarily used to generate heat, such as (large-scale) heat pumps Fossil natural gas is replaced by synthetic natural gas or hydrogen ("power-to-gas") if demand cannot be met in any other way	System and plant optimisation of the existing district heating Expansion and decarbonisation of district heating Promoting efficient decentralised heating systems with renewable energies	Concept for the structurally optimised use of geothermal energy in Aachen Municipal pre-financing of district heating networks Expansion of advice on renewable heat/heating

Security of supply and sector coupling

Sector coupling as the basis for the flexible conversion and utilisation of available energy on site in Aachen. Planning for needs-based energy imports necessary. Expansion of energy infrastructure and storage.

Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
City of Aachen with politicians, grid operators and energy suppliers, construction companies	Locally generated energy can be flexibly converted so that the generation potential can be optimally utilised on site Renewable electricity is used efficiently and in line with demand The city of Aachen becomes independent of fossil fuels and guarantees that its energy needs are covered/security of supply at all times	Making grids fit for sector coupling Expansion of energy storage systems Control and storage of volatile power generation, grid-friendly energy tariffs and operator models Ensure the import and export of renewable electricity in line with demand Production and distribution of hydrogen, synthetic gases and fuels, infrastructure development Increasing the speed of realisation	Development of a city-wide pool/platform of tradespeople incl. training

9.6. Building



In order to achieve climate neutrality by 2030, high energy and greenhouse gas savings must be achieved in the building sector. This concerns the building stock, which according to the City of Aachen's 2022 Housing Market Report comprised around 141,695 residential units in 2021, as well as new construction activities in the city of Aachen.

What is this about?

As a dynamic business and science location, Aachen faces particular challenges for climate-friendly strategies: a building stock of high architectural quality, detached and semi-detached houses as the dominant building type and, at the same time, high influx and utilisation pressure. An additional housing requirement of over 6,000 inhabitants is forecast for Aachen by [203937]. In addition to the energy-efficient refurbishment of existing buildings, consistent increases in efficiency are therefore also necessary for the construction of new housing.

Overall, major efforts are therefore required in the building sector, combined with high levels of investment and a high demand for skilled labour and resources. The technical possibilities of energy-efficient construction - both in existing buildings and in conversions and new builds - are available and can be utilised in a practical manner.

City as a role model: municipal buildings and facilities

The city of Aachen is leading by example. It is endeavouring to renovate its own building stock and to make the non-residential and residential building stock of the municipal family climate-neutral. As of April 2022, the City of Aachen's building management is responsible for 860 properties in around 622 buildings with a wide variety of uses. One positive example is the refurbishment of roofs, e.g. on the gymnasiums of municipal schools. Six locations have already been identified and are also to be equipped with a PV [system38].

In addition, the city has around 10,000 publicly subsidised housing units, of which 5,577 flats will no longer be subject to rent and occupancy restrictions by 2029. The city has a direct influence on around 5% of the flats in [Aachen39]. There are refurbishment plans for these residential buildings as of 2022.

[37] Forecast population development of the city of Aachen 2022 - 2039.In: City of Aachen, submission no. FB02/0193/WP18, dated 3 November 2022 "Population forecast of the city of Aachen 2ß22-2039".

[38] City of Aachen (2022): Aachen climate-neutral 2030: Rough outline for Aachen's path to 2030 S. 15

[39] City of Aachen (2021). Housing action plan - integrated housing strategy.

Climate-friendly and adapted urban development

Promoting sustainable urban neighbourhoods is a goal of climate-friendly urban development. In order to leverage the potential in existing buildings, an integrated approach at neighbourhood level is required. The neighbourhood level also makes it possible to examine property-independent, residential value-enhancing factors with an indirect influence on energy-efficient refurbishment (living environment, local amenities, mobility options) in an integrated manner. Urban areas that are comparatively homogeneous in terms of building age, building fabric and technical equipment are considered neighbourhoods in terms of energy-efficient refurbishment. They have a comparable need for refurbishment and similar energy-saving potential. The proportion of private homeowners in Aachen is high at 95 %[40], so this target group must be mobilised with attractive offers. The primary target groups in this field of action are

- Private homeowners (owner-occupiers, private landlords, homeowners' associations)
- Tenants
- Housing associations
- Commercial owners
- Developers and operators or property managers

These target groups can be addressed as part of neighbourhood redevelopment projects. The city of Aachen has currently defined 11 redevelopment areas or is already active in the Ostviertel, Aachen Nord, Hauptbahnhof and Burtscheid, or Beverau, among others.[41]

New construction must no longer burden the CO2 budget

New buildings must not place an additional burden on the residual CO2 budget. This makes it necessary to introduce nationwide efficiency standards for buildings that are at least greenhouse gas-neutral in terms of their carbon footprint. In this context, the selection of sustainable building materials and the establishment of innovative forms of living that are implemented in a way that conserves space and resources are also crucial. Even with very high climate protection standards, new construction is always associated with a certain amount of new land sealing. For this reason, the German government has formulated the 30-hectare target in the national sustainability strategy. The city of Aachen must also accordingly with their land. The planning and conceptual framework for these necessary developments is provided by integrated, climate-friendly and sustainable urban development. The city administration's actions always take into account the settlement areas for the city as a whole as well as potential land conflicts.

Residential building stock

The main task lies in the existing building stock. The aim is to refurbish around 36% of existing buildings to a high standard of thermal insulation by 2030. The aim is to reduce heat consumption by around 25 % compared to 2021.
This is linked to the goal of increasing the renovation rate to 4% per year. Remaining energy requirements for space heating, hot water and electricity must be covered by 100 % renewable energies. This results in a close link between the buildings area of action and the measures and activities in the energy supply area of action, meaning that they must be considered in an integrated manner. The reduction in energy consumption must also be responded to with customised energy infrastructure and energy services. It is therefore necessary to closely dovetail the refurbishment strategy with the energy supply field of action. Further energy savings can be achieved through the behaviour of residents as building users, which creates additional points of contact with the social transformation field of action.

Non-residential buildings

As with residential buildings, the focus for non-residential buildings is on existing buildings. Here too, around 36% of buildings need to be refurbished to a high standard of thermal insulation by 2030. However, the structure and utilisation of the buildings differ greatly in some cases and range from smaller production buildings to larger office and cultural buildings and large industrial halls. This challenge is being met with the help of binding standards and strategic concepts.

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[40] City of Aachen 2020. housing market report, p. 11.

[41] Council system of the City of Aachen.(2023) Available at:

https://www.aachen.de/de/stadt_buerger/politik_verwaltung/stadtrecht/bauwesen/index.html

What are the most important influences and framework conditions?

The overarching decision-making level here is that of the federal government and the local market players in Aachen. These cannot be actively controlled or determined by the City of Aachen and its holdings. However, the municipal family, the City of Aachen, can take various measures to directly or indirectly influence these stakeholder levels and exert a positive influence on the achievement of objectives.

The following are potential obstacles and significant success factors for achieving targets in the buildings sector:

- Economic factors (profitability gap, in particular due to price increases),
- Legal factors (set clear legal framework with unambiguous standards)
- Organisational factors (shortage of skilled workers, shortage of building materials)

Profitability gaps hinder refurbishments:

Taking into account the social sustainability goals for the creation of affordable housing, the economic viability gap in particular represents a decisive risk with regard to achieving the goals. Comprehensive and easily accessible funding programmes are required from the federal government to achieve this goal. The current framework of federal funding for efficient buildings has created a good basis that needs to be stabilised and expanded.

At municipal level, the city has already implemented its own "Energy-saving measures in buildings" programme following a council resolution in May 2021. Funding is provided for measures on the building envelope (e.g. insulation of external walls), building technology (e.g. replacement of heating systems) and bonus measures (e.g. environmentally friendly insulation materials). By consolidating and intensifying the funding, the City of Aachen can act directly and improve the framework conditions in favour of achieving the targets.

Obstacles due to shortage of skilled labour:

With regard to organisational factors, there is a considerable risk of market failure due to a lack of skilled personnel in the trades and planning trades. The City of Aachen can intervene indirectly here and promote cooperation with relevant groups of stakeholders who have direct potential for action. The non-profit organisation altbau plus e.V. already offers an advisory service for property owners in Aachen. The Association informs about savings options for buildings and funding opportunities. In addition, the association also acts as an intermediary for planning companies and skilled trades businesses. Beyond this intermediary role, the aim is to inspire and attract young people to train in the skilled trades in order to prevent bottlenecks in the long term.

Redevelopment areas create binding framework conditions:

At the level of the legal framework, the administration can exert its influence by introducing binding refurbishment targets. For example, there is potential for action in the designation of redevelopment areas in accordance with the German Building Code (BauGB), whereby the issue of climate protection is only one of the relevant aspects in terms of integrated neighbourhood development. In the city of Aachen, there are already several redevelopment areas in which high climate protection standards should be observed. At federal level, the framework is primarily set by the Building Energy Act, which contains requirements for the energy quality of buildings, the creation and use of energy certificates and the use of renewable energies in buildings. In an amendment, a target of 65% renewable energy use in newly installed heating systems is to apply from 2024.
The stipulated requirements mean that fewer communication measures need to be used to motivate building owners to take action. However, there is great uncertainty among the population due to the legislative process. At the same time, there are risks due to the difficulty of implementing a climate-neutral provision of space heating in existing buildings, which is associated with numerous (technical) obstacles. In addition, the legal requirements for achieving the ambitious climate targets have so far been too low.

Utilise and create various incentives

The KfW40 standard and KfW55 standard were stipulated for the construction and refurbishment of public, state-financed buildings. In addition, the introduction of the Assessment System for Sustainable Building (BNB) was specified. For the city, this means the possibility of accessing state funding for the refurbishment of public buildings. Another opportunity for the city to exert indirect influence is by incentivising roof renovations, for example as part of the heat transition/communal heat planning. This results in Synergies with the programme planned by the NRW state government

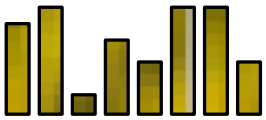
Introduction of a solar obligation for new builds and roof renovations.

Active land development with high standards:

In terms of land use, there are potential conflicts due to the redrafting of the Cologne Regional Plan. This provides for more new settlement areas for the city of Aachen than the Aachen land utilisation plan. The city has already pointed this out in a statement, as it will limit itself to the settlement areas it has defined itself. The city has further potential for action in the form of concept procedures for the allocation of urban land. In this way, sustainable construction projects can be directly promoted, as the focus is not on price but on quality - including ecological and social standards.

The city has been committed to the principle of sustainable urban development since 2001. This is expressed in corresponding Guidelines for urban land-use planning, such as mixed use, short distances and solar energy optimisation and restrictive land development that focuses on subsequent use and densification. When selling properties and in urban development contracts, the KfW Efficiency House 55 is set as the energy standard. In order to be able to assess the climate friendliness and resource efficiency of a building as early as the planning stage, new methods are constantly being developed that take into account not only emissions during use but also emissions and resource consumption during the construction phase and materials. One example of this is the resource score (also known as Factor X). The method has already been used in the Rhenish mining area to develop resource conservation housing estates.[42] The method is also to be trialled in Aachen in a climate-neutral model housing estate. Two building plots in the south of Aachen have already been put out to tender for this in a concept procedure.[43]

What is the potential?



Since higher energy standards already exist for the new building, the The greatest potential lies in the refurbishment of existing buildings. Although there is less scope for action here, this should be the focus of municipal activities.

Potential factors

The potential for reducing the final energy demand in the city of Aachen's building stock is determined by the refurbishment rate, the scope of refurbishment and the depth of refurbishment. The refurbishment rate describes the proportion of the total building stock that has been refurbished in a given period. The scope of refurbishment refers to the parts of the building that were modernised during the refurbishment, which may include the windows, the building envelope or the heating system. The depth of refurbishment indicates the energy standard to which the refurbishment of the individual parts of the building was realised. The Institute for Housing and the Environment (IWU) has defined two modernisation packages for the building age classes (BAK) and determined the corresponding final energy requirements that can be achieved for single-family houses (EFH) and multi-family houses (MFH).

Methodology and assumptions

The assessment of potential is based on the data on Aachen's building stock, which has already been described in Chapter 4.3. The data is based on the building and housing census as part of the 2011 census, meaning that buildings constructed after 2011 are not taken into account.

To determine the potential, the difference between the final energy demand in the initial state and the final energy demand after refurbishment in accordance with modernisation packages 1 and 2 is calculated for each BAK. In order to obtain an absolute value, the savings potential is multiplied by the number of buildings in the BAK and the average living space according to IWU. The calculation of potential also takes into account the fact that some buildings have already been refurbished. The assumptions about the proportion of refurbished buildings in the BAK are based on a study by the Arbeitsgemeinschaft für zeitgemäßes Bauen e.V. entitled
"Housing construction: the future of existing buildings", commissioned by the

[42] Resscore. Status: 17.05.2023. Available at: https://www.resscore.de/

[43] Integrated climate protection concept (IKSK) - implementation status July 2021 Annex to the submission - factual report p. 1

Association of Housing Associations and published in 2022.

Taking into account the results of the study, it is therefore assumed that some of the older buildings have already been refurbished to the energy standard of modernisation package 1.

No potential is given for buildings constructed after the year 2000, as it cannot be assumed that these will still be renovated by 2030 given the useful life of residential buildings.

Refurbishment rates

With a refurbishment rate of 1 % per year, this results in a total reduction potential of 56 GWh for the standard of modernisation package 1 and 140 GWh for the standard of modernisation package 2 in Aachen's building stock for the period from 2020 to 2030.

Assuming a refurbishment rate of 4 % per year, the potential for modernisation package 1 is
224 GWh and modernisation package 2 a potential of 562 GWh. A refurbishment rate of 7 % per year increases the potential to 391 GWh and 983 GWh. With a complete refurbishment of the entire building stock, the potential is 559 GWh in modernisation package 1 and 1,404 GWh in modernisation package 2.

Evaluation of potential

It should be noted that these potentials only represent a theoretical estimate of the potential, as no accurate final energy requirements are available for the buildings in Aachen and it is not possible to determine which buildings have already been modernised. In addition, the modernisation packages also include the replacement of heating systems, so there may be overlaps with the potentials in Chapter 9.3.

No potential can be derived for the new construction sector, as new construction activities always lead to an additional burden on the residual CO_2 budget and should therefore be avoided as far as possible. If this is not possible, new buildings must be climate-neutral in future and built in accordance with sustainable building standards. In addition to minimising the consumption of energy and resources for construction, this means reducing land consumption and minimising the impact on the environment throughout the entire life cycle - i.e. construction, use and dismantling. The use of sustainable building materials made from renewable raw materials, recycled materials or the reuse of building components provides important cross-references to the topic of the circular economy (see section 9.8).

Influence through urban development

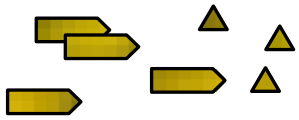
Urban development is another important means of achieving climate-neutral development of the building stock and other topics relevant to climate protection, such as the development and qualification of green and open spaces and mobility. Redevelopment areas as well as urban development and neighbourhood concepts enable a significant expansion of the city's scope for action.

The following redevelopment areas are currently designated in Aachen:

- Aachen-Brand
- Aachen main station and Burtscheid
- Aachen-North
- City centre

Beverau is also an urban redevelopment area. Furthermore, redevelopment advice is regularly an integral part of integrated urban development (e.g. in Aachen-Nord, Haaren, city centre, Beverau).

These are the 2030 guidelines



In the buildings area of action, the overarching goal is to achieve a climate-neutral building stock. This includes both the building stock of the City of Aachen (residential and non-residential buildings) and new construction activities. The objective should be firmly anchored in the urban planning and development of the city of Aachen in order to take the issue of climate neutrality into account in all planning. Concepts and solutions at neighbourhood level can contribute to achieving the target as integrated solutions. The city of Aachen already employs nine neighbourhood management teams with different focal points in the city districts. Valuable synergies could be used here within the framework of energy neighbourhood concepts.

In order to achieve the climate targets for existing buildings, an annual refurbishment rate of 4% combined with an average heat saving of 70% must be realised by 2030. This heat saving roughly corresponds to the KfW40 standard. By the target year 2030, efficiency improvements will therefore result in potential savings of 25% or more than 125 kt $_{CO2eq/a}$ in the generation of space heating. In conjunction with a conversion of the local heating supply, this can reduce annual greenhouse gas emissions in the private building stock to around 18.2 kt $_{CO2eq}$ by 2030, a reduction of more than 90 %.

New construction activities must not place an additional burden on the energy-related $_{CO2\ budget}$. This means that energy-related emissions must be close to zero. The result is climate neutrality for all new buildings. This is to be achieved with the minimum KfW40 standard, which is associated with a political decision in principle. The requirements for new buildings are to be successively increased to a plus-energy house standard. In balance sheet terms, more energy can then be generated than the individual building requires, for example by generating solar power using photovoltaics on the building roofs.

In addition, the topic of sustainable construction (selection of sustainable building materials, short transport routes, low-emission construction machinery, etc.) is another goal of the sustainable transformation. For unavoidable construction measures, for example, building materials made from renewable raw materials or recycled materials can be used. In this way, grey energy can be reduced in the construction process, which also has a positive effect on the overall balance of the building during its life cycle. However, the overarching goal is to avoid new buildings as far as possible and primarily to refurbish existing buildings to the best possible standard.

At the strategic and planning level, the following objectives are to be pursued in particular:

- Double internal development
- Mixed use in the neighbourhoods
- Social mix
- Promotion of communal living concepts / lifestyles
- Reduction of land consumption per capita

What is fundamentally needed is an interdisciplinary planning culture that provides the space for innovations and new solutions with appeal and thus encourages imitation.

Refurbishment of the private housing stock

In order to achieve the goal of climate neutrality, it is necessary to reduce the city's overall energy consumption. At over 1.7 TWh per year, private households account for the largest share of final energy consumption in the city of Aachen.

Extensive refurbishment measures can increase the efficiency of buildings and consequently reduce electricity and heat consumption. The target scenario shows the need to refurbish at least 36% of private residential buildings by 2030 - with a heat saving potential of 70% per refurbishment measure.

This corresponds to a sectoral reduction in heating requirements of 25 %.

On the electricity side, the potential for change is lower, particularly with regard to the conversion of light sources and more energy-efficient electrical appliances, as significant progress has already been made in recent years. By 2030, modernisation measures are expected to increase efficiency by less than 5 % is assumed. The remaining savings result from changes in behaviour. A slight increase in energy demand from 2030 onwards can be explained by the forecast population growth and the construction of new residential units.

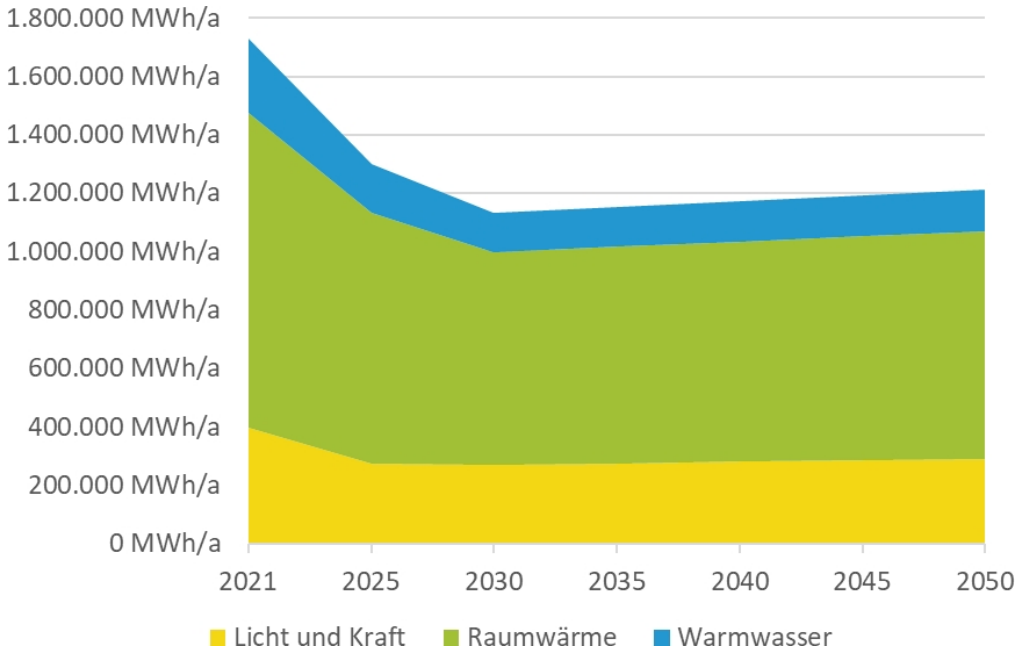


Figure 55 Development of final energy demand - private households. (Graphic: Gertec GmbH)

Refurbishment of municipal facilities

The refurbishment of municipal facilities in the city of Aachen is carried out in the target scenario in the same way as for private households. As a minimum, efficiency increases on the heating side of approx. 25 % and approx. 4 % on the electricity side. As the city has a direct influence on the modernisation of its own buildings, achieving a more ambitious level of refurbishment would be conceivable and desirable. Although the impact on the city's overall final energy consumption is small, it would create a role model function.

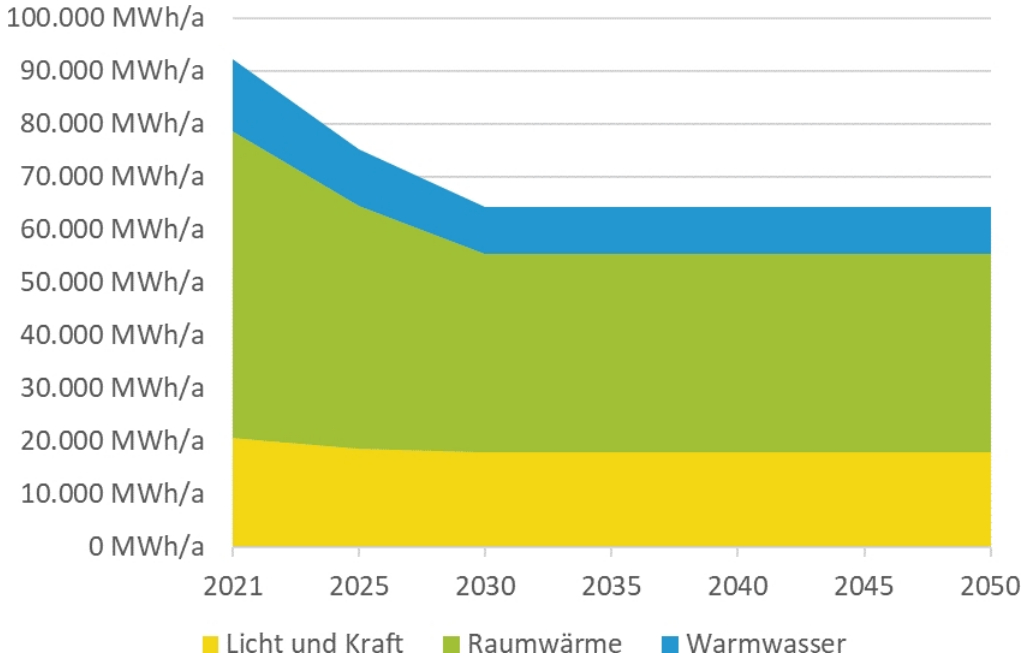


Figure 56 Development of final energy demand - municipal facilities. (Graphic: Gertec GmbH)

City as a role model: municipal buildings and facilities

This field of action is of great importance, as the city has the opportunity to act as a role model in terms of sustainability and energy efficiency. This motivates citizens, companies and other stakeholder groups to take similar measures.

Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
City administration (building management, treasury, climate protection management, investment management) incl. associated companies with energy suppliers, construction companies, solar installers, service providers (e.g. heating monitoring, energy management software), caretakers	Climate-neutral building stock in municipal ownership	Realisation of a climate-neutral and climate-adapted building stock of non-residential buildings Realisation of a climate-neutral and climate-adapted building stock of residential buildings Climate-neutral new build Energy management systems	Refurbishment of urban non-residential buildings Greening of municipal buildings Energy-efficient refurbishment of municipal residential buildings

Climate-friendly and adapted urban development

The aim of this area of action is to firmly anchor climate targets and sustainable planning in administrative action. Achieving these goals requires a coordinated approach at neighbourhood level and in the city as a whole in order to exploit synergies. At the same time, building up expertise and experience in the administrative departments and among the stakeholders involved is a decisive factor.

Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
Department 61 Urban development, planning and mobility infrastructure, Department 62 Geoinformation and land use planning / Department 63 Building supervision / Climate protection management / External experts, planners and architects, construction companies / Consumer advice centre, energy consultants, neighbourhood consultants /Remediation management Target groups: Citizens, housing industry, companies in the neighbourhood, city administration/departments	Increasing the refurbishment rate in existing buildings and reducing heating requirements Identify and leverage potential electricity savings (technical and user behaviour) Improving the quality of life and quality of stay in the neighbourhoods (focus on mobility, climate adaptation and health, sustainable building, digitalisation) Expansion and dissemination of sustainable construction	Activation of vacant lots/area management Climate-friendly urban planning	Breaking new ground - additional residential units in existing buildings and development of alternative, lifecycle-adaptable residential buildings Continuation of land management project Promotion of green urban spaces Energy-efficient preservation of historical monuments

Residential building stock

As a significant proportion of emissions are generated in existing buildings, there is a particular need for action here. Due to the diverse target groups such as tenants, owner-occupiers, housing associations, homeowners' associations, etc., a broad range of services is essential.

Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
Department 61 Urban development, planning and mobility infrastructure, Department 63 Building supervision / climate protection management / external experts, planners and architects, construction companies / consumer advice centre, energy consultants, neighbourhood and energy efficiency experts /Remediation management Target groups: private homeowners (owner-occupiers, private landlords, homeowners' associations), tenants, housing associations, commercial owners, developers and operators or property managers	Increasing the refurbishment rate in existing residential buildings and reducing heating requirements Support for owners of private residential buildings (information, advice, funding) during refurbishment Dissemination of energy-efficient technologies (refurbishment, energy supply)	Modernisation of the single-family house stock Modernisation of the multi-family housing stock (privately and commercially rented, owners' associations) Energy-efficient neighbourhood development	Advice and funding programme for renovating old buildings Modernisation of the multi-family housing stock Redevelopment model area: Eastern city centre Energy-efficient neighbourhood refurbishment (KfW 432)

New residential building

As the construction of new residential and non-residential buildings is likely to be unavoidable, they should be built with as few emissions as possible. Accordingly, standards are set with regard to land consumption, demolition capability, energy efficiency and the proportion of recycled materials for climate-friendly new construction and construction projects are integrated into urban development and heating planning.

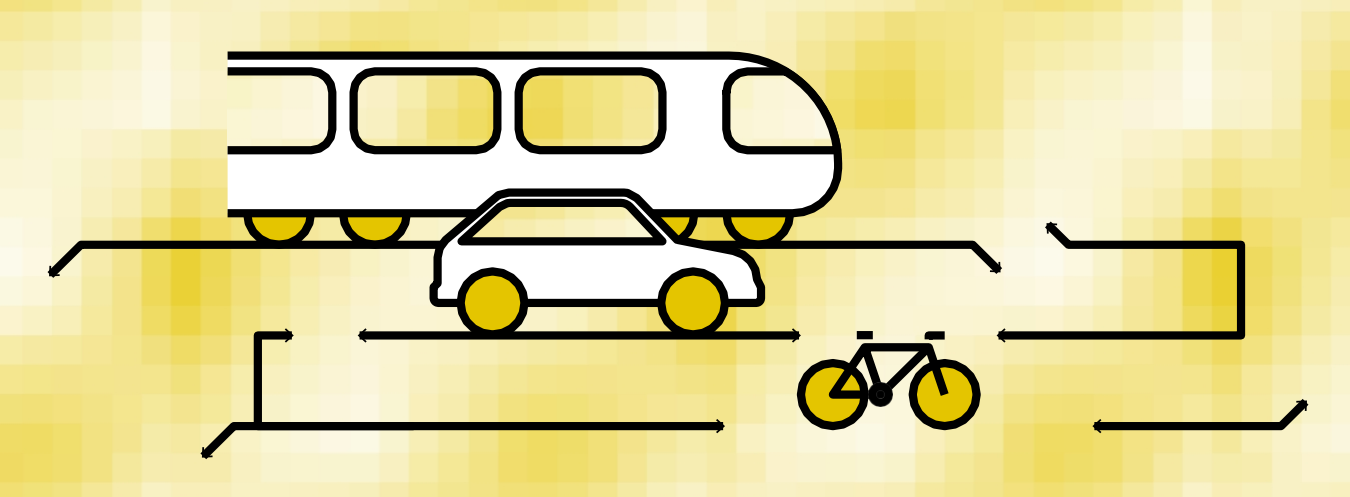
Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
Department 61 Urban development, planning and mobility infrastructure, Department 63 Building supervision / climate protection management / external experts, planners and architects, construction companies / consumer advice centre, energy consultants, neighbourhood and energy efficiency experts /Remediation management Target groups: Families, investors, housing co-operatives	Raising energy standards in new builds Increasing the demolition capability of new buildings 25 % Use recycled materials Use wood from urban forests wherever possible	New construction of climate-neutral detached houses New construction of climate-neutral apartment blocks	-

Non-residential buildings

Around 39% of buildings in Aachen are non-residential buildings, so there is considerable pressure to act; savings must be achieved across the entire building stock in order to achieve the sector targets and the city-wide targets. Due to the very different target groups and uses of non-residential buildings, a standardised and coordinated approach is necessary.

Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
Department 61 Urban development, planning and mobility infrastructure, Department 62 Geoinformation and land use planning / Department 63 Building supervision / climate protection management, planners and architects, construction companies, energy consultants Target groups: City Group, other public/non-public organisations, companies or owners and investors/project developers of non-residential buildings	Increasing the refurbishment rate in the non-residential building stock and reducing heating requirements Support for owners (information, advice, funding) during refurbishment Dissemination of energy-efficient technologies (refurbishment, energy supply) Achieving new construction that is as climate-neutral as possible (especially office buildings, schools, etc.); for manufacturing companies / commercial buildings, etc. Implementation of the highest possible standards, use of sustainable building materials and use of renewable energies in order to reduce energy consumption and emissions Establishment of sustainable construction (according to DGNB or BNB certification standards)	Realising the potential of commercial properties	Advice for tradespeople

9.7. Mobility



A successful mobility transition plays a decisive role in achieving climate neutrality for the entire city of Aachen. The mobility transition in Aachen is aimed at a transport system that protects the climate and people's health, is socially just and guarantees the quality of life in the city and region.

What is this about?

The mobility field of action deals with motorised and non-motorised transport in Aachen, which includes private mobility as well as commercial transport and logistics. Commuter transport is also included here. Accordingly, all passenger transport as well as commercial and freight transport in the city of Aachen that is handled by road, rail, water or air is taken into account. This includes destination traffic that ends in Aachen, domestic traffic with an origin and destination in Aachen, source traffic with an origin in Aachen and a destination outside the city limits and transit traffic with an origin and destination outside Aachen that crosses the city limits. In the balance sheet analysis, only the proportion of journeys within Aachen city limits is taken into account, but in reality there are greater savings if journeys are avoided or are made by eco-mobility instead of by car.

City as a role model: Mobile city group

The municipal family is leading by example and gradually converting its own vehicle fleet to climate-neutral drive systems. The conversion of the entire fleet in the city of Aachen is being actively supported.

Transport planning and mobility concepts

The city of Aachen pursues the strategy of a city of short distances. Schools and kindergartens as well as facilities for daily needs are close to where people live, and the routes to training centres and workplaces are easily accessible with alternatives to the car. This avoids trips and reduces the environmental impact of motorised private transport.

Avoiding and shifting passenger transport

The aim is to organise comfortable walking and safe cycling. Mobility should be organised flexibly and cost-effectively, children and the elderly, working people and visitors should be able to move around independently, healthily, safely and in an environmentally friendly way. Traffic will be quiet and with greatly reduced emissions. The city gains space for play, recreation, greenery and catering.

Climate-friendly drives and fuel

For motorised transport that cannot be avoided or shifted to more climate-friendly modes of transport, the aim is to reduce energy consumption and the resulting emissions per additional kilometre.

kilometres travelled as far as possible and to substitute fossil fuels (efficiency and consistency).

What are the most important influences and framework conditions?

The framework conditions for the transport field of action are strongly influenced by at federal and state level as well as grassroots movements such as Radentscheid Aachen.

In its current Mobility Situation Report from 2021, the City of Aachen has already summarised the most important framework conditions for mobility development in Aachen. New requirements and guidelines are regularly issued at the higher levels of the EU, the federal government and the state of North Rhine-Westphalia, some of which are also the responsibility of the municipalities. At the same time, there are also new funding opportunities that the city or other local stakeholder groups can utilise. Outside of municipal influence, the consequences of the climate crisis or crisis situations such as the recent coronavirus pandemic can also influence the framework for sustainable mobility. In this context, as well as influenced by other external factors or factors that are not the responsibility of the municipality, the prices for fuels and vehicles are changing dynamically on the market, which can have both positive and negative effects on the local mobility transition. In addition, new mobility offers and innovations are constantly coming onto the market, which can favour and accelerate the modal shift towards eco-mobility.

Transport planning and mobility concepts

The city of Aachen has already launched numerous strategies and projects on behalf of politicians to enable and establish sustainable mobility. The most recent milestones on this path were the adoption of the 2019 cycling decision, the resolution of the goals of the Mobility Strategy 2030 and the Integrated Climate Protection Concept with the goal of halving CO_2 emissions by 2030, both from 2020. Every two years, the city administration of Aachen publishes a Mobility Status Report, which uses quantified target indicators to illustrate the progress of the mobility transition. Additional financial and human resources were also created for implementation as part of Aachen's cycling decision.

Cooperation in the region

Aachen is well placed to benefit from the close cooperation between the city and the neighbouring municipalities in the StädteRegion Aachen in the "Netzwerk Mobilitätswende Region Aachen" (NEMORA) is cleverly organised. Four working groups are coordinating the expansion of public transport, mobile stations, regional cycling and financing issues. A memorandum of understanding was also signed by all mayors in spring 2023. A coordinated transport model is available as a planning basis for sustainable mobility in the city region. Successful projects include the Cambio car sharing service and the Velocity Aachen pedelec sharing system. The structural and organisational framework conditions in the mobility sector can therefore be considered to be quite target-oriented with regard to future challenges.

These are the potentials

The potential for reducing energy consumption and emissions in the mobility sector results from the strategies of traffic avoidance, shifting to means of transport in the eco-mobility sector and changing the drive of motorised traffic that cannot be avoided or shifted.[44]

Consistency in mobility

The strategy of consistency offers the city of Aachen many direct approaches for action. In particular, offers can be created and incentives set for the shift from motorised traffic to means of transport from the environmental network that emit less or no emissions on the same route. This means that, on the one hand, alternatives to the private car must be made more attractive, e.g. by improving the infrastructure, providing information and trial offers and prioritising road traffic. At the same time, measures should be taken to gradually make car use less attractive in order to encourage people to switch. It should be noted here that the car still enjoys many privileges in urban mobility compared to other modes of transport and that numerous advantages of car use today and in the past have been at the expense of the general public and contribute to social injustice. These include, for example, the immense use of public space by moving and stationary car traffic, the cost of free parking or the environmental damage caused by car traffic, which is not borne by the respective producers, but by society as a whole.

The municipality has direct potential for action to promote climate-friendly mobility, particularly when it comes to promoting alternatives to car use in the city. This includes, for example, the optimisation of public transport services (routes, frequency, accessibility, safety, etc.) and the expansion of cycle paths and footpaths / infrastructure.

Expand public transport

In terms of infrastructure, numerous improvements have been made in recent years in the areas of walking, cycling and public transport. The Euregiobahn is a successful model for the reactivation of railway lines and has been or will be further expanded in the Aachen region. One important planning project is the planned expansion of the RegioTram from Baesweiler to Aachen. There are good public transport connections within Aachen. The addition of express buses and On-demand services with alternative drive systems are being developed by 2027. By 2030, 95% of public transport journeys are to be electric or hydrogen-powered. In the future, autonomous shuttle buses could be operated economically on routes that are currently not covered by public transport.

Increase the share of cycling and walking

At 30%, the share of walking in the modal split in Aachen is above the national average. The creation of comfortable and barrier-free routes is seen as a central task. The flagship project is the "premium footpaths". The steadily growing number of environmentally friendly transport options shows that the conditions for a city of short distances are in place. Where everyday tasks cannot be carried out within walking distance, additional services need to be created and successfully established. Since the 2019 cycling referendum, the interests of cycling have become more important in road planning on main roads. With priority cycle routes, the city of Aachen is creating attractive cycle routes from all districts to the city centre. A main cycle network was adopted in 2023, which serves as a new basis for decisions on cycling measures.

The city's topography is a significant obstacle to the use of bicycles. A well-developed sharing service for e-bikes and e-cargo bikes or e-scooters can be an alternative, especially for routes with greater differences in altitude. E-scooters in particular offer good GHG reduction potential within the sphere of influence of the market players, provided that the switch is made from means of transport with higher emissions. Journeys that would have been made by bike or on foot anyway should not be made by e-scooter. In this case, the emissions increase in line with the emission factor of the electricity mix.

[44] The city administration of Aachen is currently in the tendering process for the expansion and adaptation of the accounting methodology for $CO_{2\ emissions}$ in the mobility sector (see Volume 2 Activity 4.2.1.2. Accounting and impact assessment of mobility measures in the ICSK). This forms an important basis for estimating GHG savings in the mobility sector more accurately and taking into account interactions between different proposed activities.

Testing new solutions

Measures such as pop-up cycle paths, pop-up bus lanes or action days such as the so-called Parking Day can be used to test new solutions and make them directly tangible for citizens. After a successful test phase, structural adjustments can then be made in the next step. In order to be able to travel the last mile or link public transport routes in a climate-friendly way, additional services such as bike hire, e-bikes, (e-)cargo bikes, e-scooters, etc. should be created across the board.
Mobile stations can bundle these services and link them together both structurally and organisationally, thus helping to ensure climate-friendly and affordable mobility in Aachen even at times or in places with poor public transport coverage.

Car park management

Possible measures to make car use less attractive are, for example, comprehensive parking space management and an increase in parking fees, including for residents' parking, and the consistent punishment of offences. Furthermore, the road space should be divided up in favour of eco-mobility and, for example, the comprehensive introduction of a 30 km/h speed limit should be examined. This will also have benefits for air purity and road safety in the municipalities

Expanding combined mobility

Neighbourhood car parks are the backbone of a close-knit network of mobility stations with bicycle parking, repair and rental facilities as well as car-sharing services. The physical services are supported by attractive mobility packages in conjunction with a significant reduction in public transport ticket prices. A campaign that fits in with the challenges of the mobility transition, which explains the project and supports the voluntary switch, helps to increase acceptance.

Increasing efficiency in mobility

One strategy for increasing efficiency is to switch to climate-friendly drive technologies. Motorised transport is no longer powered by vehicles with conventional combustion engines using fossil fuels; instead, vehicle drives are being converted to locally emission-free drives based on renewable energies. Currently, these are mainly electric motors that are powered by battery storage or supplied with electricity directly from green hydrogen via a fuel cell. Battery-electric drives are particularly suitable for passenger cars and light commercial vehicles, as they are much more efficient than electric motors. fuel cell vehicles are significantly more efficient. However, they are advantageous for heavy commercial vehicles (lorries), as longer ranges can be achieved and the refuelling process is significantly shorter. Both technologies are currently in use for public transport buses and coaches. Factors such as the route, journey times and existing infrastructure influence the choice of technology.

Despite all efforts, there will be some motorised traffic that cannot be completely avoided or shifted to other means of transport. The aim here is to make journeys as energy- and emission-saving as possible. This can be achieved, for example, through measures such as the control and optimisation of traffic flows.

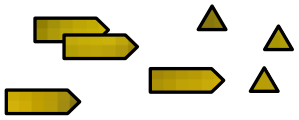
Convert fleets to climate-neutral drives and expand charging infrastructure

The rapid expansion of the charging infrastructure for electric cars and pedelecs is within the sphere of influence of the City of Aachen and the market players. This is crucial for the success of the drive transition. For people who live and work in inner-city neighbourhoods and do not have parking spaces on the premises of their homes or businesses, neighbourhood car parks could be built to meet demand. These neighbourhood car parks are operated on a cost-covering basis and offer charging facilities for all electric cars. The city of Aachen can only exert limited influence in the area of rail transport. At federal level, measures relating to the rail infrastructure of Deutsche Bahn are the responsibility of the Ministry of Transport. This concerns the investment volume and the speed of infrastructure expansion as well as specific connections such as international rail links to the BeNeLux countries for freight and passengers.

Converting commercial and freight transport to be climate-friendly

In the area of road-based commercial and freight transport, the aim is to promote a shift to rail or a switch to climate-friendly drive systems wherever possible, for example by promoting the reactivation of disused railway sidings or the development of a range of microhubs for more climate-friendly handling of courier, express and parcel transport, which has grown significantly in the recent past. The Freight Transport Round Table has been established as a cooperation body and serves to promote the transition to climate-friendly urban transport.

These are the 2030 guidelines



The objective of the Integrated Climate Protection Concept 2020 is to reduce emissions from transport to 308 thousand tonnes per year by 2030. With the Council resolution of January 2020 on climate neutrality in 2030, this amount must be reduced to zero. In order to achieve this goal, the city of Aachen is embarking on a path towards particularly exemplary urban transport.

The strategic goal of this field of action (set by Aachen's city policy) is to reduce emissions in the transport sector to almost zero. The aim is to enable all citizens and other stakeholder groups in the city of Aachen to enjoy climate-friendly, affordable/socially equitable and comfortable mobility without having to own a car. If all everyday journeys can be made easily by eco-mobility and the necessary commercial transport can be handled by rail or using climate-friendly drive systems, the local mobility transition can succeed. However, in order to achieve the goal of completely climate-neutral mobility, the necessary framework conditions must also be created at European and federal level. As things stand at present, cars with combustion engines may be newly registered in the EU until 2035. There are currently no instruments for a municipal ban on combustion engines. These factors represent a significant obstacle to achieving the target.

The city of Aachen has also set itself six overall goals for mobility as part of its Mobility Strategy 2030 from 2020:

- High road safety
- Environmentally and urban-compatible mobility
- City of short distances
- Good accessibility
- Reliable and convenient mobility
- Efficient and affordable mobility

A total of 25 measurable indicators were developed and politically agreed in order to record and evaluate developments in these areas.

To make this possible, sustainable forms of mobility should be considered and prioritised in all of the city administration's plans. Measures aimed at reducing the density of car traffic in Aachen must continue to be implemented and expanded. The city has a wide range of options at its disposal to avoid or shift car traffic or to promote the switch to alternative drive systems. The avoidance of motorised private transport can be achieved, for example, through traffic-saving settlement structures. The modal shift is achieved through a mixture of pull factors to improve the environmental network and push factors that make the use of the car less attractive.

The city of short distances will continue to be consistently pursued. This is taken into account in all city-wide and district-related development concepts and individual measures and is pursued by providing sufficient road space for pedestrians and cyclists. The aim of transport policy and transport planning in Aachen should be to reduce commercial traffic through organisational, administrative and regulatory measures. Unavoidable commercial transport should be switched to vehicles with alternative, locally emission-free drive systems without restricting local businesses. The aim here is to achieve savings through smart and optimised operational mobility in order to strengthen the competitiveness of local companies. Successful projects can also generate locational and competitive advantages for the city of Aachen as a business location.

The infrastructure for climate-friendly drives is being expanded accordingly in order to drive forward the drive revolution.

These are the development scenarios

The basic principles for climate-friendly mobility include the aspects of avoiding emissions, modal shift and increased efficiency, which are supplemented by the increased use of renewable energies. This inevitably requires a redistribution of transport volumes in favour of cycling and local public transport. In addition, a central focus of the transport transition is the switch to alternative drive systems.

For the development of the mobility sector, the results of the City of Aachen's Mobility Strategy 2030 and the study "Climate Pathways 2.0" of the Federation of German Industries.

Overall, the BDI study, which analyses greenhouse gas neutrality for Germany by 2045, assumes a 38% reduction in private transport mileage by 2045 as a result of a modal shift. The majority of this expected modal shift will be absorbed by public transport, whose vehicle kilometres will increase by almost 67% in the process. The Aachen Mobility Strategy 2030 also calculates that around 50 % of motorised private transport journeys will be less than 5 km. This scenario therefore continues to assume that these journeys will be avoided as far as possible, even if the aim is to make public transport more attractive. Freight transport will grow strongly due to the assumed economic growth in the BDI scenario. Freight transport performance across Germany increases from 765 billion tonne-kilometres per year to 995 billion tonne-kilometres per year in 2045.
For Aachen, this means an increase in freight transport of around 18%. In order to meet the 1.5-degree target and achieve climate neutrality by 2030, this scenario assumes that the targets must already be met by 2030. A significant acceleration of the implementation processes is therefore required in the transport sector.

The main driver of energy reduction is the switch to electromobility, which consumes significantly less energy per kilometre than conventional petrol and diesel engines. According to Agora Energiewende and the Öko Institut, the efficiency gain from combustion engines to electric motors is around 69%. Furthermore, data from the Federal Motor Transport Authority shows that the energy efficiency of cars has increased by around 0.7 %/a in recent decades. This efficiency gain is extrapolated in the scenario over the following years.

The European Parliament has decided to stop authorising new vehicles with combustion engines from 2035. In addition, various car manufacturers have already announced that they will gradually phase out combustion technology between 2035 and 2040.

In this scenario, the technical and expert assessment assumes that 90% of the entire passenger car fleet will be electrified by 2030, taking into account accelerated implementation within Aachen. The hydrogen share of passenger cars is estimated to be low (around 5 %), whereas it accounts for a significant share of freight transport at around 14 %. Due to the adjustments to the public transport fleet that have already been initiated, an electrified share of 70 % and a 25 % share of hydrogen-powered vehicles.

Figure 57 shows the development of final energy consumption in the mobility sector. It is clear that the most significant reduction can be expected in the area of private motorised transport through avoidance, modal shift and accelerated electrification of the existing fleet. By the target year 2030, this means a final energy reduction of around 96% for private motorised transport.

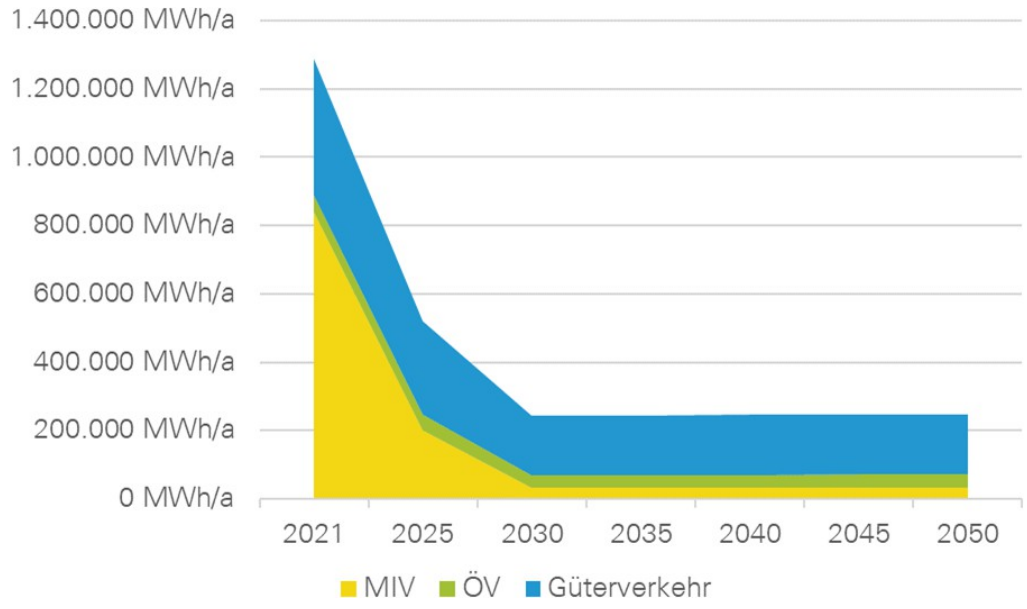


Figure 57 Changes in energy demand for mobility (Graphic: Gertec GmbH)

City as a role model: Mobile city group

Direct influence by the city can fulfil a role model function and show "what is possible". This can generate a multiplier effect through municipal employees, increase the attractiveness of the city as an employer and improve the health of employees.

Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
City administration with municipal employees Citizens also as a target group in external communication	Conversion of the municipal vehicle fleet to climate-friendly drives/vehicles (including fewer cars, more (e-)bikes and (e-)cargo bikes) Changing the behaviour of employees and creating the framework conditions by offering appropriate services (job bike, job ticket, carpooling centre, etc.) Supporting municipal companies with the changeover Expansion of charging infrastructure (use of green electricity)	Operational mobility management Climate-neutral vehicle fleet	BMM at the city administration of Aachen and the municipal holding companies Electrification of urban vehicles

Transport planning and mobility concepts

The mobility sector is an important lever for achieving climate neutrality, but also for maintaining a liveable and economically strong city of Aachen, which is why urban planning and transport planning are always considered in combination. The focus of action describes which structural framework conditions should be created for this.

Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
City administration (urban planning and development, transport planning, possibly others such as civil engineering) If applicable, superordinate building authorities Target groups: Citizens, investors/project developers, planners	Creation, restoration and preservation of traffic-saving settlement structures Strengthening the environmental network in municipal road planning Priority regulations for walking and cycling as well as public transport and innovative services Consideration/high prioritisation of climate-friendly mobility in integrated urban development concepts and priority in planning and spatial requirements	Structural framework conditions	Binding mobility concepts for Construction projects and events Balancing and impact assessment of the mobility measures in the ICSK Scientific support for the mobility transition City centre mobility for tomorrow Stabilisation of the Aachen Region Mobility Transition Network (NERORA) Zero-emission zone

Avoiding and shifting passenger transport

In the Aachen region, the car is the vehicle with a very high share of the modal split, which means that there is a very high potential for a shift to other modes of transport. Here, the local authority has direct opportunities to influence the creation of infrastructure, services and priority regulations.

Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
City administration, politics, transport companies, mobility service providers, construction companies, citizens Target group: Citizens (private + as employee)	City of short distances / 15-minute city (establishment in urban planning and development) Strengthening walking and cycling (information, awareness-raising, infrastructure, planning) Participation / accessibility (public transport, mobile stations, infrastructure) Priority of public transport over motorised private transport / reduction of privileges for car traffic Expansion of sharing services and mobile stations (needs-based and accessible) Good connections to the region and beyond	Expansion of public transport services Cycling infrastructure & walking Multimodal mobility Car park management Create incentives for the switch	Create a catalogue of incentives to reduce motorised private transport Promotion of sharing and multimodality Create a catalogue of incentives to reduce motorised private transport

Avoiding and shifting commercial traffic

Commercial transport in Aachen must also be reduced and switched to eco-mobility and more climate-friendly drive systems. The City of Aachen can support companies in converting their traffic volumes by offering advice on e.g. BMM or infrastructure and funding

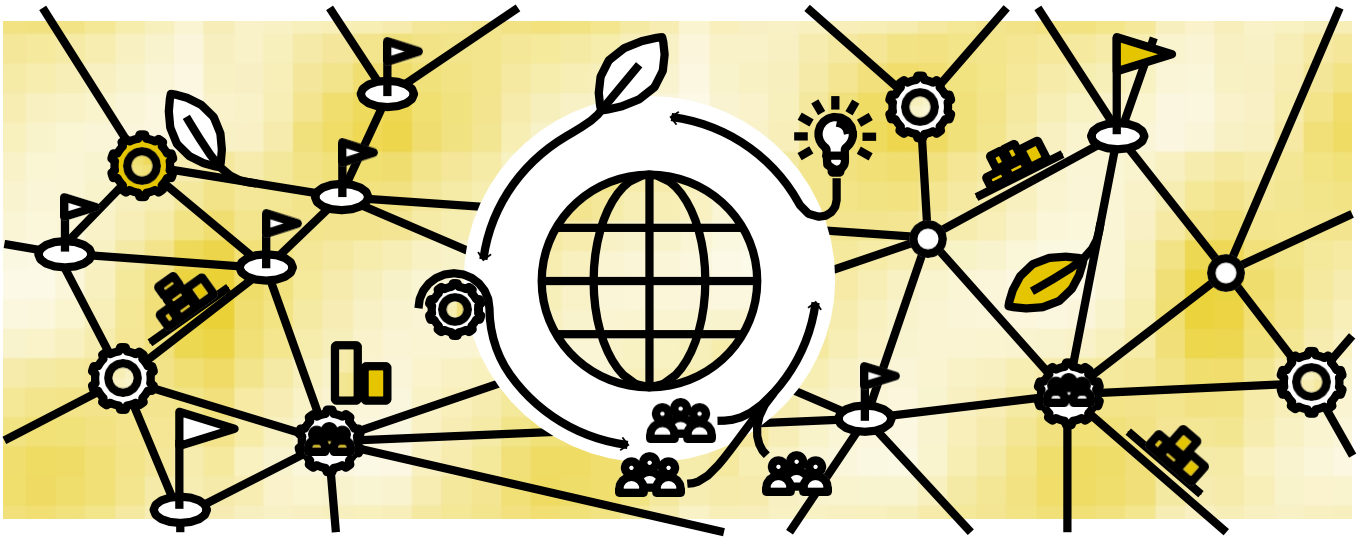
Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
City administration, STAWAG, politics, citizens, companies Target groups: Companies, employees	Creation of the necessary infrastructure for the drive transition (electromobility, hydrogen) Avoidance of space conflicts between eco-mobility and charging vehicles Establish municipal consultations on alternative drives for companies	Climate-friendly commercial transport and company mobility Company mobility management Company Strategy for the last mile	-

Climate-friendly drives and fuel

The city's active influence can improve the organisational, technical and administrative framework conditions for climate-friendly drive systems. This can reduce emissions from motorised private transport, which are necessary to achieve the target.

Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
City administration, STAWAG, politics, citizens, companies Target groups: Citizens, companies, construction/operating companies for infrastructure	Creation of the necessary infrastructure for the drive transition (electromobility, hydrogen) Avoidance of space conflicts between eco-mobility and charging vehicles Establish municipal consultations on alternative drives for companies	Offers and infrastructure to promote e-mobility Offers and infrastructure synthetic fuels for forestry, agriculture and special vehicles	Expansion of charging infrastructure

9.8. Economy



For a climate-neutral Aachen, the city's economic activities must also be geared towards climate neutrality. All economic activities in Aachen are addressed in the Economy field of action.

What is this about?

Economic activity in the city of Aachen

The Economy field of action addresses all companies and workplaces in the city of Aachen. This includes small and medium-sized enterprises (SMEs), large and industrial companies, agricultural businesses as well as the city's own companies and municipal holdings. The field of action encompasses a very diverse and varied target group. Accordingly, the measures that need to be implemented by local companies in order to move towards climate neutrality are challenging in different ways. In this field of action, the focus is on the direct and indirect areas in which the city group exerts influence. The aim is to motivate and activate these groups through municipal initiatives to implement climate protection measures in their own area of responsibility.

Climate-neutral administration - taking responsibility and overcoming challenges

Climate-neutral administration is the goal by 2030. In addition, the City of Aachen can actively implement the ambitious climate neutrality goals with its own companies and holdings and at the same time create exemplary measures and success stories.

Climate neutrality as a factor in business promotion and location development

The transformation of the existing economy (trade, commerce and industry) towards climate neutrality and the establishment of climate-neutral and sustainable companies in Aachen is one of the tasks of economic development and location development. Economic development is increasingly taking on the systematic promotion of co-operative and sustainable forms of business.

Climate neutrality as an economic policy model

Climate neutrality is a business issue for trade, commerce and services as well as for industry. Climate change harbours a variety of risks for business locations. As a result of climate change, supply routes can be disrupted and thus the supply of raw materials, but also intermediate production or the transport of goods can be impaired[45].

[45] Source: German Adaptation Strategy (DAS).

with electricity from renewable energies is becoming a location factor. Companies are increasingly facing up to their social responsibility and fulfilling the demands of their customers, employees, investors and partners for more climate protection and sustainability. Eco-efficient (better production) and eco-effective (cradle-to-cradle) product development offers opportunities for positioning on the market. Climate neutrality in the commercial, trade and services and industrial sectors are therefore key areas of action for the IKSK.

Waste and the circular economy - conserving resources and protecting the climate

The limits of resource consumption have already been reached in many cases in view of the ecological limits.
Sustainable production and consumption patterns must therefore be promoted and the demand for resources reduced. In Aachen, the growth in consumption is therefore to be decoupled from the consumption of non-renewable raw materials by establishing a consistent circular economy.

Agriculture, food industry and regional trade structures

Regional trade structures promote regional value creation and minimise greenhouse gas emissions through short distances. The city of Aachen has a direct influence on the agricultural use of urban farmland in the supply of food by regulating the leasing of land accordingly. The city of Aachen can influence the proportion of regional and sustainable production by utilising its own demand potential in the context of municipal communal catering and indirect influence by supporting sustainable production and trade processes.
Finally, the city can influence consumer behaviour by advising, activating and qualifying citizens.

These are the most important influences and framework conditions

The framework conditions for these fields of action lie in particular at the level of the market players and in the municipal family of the City of Aachen.

The challenge of the 20s

In recent years, issues such as the supply of energy and raw materials have increasingly come to the fore, not least due to the COVID-19 pandemic and the war in Ukraine. The disruptions in global supply chains, particularly in relation to fossil fuels, have called security of supply into question. In addition, many industries are facing an increasing shortage of skilled labour, which poses a challenge for companies as a whole.

EU mission "100 climate-neutral cities by 2030"

Although the municipal level has a direct influence on its own organisation, it can only have an indirect impact on other areas of the local economy. However, Aachen is one of nine German cities to be part of the EU's 100 climate-neutral cities mission and will have a new instrument in the form of climate city contracts to pursue the goal of climate neutrality together with private actors and companies.

City as an active partner

Through established structures such as the business development organisation, but also through new structures such as the climate agency, the city can

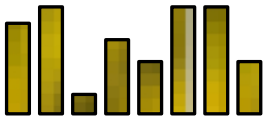
Aachen as an active partner in sustainability issues and actively advise companies.

Sustainable agriculture and food industry

The transformation to a sustainable agricultural and food industry requires comprehensive changes across the entire value chain in cooperation with agriculture. Factors here include, for example, the preliminary stage of fertilisation and plant protection, the production stage of agriculture, the processing stage of the food industry - the marketing stage of trade and the consumer side.

The legal framework is primarily set at EU level (e.g. EU legislation on organic farming) and at federal level. The aim of the federal government is to increase the proportion of organic farmland to 30% of the total agricultural area in Germany by 2030. To this end, existing instruments and subsidies (e.g. the Federal Programme for Organic Farming and Other Forms of Sustainable Agriculture (BÖLN)) are to be expanded.

These are the potentials



Efficiency potential

Increasing efficiency in the commercial sector is particularly relevant, not least in view of the acute threat of energy supply shortages. They interface with the building sector through efficiency measures on building envelopes, the heating and cooling technology used and electricity-based applications such as lighting and the use of electronic devices. Another interface is with the mobility sector through the use of appropriate vehicles in company fleets, both in terms of employee mobility and in logistics and sector-specific vehicles for use in agriculture, construction, waste disposal and many other areas. A third area involves increasing efficiency in production processes for materials and goods, which is of particular interest to energy-intensive companies.

In addition to efficiency improvements in the energy sector, resource efficiency has also increasingly become the focus of attention in recent years. Due to supply difficulties, for example during the lockdowns in the COVID-19 pandemic, but also due to increasingly scarce raw materials in certain areas, companies are also increasingly confronted with questions of supply security. With regard to emission levels, there are close links between climate protection and resource conservation: substances and materials that can be saved in the manufacture of products and goods do not have to be extracted, transported and further processed, thus leading to reduced energy consumption. Against this background, the ICSK includes not only energy-related measures but also those that address resource efficiency and the circular economy.

In agriculture, in addition to the efficiency measures already mentioned, such as the insulation of buildings, efficient lighting, appliances, vehicles, etc., there are further starting points. These include, for example, cold chains in food production, but also the switch to organic farming, the promotion of local and regional production and small-scale approaches to urban gardening or urban farming. From an efficiency perspective, there are also interfaces with sufficiency in the area of avoiding food waste in agricultural production.

Avoiding waste is also the top priority in waste management when it comes to climate and resource protection. Waste that is not produced in the first place does not have to be transported away, processed or otherwise treated, which reduces energy consumption. There is also potential for efficiency in the optimised separation of waste, treatment technologies and, last but not least, in the recycling of materials and their reprocessing as a relevant contribution to the development of a circular economy. Digitisation strategies can provide support here, for example in the area of optimised routing and collection of waste as required.

Consistency

In the area of consistency, a rough distinction can be made between two areas: With regard to energy supply, the switch to renewable energy sources and, in the area of resources, the substitution of energy- and resource-intensive non-renewable substances and materials with recycled or recyclable and renewable raw materials and materials.

This opens up various opportunities in the energy sector. For example, the use of hydrogen is seen as a great potential for a more sustainable energy source in various areas, but other renewable energy sources are also an option for more or less energy-intensive businesses. At the same time, commercial buildings and areas offer potential for the expansion of renewable energy systems and waste heat from commercial processes can also play a role in the local energy supply, for example by feeding it into district or local heating networks.

From a resource conservation perspective, various aspects also play a role in consistency. This concerns the switch to more sustainable substances and materials, but does not only include the material side, but also aspects such as reparability, the possibility of separating certain fractions by type and the expansion of economic sectors in the area of reuse and recycling.

In agriculture, the strategy of consistency can include the use of renewable energies for buildings, vehicles and processes as well as the switch to organic farming. It is not only larger farms that play a role here. Smaller initiatives from the fields of urban gardening, urban farming or solidarity agriculture can also make their contribution here. With local or regional production, avoided transport routes and

The agricultural sector can make a contribution to climate and soil protection by using ecological production and farming methods.

Consistency potential in waste management can be found in the use of recycled materials and substances and in the conversion of energy requirements for transport and corresponding processes to renewable energies.

The potential for consistency is taken into account in the ICSK in the energy supply field of action.

Sufficiency

Sufficient production is characterised by the avoidance of resource consumption. It is about the right balance in terms of production, consumption, utilisation or use. Sufficiency minimises rebound effects and is therefore a necessary complement to efficiency and consistency strategies.
Entrepreneurial sufficiency takes responsibility for all people (stakeholders) along the value chain of the product and service. Knowledge about the value chain becomes transparent through education and sensitisation of employees, customers and suppliers.
Companies often lack instruments and strategies for realising sufficiency potential. The aim is therefore to impart knowledge and experience in dealing with sufficiency strategies in companies.

Basic requirements for implementation

The basic prerequisite for establishing an economy geared towards efficiency and consistency in Aachen is to sensitise local and economically active companies to efficient and consistent economic activity. Above all, companies must be enabled to reorganise their activities, operating procedures and operational processes accordingly. The application of sufficiency strategies requires the communication of new Approaches to company orientation. The task of the City of Aachen is to create the necessary framework conditions for this, for example for a change of energy source in manufacturing companies or for the use of alternatively fuelled vehicles in company fleets. In addition to providing the technical infrastructure, this primarily includes providing companies with comprehensive information and advice on their options. For agriculture, the implementation of the efficiency and consistency strategy also means switching to organic farming and local and regional marketing of their products. The city of Aachen can support this strategy by offering agricultural businesses secure sales markets as customers for their agricultural products (in canteens, daycare centres, school canteens, etc.).

Circular economy

Do not consume more resources than are produced again: This is the basic idea behind a sustainable circular economy.
There is great potential for GHG reduction in the construction industry in particular. The "grey energy" bound in building materials and the "grey emissions" are relevant parameters for a climate neutrality strategy. In the European Union, CO_2 emissions from the production of building materials account for around 9% of total emissions from all sectors. Even if the "grey emissions" are not yet part of Aachen's GHG balance, the IKSK takes into account the potential for reducing these emissions. On the one hand, there is potential through the selection of sustainable building materials, such as wood as a building material, the recycling of building materials and reuse. Recycling includes the recycling of building materials, e.g. for the production of R-concrete. Reuse aims to reuse construction elements in particular.

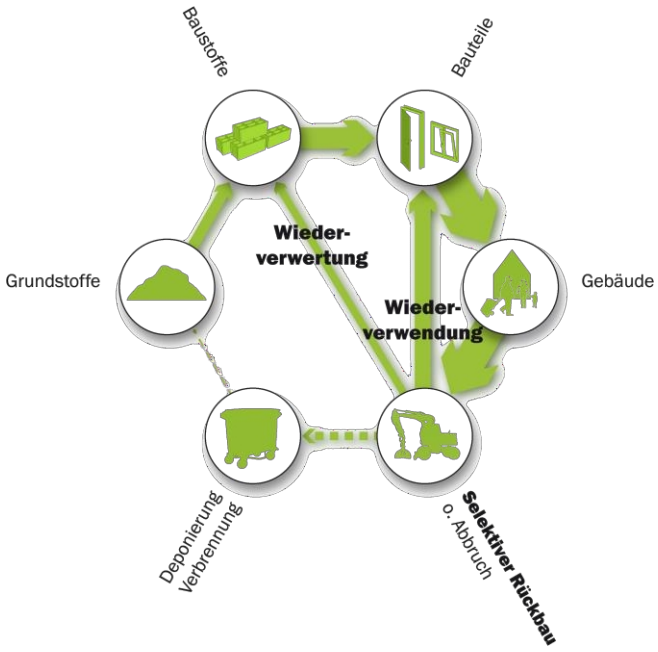
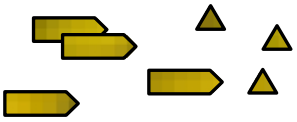


Figure 58 Material cycle in the building industry (source: Masterplan 100 % Climate Protection City of Herten, graphic Jung Stadtkonzepte, Cologne)

These are the 2030 guidelines



The transformation of the economy towards climate neutrality cannot be achieved through technical efficiency solutions alone, but requires a rethink of economic policy. Climate neutrality must become an integrated goal for Aachen as a business location, while at the same time pursuing the goal of securing and creating jobs. The right framework conditions are crucial here and appropriate guidelines for the transformation of existing companies and the establishment of new climate-neutral businesses must be created. Climate protection, economic development and regional development therefore go hand in hand. The guidelines are as follows:

- The development goal of Aachen as a business location and the guiding principle of economic policy is climate neutrality as a locational advantage. Existing companies and New settlements are actively supported in the transformation towards climate neutrality.
- Modernisation measures in thermal production will reduce industrial consumption for the provision of process heat by 20 % by 2030, to around 540 GWh per year.
- In order to comply with the 1.5°C budget, the annual greenhouse gas emissions caused by the economy will be reduced by around 89% by 2030 - taking into account a change in electricity and heat supply - to around 79 kt $_{CO2eq}$ per year. The direct potential for change in the economic sector by increasing efficiency and changing behaviour is 122 kt $_{CO2eq/a}$.

Reducing energy consumption in industry

The development scenario in the Economy sector was based, among other things, on future assumptions from the DENA pilot study (2020).
"Towards climate neutrality". For the commercial building stock, the study assumes modernisation rates of 2.4 % per year by 2045 as an ambitious target. For the Aachen case of climate neutrality by 2030, however, an acceleration must be taken into account here, so that refurbishment rates of 4.0 % per year are required, which were determined for the course of the development path.

With regard to process heat, the DENA pilot study forecasts a savings potential of 19.8 % for the commercial sector by 2045. In order to achieve this target by 2030, an average reduction of around 55 % per modernisation is required, assuming a modernisation rate of 4 % per year. This reduction can be achieved through innovative, energy-efficient processes and the increased use of electricity in the processes. Across the city, a modernisation of the corresponding systems of 36 % by 2030.

In addition to the technical energy savings that lead to the described effects of energy efficiency, it is necessary to consider the potential for behaviour-related energy savings. Sufficiency savings of 10 % were taken into account for the economic sector on the basis of information from the Federal Environment Agency's study (2018) "Modelling more climate protection with sufficiency".

The main final energy application with the largest share in the industry sub-sector is process heat. Potential absolute savings are greatest for this application by 2030.

In the industrial sector, final energy demand can be reduced by modernising production, lowering process heat temperature levels and using process heat more efficiently, for example through cascade use. The scenario envisages a 20 % reduction in this area by 2030.

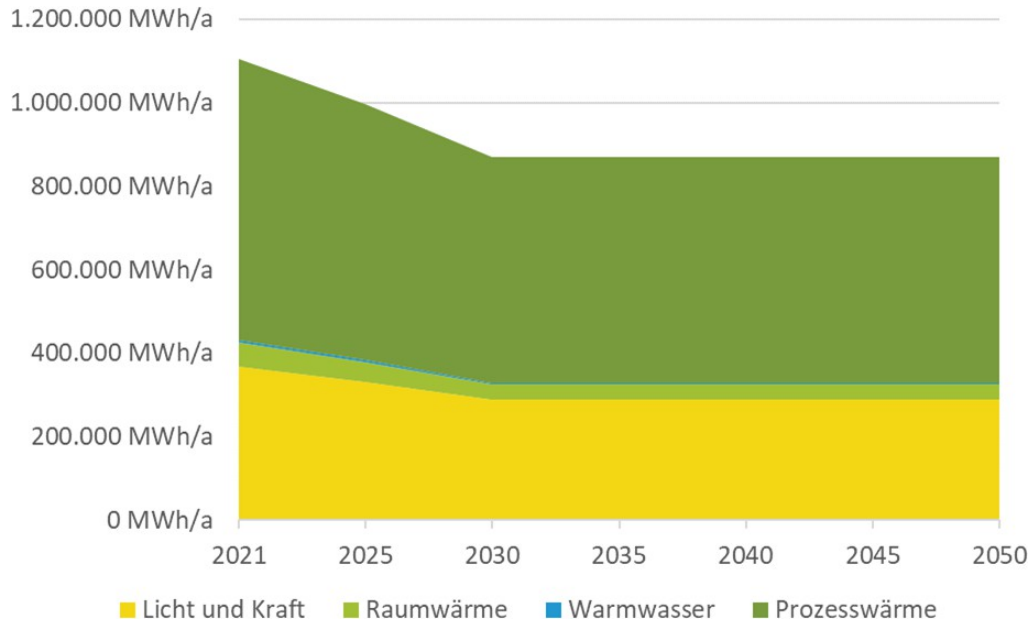


Figure 59 Development of final energy demand - industry. (Graphic: Gertec GmbH)

Reducing energy consumption in the commercial, retail and service sectors

The main final energy application with the largest share in the tertiary sector is space heating. Possible absolute savings are greatest for this application by 2030. For the tertiary sector, final energy savings are mainly achieved through refurbishment and modernisation in this area. The scenario envisages a 35 % reduction in this area by 2030.

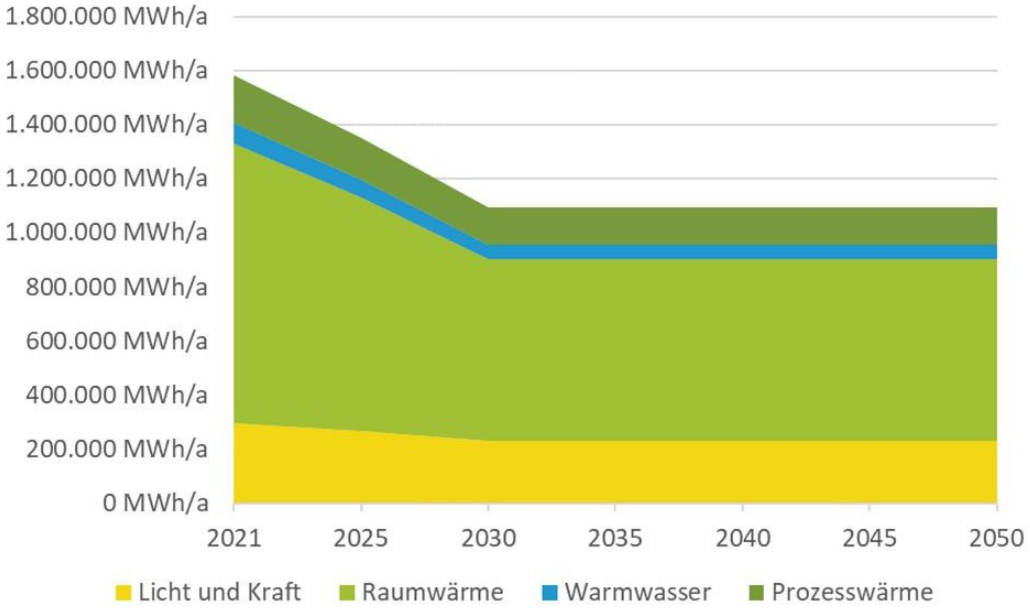


Figure 60 Development of final energy demand - trade, commerce, services. (Graphic: Gertec GmbH)

City as a role model: climate-neutral administration

The city administration is utilising its role model function and creating the necessary structures for a climate-neutral urban family. In addition to a reorganisation of equipment and procurement processes, urban development is also being transformed. The city of Aachen is leading by example in the area of building material recycling and resource efficiency.

Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
FB 60 (contract, award and subsidy management), FB 36 (climate and environment); E18 - Aachener Stadtbetrieb FB 37 - Fire and rescue service Department III - Urban Development, Construction and Mobility Department VII - Climate, City Operations and Buildings E 26 - Facility Management BLB	Utilising the potential for reducing emissions within the administration and municipal holdings Creating structures for the circular economy Strengthening resource efficiency	Climate-neutral equipment and procurement Climate-neutral IT infrastructure Leverage behaviour-related savings potential Climate-friendly urban construction & building sites	Sustainable procurement Climate-friendly action in real-world laboratories Workplace"

Economic development and location development

Not least due to its geographical position and the density of universities, the city has good prerequisites for the decarbonisation of existing economic development and a transformation towards an attractive, climate-friendly business location. This also includes strengthening regional value creation through new pillars, such as industries in the circular economy and bioeconomy.

Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
FB 02 - Economy, Science, Digitalisation and Europe	Strengthening regional value creation Attracting new industries and companies Implement innovative economic forms such as the circular economy	Economic development 4.0 Site development and infrastructure measures for sector coupling in industrial estates	"Sustainable and efficient economy" funding programme Sustainable site development (industrial estates) Climate networks in the industrial estates

Climate-neutral trade, commerce and services

A climate-neutral commercial, retail and service sector is essential in order to achieve the goal of climate neutrality by 2030. Aachen's companies are actively involved and supported in the transformation process.

Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
FB 02 - Economy, Science, Digitalisation and Europe	Transformation of 50 % of existing companies, regardless of their orientation, to a climate-neutral form of operation by 2027	Advice on energy supply and energy saving Promoting climate protection effectiveness in the workplace	Support programmes to increase energy efficiency

Climate-neutral industry

Decarbonisation of the manufacturing industry sometimes requires very specific conversions. One possible solution could be hydrogen. The city of Aachen is already actively providing an alternative energy supply for industry.

Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
Department VII - Climate. City operations and buildings FB 02 - Economy, Science, Digitalisation and Europe	Strategy development for hydrogen demand Decarbonised heat supply	Sustainable production with renewable energies Promoting climate protection effectiveness in the workplace	Supporting companies in evaluating the switch to hydrogen technologies by providing information, advice and networking

Waste and circular economy

Resource recovery from the construction industry reduces the amount of grey energy used in the production of building materials and often saves on international transport routes for materials. It also contributes to regional value creation and location factors in the form of a circular economy.

Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
E 18 - Aachener Stadtbetrieb FB 36/700	Improvement of post-consumer resources Improving recycling structures in the Aachen urban area Introduction of a circular economy in the construction industry via pilot projects	Promoting the recycling of products and materials Disseminating NaWaRo as building materials Waste avoidance Establish and expand the circular economy in industry and the tertiary sector Circular economy in the construction industry	Circular economy in practice: developing a building yard of the future for Aachen's municipal services Driving forward resource recycling Component and resource storage Circular economy in the construction industry Develop criteria for climate-neutral construction sites

Agriculture, food industry and regional trade structures

Regional trade structures are an important factor in achieving climate targets and contribute to the preservation of agricultural land, the cultural landscape, catering and tourism.

Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
FB 02 - Economy, Science, Digitalisation and Europe FB 23 - Real Estate Management	Strengthen regional trade structures, make regional food more popular Encourage local restaurants to use more regional products Anchoring multiple land use in urban areas via pilot projects, e.g. agri-PV and agroforestry systems	Promote regional marketing, production, production and marketing in the area of sustainable nutrition Expansion of sustainably managed agriculture	Regional organic hub - sustainable food production and distribution Strengthening local retail and sustainable transformation of the catering industry Leased land of the city of Aachen is used to strengthen organic farming Pilot project in agroforestry

9.9. Social transformation

The goal of climate neutrality also requires a comprehensive transformation across society as a whole. In terms of climate protection, this can be understood as a change in awareness in all parts of society.

What is this about?

Climate-friendly behaviour requires a rethink:

Winning people over to climate-friendly behaviour requires realistic visions and goals for change, arguments with persuasive power, concrete knowledge for action and concrete experiences of success. The prerequisite for this is an appreciative and cooperative environment "without pointing fingers" with a climate-friendly living environment, offers to join in, try things out and develop individual climate-friendly behavioural skills - even if CO_2 reduction is not the primary goal, but an additional benefit.

(Re)discovering your own abilities (e.g. repairing things), encouraging them and experiencing the positive effects on your own life and well-being is a key to acceptance.

This new awareness is turning away from old ways of thinking and placing climate friendliness and resource conservation as one of the most important standards. For a large part of the population, climate-friendly behaviour is thus becoming the new standard, which no longer requires a conscious decision but has become routine. Climate-friendly behaviour can be implemented in all areas of social life, which can be divided into the following areas: Housing and energy, consumption and nutrition, and mobility.

Social transformation is also a systemic task

Although individual, smaller changes in behaviour do their part to protect the climate, a social transformation requires support in order to bring about a broader, more fundamental change. Furthermore, the responsibility for transformation does not lie solely with the individual, but depends on the framework conditions. The municipal family, market players and the EU, federal and state governments shape these framework conditions in such a way that individuals have the opportunity or even the incentive to make climate-friendly decisions. Framework conditions can be understood to mean legal requirements as well as offers from the city of Aachen.

Climate awareness and transfer

It is crucial that climate-friendly behaviour is enabled and promoted equally in all parts of society.
Determining factors for the penetration of the population can be, for example, age, level of education, language skills and economic opportunities. The following building blocks can be part of a strategic approach to the population: activate, encourage, qualify and multiply

Climate-friendly living environment

Improving the quality of life of all people in Aachen in the face of climate change and the associated challenges is an integrated task of urban development.

Climate protection in everyday life

Personal behaviour and individual decision-making routines determine everyday actions and therefore also the ecological footprint of every citizen. The teaching and practical application of climate-friendly behavioural routines are successes in everyday life that strengthen self-efficacy, activate people to take further steps and also motivate others.

Climate protection and education

Education is a key factor in achieving climate protection goals. Sustainability and climate protection are lifelong educational topics. Education for sustainable development (ESD) points the way forward, how their own actions and climate-friendly lifestyles have an impact on the environment. This not only strengthens the individual's perceived self-efficacy, but also has positive consequences for others. Aachen pursues a broad approach in the sense of an ESD educational landscape and educational campaign on sustainability topics. The anchoring and implementation of Education for Sustainable Development (ESD) should therefore be ensured in cooperation with all education providers and stakeholders.

Climate protection in culture and leisure

Social transformation processes begin with people who are willing to change as pioneers and role models. Aachen has a broad cultural scene and is known worldwide as a tourist destination. The culture, leisure and tourism sectors therefore offer great potential to promote sustainability and climate protection issues in Aachen and beyond the city's borders as role models and multipliers.

These are the most important influences and framework conditions

The framework conditions for social transformation are determined by various factors. Various trends can currently be recognised.

Rebound effects - increasing land consumption and trends towards larger vehicles

The living space per capita has risen to 47.7 m² per capita in 2021 and the level of technical equipment in households is also increasing[46]. The same trend can be observed for both the degree of motorisation and car mileage.

"Not-In-My-Backyard":

In the area of energy, it can be seen that even if the expansion of renewable energies is supported, residents often have reservations about projects in their immediate neighbourhood. However, it can also be seen that people who already have points of contact with renewable energy in their neighbourhood are more open to renewable energy projects.

Social polarisation

On the one hand, there is a growing environmental awareness in society, which is reflected in the Fridays for Future movement. Young people in particular attach great importance to climate protection. This is also reflected in consumer decisions such as offsetting air travel and purchasing green electricity. However, there is also growing resentment towards climate protection, for example in relation to the amendment of the GEG or climate activism. There is a fundamental fear of change and the unknown.

They do not associate climate protection with positive effects on their personal quality of life. Rather, the public debate is dominated by concerns about bans, restrictions and sacrifices. In this respect, climate protection needs a new "framing" that emphasises the benefits for people's living environment, reduces fears and leaves a feeling of "everyday relief".

Social change begins with innovation

Social change takes place gradually in the sense of a diffusion model. Innovations play a special role here: innovators and pioneers of change form the nuclei for new lifestyles and alternative behaviour. A model of innovation diffusion assumes that innovations diffuse across different milieus in several phases (see Figure 61 Figure 61). The model makes the basic "innovation career" clear: in an early innovation phase, the range of milieus involved is small, with further milieu groups joining in as diffusion progresses - until the innovation finally becomes the standard.

The model distinguishes between innovators, early adopters and laggards. In this model, "agents of change" support the change process by actively initiating innovations or encouraging others to follow suit by acting as role models.

[46] Federal Environment Agency. As of 2022. Available at: https://www.umweltbundesamt.de/daten/private-haushalte-konsum/wohnen/wohnflaeche#zahl- der-wohnungen-gestiegen (accessed on 17 May 2023);

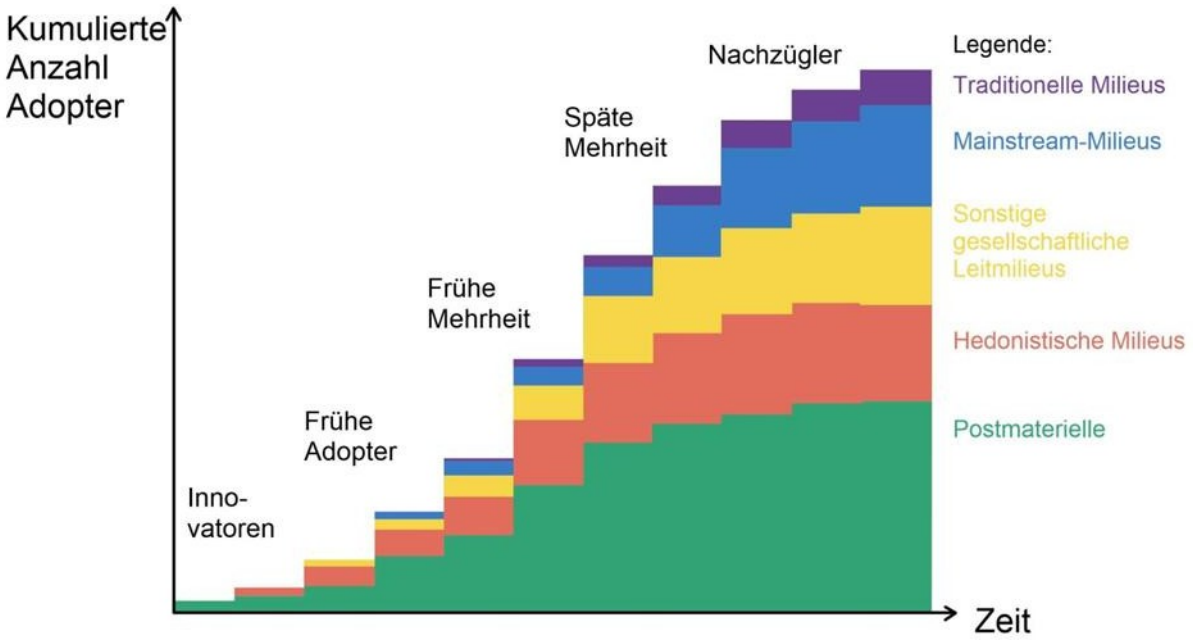


Figure 61 Hypothetical diffusion curve of a climate-friendly socio-technical innovation with respective milieu-specific cumulative adopter shares[47]. (Graphic: Gertec GmbH)

Reaching critical mass

A critical mass of people is required for change to be initiated and accelerated. Based on findings from game theory, transformation research assumes that it is not necessary for an entire group to be convinced of a strategy, but that it is sufficient to reach a certain number of people. More recent research assumes that a critical mass of around 25 % of a group is required for this[48].

Creating a decision-making environment for climate- and resource-friendly behaviour

Elements of a sufficiency strategy for Aachen should therefore consist of programmes to activate and qualify urban society and to promote multiplier effects. The responsibility for climate- and resource-friendly behaviour does not lie solely with the citizens. What is needed is a decision-making environment in which alternative actions are possible, affordable and achievable. Local authorities, municipal companies, initiatives and providers of energy and climate-friendly services can influence the decision-making environment.

actively work to expand the circle of people who opt for energy and climate-friendly offers and behavioural routines.

Promote innovation niches: The strategy is based on a diffusion model, according to which innovators and early adopters are addressed first in order to anchor new climate-friendly solutions and behaviours in urban society. The next step is to gradually expand the circle of people who opt for climate-friendly behaviour. This requires a favourable environment for climate-friendly decisions with suitable and attractive benefits. The strategy is therefore based on the marketplace model, where providers of climate-friendly products and services and decision-makers can exchange ideas.

This requires "pioneers of change" who develop new ideas for climate- and resource-friendly offers and behaviours. They create experiential spaces in which new offers can be experienced. The marketplace model assumes that households interested in change get to know new products and behaviours in this way

[47] Angelika Gellrich: From minority to majority? Psychosocial influences on the spread of climate-friendly innovations. University of Kassel. 2016

[48] Damon Centola et al, "Experimental Evidence for Tipping Points in Social Convention", University of Pennsylvania, 2018

can. Their providers benefit from the experience and feedback, improve their own offerings and achieve a higher level of customer satisfaction through the improved benefits and promotion by the innovators and early adopters an extended circle of users. This creates a self-reinforcing development dynamic for social transformation.

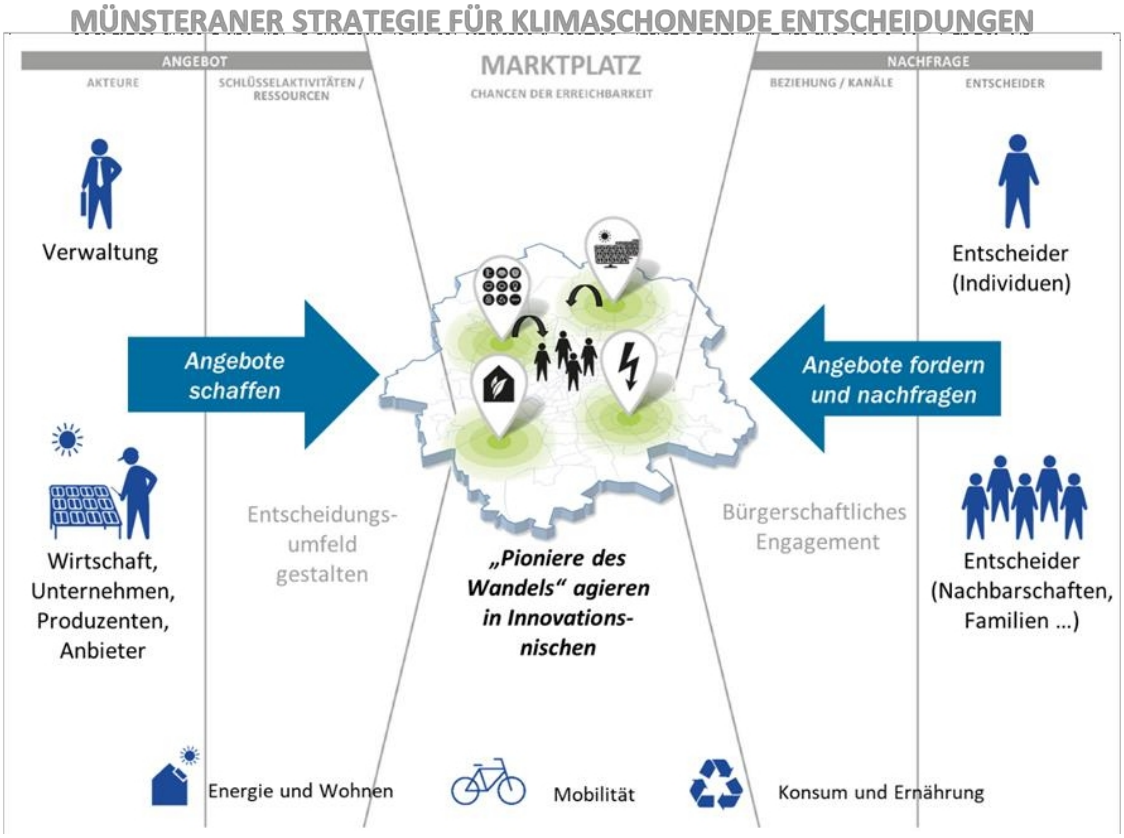


Figure *62* The marketplace model - example of the city of Münster. (Graphic: Jung Stadtkonzepte, Cologne & Gertec GmbH)

Change comes about through your own actions and requires courage

Encouragement activates people to "take a step forward" - towards a climate- and resource-friendly lifestyle. Encouragement sharpens the perception and appreciation of one's own potential and confidence in one's own abilities. Encouragement begins with strengthening a sense of belonging. Outreach campaigns, making the benefits of "without CO_2" clear, attractive offers to join in, celebrating successes or competitions are all ways of activating people.

Qualification

Enable the change process by imparting knowledge and skills: Calls for major changes are no good for changing people's attitudes. Small steps to change behavioural routines and constant repetition are more promising. This requires knowledge (specialised and process knowledge) and opportunities to try things out.

Encouraging more self-confidence and developing knowledge and skills forms the basis for change. The aim is to qualify and empower citizens to find solutions and experience their impact (direct feedback). The following process steps are part of the qualification phase: strengthening self-confidence for one's own solutions, testing and trying things out (promoting self-efficacy). One example of training in the area of climate-friendly behaviour is the City of Münster's climate coaching programme.

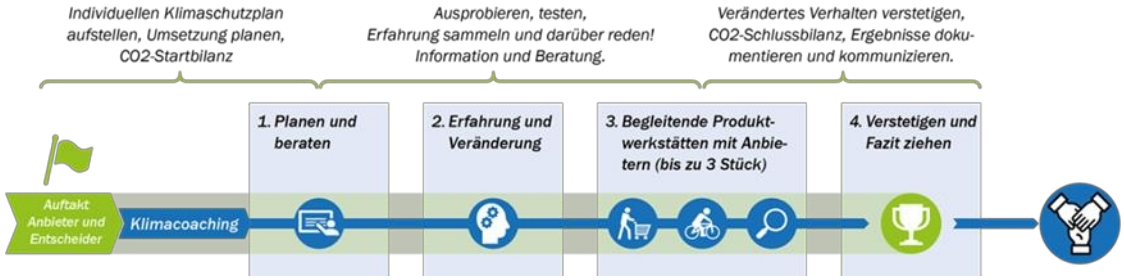


Figure 63 Example of the climate coaching process, City of Münster. (Graphic: Bodo Wirtz)

Multiply

Expanding the scope of action: The aim is to expand the individual scope of experience and action to more and more people and to further strengthen the sense of belonging.
A sense of community arises through recognition of one's own commitment and the realisation that one is making a contribution to the community. The result is a positive focus on what has been achieved and the desire to intensify the commitment. The city provides support through suitable offers for further development and gives participants the opportunity to intensify climate-friendly behaviour.

These are the potentials

Limiting the rebound effect

The relationship between an increase in efficiency and an increase in additional demand is known as the rebound effect. The Federal Environment Agency defines rebound effects in the case of efficiency increases as follows: "We speak of rebound effects in the case of efficiency increases if the increase in efficiency results in increased demand or use and the potential savings in the use of resources are not fully utilised as a result." Rebound effects occur with most energy efficiency measures.

Reduced utilisation costs and absolute savings through efficiency measures tempt people, for example, to intensify their use or to invest the money saved in other consumption. The "good feeling" of having carried out an energy-saving measure or having behaved in a resource-saving manner can lead to more careless use of energy (insulating the house, opening windows while the heating is on) or to a reduction in sustainable behaviour elsewhere (not using the tumble dryer but going on holiday).

Consumers tend to adopt energy-saving behaviour if, for example, they expect energy or usage costs to rise (efficient heating installed, but the price of gas increases), the use of energy services becomes a habit, personal and social norms for energy-saving use are strongly developed or if an environmental self-image plays an important role in their own identity.

The large number of rebound effects and the limited success to date in limiting them make it clear that technological measures alone are not enough to achieve the climate protection targets. The energy and climate targets cannot be achieved through efficiency measures alone - sufficiency is indispensable as a pillar of the municipal climate neutrality strategy.

Potential for sufficient behaviour

A city cannot impose climate-friendly lifestyles and goals on its citizens. Nevertheless, transformation processes for more energy- and climate-friendly behaviour in urban society can be actively shaped, accelerated and in part controlled in the sense of a sufficiency strategy.

- Sufficiency has an effect on the absolute reduction of greenhouse gases and also reinforces the effect of efficiency and consistency strategies by reducing rebound effects.
- Sufficiency as a consumption- and behaviour-related climate protection component thus takes on a special significance alongside efficiency and consistency and is therefore an indispensable complementary pillar for the ICSK.
- Sufficiency should deliberately not be defined solely in terms of renunciation, new lifestyles and qualities of life as a normative force. Sufficiency here rather stands for energy- and resource-saving alternative actions with individual benefits.
- Social change takes place gradually in the sense of a diffusion model: Innovators and pioneers of change form nuclei for new lifestyles and alternative behaviour. A critical mass of people is required for this process to get underway and be accelerated.
- Local authorities, municipal companies, initiatives and providers of energy- and climate-friendly services can actively influence the decision-making environment in order to expand the circle of people who opt for energy- and climate-friendly services and behavioural routines.
- Elements of a sufficiency strategy for Aachen should therefore consist of offers to activate and qualify Aachen's urban society and to promote multiplier effects.

Fundamental consideration of sufficiency potentials

Sufficiency specifically refers to three approaches, each of which differs in terms of different options for action and the degree of change in the benefits: Reduction, substitution and adaptation.

Sufficiency as a strategy directly affects the essential basic needs in the areas of consumption and nutrition, mobility, housing and energy. On the one hand, this guarantees great potential for climate-friendly behaviour, but at the same time sets limits. The extent to which sufficiency potential can be realised is characterised by inhibition thresholds. A sufficiency strategy must therefore overcome resistance and minimise inhibitions.

The basic sufficiency potentials in the three areas of consumption and nutrition, mobility and housing and energy are described below:

Consumption and nutrition

In the area of climate-friendly consumption and the corresponding diet, a variety of socio-cultural, demographic and socio-economic factors, in addition to individual psychological factors, have an impact on consumption and dietary behaviour. This makes it particularly difficult to draw conclusions about generally applicable mechanisms of action and has not yet been satisfactorily resolved in either German or international research.

In principle, it can be assumed that most consumers do not utilise their scope for action for climate-friendly consumption and a corresponding diet. The reasons for this are the interplay between infrastructural opportunities for action, incentives for action and individual willingness to act, as well as restrictions on action due to economic, political, legal and socio-cultural factors. The limits of knowledge and judgement play a particularly important role in the area of consumption and nutrition: product information is often not available or only with increased effort, and the quality of products is not initially perceptible.

As this field of action is also characterised by a large number of small, everyday actions and consumption decisions, the view that personal influence is of little relevance here. It is precisely this multitude of recurring decisions, which in total have an impact on large economic sectors, that results in high sufficiency potential within the field of action. These are basically spread over six decision-making stages: the basic decision on consumption and nutrition, the selection of product categories, the choice of product or brand, purchasing behaviour, use and disposal of the product. Potential can be realised through the following approaches, for example:

- Shifting holidays to regional destinations that can be reached without a plane if possible.
- Consumption should focus on long-lasting qualities, especially for clothing and electronic goods.
- Repairing damaged items instead of buying new ones.
- Purchase seasonal and regional (organic) products.
- Enjoy food and eat consciously (slow food, alternatives to meat).
- Consumption of own garden products (use of own garden, production of products).
- Participation in swapping circles (swapping and borrowing, using instead of owning).

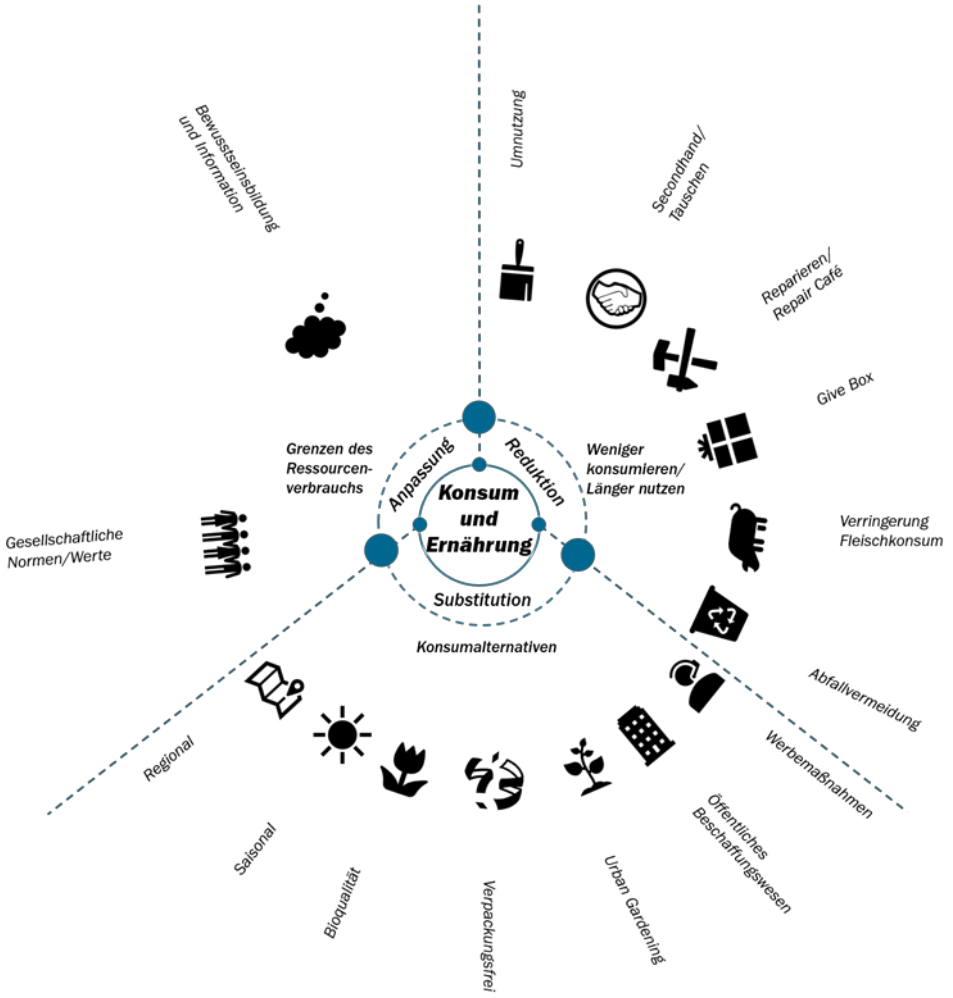


Figure 64 Sufficiency potential and approaches to action in the area of consumption and nutrition (Graphic: Bodo Wirtz)

Buildings and energy

The need for sufficiency is clearer in no other field of action than in the area of climate-friendly housing and energy: while the space heating requirement per square metre continues to fall due to efficient developments, the living space per capita is increasing so much that savings are being used up and the space heating requirement will not fall between 1970 and 2030 - despite technical progress. Trends such as shrinking households, older people living in large spaces or increased demands can hardly be met with technical efficiency improvements. In addition to attractive construction concepts that are also viable for the masses, what is needed above all is a willingness to change behaviour in the particularly sensitive area of one's own home. In principle, there is great potential for sufficiency in contrast to firmly established social models, for which there are still very few positive counterexamples. In addition to structural concepts such as flexible and temporary forms of living, smaller living standards or redensification and

Conversion measures also include measures such as living together in different phases of life (students for older people) or the communal use of guest rooms or offices as required. These concepts play a prominent role in the field of action under discussion in order to initiate a fundamental change in image, which makes it possible to activate sufficiency potential on a large scale. Potential in the area of housing can be realised, for example, through

- Shared use of rooms.
- Short distances (e.g. leisure facilities nearby).
- Flexible room concepts and needs-orientated change of living space.
- Densified buildings.
- Save energy (e.g. through correct heating).
- Voluntarily refraining from building a new home and favouring flats close to the city in order to be able to reach work and shopping facilities without a car as far as possible.

- Use of durable products (such as furniture).
- Collective use of appliances (several households share a washing machine in the basement, for example).

In the energy sector, savings can be achieved by quantitatively reducing the requested technology benefits, the required reductions or the desired appliance equipment. In this case, the benefits are hardly changed, but merely utilised to a lesser extent (e.g. purchase: smaller TV set, use: lower washing temperature). Qualitative substitution replaces consumption, use of technology, aspects of supply and lifestyle with goods, services or behaviour with lower energy consumption. Adaptation means adapting the supplied technology to the required technology benefit by excluding oversized, unused or underutilised technology benefits. Two types of application can be distinguished:

- The sufficiency type of appliance equipment is aimed at actions and decisions at the time of purchase, which also includes complete renunciation.
- The sufficiency type of device use, on the other hand, is aimed at all actions and decisions during use and also includes social practices and everyday routines.

The greatest savings effects are achieved when both types are combined (see Figure 64Figure 65)

Potential savings in electricity and hot water

Refrigerators and freezers: Overall, the purely usage-related savings potential for refrigerators and freezers is 20 to 30 % of current electricity consumption. At the level of individual private households, electricity savings of up to 90 % can be achieved in the area of refrigeration and freezing, including the following measures: Choosing a location away from heat sources, keeping the heat dissipation of the refrigerator free and clean, optimised temperature selection, regular defrosting, switching off during longer periods of absence, efficiency class and compliance with the actual requirements when purchasing a new appliance, not using the old appliance as a second appliance, using fresher food that is purchased more frequently and/or does not require electrical cooling, and using appliances with energy-saving special functions.

Washing: In the area of washing, a savings effect of up to 80 % can be achieved by reducing the size of the appliance or the energy-saving design by reducing the capacity of the washing machine (from 7 to 6 kg) (reduction). Various behavioural changes can also reduce the amount of laundry produced (substitution) and the energy consumption can be adapted proportionally to the load level using sensor technology (adaptation). The reduction in washing frequency (1.5 cycles per week instead of 2.25) leads to a lower frequency of use of the appliance and can be achieved through reduction and substitution measures such as appliance downsizing. The lower intensity during use can be achieved by lowering the temperature to 40 degrees (instead of 60 degrees) during washing.
75 % of the wash cycles can be achieved.

Drying: The combined measures in the drying field of action can achieve a savings effect of up to 60 % or 100 % if the dryer is abolished: A reduction in the frequency of use of the appliance can be achieved by reducing the frequency of drying from 1.3 cycles to 1 cycle per week and abolishing the dryer. Partial or complete or year-round or seasonal non-electric drying is a suitable substitution measure.
In addition, the dryer can be switched off when the required degree of dryness is reached (reduction or adjustment).

Dishwashing: Overall, electricity savings of up to 70 % can be achieved in the area of dishwashing: Reducing the capacity of the dishwasher by downsizing to a smaller appliance, reducing the amount of crockery produced (substitution) and adapting energy consumption to the load level using sensor technology.

Cooking and baking: The cooking and baking area of action has an electricity saving effect of up to 60 % with regard to the cooker, oven, microwave and coffee machine and their usage routines: The useful life of the appliances can be extended by utilising residual heat and eliminating stand-by and ready modes (adaptation) as well as avoiding heated food more often (reduction). Substitution measures include, for example, communal cooking and the use of raw food and cold dishes.

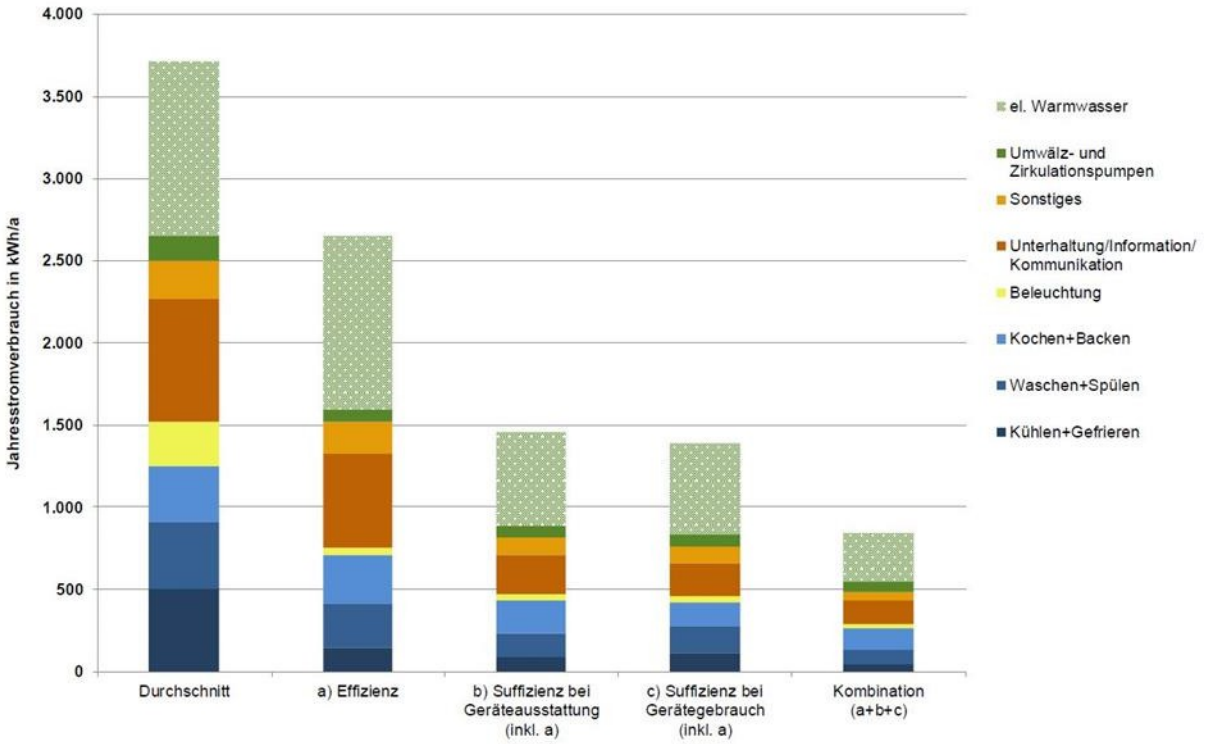
Lighting: Overall, the following measures in the area of lighting result in electricity savings of up to 90 %: A shorter period of use (1.25 h per day instead of 1.7 h or 1.5 h) can be achieved by deliberately switching off lights in unused rooms/zones (reduction), targeted (structural) utilisation of daylight and shifting certain activities to bright phases of the day (substitution) and automatically shortening the duration of lighting (adaptation). An intensification of use can be achieved by lowering the average illuminance (from 80 lx to 75/70 lx) by reducing oversized light sources, better integration of the

daylight in routines (substitution) and through sensor technology (adaptation).

Entertainment, information, communication: Taking all measures into account, savings of up to 80 % can be achieved in the area of entertainment, information and communication.

By deliberately reducing the period of use and stand-by losses, even to the point of removing the device (reduction), replacing usage times with analogue activities (substitution + special case of convergence) and appropriate sensor technology (customisation), the service life can be reduced. In addition, smaller devices can be used (reduction).

Hot water: Overall, a savings effect of up to 70 % can be achieved in the area of hot water with circulation pumps. Hot water consumption can be reduced by deliberately shortening the utilisation time (reduction), changing the intensity of use (e.g. showering instead of taking a full bath; substitution)



as well as the use of night setback programmes and water-saving fittings (adaptation).

Figure 65 Annual electricity consumption taking into account efficiency and sufficiency measures[49] (Graphic: Gertec GmbH)

[49] F. Lehmann, F., Weiß, U., Brischke, L. et al.:, "Stromeinspareffekte durch Energieeffizienz und Energiesuffizienz im Haushalt. Modelling and quantification for the private household sector in Germany". Ifeu - Institute for Energy and Environmental Research Heidelberg, Berlin, 2015.

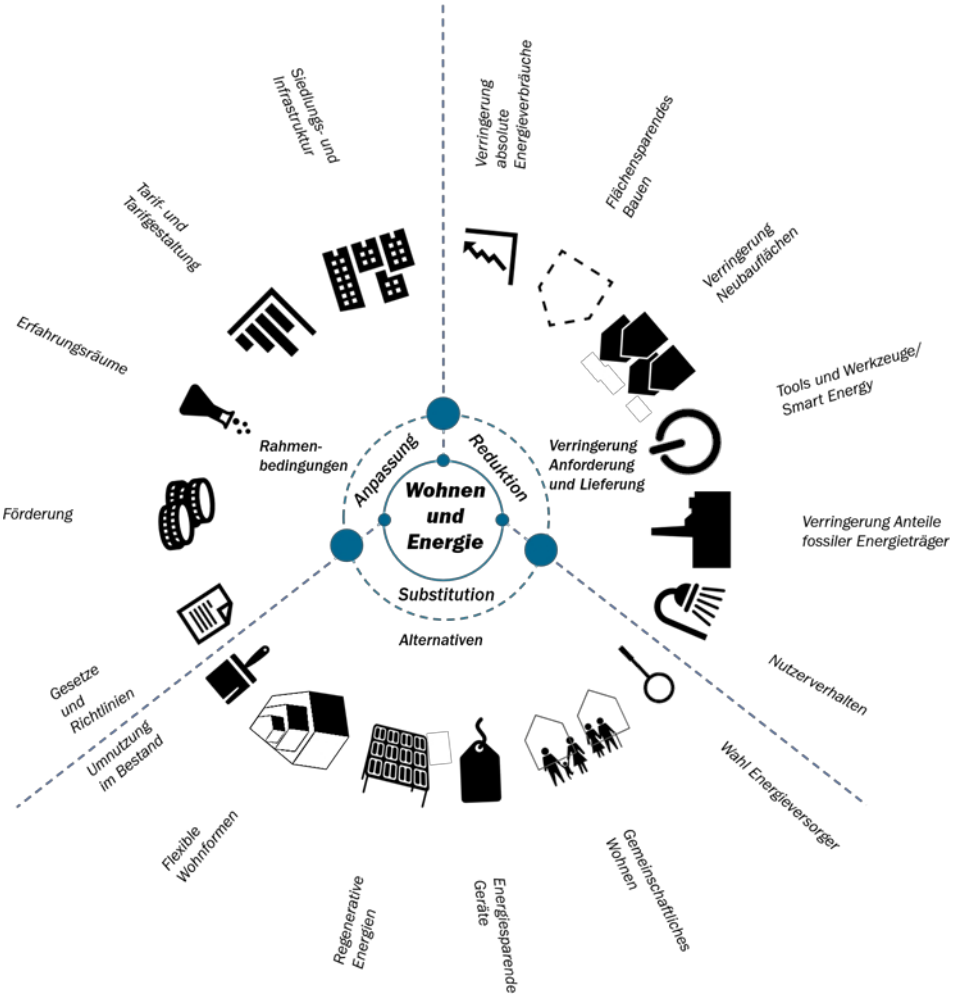


Figure 66 Sufficiency potential and approaches to action in the area of housing and energy (Graphic: Bodo Wirtz)

Transport

The area of climate-friendly mobility holds particularly great potential for sufficiency: the negative environmental consequences of daily mobility behaviour account for a very significant proportion of the overall impact on the climate and environment.

For the citizens of Aachen, the strategy of sufficiency in transport primarily means being less physically mobile and making fewer physical journeys. Sufficiency therefore means changing individual mobility behaviour in such a way that less energy and resources are consumed. Specifically, fewer and shorter journeys are made and primarily low-emission and emission-free means of transport are used. In

A mobility system geared towards the possibility of sufficient behaviour therefore also addresses issues of efficiency and consistency. As a result, the task for planning is to design the framework conditions in such a way that sufficient behaviour is also possible for citizens and destinations can still be reached comfortably, safely and easily with less traffic and, above all, without a car.

In its study "Less traffic - more quality of life "[50] published in May 2022, the Federal Environment Agency names eight key measures to promote sufficient mobility, all of which can also be transferred to Aachen or implemented in Aachen. Some of these measures can also be

[50] Federal Environment Agency (ed.) (2022): Less traffic, more quality of life - Guidelines for communicating sufficiency as a goal of municipal transport policy. Dessau. Online available at https://www.umweltbundesamt.de/sites/default/files/medien/376/publikationen/less_traffic_more_quality_of_life_guide_2022_09_21.pdf

activities and deepen or expand them. These include setting up speed and access restrictions as well as parking and stopping bans, offering incentives for sufficiency-oriented mobility behaviour, developing low-car and car-free residential areas, expanding sharing services, converting traffic areas primarily reserved for motorised private transport into traffic areas for eco-mobility, expanding the infrastructure for alternatives to the car, offering multimodal and digitally bookable tariffs and levying user charges for road infrastructure. The municipal level or the responsibility of the administration is the central level of action and implementation for the establishment of a mobility system geared towards sufficiency. On the one hand, the problem pressure and need for action of a non-sustainable or non-sufficient transport system is particularly evident at the municipal level, while at the same time the city of Aachen also has many opportunities for action for more sufficient mobility through settlement, transport and urban land-use planning, among other things.

Good access to the climate-friendly mobility offers already available in Aachen is essential for climate-friendly mobility - this must be communicated accordingly and does not immediately lead to the use of such offers.

Behaviour regarding the choice of means of transport is often formed at a young age and then initially maintained; changes are often perceived as unpleasant and meet with particularly strong resistance. This behaviour in the area of mobility, which is strongly influenced by habits, makes changes particularly difficult and requires long-term processes. At the same time, the steering influence of local authorities in this field of action is particularly strong and can leverage sufficiency potential through strategies of traffic avoidance and modal shift and the creation of the necessary framework conditions. This potential can be realised, for example, through

- Speeding up public transport and prioritising it in the distribution of traffic areas at the expense of motorised private transport.
- Avoiding or reducing air travel and car journeys, not owning a car.
- Improving conditions for walking and cycling, prioritising the use of bicycles, trains, carpooling and car sharing.
- The promotion of living close to work and mobile working.
- Adapted means of transport (conscious use of the car, combination of routes).

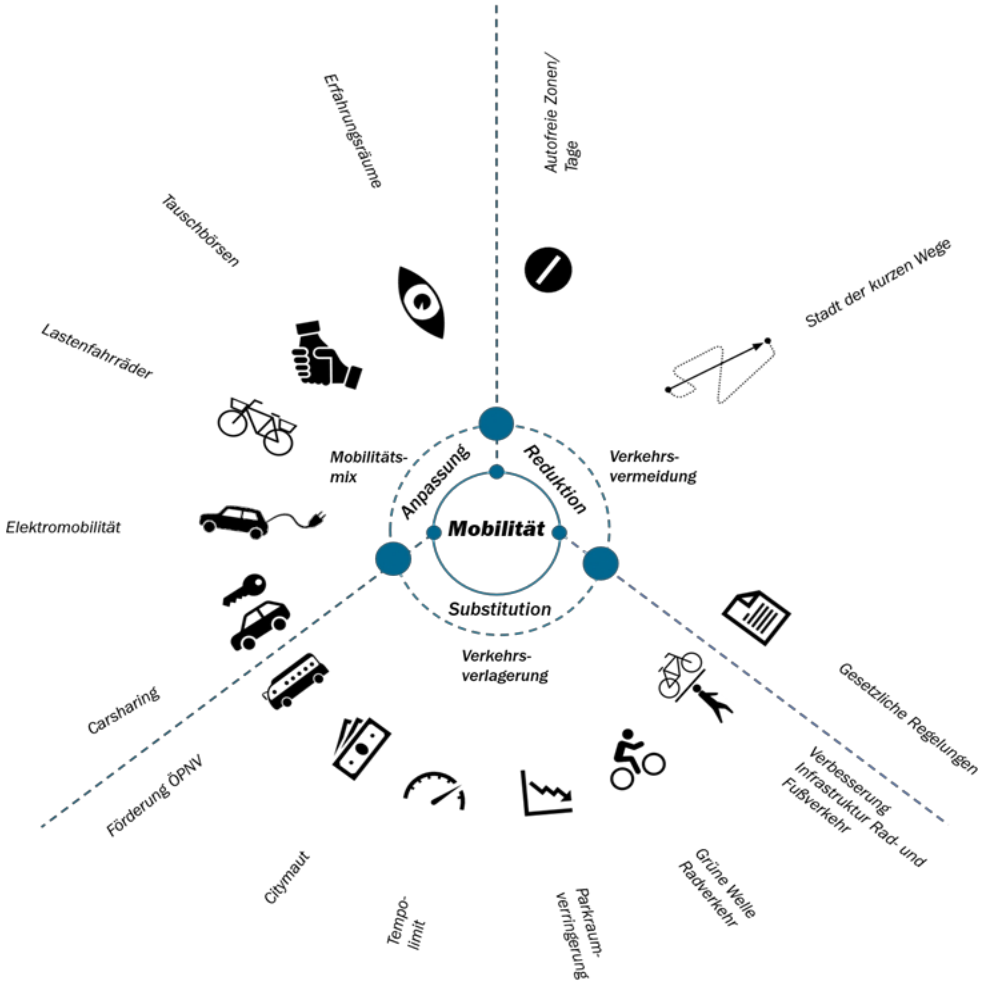


Figure 67 Sufficiency potential and approaches to action in the area of mobility

Promoting sufficiency potential through climate-friendly behaviour in private households

Private households are particularly relevant for the success of the transformation: On the one hand, they contribute 30 % to the total final energy consumption in Aachen, and on the other hand, they play an important role as
"settings" play an important role for a sufficiency-oriented lifestyle. However, this great potential of private households faces particular obstacles, which also make them a challenging target group.

The high complexity of decision-making, the influence of the social environment, the fear of loss of time, freedom, comfort and status are feared in many non-sufficiency-oriented households[51]. Sufficiency and therefore

[51] Melanie Lukas: Sufficient households - illusion or possibility? 2015.

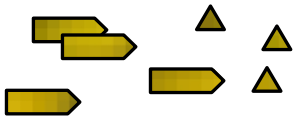
The change in behaviour associated with these households is prejudiced[52].

Realistic approaches for the broader anchoring of sufficient behaviour can therefore be found above all in "everyday sufficiency" through changed practices and cultural techniques. This is less about doing without and more about alternative behaviour that conserves energy and resources.

Sufficiency thus takes place in individual areas of life and aims at the individual benefit for the individual, be it through adaptation to the time or budget situation or through individual additional benefits, such as health effects or psychological effects.

[52] Marco Sonnberger et al: A sociological view of energy consumption in private households. 2016; Melanie Lukas: Sufficiency in households - illusion or possibility? 2015.

These are the 2030 guidelines



The behaviour-related savings target for the annual emissions level (in relation to energy consumption) in the area of action "Societal transformation" is as follows by 2030
79,000 tonnes of CO2eq per year.

By 2030, a critical mass of around 25% of Aachen's citizens should have received and accepted activation and qualification programmes.

Climate protection and sustainability are firmly anchored in Aachen's educational, cultural and leisure programmes.

Through appropriate educational and cultural programmes and the adequate addressing of different population groups, equal social and political participation of all Aachen residents is achieved.

These are the development scenarios

Savings through behavioural change

In addition to the technical building and system savings that lead to an increase in efficiency, it is also necessary to consider behaviour-related savings in order to achieve the target. This sufficiency potential can be leveraged by raising awareness of user behaviour and increasing acceptance. In the scenario calculation, it is assumed that the greatest sufficiency potential exists in private households. This was calculated on the basis of study and project-related empirical values and amounts to 30 % for electricity, 9 % for space heating and 23 % for hot water. For the other sectors - tertiary, industry and municipal facilities - the scenario calculation is based on a value of 10 % in each case. The savings from behavioural changes should be strategically achieved as early as possible. On the one hand, behaviour-related savings can be achieved quickly with low-threshold measures; on the other hand, the influence of behaviour decreases as the overall system becomes more climate-neutral. In this respect, the scenario assumes that the percentage share of sufficiency will decrease by 2030.

The clear influence on GHG reduction and consequently on achieving the climate neutrality target is illustrated in the figure below:

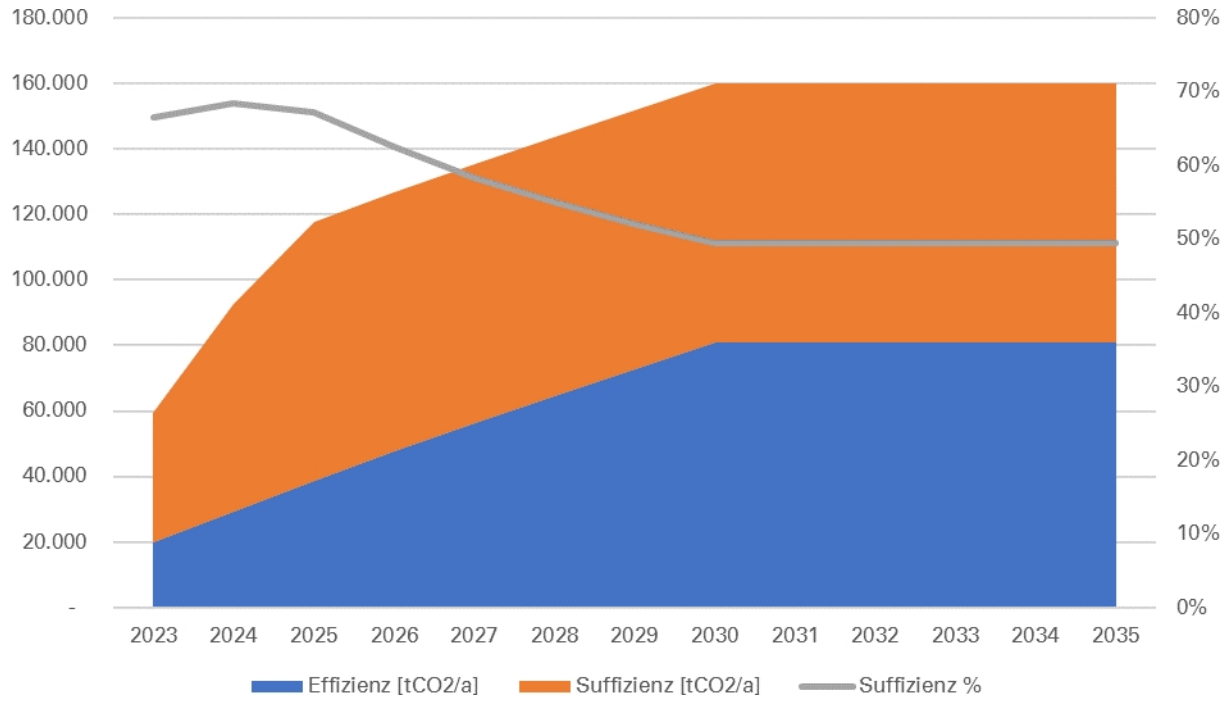


Figure 68 Illustration of sufficiency and efficiency potential in the reduction of greenhouse gases (Graphic: Gertec GmbH)

Priorities for action and measures

Climate awareness and transfer

Change comes from innovation. We are looking for multipliers and "pioneers of change": they are allies who create innovation niches and spaces of experience (real-world laboratories) in which new climate-friendly offers are created, developed jointly by providers and users and put into practice. This requires places where alternative, sustainable and climate-friendly behaviour can be tried out and consolidated. Neighbourhoods are suitable spaces for this. The measure aims to promote spaces for innovation and experience.

Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
Department VII, Division 36 - Climate and Environment FB 13 Communication and City Marketing	Addressing new and larger stakeholder groups. Win over 25 % of Aachen's citizens in favour of the transformation (critical mass) Promoting innovations for climate-friendly behaviour Create alternatives for climate-friendly action, especially in the neighbourhood Support counselling and networking	Promoting pioneers of change and opening up spaces for innovation and experience	Making climate neutrality tangible and best practice examples visible

Climate-friendly living environment

Ecologically sustainable settlement areas, open spaces adapted to climate change and social infrastructure in all neighbourhoods are some of the starting points for a climate-friendly living environment. Climate protection becomes visible to the population, inspires climate-friendly behaviour and makes the benefits of climate protection for the quality of life visible.

Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
Dec. 7 Department 36 - Climate and Environment E26 - Facility Management FB 13 - Communication and City Marketing	Citizens are aware of urban measures for a climate-friendly living environment	Integrating climate protection into the urban environment	Pilot projects for unsealing school and nursery grounds

Climate-friendly behaviour in everyday life

The focus of action is based on the theory that self-efficacy, i.e. the conviction that one can make a contribution against global warming, is a key driver for more climate-friendly action. The priority area therefore focuses on measures and recommended activities that strengthen citizens' self-efficacy for climate-friendly action and raise the behavioural potential for reducing greenhouse gases. The focus of action looks at the potential for GHG emissions in the areas of climate-friendly consumption and nutrition, activities to promote sustainable forms of housing and behaviour-related potential for energy saving and climate-friendly mobility behaviour.

Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
FB 13 - Communication and City Marketing Department 7 FB36 - Climate and Environment Citizens Municipal companies and investments Aachen Nutrition Committee	All citizens had the opportunity to try out climate-friendly behaviour through low-threshold offers, 25% of people accepted such an offer. Activating and qualifying Aachen citizens to adopt climate-friendly behaviour in everyday life Reduce barriers to trying out and testing climate-friendly alternatives and promote acceptance through increased perceived self-efficacy. Bringing companies and organisations as providers of climate-friendly products and services together with private households as decision-makers in various formats.	Participatory campaign to activate and qualify Aachen's citizens Promote regional and seasonal nutrition Implement and monitor an increase in food utilisation	Join-in campaign including volunteer climate trainers for activation and qualification Healthy and sustainable communal catering

Climate protection and education

Despite the broad thematisation of climate protection in the media etc., a large proportion of the population does not have enough information and is not adequately empowered to make climate-friendly decisions. By anchoring and qualifying them, a multiplier effect is to be promoted throughout urban society, the transformation to more climate-friendly behaviour accelerated and a significant reduction in GHG emissions achieved

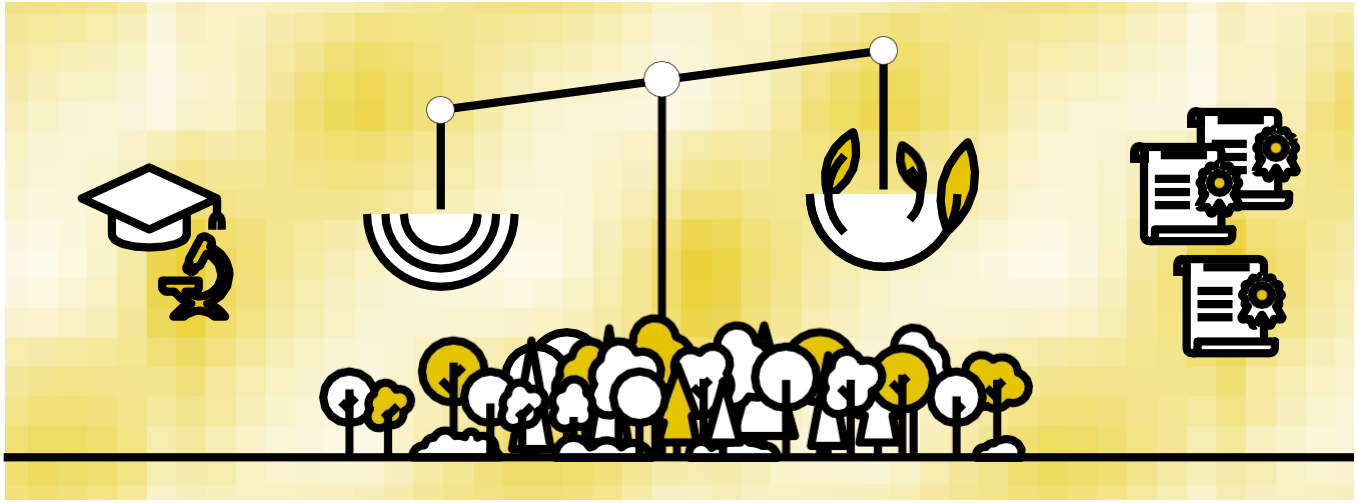
Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
Dept. 4 - Education, Youth and Culture FB 45- Children, Youth and School E 42 - Adult Education Centre Department 7 FB 36- Climate and environment Citizens, pupils, teachers	Education for sustainable development is anchored as a key topic in all educational and knowledge institutions in the city. This applies in particular to schools: Education for Sustainable Development (ESD) is anchored in the school programme in all schools. Specific measures for education for sustainable development take place regularly in all open all-day programmes at Aachen's schools and daycare centres. Special emphasis is placed on nutrition and consumption.	Experience- and process-based environmental education for climate protection and sustainability	Monitoring and support of climate and sustainability activities at schools for structural change Teaching energy efficiency and renewable energies in schools as "hands-on material" Develop and implement climate education concepts

Climate protection in culture and leisure

Culture and leisure activities can be used to create low-threshold points of contact with climate protection that can be realised without the "carrier medium" would not have arisen. Approaching people via familiar structures, such as their own association, is met with greater openness. Climate protection and sustainability thus become the subject of a wide range of activities. The measures are intended to strengthen the multiplier effect in the areas of culture, sport and leisure and actively promote projects.

Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
E 46/47 - Municipal theatre and music directorate E49- Cultural operations FB 52 - Sport Dec. 7 FB 36 - Climate and environment Associations, cultural institutions, initiatives of the city of Aachen	Promoting a culture of change in terms of sustainable and climate-friendly use of energy and resources Introducing people to sustainability issues Increase the multiplier effect of culture and sport.	Promote providers of leisure facilities as multipliers for climate protection and sustainability Cultural professionals as multipliers for climate protection	Structural changes with the handprint! - Workshops and support for implementation within the administration and with multipliers in associations and initiatives

9.10. Compensation



Alongside efficiency, consistency and sufficiency, offsetting is the fourth strategic pillar of the climate neutrality strategy. The overriding premise is the reduction of greenhouse gas (GHG) emissions. Unavoidable GHG emissions must be offset. There are various types of offsetting mechanisms that differ in their approach and quality. The field of action integrates the compensation mechanisms into the climate neutrality strategy.

What is this about?

Compensation - when all other options have been exhausted

Offsetting $CO_{2\ emissions}$ should only be seen as the last, unavoidable step at the end of a process whose primary aim must be to avoid the emissions caused altogether or at least reduce them.

Only once it has been ensured that all avoidance and reduction measures have been taken into account should compensation be considered for the remaining, unavoidable emissions.

Green infrastructure to bind CO_2

The preservation and expansion of areas that can permanently store carbon from the atmosphere in biomass and soils due to the way they are used is the first choice when it comes to the question of compensation. Green infrastructure primarily includes forest areas, agricultural areas and green and recreational areas. Vegetation areas in particular, such as agricultural, forest and wooded areas, play an important role due to their ability to remove carbon dioxide from the atmosphere and store it as carbon in their soil.

biomass plays a central role in reducing CO_2 emissions.

Compensation at company level

$CO_{2\ emissions}$ generated by Aachen-based companies that cannot be completely eliminated through technical, organisational or other measures have the option of achieving climate neutrality by purchasing certificates. Companies from the trade, commerce and industry sectors must be advised and supported in their choice.

Technical systems for CO_2 compensation and storage

In addition to the purchase of certificates, possible approaches include the technical compensation of emissions by storing them and the permanent storage of emissions in green infrastructure or biomass. The avoidance of GHG emissions is also the top priority in terms of the precautionary principle in environmental and climate protection and is clearly prioritised for the implementation of climate neutrality. Ongoing research must be closely monitored in order to identify the potential for Aachen at an early stage, to utilise the potential of technical

to examine the use of CO_2 offsetting and formulate concrete recommendations for its use.

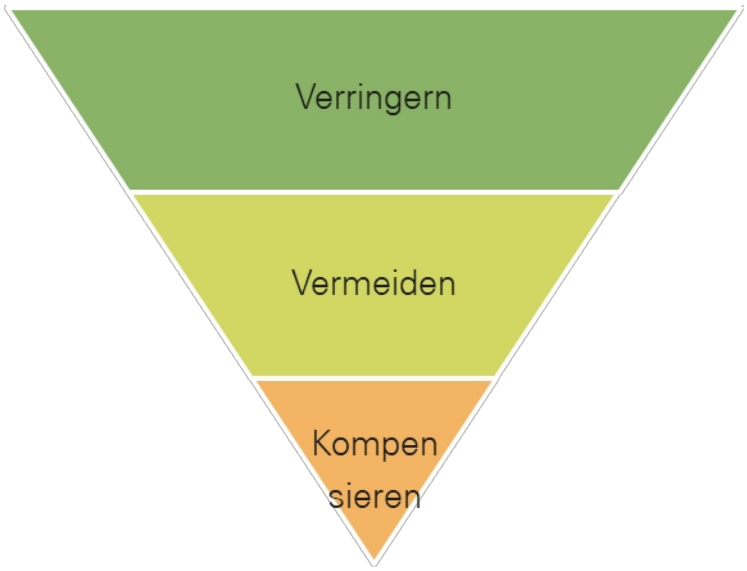


Figure 69 Schematic illustration of the prioritisation of measures to achieve climate neutrality. Reduction and avoidance should always come first, offsetting remains a "last resort". (Graphic: Gertec GmbH)

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These are the most important influences and framework conditions

compensation will be unavoidable if the city of Aachen is to achieve the goal of climate neutrality. The international framework conditions for offsetting are presented in this section.

Negative emissions - CO_2 sinks

- The principle of "negative emissions (sinks)" assumes that CO_2 is removed from the atmosphere and permanently stored (carbon dioxide removal (CDR)). A distinction is made between biological (e.g. afforestation), technical (e.g. capture and storage) and geochemical processes (e.g. weathering).
- Possible technical processes include biomass CCS (BECCS), direct air carbon capture and storage (DACCS) or the material binding of CO_2 in green polymers (green naphtha).
- Most of these procedures still need to be extensively researched and tested in order to rule out risks.
- Natural $CO_{2\ sinks}$ are measures (ecosystem-based approaches) in the area of land use, land use change and forestry. This includes, for example, the rewetting of moors.
- With these approaches, there is still a particular need for research into the durability of $CO2_{storage}$ or balancing. In this respect, these approaches also require further research and testing.

Voluntary compensation" market mechanism

In principle, the market for voluntary offsetting can be divided into two different approaches: Credits and allowances.

- The credit describes the more commonly known offsetting option, in which emissions are displaced, compensated or bound by climate protection projects. The resulting avoidance or reduction of emissions is then ideally certified by a qualitative seal of approval and offered for sale as an offsetting measure.
- A less common option is the purchase of emission allowances from capped emissions trading systems, such as the European Union Emissions Trading Scheme.

Quality features of the credit note

Carbon credits are based on climate protection projects that aim to avoid or reduce and quantify emissions. The emissions avoided in this way are sold by the project operators via various providers to private, municipal or commercial consumers, who use these credits to offset their, ideally unavoidable, emissions.

In order to guarantee consumers a reliable and qualitative implementation and quantification of climate protection projects, various seals of approval offer their certifications in compliance with the respective seal of approval-dependent quality criteria. However, the standards of the seals of approval and therefore the quality of the seals of approval vary greatly. Accordingly, there are some seals of approval that border on fraud and do not guarantee that offsetting actually takes place.

International standards

To ensure reliable and high-quality offsetting, care should therefore be taken to ensure that offsetting certificates have been certified in accordance with the now generally established "Gold Standard" best-practice seals of approval, ideally in conjunction with the CDM (Clean Development Mechanism) or the VCS (Verified Carbon Standard). The most important quality criteria of reputable quality seals/certifiers are explained below.

- Additionality: The emission reduction or avoidance must be additional, for example in that it would not be economically or legally feasible without the purpose of certification.
- Permanence: Only projects that guarantee a permanent and irreversible reduction in emissions may be certified.
- Calculation, monitoring and verification: Only methods that have been validated and recognised by independent and external auditors may be used.
- Transparency and set of rules: Clear and transparent rules should be followed to enable easy verification and traceability of the assessments.
- Time of issue: The certificates may only be issued after the realised emission reductions in order to achieve the

risk of non-implementation. It should therefore be "post-certificates" and not "pre-certificates".

- Double counting: It must be avoided that the emission reduction is sold or counted more than once.
- Involvement of the local population: $CO_{2\ compensation}$ should ensure the participation and consent of the people affected locally in order to increase the acceptance and benefits of the projects.
- Sustainable development: In addition to reducing emissions, carbon offsetting should also contribute to other UN sustainability goals, such as poverty reduction, health protection and biodiversity conservation.

The problem of double counting

While compliance with most of the criteria listed is unproblematic to implement as an established standard, there is a need for clarification with regard to the "double counting" criterion. The avoidance of double counting is a central accounting principle. The Kyoto Protocol and later the Paris Agreement present project operators with the challenge of guaranteeing the integrity of the offsetting services they generate.

Due to the binding emission reduction targets (Nationally Determined Contributions) agreed as part of the Paris Agreement, all signatory states have their own obligation to reduce emissions and therefore also to compile their own CO_2 inventories.

If, for example, a solar power project is implemented in a state, the renewable electricity generated and fed into the grid leads to a greener electricity mix. The emissions avoided by the greener electricity mix are automatically offset by the state itself via the CO_2 inventory in the energy sector.

If the operator of the solar power project sells the avoided emissions to consumers interested in offsetting, the emissions reduction is counted twice: Once by the state and once by the buyer of the offset. This double counting must be avoided.

Solution approach Corresponding Adjustments

The solution to this problem of double counting was found at COP26 in Glasgow with the rules for offsetting in Article 6.4 of the Paris Agreement. This stipulates that in order to ensure that double counting is avoided, the project operators of climate protection projects must reach a secure agreement with the respective host countries in which the projects are carried out that the host countries will offset the avoided emissions from their own emissions.

climate balance. This process is known as corresponding adjustment.

In all signatory states to the Paris Agreement, (qualitatively) certified offsetting is therefore only possible with project-specific corresponding adjustments.

As a result, there are now two different products on the voluntary offsetting market:

On the one hand, there are the already mentioned offset certificates with corresponding adjustment and securely avoided double counting as a higher quality variant, and on the other hand, so-called "contribution claims" can now be purchased from many platforms. With these contribution claims, consumers can financially support climate protection projects, but cannot claim the emission reductions achieved for their own climate protection targets. The project country will therefore count the emission reductions towards its own NDC without double counting, as the buyer of the contribution claim does not acquire the reductions for themselves, but only acts as a supporter of climate protection measures.

The price of an offset certificate according to the current best Practice is approximately € 23/tCO2 at the time of reporting.

Authorisations

The other approach to avoiding/offsetting emissions described in the introduction is the purchase and retirement of emission allowances from capped emissions trading systems such as the European emissions trading system. This caps the emissions of various energy-intensive sectors such as the energy sector or industry.

The principle of emissions avoidance through the purchase of emission allowances is achieved by the unused withdrawal of emission allowances from the European Emissions Trading Scheme, which are then no longer available to the polluters. The consumer motivated to offset benefits in several ways.

By reducing emissions according to the level of the Certificates

- The shortage of supply increases the price of the remaining certificates and thus makes the continued use of fossil fuels more expensive
- The costs for the certificate go to the EU member states, which use the money collected to feed into a climate and energy fund

Another advantage is that the emissions trading system is already established in a reliable quality and therefore offers a high level of consumer security.

However, the market stability mechanism built into the EU trading system must be taken into account. This can lead to a further reduction in the total quantity of emission allowances, meaning that unused allowances are cancelled. There is therefore a risk that the purchase and unused cancellation of emission allowances will simply lead to fewer unused emission allowances being cancelled by the EU via the market stability mechanism.

The strategically wisest course of action here would therefore be to purchase and then hold them, but without cancelling the emission certificates.

The price for EU CO2 emission allowances at the time of the Reporting at approx. 87 €/tCO2.

These are the potentials

Potential and prospects of natural greenhouse gas sinks

Due to the aforementioned risk of double counting, natural greenhouse gas sinks can still not be officially offset against the municipal balance sheet. The city of Aachen is an exception due to its participation in the EU's "100 climate-neutral cities" mission. In addition to forests and green spaces, green infrastructure also includes avenues, bushes, hedges, green buildings and parks, which provide many ecosystem services over and above their use as greenhouse gas sinks and should therefore be preserved and expanded.

[53] European Commission, 2021. EU Mission Climate Neutral City Infokit. [online] Available at https://commission.europa.eu/system/files/2021-11/ec_rtd_eu-mission-climate-neutral-cities-infokit.pdf (Last accessed on 14.09.2023, 15:59)

What does this mean for Aachen?

Strategies must be developed to ensure that the amount of greenhouse gases required to achieve climate neutrality is compensated for without undermining the success of emissions reduction. As a "Mission City", the City of Aachen must comply with the criteria set out in point 3.2 of the Info Kit53 for offsetting unavoidable greenhouse gas emissions. The emissions to be offset should not exceed 20 % of the city's greenhouse gas balance. The City of Aachen has the following options:

Green infrastructure as carbon sinks: Natural sequestration through the expansion and strengthening of natural sinks in Aachen, such as the Aachen Forest, trees and green spaces within the city limits, protect the GHG budget.

Technical solutions as carbon sinks: Technical solutions offer opportunities to remove GHG emissions from the atmosphere and store them ("carbon capture and storage"). Possible technical processes include biomass CCS (BECCS), direct air carbon capture and storage (DACCS) or the material binding of CO_2 in green polymers (green naphtha). The first pilot plants are already being used in Aachen.

Participation in the voluntary offsetting market: Carbon credits - certified according to international standards and by independent auditors - are suitable instruments for offsetting unavoidable GHG emissions in Aachen.

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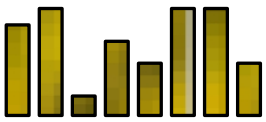

At present, however, agriculture in Aachen is a net source whose emissions exceed the natural compensation potential of the forest areas in Aachen54. In the medium to long term, emissions from active agriculture in Aachen should be reduced and the sink capacity of forest and green spaces increased to such an extent that the sector can be considered "net zero". It is necessary to plan with a generous buffer, for example to take into account the susceptibility of the sink capacity of trees to drought or pest infestation.

[54] It is assumed that the sequestered greenhouse gases in the form of wood are not used for heat generation, for example, but remain stored in the long term in the form of construction and furniture wood.

The city of Aachen is already well positioned in terms of forestry: since 1993, around 5% of the city's forest areas have been managed according to Forest Stewardship Council (FSC) criteria and the findings have been transferred to the natural commercial forest. The FSC certification was last extended by five years in 202355. In addition, the current growth of the Aachen municipal forest is 17,464 m3, which is above the removal rate stipulated by the state forestry law (14,465 m3), which means that the forest is actively binding oxygen. In future, forestry activities should be expanded to include wood processing, e.g. in co-operation with building and urban planning authorities. The comparatively high proportion of deciduous forest in Aachen's forests is well suited for construction measures such as extensions, but also multi-storey buildings and other branches of the wood-based bioeconomy. However, the city does not currently have the necessary infrastructure to carry out the processing itself. Regional planning also needs to be adapted in order to create a future sink potential via additional forest areas in accordance with EU mission specifications.

In addition to its storage potential, green infrastructure also has a substitution effect, e.g. green roofs and buildings reduce the energy required to cool a building. According to a study, green building measures can reduce CO2eq emissions from industrial and commercial sites by up to 18 %56.

Potential and prospects for technical CO2 compensation and storage

With the exception of a few pilot projects, such as the world's largest plant in Iceland, technical compensation solutions such as carbon capture and storage (CCS) have so far been difficult to realise at scale. Although various studies hold out the prospect of an efficiency of 65-80% for the capture and subsequent permanent geological storage of co257, the technology is not without risks and criticism. On the one hand, the capture, transport and storage of CO2 requires a high additional energy input, while on the other hand there remains a residual risk of leakage of the stored CO2 into the soil and groundwater, for example through the displacement of saline groundwater in deep aquifers. These risks make long-term monitoring of CCS technologies a prerequisite, but this is not yet comprehensively available. However, the operation of test and research facilities is possible to a limited extent under the Carbon Dioxide Storage Act (KSpG). Together with the Fraunhofer IEG, the city of Aachen is planning the construction of a research facility for direct air capture (DAC) and storage (mineralisation), among other things, in combination with the establishment of a real laboratory for georesources at the Weisweiler lignite-fired power plant58. The first construction phase was already started in 2022, and a total of around 100 million euros is to be invested in the facility. However, it is unclear how this research facility will be designed and operated in the medium term. The city of Aachen is also looking at approaches for retrofitting CHP plants and the Weisweiler waste incineration plant with post-combustion carbon capture (PCCC) technologies, even if a long-term solution for storing the captured CO2 must also be found here.

55 City of Aachen, 2023. principles of natural forest management, (online) Available at: https://www.aachen.de/de/stadt_buerger/umwelt/wald/03_waldwirtschaft/einleitung/index.html

56 Pan, H., Page, J., Shi, R. et al. Contribution of prioritised urban nature-based solutions allocation to carbon neutrality. Nat. Clim. Chang. 13, 862-870 (2023). https://doi.org/10.1038/s41558-023-01737-x

57 Federal Environment Agency, 23.05.2023. Carbon Capture and Storage. [online] Available at: https://www.umweltbundesamt.de/themen/wasser/gewaesser/grundwasser/nutzung-belastungen/carbon-capture-storage#grundlegende-informationen

58 City of Aachen, 2022. cornerstone paper Aachen Climate Neutral - Heat Transition 2030 [online] Available at: https://www.aachen.de/DE/stadt_buerger/energie/waermewende/Aachen-klimaneutral_Waermewende_2030-Eckpfeiler.pdf

These are the 2030 guidelines

In principle, the city of Aachen's GHG budget must not be burdened beyond the target value. Monitoring must check compliance with the development path and react flexibly. $CO_{2eq\ savings}$ must be rewarded transparently and visibly for everyone as a direct consequence of action. Emissions that exceed the development path must be reduced or offset. The risk of the carbon leakage effect must not be ignored. Reducing emissions purely on the balance sheet without decarbonising processes merely shifts "the problem" and weakens local value creation.

Green infrastructure to bind CO_2

Aachen is in a special position and can use this to develop innovative solutions that can serve as a model for other cities. Green infrastructure provides various ecosystem services and is a pillar of climate change adaptation. The synergy effects of green infrastructure also indirectly address other challenges posed by climate change. A diversified bioeconomy strengthens regional value creation in the long term.

Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
Parks department FB 36 - Climate and environment	Maintaining and strengthening the existing green infrastructure, in particular woodland and green spaces Expansion of green infrastructure in urban areas, in particular planting street trees and opening up sealed surfaces Initiating a sustainable bioeconomy	Adaptation of regional and land use planning Strengthening the bioeconomy campaign, in particular processing and utilisation of own timber in urban construction projects Unsealing of heavily sealed areas, especially in the city centre, around daycare centres, schools, care facilities and hospitals	Increase the number of green spaces and tree plantations (natural CO_2 sinks)

Compensation at company level

Knowledge of production and processes supports corresponding decarbonisation measures, companies find their process-specific solutions. Local companies are actively involved in decarbonisation processes, possible solutions can be scaled up more quickly or transferred to broad application. This approach reduces the shift in responsibility. All companies are given the opportunity to seek advice on the topic of offsetting.

Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
Department of Business, Science, Digitalisation and Europe (FB 02/000)	Communicate uniform standards for offsetting through the purchase of emission certificates	Establish uniform purchasing and reporting standards for emission certificates.	Consultancy services for Aachen-based companies on compensation options

Technical systems for CO_2 compensation and storage

Technical solutions for CO_2 capture and storage can enable existing infrastructure and industry to run in the medium term and capture emissions that cannot be prevented. The basis is a comprehensive knowledge base for the design, implementation and monitoring of these technologies, which are to be researched at the Aachen site. Technical solutions for $CO_{2\,capture}$ and storage can enable existing infrastructure and industry to run in the medium term and capture emissions that cannot be prevented.

Who acts with whom?	Strategic goals	What measures are required?	What activities support the implementation?
Facility Management & FB 61/100 of the City of Aachen Fraunhofer Institute INE STAWAG (indirect). Aachen University of Applied Sciences RWT Aachen Chair of Building and Room Air Conditioning Technology; Chair of Geotechnical Engineering in Civil Engineering and Institute of Geomechanics and Subsurface Engineering; Chair of Energy Efficient Building Institute NOWUM-Energy Solar Institute Julich -SIJ Institute for Data-based Technologies (IDT)	Research technical approaches for CO_2 compensation such as PCCC technologies and their chains and monitoring Transferring findings from research facility to broader application Realisation of the planned research facility for direct air capture (DAC) at the Weisweiler lignite-fired power plant, among other things	Advising industrial and manufacturing companies on technical solutions, the legal framework for CO2 storage and the required infrastructure Identify potential for technical compensation and $CO2_{storage}$	Potential study on technical compensation

10. Cost-benefit analysis

Now that the strategic objectives in the fields of action have become clear, this chapter assesses the challenges and benefits required to achieve the objectives.

The challenges of transformation require considerable investment in all areas of activity. These economic endeavours are also associated with benefit aspects that need to be equally considered in a weighing-up process. The prioritisation and selection of measures based solely on a simple consideration of the criterion of euros per tonne of CO_{2eq} saved does not do justice to the complexity of the task. In addition to the costs of the transformation, it is necessary to clearly demonstrate the benefits of the transformation beyond the pure CO_{2eq} reduction as a sound basis for decision-making.

In addition to the question of costs, this always includes a consideration of the induced benefits. The generic term "cost-benefit analysis" is used here to describe a step in the process in which the assessment of the investment costs is accompanied by an assessment of various benefits.

10.1. Methodological approach

The following methodological approaches are used to determine the cost and benefit levels:

1. In this study, the cost-benefit analysis is carried out for the fields of action and key areas of action with their respective measures. In each case, the level of the key areas of action is shown (see Chapter 8.1). Only action priorities that can achieve an absolute GHG reduction are considered. Priority areas with e.g. B. predominantly administrative or planning measures are therefore not considered.

2. The cost-benefit effects are determined for the target scenario and the trend scenario and compared with each other. Only in this way can both challenges and benefit levels are considered in a differentiated manner. The scenarios provide the basic data for the calculation.

3. The actual cost-benefit analysis analyses the financial requirements, economic efficiency, cost efficiency for CO2eq reduction, environmental benefits and regional benefits and weighs these up. This results in an overall assessment of the benefits of the financial resources used in the transformation process.

The result of this analysis provides a basis for assessing obstacles and opportunities and weighing up the measures to be taken to achieve the objectives.

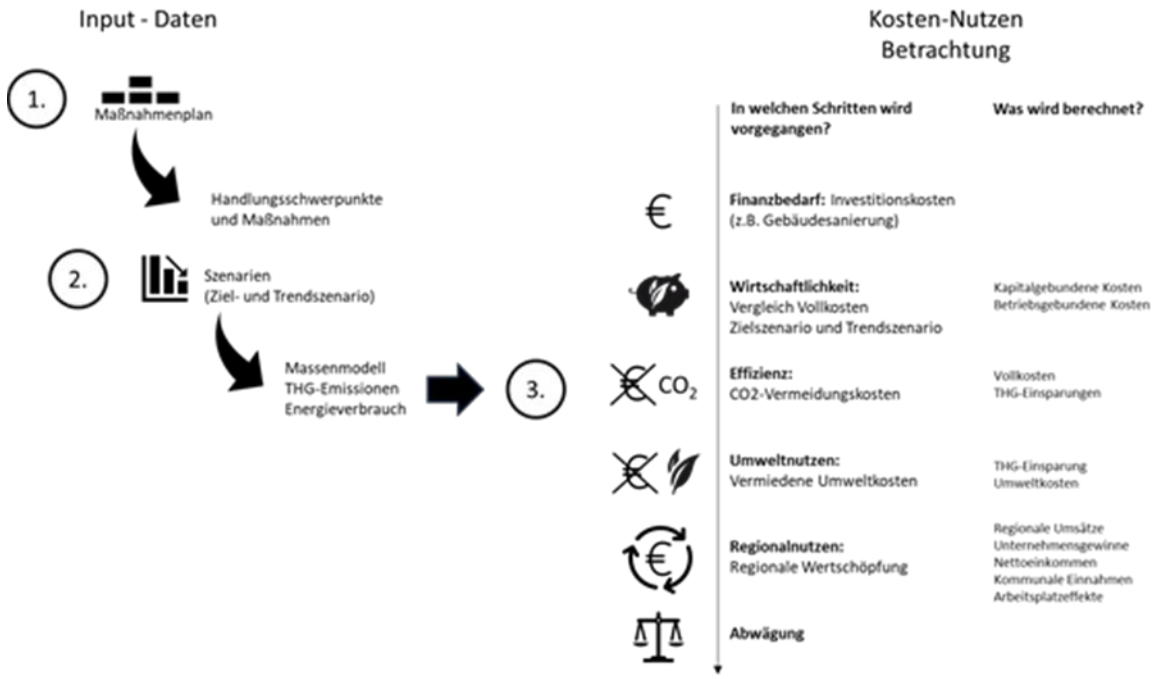

Figure 70 Schematic representation of the methodological approach for the cost-benefit analysis. (Graphic: Bodo Wirtz)

10.2. Estimate investment costs

The dimensions of the transformation given here are rough estimates and represent a section of the required investments. The cost calculation is based on the formulated targets for greenhouse gas neutrality.

The costs of the transformations are calculated on the basis of rough estimates of a quantity structure and specific cost parameters.

The absolute investment is estimated at 7.2 billion euros.

Only action priorities that require investments and lead to absolute greenhouse gas reductions are considered. The investments are distributed among the EU, federal government, state, city group and market players.

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Figure 71 shows the differences between the target and trend scenarios in terms of absolute investment costs per area of action, broken down by key areas of action; Table 14 compares the costs of the scenarios. This enables a statement to be made about the additional investment required to achieve the goal of climate neutrality.

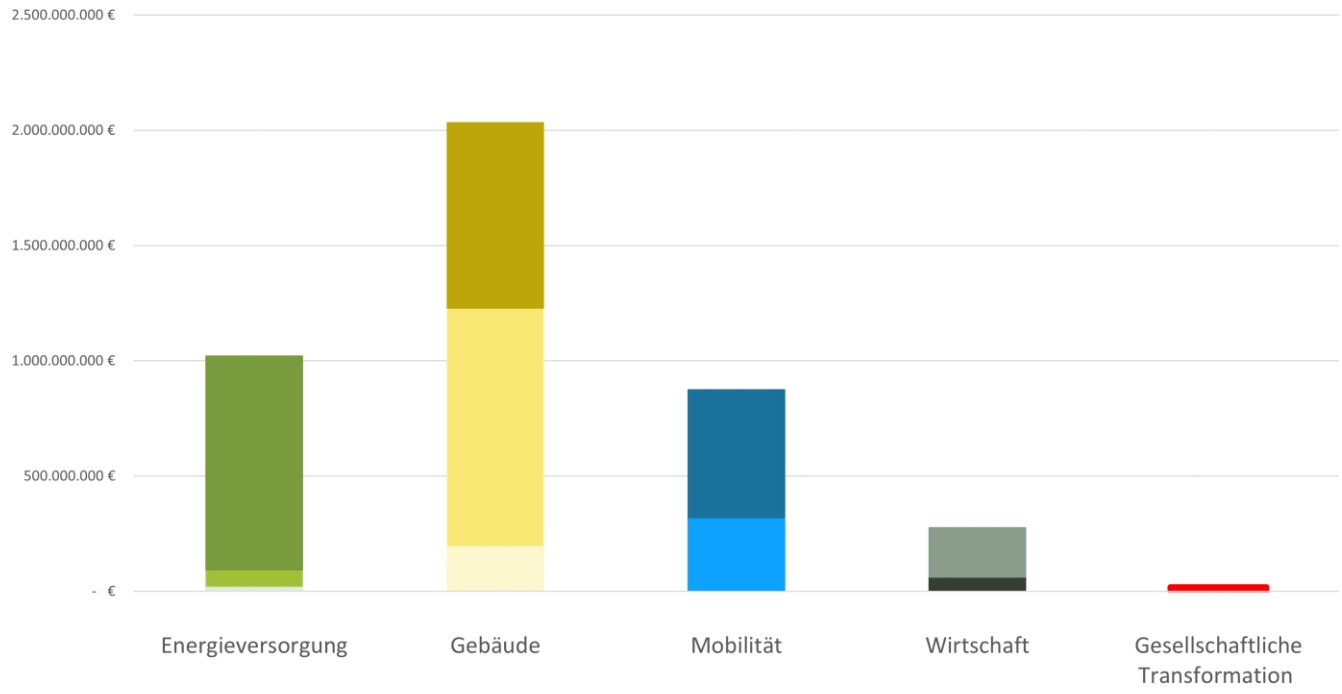

Figure 71 Comparison of investment costs between the target and trend scenarios according to fields of action. (Graphic: Gertec GmbH)

Energy supply

City as a role model: energy supply and generation: The municipal family also wants to lead the way in the area of municipal energy supply. To this end, electricity and heating requirements are to be covered by renewable energies. The target scenario aims to expand photovoltaics by 21.4 MWp on municipal buildings, while only 13.7 MWp is assumed in the trend scenario. Wind power is expanded to 11.3 MW in the target scenario and 4.3 MW in the trend scenario. The cumulative costs for this amount to € 46.6 million in the target scenario and € 26 million in the trend scenario. Depending on the heat generation mix, the expansion of plants to cover the heat demand is estimated at € 234.1 million in the target scenario and € 26 million in the trend scenario.
131.6 million was recognised.

Locally and renewably generated electricity: The focus of action deals with the expansion of local renewable energy potential. The target scenario aims to expand photovoltaics by 149 MWp and add 39 MW of wind power. In the trend scenario, 130 MWp of photovoltaics and 5 MW of wind power will be expanded. Cumulatively, this leads to investment costs totalling EUR 273.4 million in the target scenario and EUR 201.4 million in the trend scenario.
Euro in the trend scenario.

Decarbonised heat supply: Specifically, the investment costs of the heat supply amount to around €901/(MWh/a) in the target scenario and €507/(MWh/a) in the trend scenario, which leads to a total investment of around €2.12 billion in the target scenario and €1.19 billion in the trend scenario. The heat supply mix corresponds to the configurations in the target and trend scenarios.

Building

Public buildings and facilities: 428 €/m² is assumed in both scenarios for the modernisation of the municipal family's building stock. In the target scenario, 36% of the building stock will be extensively modernised by 2030 and 13% in the trend scenario. Under these framework conditions, investment costs of around € 302.9 million result for the target scenario and an investment requirement of € 106 million for the trend scenario for the refurbishment of public buildings and facilities.

Refurbishment of existing residential buildings: The focus is on the energy modernisation of Aachen's single-family and multi-family housing stock. The living space is estimated at 10.3 million m². The specific costs of modernisation amount to 428 €/m². In the target scenario, 36 % is modernised, in the trend scenario 13 %. In total, investment costs of around €1.59 billion result for the target scenario and an investment requirement of €555 million for the trend scenario. The refurbishment costs are mainly incurred for the

housing industry and private homeowners. The economic viability for the housing industry is completely different to that of owner-occupiers. Landlords can pass on 8% of the costs to tenants each year after deducting maintenance costs (business-as-usual costs) and subsidies (e.g. repayment subsidy). Depending on the framework conditions (rent levels), refurbishments are more economical from this point of view. For owner-occupiers, there is an economic amortisation taking into account subsidies and the avoided energy costs. The refurbishment target is independent of a time dimension. However, obstacles such as a lack of skilled labour or acceptance problems pose risks to implementation.

Climate-neutral non-residential buildings: The area for non-residential buildings is estimated at approx. 8 million m². In the target scenario, 36 % is refurbished, in the trend scenario 13 %. At € 428/m², investment costs of € 1.24 billion are incurred in the target scenario and € 433.1 million in the trend scenario.

Mobility

Traffic avoidance and modal shift: The target scenario is based on Scenario B of the mobility transition, in which cost-effective and flexible mobility strives for particularly exemplary urban transport. Assuming €2,500 per tonne of CO_2 avoided, the costs of reducing transport-related emissions by more than 126 tonnes of CO2/a amount to €318.4 million.

Climate-friendly drives and fuels: The focus of action estimates the investment costs required for a comprehensive change in drive technologies. While the target scenario assumes an e-mobility share of 90.9% and a hydrogen vehicle share of 5.3% in 2030, the trend scenario only assumes an e-mobility share of 14.4% and a hydrogen vehicle share of 1.9%. In the case of public charging points, based on the EU Directive "Development of infrastructure for alternative fuels", a ratio of ten public charging points per 100 electric vehicles is assumed. In line with the DENA study "Private charging infrastructure potential for Germany", the private charging infrastructure is estimated at 85 charging points per 100 electric vehicles. With additional investment costs of €3,000 for electric vehicles and
40,000 for hydrogen vehicles and € 2,000 investment costs per charging point, the investment costs in the target scenario amount to around € 715.1 million. The investment costs in the trend scenario amount to around € 158.5 million.

Economy

Trade, commerce, services: The costs of transformation in the trade, commerce and services sector are included in this priority area. As the costs of heat savings through refurbishment measures are included in the climate-neutral non-residential buildings priority area, the costs of changing the process heat mix and implementing measures to increase sufficiency are considered here. In the economic context, it is also assumed that 25% of the approximately 118,000 employees subject to social security contributions in the tertiary sector will be qualified. With qualification costs of around € 250 per employee in the target scenario, costs of around € 7.4 million are incurred. No such measures are envisaged in the trend scenario, meaning that no capital-linked costs are recognised.

The process heat mix is applied in the same way as the overall heat mix in the scenarios. In order to analyse only the change in energy source, the same process heat demand of 138,250 MWh/a in 2030 is assumed in both the trend and target scenarios. Average investment costs in the target scenario are around € 900/MWh, whereas only € 507/MWh are assumed in the trend scenario. This leads to investment costs of around € 124.6 million in the target scenario and € 70 million in the trend scenario for the conversion of the process heat mix.

Industry: The costs of transformation in the industry sector fall under this priority area. Here, too, the costs of heat savings through refurbishment measures are included in the priority area of climate-neutral non-residential buildings, so that the costs of changing the process heat mix and implementing measures to increase sufficiency are taken into account. With

A training programme for 25% of the approximately 21,000 employees subject to social security contributions in the industrial sector and training costs of around € 250 per employee in the target scenario result in costs of around € 1.3 million. No such measures are envisaged in the trend scenario, meaning that no capital-linked costs are recognised.

The process heat mix is applied in the same way as the overall heat mix in the scenarios. In order to analyse only the change in energy source, the same process heat demand of 541,000 MWh/a in 2030 is assumed in both the trend and target scenarios. Average investment costs in the target scenario are around € 900/MWh, whereas only € 507/MWh are assumed in the trend scenario. This leads to investment costs of around € 487.6 million in the target scenario and € 274.1 million in the trend scenario for the conversion of the process heat mix.

Social transformation

Climate protection in everyday life: In order to achieve permanently stable climate-friendly behaviour in everyday life, around 25 % of the total of around 249,900 Aachen citizens must be activated and qualified through specific offers. Experience shows a concrete energy-related reduction potential of between 1 and 1.5 tonnes per person per year. The costs for the necessary transformation-related measures are estimated at around 300 euros per qualified person, i.e. 18.7 million euros for qualification, participation and communication measures.

Priorities for action	Investment costs Target scenario	Investment costs Trend scenario	Difference scenarios
Climate protection in everyday life	18.700.000 €	- €	18.700.000 €
Social transformation	18.700.000 €	- €	18.700.000 €
Trade, commerce, services	132.000.000 €	70.000.000 €	62.000.000 €
Industry	488.900.000 €	274.100.000 €	214.800.000 €
Total economy	620.900.000 €	344.100.000 €	276.800.000 €
City as a role model: public buildings and facilities	302.900.000 €	106.000.000 €	196.900.000 €
Residential building refurbishment	1.586.900.000 €	555.400.000 €	1.031.500.000 €
Climate-neutral non-residential buildings	1.237.700.000 €	433.200.000 €	804.500.000 €
Total buildings	3.127.500.000 €	1.094.600.000 €	2.032.900.000 €
City as a role model: energy supply and generation	46.600.000 €	26.000.000 €	20.600.000 €
Locally and renewably generated electricity	273.420.000 €	201.400.000 €	72.020.000 €
Decarbonised heat supply	2.120.600.000 €	1.192.100.000 €	928.500.000 €
Total energy	2.440.620.000 €	1.419.500.000 €	1.021.120.000 €
Traffic avoidance and modal shift: passenger transport	318.400.000 €	- €	318.400.000 €
Climate-friendly drives and fuels	715.100.000 €	158.500.000 €	556.600.000 €
Total mobility	1.033.500.000 €	158.500.000 €	875.000.000 €
Sum of all fields of action	7.241.200.000 €	3.016.700.000 €	4.224.500.000 €

Table 12 Comparison of investment costs between target and trend scenario by area of action

Economic efficiency: full cost analysis in comparison

The investment costs presented above provide an indication of the financial cost of the transformation. However, they are not sufficient as the sole criterion for evaluating the main areas of action and the associated measures. The comparative full cost analysis enables a more differentiated view:

The comparative full cost analysis calculates the annual full costs for the main areas of action for the target scenario and compares these with the annual full costs in the trend scenario. The full costs include the annuity investment costs and the annual demand-related costs. For the "refurbishment of existing buildings" action priority, for example, this means that not only the investment in a building is taken into account, but also the associated savings in energy costs. This comparison therefore provides an indication of the cost-effectiveness of climate neutrality efforts compared to the trend development (Figure 72) illustrates the full cost analysis for each area of action:

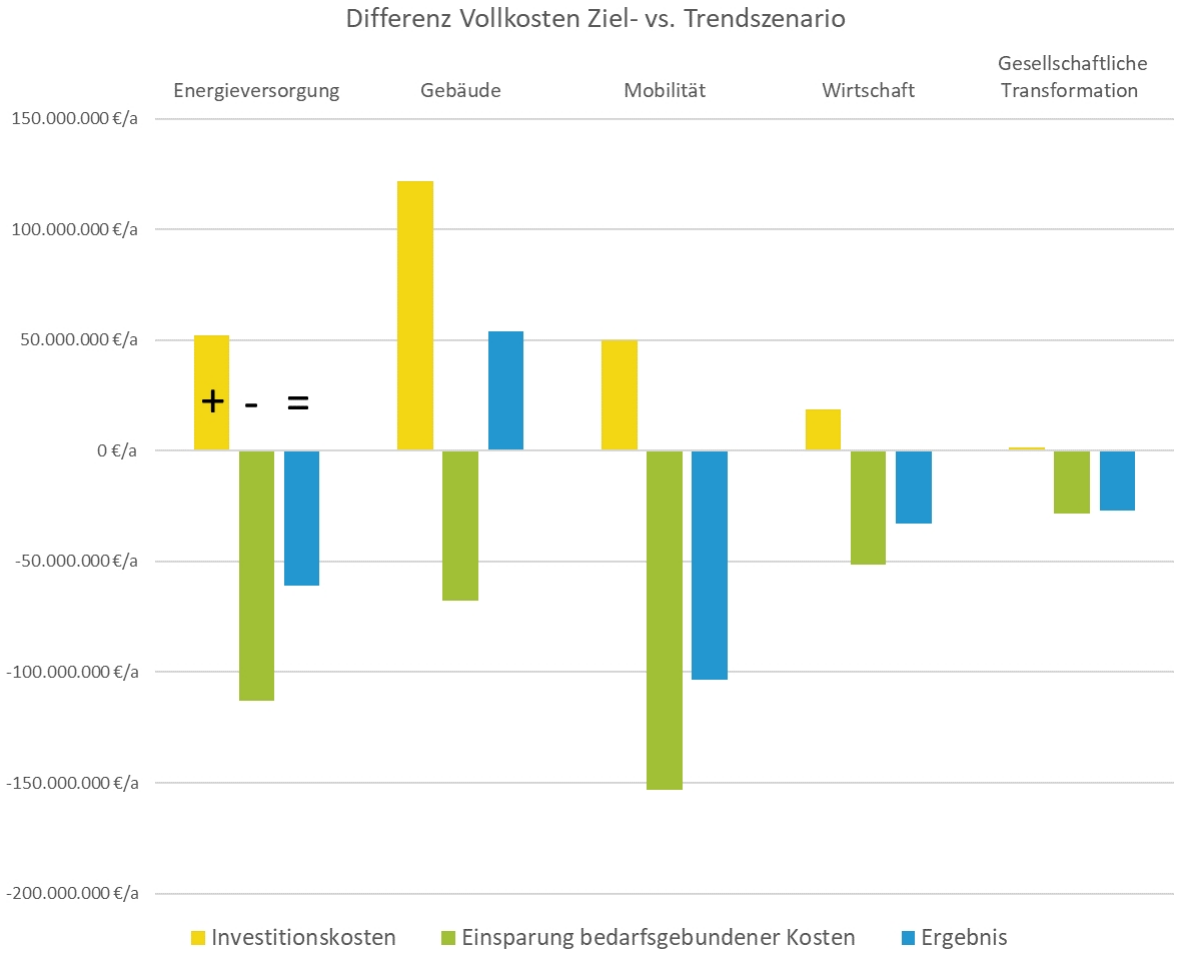

Figure 72 Comparison of the difference between the target vs. trend scenario for the full annual costs per area of action

The comparative analysis shows that, with the exception of the focus on buildings, a positive overall economic result is achieved in all areas of action by taking into account the savings in demand-related costs.

Particularly in the area of mobility, the savings in demand-related costs have a significant effect on economic efficiency. The reason for this is the high penetration rate of electrification in the area of mobile private transport (MIV). By 2030, this is 90.9% in the target scenario and only 14.4% in the trend scenario. Due to the additionally assumed avoidance of 50% of journeys in MIT, the final energy demand for MIT is reduced to approx. 34,400 MWh/a in the target scenario.

In the trend scenario, no avoidance of journeys by private motorised transport is assumed, which means that a slight change in the drive mix would result in a mobility-related final energy demand of just under
682,000 MWh/a is recognised. The demand-related costs
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amount to € 11.9 million in the target scenario, compared to € 159.2 million in the
trend scenario.

Field of action	Difference in investment costs	Savings on demand-related costs	Result
Social transformation	1.260.000 €/a	-28.310.000 €/a	-27.050.000 €/a
Economy	18.700.000 €/a	-51.600.000 €/a	-32.900.000 €/a
Building	121.700.000 €/a	-67.700.000 €/a	54.000.000 €/a
Energy supply	52.090.000 €/a	-113.000.000 €/a	-60.910.000 €/a
Mobility	49.800.000 €/a	-153.300.000 €/a	-103.500.000 €/a

Table 13 Comparison of investment costs and savings in demand-related costs per field of action.

Estimating the costs of CO2 avoidance

The investment costs show the financial outlay, while the comparative full costs provide an indication of the economic efficiency. The next step is to assess the efficiency of the climate protection efforts.

A suitable method is the calculation of CO2eq avoidance costs. The CO2 avoidance costs describe the amount in euros per tonne of CO2eq that is incurred for the reduction of a certain amount of CO2eq compared to a reference technology. The abatement costs are therefore an indicator of the cost efficiency of a climate protection measure per tonne of CO2eq avoided.

This report compares the efficiency of the measures in the key action areas of the target scenario and the trend scenario.

By definition, the use of CO2eq avoidance costs is only permissible if a measure leads to a reduction in CO2 compared to the reference. Negative abatement costs arise if the implementation of a measure saves more money than is invested.

Methodological digression: The avoidance costs are the annuity costs that are incurred on the basis of a
.

reference date to reduce a certain amount of greenhouse gases. The annuity costs include capital-related costs, demand-related costs and other costs. The capital-related costs are calculated on the basis of the transformation costs roughly determined in the previous chapter. The demand-related costs result in particular from energy procurement costs. When calculating the avoidance costs of an energy-efficient refurbishment, the energy savings and the associated energy procurement costs are therefore taken into account in addition to the investment costs for insulation measures.

The abatement costs are then calculated as the quotient of the difference in costs and emissions between the greenhouse gas reduction measures in the target scenario and the trend scenario.

External environmental costs are internalised by comparing them with the greenhouse gas avoidance costs and the resulting avoided environmental damage in euros per year.

The CO2 avoidance costs are calculated from the weighted average of the CO2 savings per action priority and shown in Figure 73.

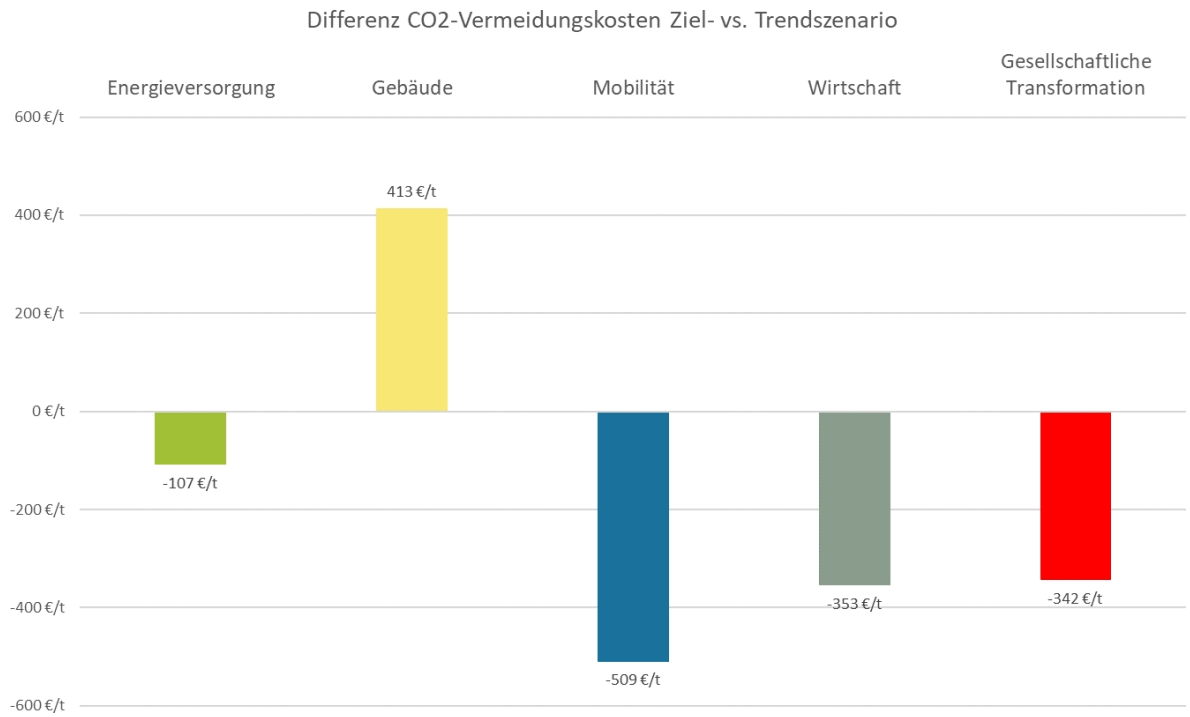


Figure 73 Comparison of the specific CO_2 avoidance costs per field of action in €/t.

Field of action	Difference in CO_2 avoidance costs
Social transformation	-342 €/t
Economy	-353 €/t
Building	413 €/t
Energy supply	-107 €/t
Mobility	- 509 €/t

Table 14 Overview of the difference between the target vs. trend scenario for the full annual costs per area of action

A comparison of the CO_2 avoidance costs of the two scenarios shows that, with the exception of the "Buildings" focus, all action priorities have an economically favourable ratio of static avoidance costs. This is due to high initial investment costs.

Avoided environmental damage

This approach is based on the methodology convention of the German Environment Agency. Damage costs (environmental costs) estimate the costs incurred by society as a result of GHG emissions and the resulting climate change. Environmental costs for the year 2020 are as follows

Federal Environment Agency at 237 €/tCO2 and 680 €/tCO2 respectively. The difference in valuation results from a weighted allocation of the damage to future generations. The higher value is based on the assumption that current and future damage are weighted equally, i.e. the welfare of current and future generations is taken into account to the same extent. In the following, 237 €/tCO2 is used.

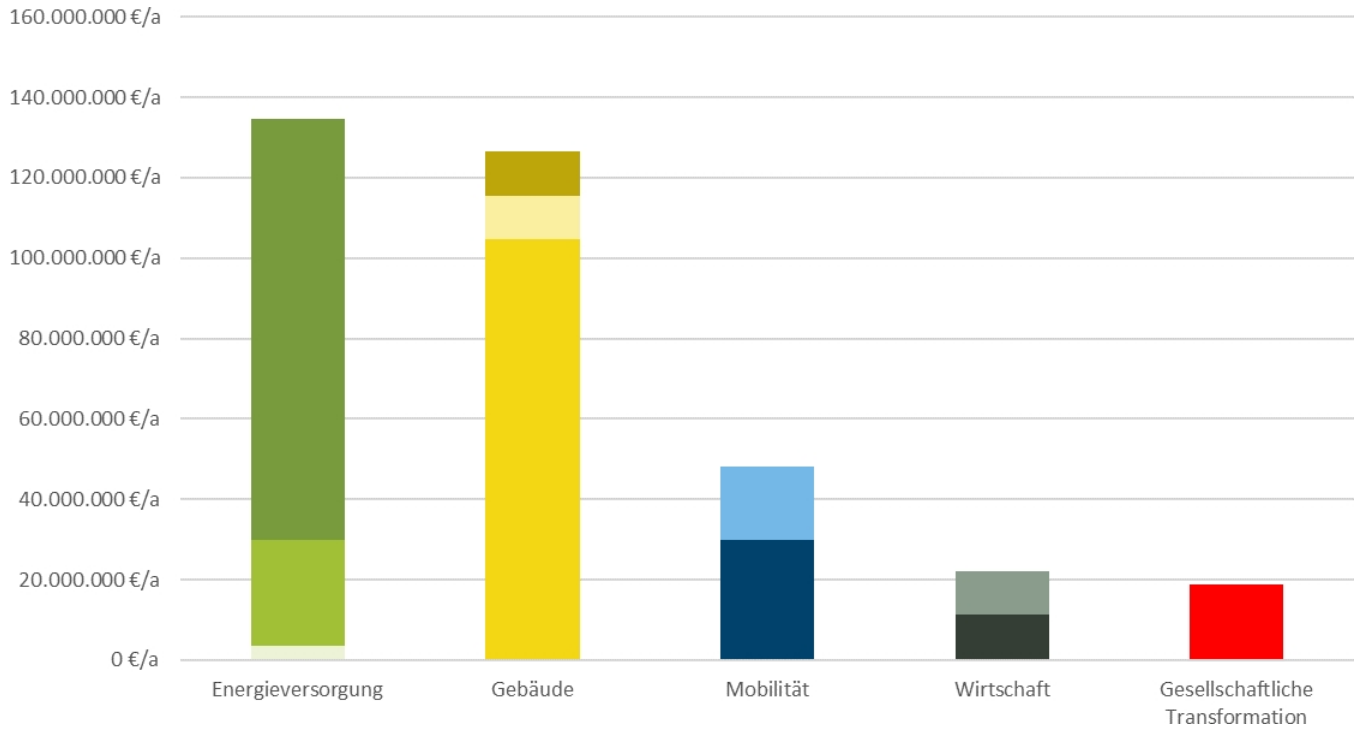


Figure 74 Comparison between target and trend scenario of avoided environmental damage.

Table 15 shows that all key areas of action lead to the avoidance of environmental damage. The focal areas of energy and buildings have the greatest potential.

Field of action	Difference in avoided environmental damage Target vs. trend scenario
Social transformation	18.720.000 €/a
Economy	22.100.000 €/a
Building	126.700.000 €/a
Energy supply	134.700.000 €/a
Mobility	48.200.000 €/a

Table 15 Overview of avoided environmental damage per field of action

10.3. Regional added value

A region or city benefits from the utilisation of resources in its area - that is the basic idea behind regional value creation.

There is no generally applicable definition of the term. The Institute for Applied Material Flow Management (IfaS) defines regional value creation as "the sum of all additional values (...) that are created in a region in a certain period of time. In addition to purely monetary aspects such as cost reduction, increase in purchasing power, new jobs or
Preservation of jobs, higher tax revenue, etc. in particular social, ethical and ecological aspects". The Institute for Ecological Economy Research (IÖW) defines value creation at municipal level as the composition of The profit realised (after tax) by the companies involved, the net income of the employees involved and the municipal taxes paid on the basis of the value creation steps under consideration.

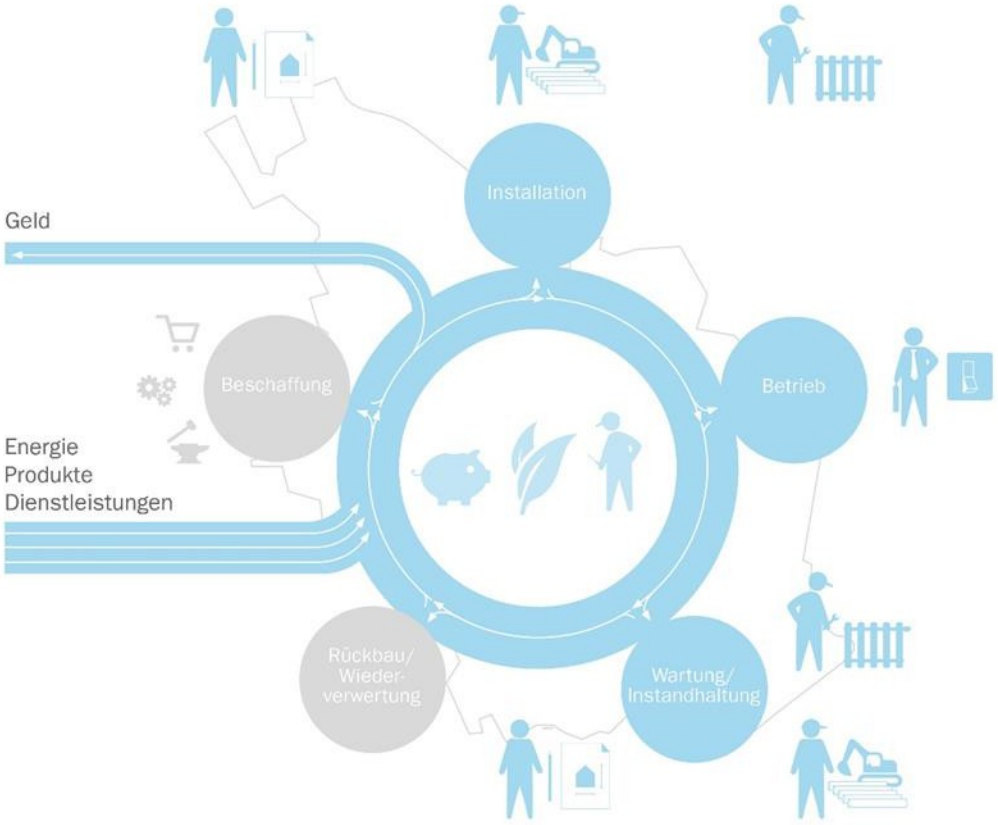


Figure 75 Schematic representation of the regional value creation cycles. (Graphic: Bodo Wirtz)

For municipal processes, it has proven useful to take into account the value added that is generated within the boundaries of the local authority and the companies and their employees based there, as well as the municipal value added of the local authority. The effect is described by the company profits, the net income of the employees and the revenue of the City of Aachen in the form of of tax revenues, levies and fees. The job effects associated with the added value in the main sectors involved are also taken into account. The basis for this calculation would therefore essentially be revenue in the climate protection sector, for example from the refurbishment of buildings, the construction of solar power plants or the expansion of the district heating infrastructure.

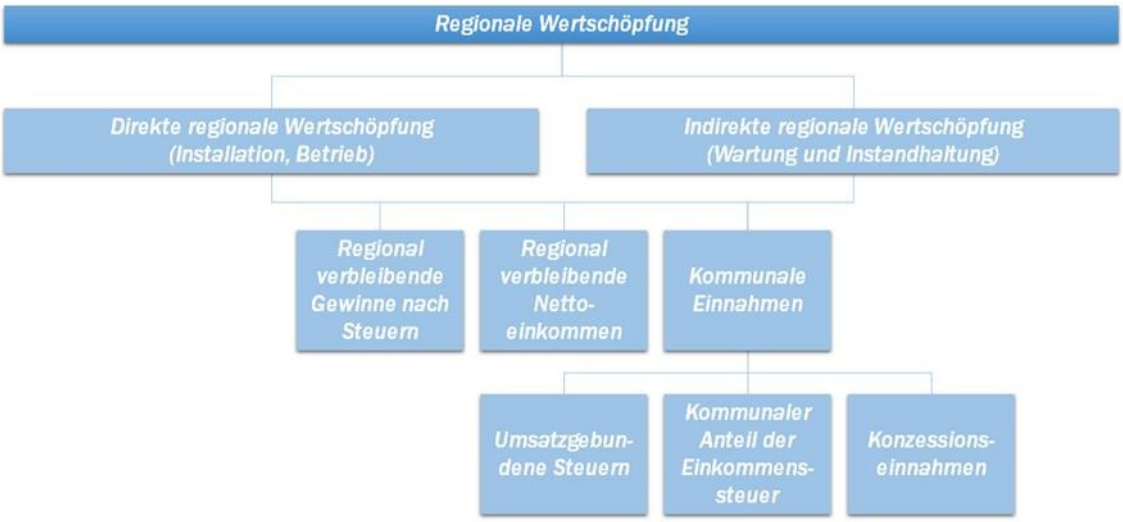


Figure 76 Schematic representation of direct and indirect regional value creation. (Graphic: Gertec GmbH)

On this basis, the resulting company profits, the net income of employees and municipal revenues are roughly calculated. Job effects in the relevant sectors are derived. The model calculates the cumulative specific, employees subject to social insurance contributions in full-time equivalents. The calculation shows how many full-time equivalents (FTEs) can be realised in relation to regional sales. The additional jobs created are not explicitly quantified.

Field of action	Regional sales	Net income	Profits (after taxes)	Municipal revenues	Workstation equivalents
Social transformation	-590.000 €/a	- 100.000 €/a	-13.000 €/a	0 €/a	0
Economy	5.590.000 €/a	2.190.000 €/a	280.000 €/a	110.000 €/a	62
Building	55.500.000 €/a	17.400.000 €/a	2.500.000 €/a	1.000.000 €/a	501
Energy supply	22.400.000 €/a	7.900.000 €/a	1.040.000 €/a	420.000 €/a	225
Mobility	12.300.000 €/a	5.200.000 €/a	600.000 €/a	300.000 €/a	147

Table 16 Differences in regional turnover and job equivalents by field of activity

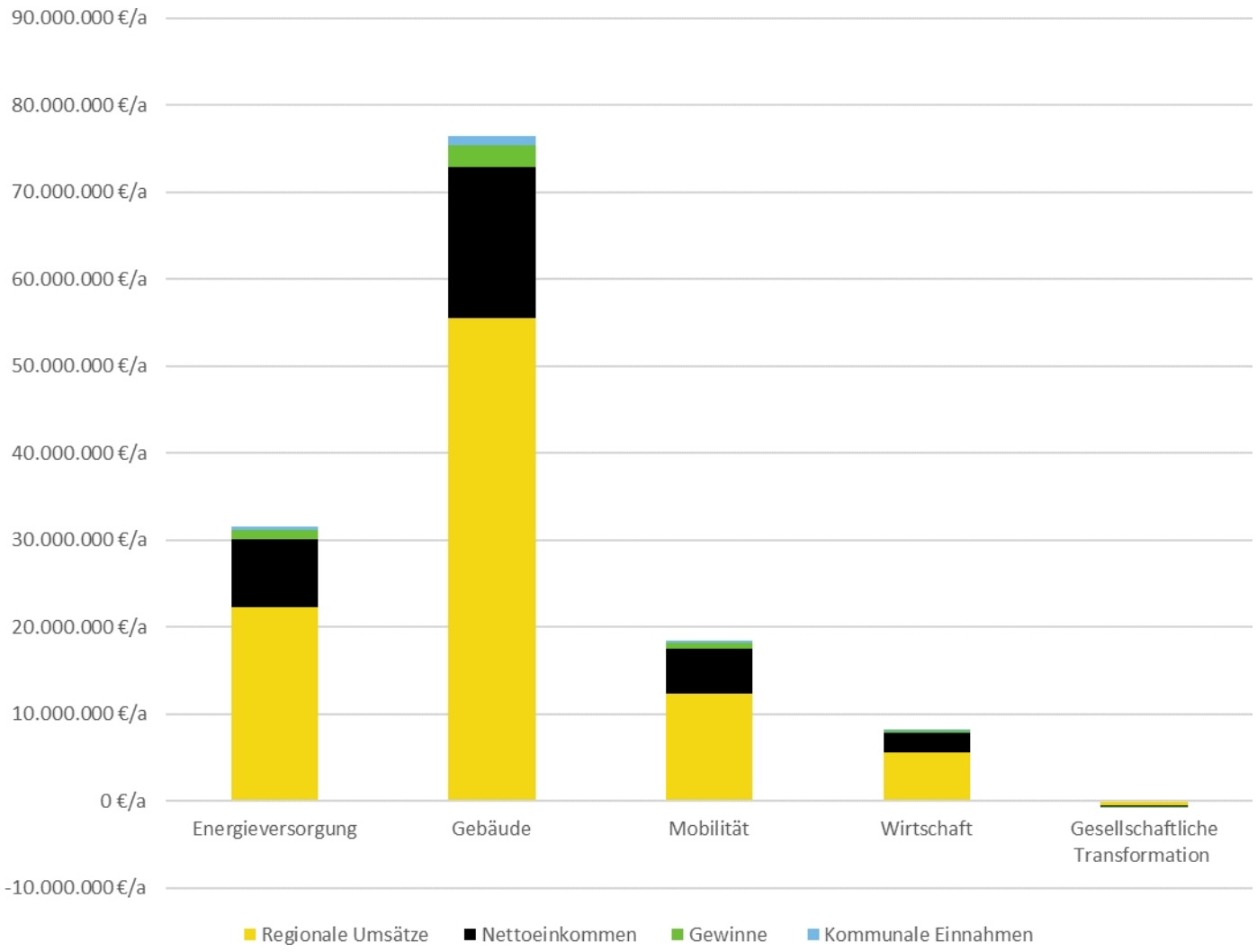


Figure 77 Differences in regional turnover and job equivalents by field of activity

Social transformation

Field of action	Regional sales	Net income	Profits (after taxes)	Municipal revenues	Workstation equivalents
Climate protection in everyday life	- 590.000 €/a	- 100.000 €/a	-13.000 €/a	0 €/a	0

Table 17 Differences in regional turnover and job equivalents in the priority area of society

Economy

Field of action	Regional sales	Net income	Profits (after taxes)	Municipal revenues	Workstation equivalents
Trade, commerce, services	890.000 €/a	480.000 €/a	50.000 €/a	20.000 €/a	13
Industry	4.700.000 €/a	1.710.000 €/a	230.000 €/a	90.000 €/a	49

Table 18 Differences in regional turnover and job equivalents in the priority area of the economy

Building

Field of action	Regional sales	Net income	Profits (after taxes)	Municipal revenues	Workstation equivalents
City as a role model: municipal buildings and facilities	5.500.000 €/a	1.700.000 €/a	200.000 €/a	100.000 €/a	49
Residential buildings: Refurbishment of existing buildings	27.600.000 €/a	8.800.000 €/a	1.300.000 €/a	500.000 €/a	253
Climate-neutral non-residential buildings	22.400.000 €/a	6.900.000 €/a	1.000.000 €/a	400.000 €/a	199

Table 19 Differences in regional turnover and job equivalents in the buildings action area

Energy supply

Field of action	Regional sales	Net income	Profits (after taxes)	Municipal revenues	Workstation equivalents
City as a role model: energy supply and -generation	200.000 €/a	150.000 €/a	10.000 €/a	10.000 €/a	4
Locally and renewably generated electricity	700.000 €/a	500.000 €/a	40.000 €/a	20.000 €/a	5
Decarbonised heat supply	21.500.000 €/a	7.200.000 €/a	990.000 €/a	390.000 €/a	206

Table 20 Differences in regional turnover and job equivalents in the priority area of energy

Mobility

Field of action	Regional sales	Net income	Profits (after taxes)	Municipal revenues	Workstation equivalents
Traffic avoidance and modal shift: passenger transport	6.300.000 €/a	1.900.000 €/a	300.000 €/a	100.000 €/a	56
Climate-friendly drives and fuels	6.000.000 €/a	3.300.000 €/a	300.000 €/a	200.000 €/a	91

Table 21 Differences in regional turnover and job equivalents in the priority area of mobility

10.4. Categorisation of the results

The aim of this chapter is to summarise the parameters developed and to enable a holistic view of the effects investigated.

Recommendations for strategy optimisation and prioritisation of measures are formulated on the basis of the cost-benefit analysis and the assessment of the target evaluation. The result is a climate neutrality strategy described in terms of content and timeframe with prioritisation of the various key areas of action.
The difference between investment and operating costs alone cannot be used to prioritise the fields of action. Rather, in addition to the $CO_{2\ avoidance\ costs,\ an}$ integrated review must also be carried out of how much CO_2 is saved, how high the avoided environmental costs and how large the regional value creation effects are - i.e. how large the "climate protection return" is.

This integrated view is made possible by the fact that the previously derived key figures are calculated specifically per tonne of CO_2 saved. The unit for each category is therefore €/t. The following figure 78

Figure 78 illustrates the procedure.

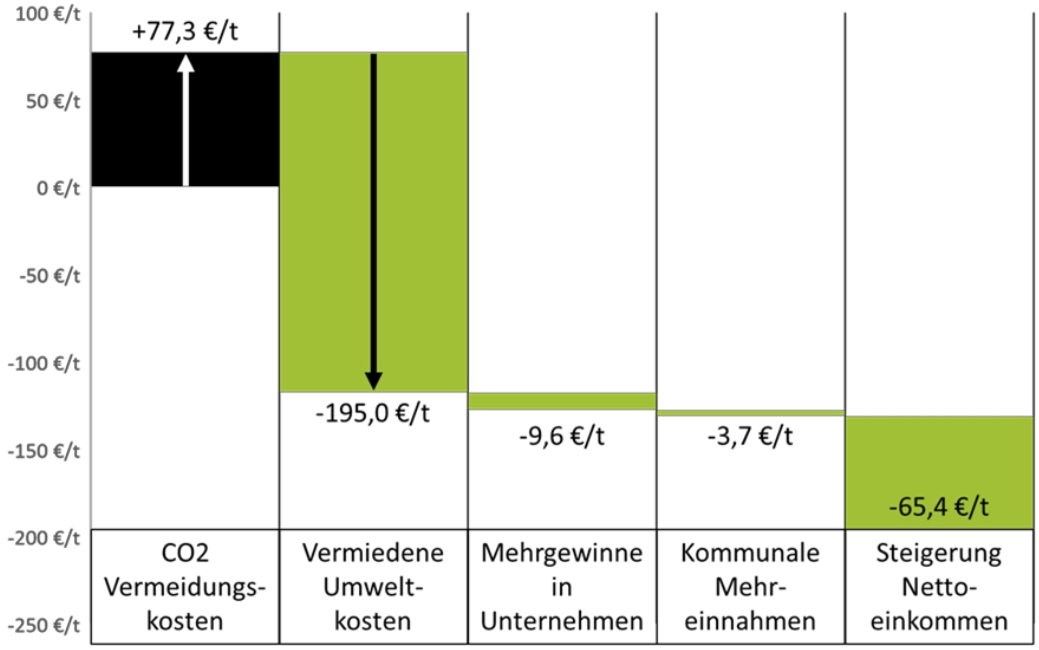


Figure 78 Principle representation of the "climate protection return" of an exemplary focus of action - negative values mean a positive effect here. (Graphic: Gertec GmbH)

The figure shows that the $CO_{2\ avoidance\ costs}$ of the focus of action investigated amount to around € 77 per tonne of CO_2 saved. Just by looking at the avoided environmental costs of €195 per tonne of CO_2, the action focus thus achieves negative total avoidance costs. If the specific regional value creation effects (additional profits in companies, additional municipal income and the increase in net income per tonne of CO_2 saved) of around 79 €/t are subtracted, the specific abatement costs in the priority area of action amount to around -196 €/t. This form of presentation is also chosen in the following overview table, in which the average specific abatement costs both for each

The diagrams also show the specific costs for each area of action (left-hand column). The simplified diagrams provide a rough indication of the ratios of cost items for each area of action.

Given the current framework conditions, investing in ambitious climate protection measures in all key areas of action, with the exception of the buildings sector, is not an option.
"economical" as soon as the effects on society as a whole are included, as illustrated in Figure 79. Due to the high reduction potential in the building sector, an attractive funding framework is necessary here in order to realise the potential.

The City of Aachen's goal of climate neutrality by 2030 requires swift and comprehensive action.

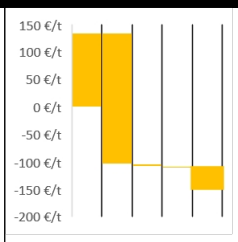
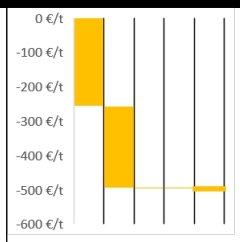
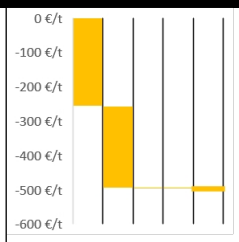
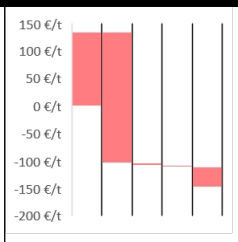
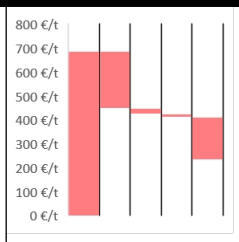
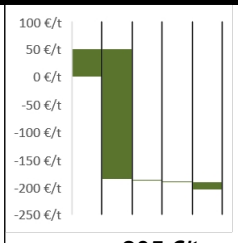
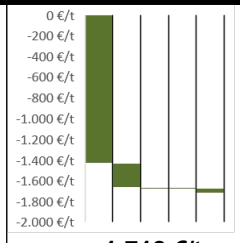
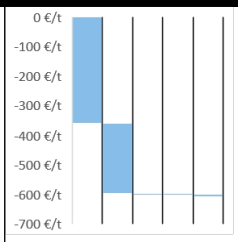
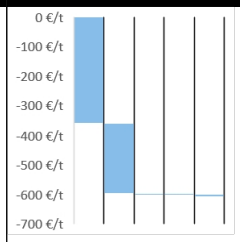
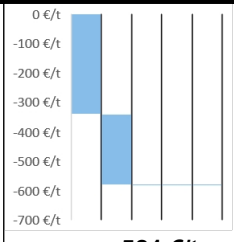
Energy supply	City as a role model: energy supply and generation	Locally and renewably generated electricity	Decarbonised heat supply
Ø - 361 €/t	 -779 €/t	 -501 €/t	 -311 €/t
Building	City as a role model: municipal buildings	Residential building stock	Non-residential buildings
Ø 17 €/t	 -147 €/t	 -384 €/t	 232 €/t
Mobility	Avoiding and shifting passenger transport	Climate-friendly drives and fuels	
Ø - 539 €/t	 -205 €/t	 -1.718 €/t	
Economy	Climate-neutral trade, commerce and services	Climate-neutral industry	
Ø - 618 €/t	 -609 €/t	 -630 €/t	
Society	Climate-friendly behaviour in everyday life		
Ø - 581 €/t	 -581 €/t		

Figure 79 Specific avoidance costs per field of action and focus of action. (Graphic: Gertec GmbH)

11. Powerfully controlling the process

As already made clear in the chapter "The transformation at a glance": The city of Aachen cannot control the path to climate neutrality in its entirety, but it can actively shape and accelerate it with a view to achieving the target and influence it directly or indirectly with its own measures and activities. This requires good coordination and communication structures for control and organisation within the administration, between the administration and municipal companies and with the city's population.

The following chapter describes the recommendations for organisational and procedural management at the strategic management and implementation level. The recommendations build on the insights gained into the organisational structures of Aachen's administration and develop these further specifically for Aachen's structures.

11.1. What control tasks are there?

Against the background of the principles described in section 5.3, four overarching management tasks can be identified along a management process: Strategic management, organisation, implementation and monitoring and controlling.

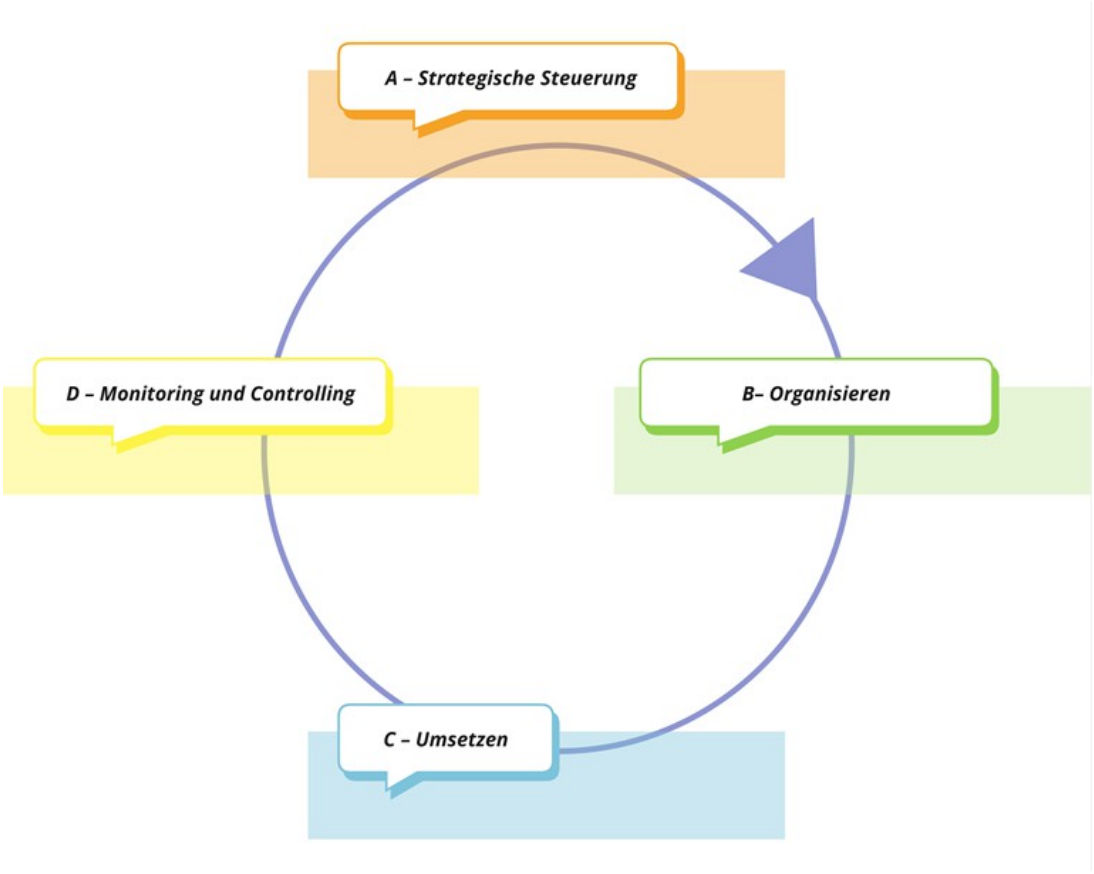


Figure 80 Control circuit (Graphic: Gertec GmbH)

A: Strategic management

Making strategic decisions for implementation

Strategic management makes decisions on implementation and makes recommendations to the specialised committees and the Aachen City Council. Control options arise from the City of Aachen's direct and indirect influence within the framework of local self-government.

- Direct influence refers to the city's ability to have a direct and immediate impact on greenhouse gas emissions.
- Indirect influence refers to opportunities for municipal action that have an indirect effect.

They harbour a probability of reducing greenhouse gas emissions, but this depends on the degree of involvement of third parties (companies, private households, etc.).

Strategic project initiation and development

Project initiation and development is a core task of strategic management. The portfolio of measures and activities forms the backbone for managing the process. As in the first ICSK, this portfolio provides for a parallel top-down and bottom-up strategy through the networking of municipal and civic measures and projects. In the top-down approach, control options arise through the direct and indirect influence of the City of Aachen within the framework of

of local self-government. The direct and indirect control options are bundled in measures and activities of the City of Aachen. Examples include classic measures such as civic urban gardening in combination with municipal support, as well as new measures such as cooperation between companies and the city as part of climate city contracts.

The bottom-up approach focuses on the initiation and promotion of projects and measures as citizen projects, projects by companies and associations. These are integrated into the implementation strategy of the climate neutrality strategy within the framework of the Climate City Contract and thus form the driving force behind the change process. Central questions that clarify the principles of action can be:

- Does the project serve to reduce greenhouse gases?
- Does the project create economic added value in terms of regional value creation?
- Does the project help to improve the quality of life for citizens in Aachen?
- Does the project have innovative power and appeal?

B: Organise

Transparency and knowledge transfer:

By creating transparency, an overview of current and past activities is established. This makes it possible to organise knowledge management for the experience gained. Data, information and knowledge are kept up to date in this way.

Idea management:

Ideas management promotes new ideas for measures and projects through targeted offers and formats and accompanies the path from idea to measure.

C: Realisation

In order to fulfil the target path, the city can use legal, planning and financial means to shape the framework conditions for the implementation of measures. The implementation of the strategy is based on a parallel top-down and bottom-up strategy: Municipal and civic measures and projects are networked and their implementation is set in motion for the sustainable development of Aachen. Important tasks of the implementation management are

- Coordination and management of resources: Required resources are identified and their utilisation planned as part of strategic planning. This includes human resources, but also funds to promote innovation and investment.
- Promotion of cross-sectional cooperation: Cross-sectional cooperation promotes the exchange of expertise, enables integrated and interdisciplinary solutions and helps to reduce resources. Internal training and further education is the basis for cross-sectional work.
- Communication that strengthens commitment: Internal and external communication promotes mutual understanding and thus acceptance of the implementation. Working in Networking is the basis for co-operative solutions and the exchange of knowledge and experience.
- Funding management: Funding programmes for the acquisition of funding are recorded across the board and advice is provided within the municipal family on the acquisition of funding.

Recommendations for the binding anchoring of the control processes

For the management of the climate protection process within the city administration of Aachen, the further development of a binding follow-up mechanism is recommended if the city's targets are not met.

- Annual balancing according to the BISKO method and determination of the previous year's emissions data.
- Target/actual value comparison for the sector-specific CO2eq emission and budget targets (annual).
- Case 1: Maximum annual emission volumes complied with = no need for readjustment
- Case 2: Annual emission volumes exceeded in one or more sectors => need for readjustment
- Consideration and recommendation for readjustment

- Departments and municipal holdings (every six months) weigh up and present activities for subsequent control with direct or indirect influence.

The measures and activities must be communicated transparently to the Aachen City Council and, if necessary, adopted. This mechanism can be gradually extended to the investments in the Group. This procedure requires the binding anchoring of climate protection targets in the individual departments as well as interfaces to the shareholdings.

D: Monitoring and controlling

Monitoring and controlling in Aachen are digital, transparent and flexible. Monitoring and controlling records and evaluates the progress of the process using specific indicators to determine whether the key objectives in the fields of action are being met. It is consistently designed and implemented as a digital system with open data interfaces. This chapter describes the principles of monitoring and controlling.

- Evaluation and success monitoring: Multi-project management uses a standardised data structure that users can access through supports their transparency in the targeted generation, storage and retrieval of data, information and knowledge.
- Balancing: Regular GHG balancing is carried out and the data is analysed and interpreted.

Climate relevance test

This includes the preparation of decision papers for policymakers and the formulation of recommendations for prioritisation in the committees.

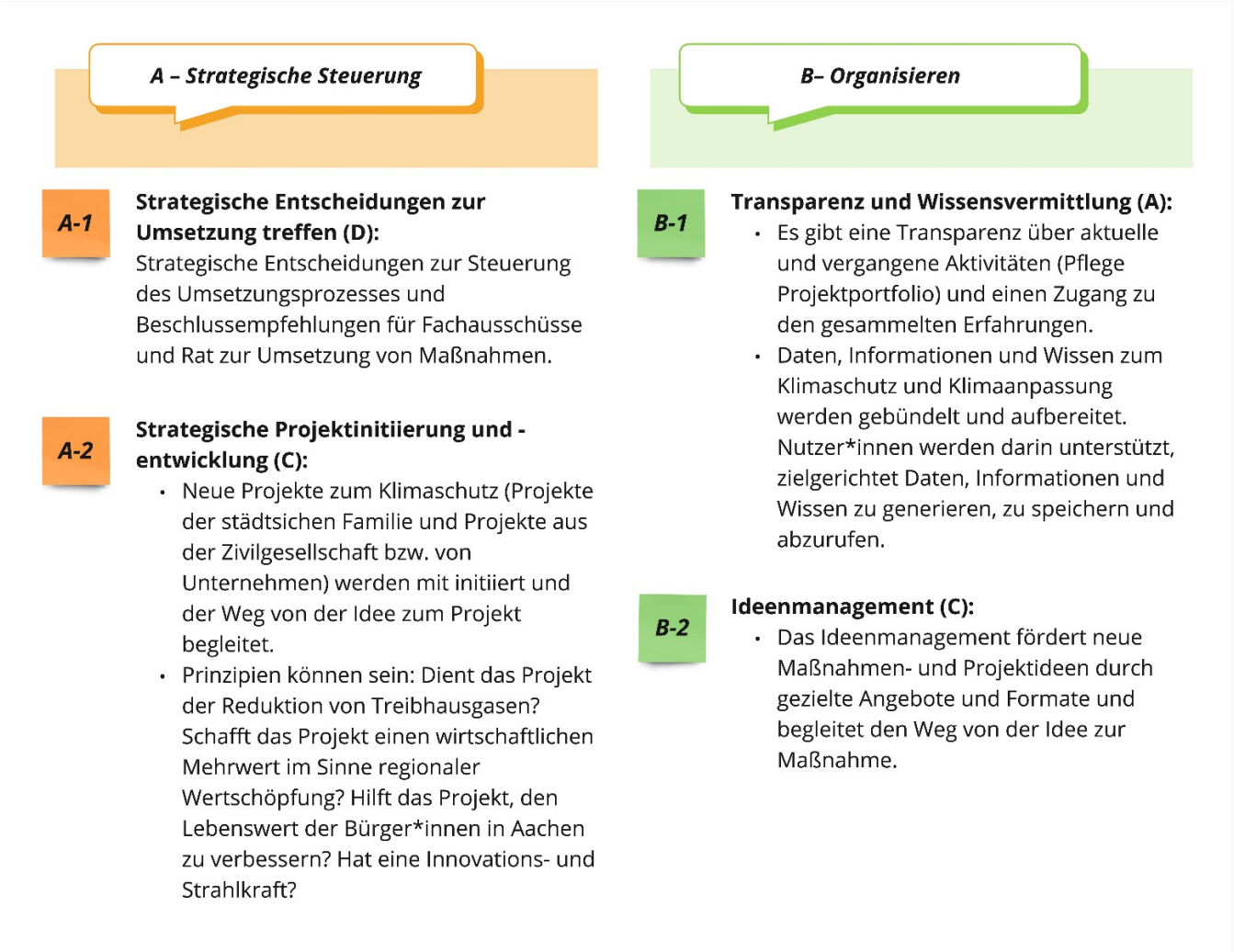


Figure 81 Detailed view of the overview graphic 80 - Part 1 (Graphic: Bodo Wirtz)

Figure 82 Detailed view of overview graphic 80 - Part 2 (Graphic: Bodo Wirtz)

11.2. Who can take over the control tasks?

The previous chapter described the necessary management processes and tasks. This chapter formulates recommendations as to which organisational units of the City of Aachen can take on these tasks. To this end, the organisational unit is first described and the tasks assigned in the next step.

Climate Protection Conference:

The Climate Protection Conference is the central body for strategically steering the city of Aachen towards climate neutrality. It is made up of the most important internal stakeholders in the city administration for climate neutrality. The Climate Protection Conference steers the strategic decisions for the City of Aachen and prepares the resolution recommendations for the committees and the Aachen City Council. The recommendations prepared by the multi-project management team for prioritising the available funds are discussed and, where possible, decided upon here. The Climate Protection Conference is chaired by the head of Department VII.

Multi-project management - Team

Multi-project management is a management method for project-orientated companies. It enables the management of a large number of projects under changing political, financial and personnel conditions. In contrast to project management for individual projects, multi-project management keeps an eye on the overall result of all projects. Multi-project management in municipal climate protection means managing and actively controlling a portfolio of measures and activities in line with the formulated municipal climate protection goals. The multi-project management team is closely interlinked with the climate management team in the Climate and Environment department; ideas, measures, analyses, assessments, etc. developed here are taken up and used or further processed for overall management.

In contrast to the management of the individual projects anchored in the ICSK (e.g. solar expansion on municipal administration buildings), multi-project management focuses on the entire portfolio of climate protection projects and pursues overarching and long-term municipal climate protection goals. The multi-project management team supports all departments and specialist areas relevant to the City of Aachen's climate neutrality across the board. In order to work efficiently, multi-project management requires processes and tools for information exchange, management, monitoring and controlling. These must be developed and implemented by an effective multi-project management team (see Transparency).

The multi-project management team should consist of at least three, preferably four members. Part of the team is the above-mentioned strong leader who - hand in hand with the head of department - gives the topic of climate neutrality a face in the city administration and externally in urban society. When staffing the multi-project management team, it is important to ensure that it is not specialised experts who are needed, but generalist and cross-sectional multi-project managers. Multi-project management is part of Department VII.

All departments:

The departments manage their climate protection activities along the line. They ensure that the climate coordinators (KK) in the departments, together with the multi-project management team, make the progress of the measures transparent. In their internal communication, the departments promote the commitment of each individual to the strategic goal of the City of Aachen to quickly become climate-neutral as a pioneering city.

IKSK team / climate coordinators of the departments:

The climate coordinators (CC) act as agents of change in the departments: The task of the climate coordinators is to anchor the implementation of the climate goals in the departments and specialist areas and to disseminate them. They therefore act as change agents for the implementation process. The climate coordinators are the point of contact and interface between the departments and multi-project management and ensure the implementation of the climate protection goals. The multi-project management team brings these activities together in a joint steering committee (transformation team). It thus ensures

internal administrative transparency and the exchange of knowledge. Climate coordinators are, for example, members of the EEA or ICSK team.

Department VII:

As the original specialist representative for the topic of climate and the environment, Department VII is the central sponsor for climate neutrality. This is reflected in the fact that the multi-project management team is organisationally attached to this department as a staff unit. The responsible head of department is the disciplinary superior of the team. The head of department encourages and challenges his MPM team.

Department 36 Climate and Environment (Climate Management Team):

Climate Management in Department 36 is the central specialist partner for the desired transformation process. This is where the relevant climate protection activities for the climate and environment are initiated and implemented. The team supports and advises those responsible for the individual ICSK measures from a technical perspective and provides practical support for their project implementation. The task of strategically managing the overall climate neutrality process for the city administration and the task of multi-project management are transferred from the department's climate management to the multi-project management staff unit. In this way, management and specialised work can be differentiated and communicated transparently in terms of role clarity. One of the central specialist tasks in the management of the overall process is the regular balancing of GHG emissions. Department 36 prepares the balance sheet from a technical perspective, analyses it and evaluates developments and trends from a technical perspective, including with regard to target achievement. Multi-project management takes up the results and disseminates them with the monitoring report. In this way, Department 36 controls the content, but the communication work is carried out by the multi-project management team.

FB 13 Communication and City Marketing:

Department 13 also plays a strong role as a specialist partner for the multi-project management team. It has the task of supporting the multi-project management team with external and internal communication.
It also ensures that the topic of climate neutrality is integrated into the city of Aachen's existing and developing campaigns. As a strategic goal of the City of Aachen and as a cross-cutting issue, climate neutrality is a topic that is addressed in different facets and in different contexts. (e.g. with sustainability, climate impact adaptation, transport transition) must be addressed. A balanced mix must be found here for the presentation of the city of Aachen. Finding this balance is an important joint task for Department 13 and the multi-project management team.

FB 60 Contract, procurement and funding management:

The success of the city of Aachen stands and falls with the opportunities to invest in climate-friendly measures. In close cooperation with the multi-project management team, Department 60 has the task of monitoring the EU, federal and NRW state funding scene, identifying interesting offers and, following an internal review with the departments, acquiring the funding and allocating it to the City of Aachen's budget. In addition, an ongoing exploration of measures worthy of funding is carried out by the departments of all departments in close coordination with the MPM team. Department 36 advises and supports the technical evaluation of funding opportunities and then provides the relevant assessments to Department 60 and the multi-project management team.

Climate Agency:

The Climate Agency forms the central interface between the municipal family (city administration, municipal holdings) and the actors in urban society (companies, interest groups, initiatives, etc.). The Climate Agency provides advice and empowerment. At the same time, the agency acts as a municipal service provider in the area of central funding programmes (refurbishment of old buildings and solar expansion) via the Altbauplus facility assigned to it.

Activities and mutual support requirements are harmonised in a regular meeting with the multi-project management team of the city administration. Project ideas worthy of funding are pursued together with Department 60. Important communication measures are driven forward together with Department 13. While the multi-project management team is primarily involved in the city administration, the climate agency works in the direction of urban society.

The following figure shows an overview of the control tasks from chapter 11.1

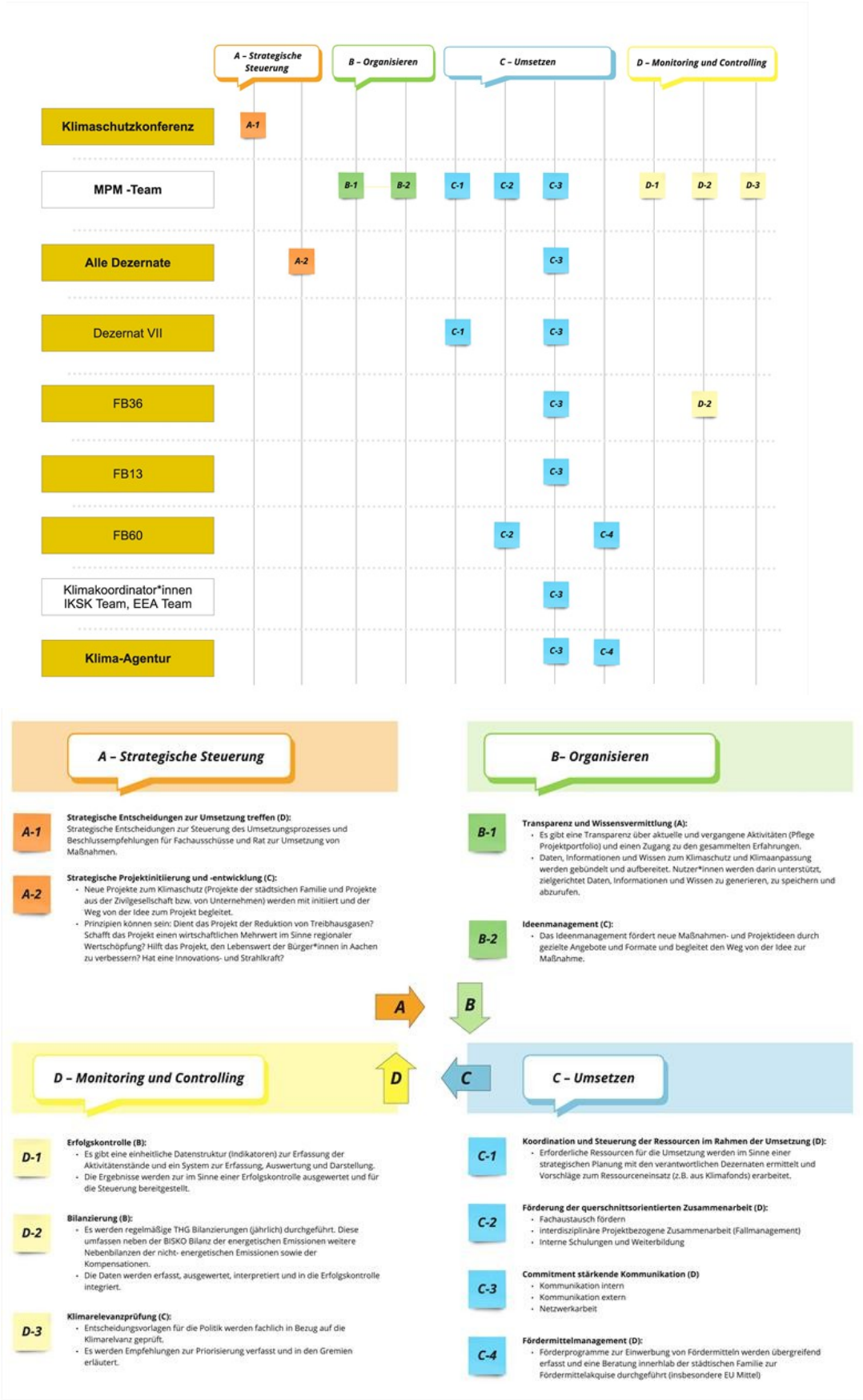


Figure 83 Overview of task distribution (Graphic: Bodo Wirtz)

11.3. Decision-making processes

The previous chapters have identified the central management tasks and the recommended allocation of tasks to the individual stakeholders. In the following, the relationships between the actors in the context of decision-making processes will be described.

Making processes more efficient

The goal of climate neutrality requires both human and financial resources as well as the prioritisation of projects. This requires good coordination between politics and administration. In order to organise decision-making processes as efficiently as possible, the Climate Protection Conference is used as the central steering level between administration and politics in the area of climate neutrality. Following internal coordination, it submits political draft resolutions and new project ideas to the city council and the relevant committees. It also reports at regular intervals on the status of projects and the strategic course. The multi-project management team is responsible for content and technical preparation.

which monitors the status of the projects in close dialogue with the climate coordinators and prepares interim results in a transparent manner. The climate protection coordinator coordinates the required and available budget funds with the administrative board. Once political decisions have been made, it is also the task of the climate protection conference to sort out the strategic direction and to feed this into the implementation level via the multi-project management team and the climate coordinators. This ensures that the decisions that lead to implementation and contribute to climate neutrality have a political tailwind.

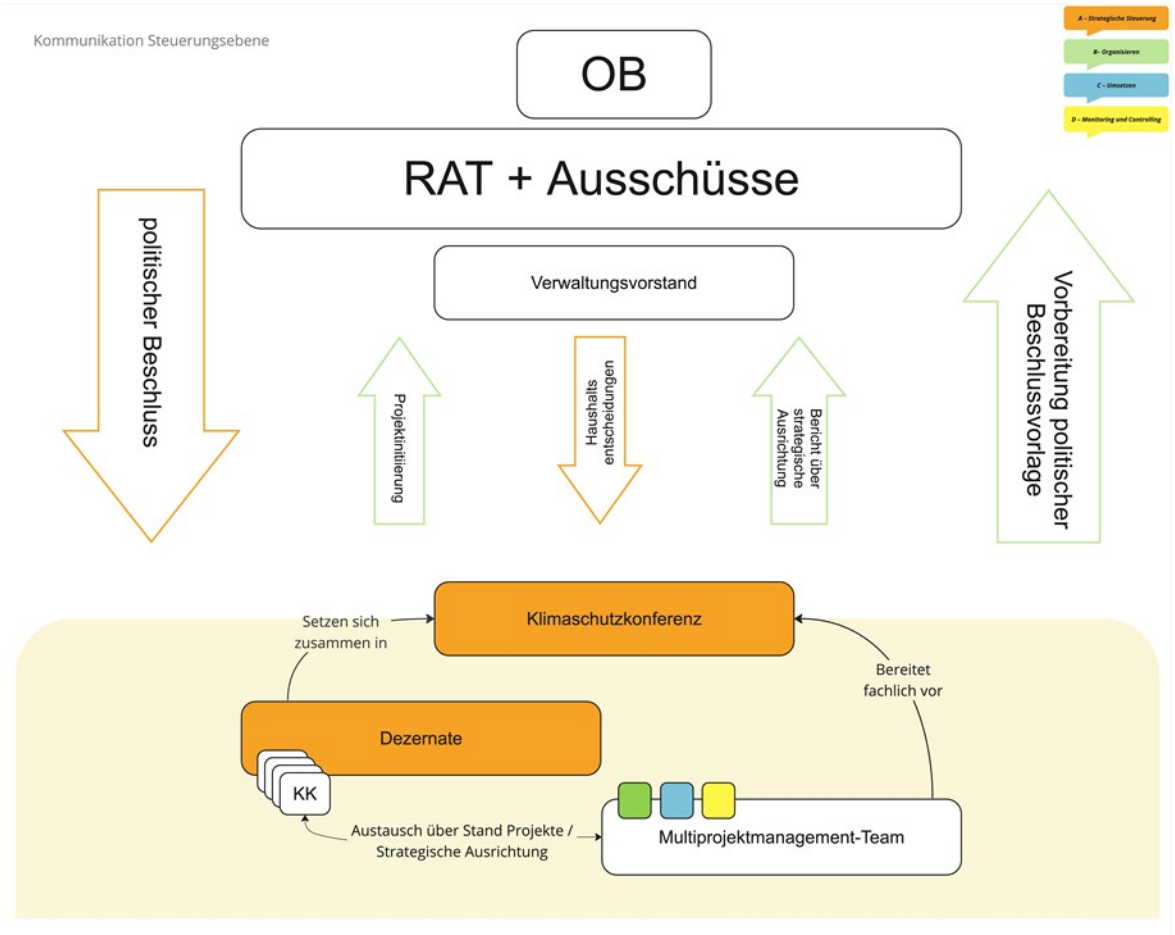


Figure 84 Graphic overview of communication channels - decision-making processes (Graphic: Bodo Witz)

11.4. Internal and external communication

At the implementation level, strategic management is supplemented by process organisation through the multi-project management team and the climate coordinators.

The role of the administration

The implementation of measures takes place within the departments. Department 60 provides targeted advice on available funding. The climate coordinators as change agents establish a close link to multi-project management. Multi-project management takes on the organisation of overarching processes. FB 36 assumes the role of balancing for the internal monitoring process. The results are transmitted to multi-project management on the one hand and fed back to the departments on the other.

In addition, FB 13 promotes an internal administrative communication process that is intended to make the success of individual projects visible.

In addition to the core administration, the municipal companies and holdings are also involved in the implementation of the measures and activities. This is where the climate agency is to build a bridge. Similar to Department 60, it advises the municipal companies and holdings on funding and, together with Department 13 and Department 36, forms a communication network for the activities. This network also informs the general public about the City of Aachen's activities and measures.

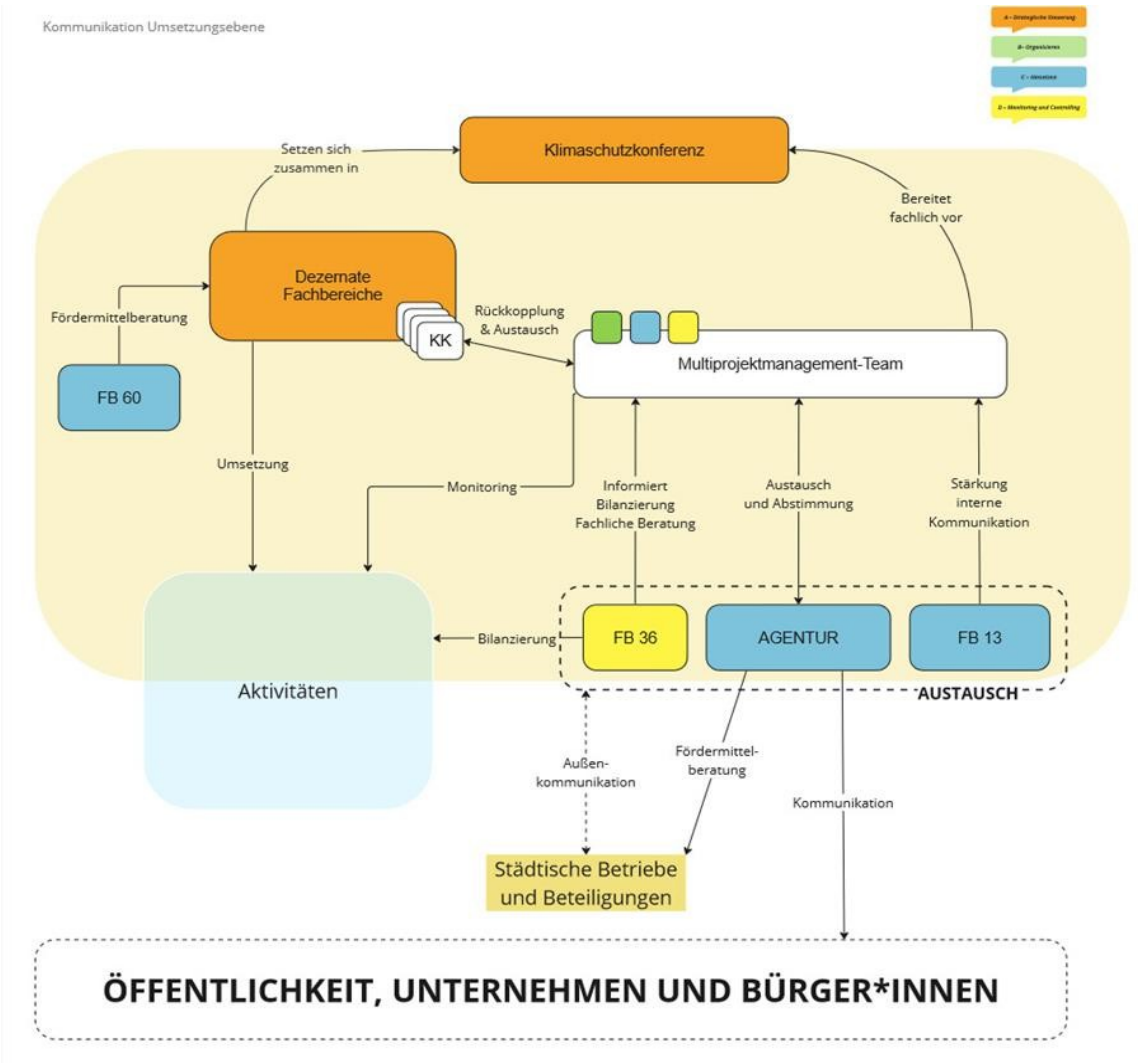


Figure 85 Graphic overview of communication channels - implementation level (Bodo Wirtz)

11.5. Anchoring in the organisational structure

Multi-project management must be firmly anchored in the city administration, with all departments and specialist areas playing a central role in the transformation process.

The diagram illustrates once again how the individual roles are embedded in the internal administrative structures and brings together the communication channels. The Climate Protection Conference is the summarising body for climate neutrality in the administration and translates political decisions into strategic administrative action. In Department VII As the Department for Climate and

The Organising Multi-Project Management is located in the Environment department. This, in turn, is the central focal point for the climate coordinators, who can be found in all departments. In this way, all communication structures are integrated into existing structures in the best possible way.

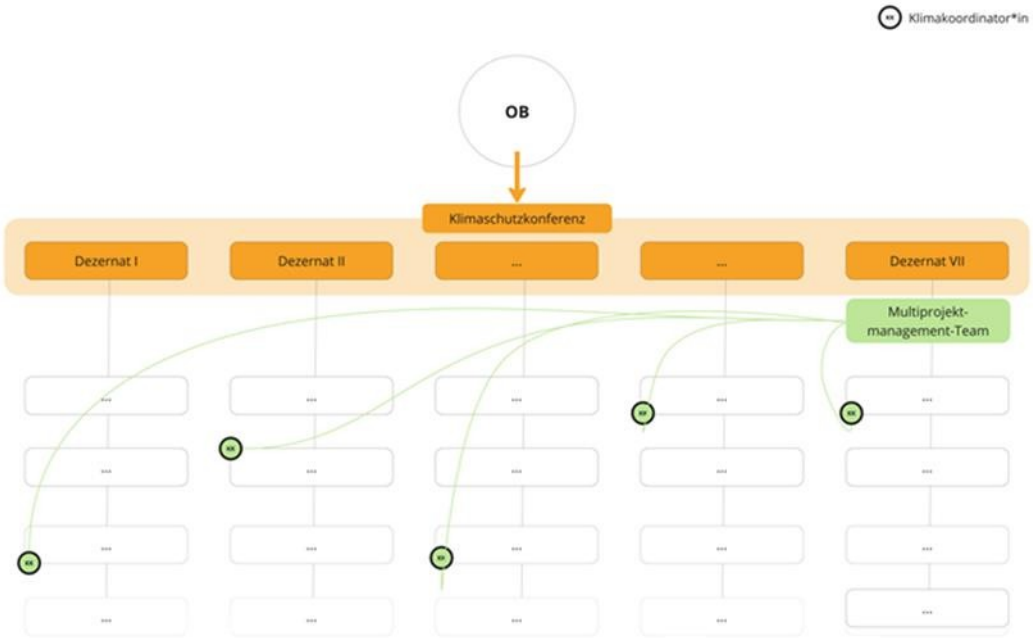


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Figure 86 Schematic representation of the multi-project mangament (Graphic: Bodo Wirtz)

Excursus: Perspectives of an implementation-oriented organisation: The establishment of an implementation-oriented agency promotes the acceleration of implementation. The agency is a pool of ideas and knowledge, initiates projects in a targeted manner and implements them. Suitable organisational forms are, for example, project companies, foundations or associations, also as an instrument for joint public and private financing. The governing bodies of the foundation or association are steering groups such as the foundation council or the association board, in which representatives of the city as well as stakeholders from companies, institutions and organised citizens are involved.

11.6. Keeping an eye on the goal: Monitoring and controlling

The climate neutrality strategy for Aachen is a living process of practical and implementation-orientated measures and activities. They form the backbone of the implementation process and bring together people, knowledge, money and commitment - geared towards the goal of climate neutrality by 2030. This living process requires an ongoing target/actual value comparison of target achievement (measurement) as well as constant readjustment, correction, stopping and restarting (adaptation).

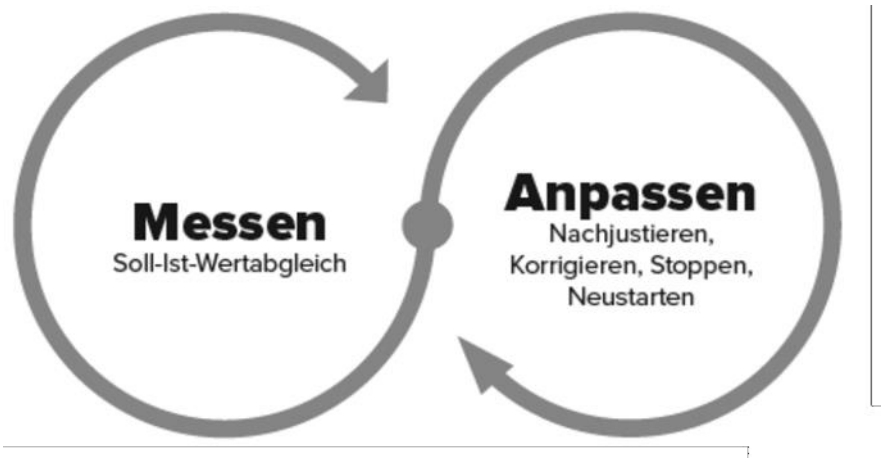

Figure 87 The control loop of measuring and adjusting (Graphic: Bodo Wirtz)

Monitoring and controlling instruments

Project portfolio plan: The project portfolio plan allows all projects to be visualised at a glance. It provides quick information about the main focus and project category, project status and the most important players in each individual project. The project portfolio plan depicts the overarching action plan. All measures are structured according to fields of action, key areas of action, measures and activities. As a process-accompanying tool, measures can be differentiated and clustered according to the offices or project organisers involved, time and financial expenditure.

Measures and project database: The measures and project database records all important data and allows ongoing measures and projects to be analysed and communicated.

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Measures and project profiles: The profiles describe the content of the measures and objectives as well as the most important indicators for monitoring success.

Factor analysis: The factor analysis is a regular screening procedure to identify changes in the environment for achieving the goal of climate neutrality and to derive measures from this. The factor analysis is therefore both an early warning system and an important basis for developing realisable measures.

Digital monitoring: Digital monitoring automates the recording of relevant indicators and improves the data exchange workflow. The digitalisation of monitoring as an instrument of multi-project management and support for the departments during its introduction is recommended in the long term.

Indicator system

In line with the "thinking from the goal" approach, a key task for the process is to generate suitable measures and projects to achieve the goals. The development and introduction of an indicator system is therefore recommended. The indicator system formulates specific, year-specific sector targets for GHG reduction for each field of action and the key areas of action.

The key objectives provide the strategic framework for implementation. Depending on the level, objectives can be ecological, social and economic objectives. They can be technically or politically justified. They must therefore be defined at the individual levels according to their meaningfulness and the possibility of binding definition. As a minimum, the following must be defined
should:

- Greenhouse gas reduction targets (city-wide, fields of action with direct relevance for GHG savings - are described)
- Targets for compliance with the residual CO2 budget (city-wide level)
- Targets for final energy savings (city-wide, fields of action with direct relevance for final energy savings)

Recording and analysing the indicators for target achievement: Compliance with the targets is indicated with the help of indicators. Leading indicators are the annual CO2 emissions, the residual CO2 budget and final energy consumption. The following levels are recommended for the indicator system:

- City-wide indicators
- Indicators at the level of the fields of action
- Indicators at the level of measures and activities

The indicators should be selected according to the criteria of relevance and availability. The process for recording the indicators and providing the necessary data must ultimately be ensured by Controlling.

Controlling instruments are

- Baseline balance: The continuously updated baseline balance forms an important data basis for determining the baseline values and comparative values for controlling the overarching municipal GHG reduction targets. The formal balance sheet is the BISKO balance sheet. The balance sheet should be updated annually.
- Target/actual value comparison of GHG emissions and final energy consumption: By regularly comparing the indicators with the formulated targets, information can be derived as a basis for process control via multi-project management. The annual agreement between the target values and actual values is displayed at the level of the city as a whole and at the level of the fields of action.

Indicator recording

The strategy for achieving climate neutrality is described by a portfolio of measures. The portfolio of measures is not a rigid plan, but represents an ongoing process - activities are added and completed activities are removed from the portfolio.

Documentation as a monitoring tool

It is therefore particularly important that activities in the fields of action and key action areas are documented, that the status is recorded using indicators and that the success of implementation can be evaluated and presented transparently. One basic problem is the availability of data and the effort involved in recording it. In climate protection processes, indicators should be surveyed annually if possible. As indicators are usually recorded "manually" and data sources, contact persons or data transfer processes often change, this process is very time-consuming. In practice, evaluations are therefore often carried out at intervals of 3 to 5 years. As a result, the controlling system is incomplete and not up to date.

A digital organisation and management tool with a database connection is therefore required to map the portfolio of measures. It must be usable within the framework of multi-project management at the City of Aachen and have freely configurable input options and output options in text and graphics. The evaluation and presentation of the monitoring results must be transparent, informative and easy to understand. This includes the presentation of the target-actual development (e.g. GHG emissions (annual), final energy (annual), CO_2 residual budgets (annual)), the presentation of specific indicators in real time (e.g. feed-in of PV electricity into the power grid) or dashboard displays.

The development and introduction of a digital system for recording indicators is therefore recommended. Recording and output should be possible on three levels:

- Restricted data access: The system must ensure the confidentiality of sensitive data in exchange with organisations and companies within (administration, investments) and outside the City of Aachen Group. It is necessary to define access rights and an authorisation concept that enables access by multi-project management.
- Open data access (Open Date): Climate protection is in the public interest. The system should therefore also enable the open exchange of data with organisations and citizens. Data that is not subject to restrictions should be usable and viewable by everyone.
- Dashboard: Transparency regarding the results of accounting and compliance with the formulated targets is an essential prerequisite for successful management. Dashboards can play an important role in communicating key data and facts. Dashboards are electronic graphical user interfaces that condense key data and visualise it in a way that is appropriate for the target group.

12. Promoting an inherent dynamic: The administration's contribution to Climate City Contract at a glance

The strategic considerations of the ICSK result in activities as a contribution to the Climate City Contract for the administration. This chapter provides an overview of the activities. With the help of tabular overviews, the information on GHG savings, costs and time expenditure is presented at all four levels (field of action, focus of action, measure and activity). This gives the reader an initial overview of the activities. In addition, the activities are presented in the form of a timetable. A detailed analysis of the activities is provided in Volume 2 with the help of the activity profiles.

12.1. Overview of contributions of the fields of action to greenhouse gas reduction

		in t/a
1	**Governance**	**30,000 tCO2/a**
1.1	**City as a role model: transformation as a management task**	**30,000 tCO2/a**
1.1.1	Measure: Set up multi-project management with monitoring and controlling	
1.1.1.1	Introducing and anchoring multi-project management	
1.1.1.2	Dashboard: Monitoring & controlling with balance sheet	
1.1.1.3	Climate neutrality transformation strategy - practical solutions for implementation	
1.1.2	Measure: Comprehensive instruments for process control and initiation of projects	30,000 tCO2/a
1.1.2.1	Updating the climate relevance assessment to prioritise climate-relevant decisions	
1.1.2.2	Introduction of climate funds	30,000 tCO2/a
1.1.2.3	Comprehensive subsidy management	
1.1.3	Measure: Integrating the goal of climate neutrality into the structure of the municipal family	
1.1.3.1	Introduce climate coordinators in all departments	
1.1.3.2	Climate protection in and further adaptation of the infrastructure of the fire and rescue services and municipal operations	
1.1.3.3	Agency for Climate, Energy and Sustainability	
1.1.4	Measure: Regional and supra-regional cooperation and networks	
1.1.4.1	CoLab pilot project	
1.1.5	Measure: Political influence for climate protection and sustainability	
1.2.	**Urban development as a climate management task**	**0 tCO2/a**
1.2.1	Measure: Framework conditions for climate-adapted urban development	
1.2.1.1	Establishment of an Urban Data Working Group - advertisement for an Urban Data Coordinator position to pool and analyse urban data	
1.2.1.2	Climate protection management for integrated urban development concepts and projects to redesign public spaces	
1.3	**Communication**	**0 tCO2/a**
1.3.1	Measure: External communication campaigns for the public and business	
1.3.2	Measure: Offer and organise internal communication training courses	
1.4	**Transformation into civil society responsibility**	**0 tCO2/a**
1.4.1	Measure : Citizen information and involvement	
1.4.1.1	Citizen participation formats for climate neutrality	
1.4.2	Measure: Create networks	
1.5	**Climate protection and social participation**	**0 tCO2/a**
1.5.1	Measure: Neighbourhood management	
1.5.1.1	Introduction of a municipal climate fee	
1.6	**Climate and health**	**0 tCO2/a**
1.6.1	Measure: RWTH Health and Climate Research Co-operation	
1.6.2	Measure: Organisational unit for civil protection	

		in t/a
2	**Energy supply**	**29,000 tCO2/a**
2.1	**City as a role model: energy supply and generation**	**4,500 tCO2/a**
2.1.1	Measure: Decarbonisation of the heat supply in the urban family	4,000 tCO2/a
2.1.1.1	Climate-neutral electricity and heat supply for properties under municipal control	4,000 tCO2/a
2.1.2	Measure: Expansion of renewable electricity generation in the urban family	500 tCO2/a
2.1.2.1	Ground-mounted PV systems on urban areas	500 tCO2/a
2.2	**Urban energy planning**	**0 tCO2/a**
2.2.1	Measure: Integrated heat and energy planning	
2.2.1.1	Masterplan - integrated, comprehensive energy planning	
2.2.1.2	Heat planning	
2.3	**Locally and renewably generated electricity**	**24,500 tCO2/a**
2.3.1	Measure: Promoting participation and operator models	
2.3.1.1	Energy in the hands of citizens	
2.3.2	Measure: Tapping wind power potential	10,900 tCO2/a
2.3.2.1	Safeguarding / expansion of wind energy	10,900 tCO2/a
2.3.3	Measure: Expansion of photovoltaics on residential and non-residential buildings	10,400 tCO2/a
2.3.3.1	Solar offensive on all suitable roof surfaces	10,400 tCO2/a
2.3.4	Measure: Expand ground-mounted photovoltaics	3,200 tCO2/a
2.3.4.1	Concept development: Identification and utilisation of PV open space potential	3,200 tCO2/a
2.	**4Decarbonised heat supply**	**0 tCO2/a**
2.4.1	Measure: System and plant optimisation of the existing district heating system	
2.4.2	Measure: Expansion and decarbonisation of district heating	
2.4.3	Measure: Promote efficient decentralised heating systems with renewable energies	

2.5	**Security of supply and sector coupling**	**0 tCO2/a**
2.5.1	Measure: Making grids fit for sector coupling	
2.5.2	Measure: Expansion of energy storage	
2.5.3	Measure: Control and storage of volatile power generation, grid-friendly energy tariffs and operator models	
2.5.4	Measure: Ensure the import and export of renewable electricity in line with demand	
2.5.5	Measure: Production and distribution of hydrogen, synthetic gases and fuels, infrastructure development	
2.5.6	Measure: Increasing the speed of implementation	
2.5.6.1	Establishment of a city-wide pool of tradespeople and a platform including training opportunities	
		in t/a
3	**Building**	**27,200 tCO2/a**
3.1	**City as a role model: Municipal buildings**	**15,400 tCO2/a**
3.1.1	Measure: Implementation of a climate-neutral and climate-adapted building stock of non-residential buildings	12,300 tCO2/a
3.1.1.1	Refurbishment roadmap for municipal non-residential buildings	12,300 tCO2/a
3.1.2	Measure: Implementation of a climate-neutral and climate-adapted building stock of residential buildings	3,100 tCO2/a
3.1.2.1	Action plan for the energy-efficient refurbishment of municipal residential buildings	3,100 tCO2/a
3.1.3	Measure: Climate-neutral new build	
3.1.4	Measure: Energy management systems	
3.2	**Climate-friendly and climate-adapted urban development**	**9,400 tCO2/a**
3.2.1	Measure: Activation of vacant lots/area management	
3.2.1.1	Breaking new ground - additional residential units in existing buildings and development of alternative, lifecycle-adaptable residential buildings	
3.2.2	Measure: Climate-friendly urban planning	9,400 tCO2/a
3.2.2.1	Energy-efficient monument conservation	
3.2.2.9	Climate campaign for leasehold properties in the city	9,400 tCO2/a
3.3	**Residential building stock**	**2,400 tCO2/a**
3.3.1	Measure: Modernisation of the single-family house stock	
3.3.2	Measure: Modernisation of the multi-family housing stock (privately and commercially rented, owners' associations)	2,400 tCO2/a
3.3.2.1	Consultancy campaign: energy-efficient modernisation of the multi-family housing stock	2,400 tCO2/a
3.3.3	Energy-efficient neighbourhood development	
3.3.3.1	Redevelopment model area: Eastern city centre	
3.4	**New residential building**	**0 tCO2/a**
3.4.1	Measure: New construction of climate-neutral detached houses	
3.4.2	Measure: New construction of climate-neutral apartment blocks	
3.5	**Non-residential buildings**	**0 tCO2/a**
3.5.1	Measure: Realising the potential of commercial properties	

		in t/a
4	**Mobility**	**0 tCO2/a**
4.1	**City as role model: Mobile city group**	**0 tCO2/a**
4.1.1	Measure: Company mobility management	
4.1.1.1	BMM at the city administration of Aachen and at the municipal holding companies	
4.1.2	Climate-neutral vehicle fleet	
4.2	**Transport planning and mobility concepts**	**0 tCO2/a**
4.2.1	Measure: Structural framework conditions	
4.2.1.1	Binding mobility concepts for construction projects and events	
4.2.1.2	Balancing and impact assessment of the mobility measures in the IKSK	
4.2.1.4	City centre mobility for tomorrow	
4.2.1.5	Network Mobility Transition Aachen Region (NEMORA)	
4.2.1.6	Zero-emission zone	
4.3	**Avoiding and shifting passenger transport**	**0 tCO2/a**
4.3.1	Measure: Expansion of public transport	
4.3.2	Measure: Cycling infrastructure and pedestrian traffic	
4.3.3	Measure: Multimodal mobility	
4.3.3.1	Promotion of sharing and multimodality	
4.3.4	Measure: Car park management	
4.3.5	Measure: Incentives for the switch	
4.4	**Avoiding and shifting commercial traffic**	**0 tCO2/a**
4.4.1	Measure: Climate-friendly commercial transport and company mobility	
4.4.2	Measure: Company mobility management Company	
4.4.3	Measure: Strategies for the last mile	
4.5	**Climate-friendly drives and fuels**	**0 tCO2/a**
4.5.1	Measure: Offers and infrastructure to promote e-mobility	
4.5.1.1	Expansion of the charging infrastructure	
4.5.2	Measure: Supply and infrastructure of synthetic fuels for forestry, agriculture and special vehicles	

		in t/a
5	**Economy**	**37,700 tCO2/a**
5.1	**City as a role model: climate-neutral administration**	**0 tCO2/a**
5.1.1	Measure: Climate-neutral equipment and procurement	
5.1.1.1	Sustainable procurement	
5.1.2	Measure: Climate-neutral IT infrastructure	
5.1.3	Measure: Leverage behaviour-related savings potential	
5.1.4	Measure: climate-friendly urban construction and building sites	
5.2	**Economic promotion and location development**	**3,000 tCO2/a**
5.2.1	Measure: Economic development 4.0	3,000 tCO2/a
5.2.1.1	"Sustainable and efficient economy" funding programme	3,000 tCO2/a
5.2.2	Measure: Site development and infrastructure measures for sector coupling in industrial estates	
5.3	**Climate-neutral trade, commerce and services**	**0 tCO2/a**
5.3.1	Measure: Consultancy on energy supply and energy saving	
5.3.2	Measure: Promoting climate protection effectiveness in the workplace	
5.4	**Climate-neutral industry**	**33,900 tCO2/a**
5.4.1	Measure: Sustainable production with renewable energies	33,900 tCO2/a
5.4.1.1	Supporting companies in evaluating the switch to hydrogen technologies, providing information, advice and networking.	33,900 tCO2/a
5.4.2	Measure: Promoting climate protection effectiveness in the workplace	
5.5	**Waste and recycling management**	**0 tCO2/a**
5.5.1	Measure: Promote recycling of products and materials	
5.5.1.1	Circular economy in practice: development of a building yard of the future for Aachen's municipal utility company	
5.5.2	Measure: Disseminate NaWaRo as building materials	
5.5.3	Measure: Waste avoidance	
5.5.4	Measure: Establish and expand the circular economy in industry and the tertiary sector	
5.5.5	Measure: Circular economy in the construction industry	
5.5.5.1	Component and resource warehouse	
5.5.5.2	Circular economy in the construction industry	
5.5.5.3	Develop criteria for a climate-neutral construction site	
5.6	**Agriculture, food industry and regional trade structures**	**800 tCO2/a**
5.6.1	Measure: Promote regional marketing, production and production in the area of sustainable nutrition	800 tCO2/a
5.6.1.1	Regional BioHub - Sustainable food production and distribution	800 tCO2/a
5.6.1.2	Strengthening local retail and sustainable transformation of the catering industry	
5.6.2	Measure: Expansion of sustainably managed agriculture	
5.6.2.1	Lease agreements of the city of Aachen are used to strengthen organic farming	
5.6.2.2	Pilot project in agroforestry	

		in t/a
	6Social transformation	**16,100 tCO2/a**
6.1	**Climate awareness and transfer**	**0 tCO2/a**
6.1.1	Measure: Promoting pioneers of change and opening up spaces for innovation and experience	
6.1.1.1	Making climate neutrality tangible and best practice visible	
6.	**2Climate-friendly living environment**	**0 tCO2/a**
6.2.1	Measure: Integrating climate protection into the urban living environment	
6.3	**Climate-friendly behaviour in everyday life**	**16,100 tCO2/a**
6.3.1	Measure: Participatory campaign to activate and qualify the citizens of Aachen	16,100 tCO2/a
6.3.1.1	Participatory campaign with volunteer climate trainers	16,100 tCO2/a
6.4	**Climate and education**	**0 tCO2/a**
6.4.1	Measure: Experience- and process-based environmental education for climate protection and sustainability	
6.4.1.1	Monitoring and support of climate and sustainability activities at schools for structural change	
6.5	**Climate protection in culture and leisure**	**0 tCO2/a**
6.5.1	Measure: Promote providers of leisure facilities as multipliers for climate protection and sustainability	
6.5.1.1	Structural changes with the handprint! - Workshops and support for implementation within the administration and with multipliers in associations and initiatives	
6.5.2	Measure: Promoting cultural professionals as multipliers for climate protection and sustainability	
7	**Compensation**	**0 tCO2/a**
7.1	**Green infrastructure for CO2 sequestration**	**0 tCO2/a**
7.1.1	Measure: Aachen forest in transition	
7.1.2	Measure: Development and protection of natural CO2 sinks	
7.1.1.2	Increase the number of green spaces and tree plantations (natural CO2 sinks)	
7.2	**Technical systems CO2 compensation and storage**	**0 tCO2/a**
7.2.1	Measure : Identify potential for technical compensation and CO2 storage	
Total all fields of action		**140,000 tCO2/a**

12.2. Overview of costs

		Total total in €
1	**Governance**	**8.625.200 €**
1.	**1City as a role model: transformation as a management task**	**7.562.700 €**
1.1.1	Measure: Set up multi-project management with monitoring and controlling	830.000 €
1.1.1.1	Introducing and anchoring multi-project management	180.000 €
1.1.1.2	Dashboard: Monitoring & controlling with balance sheet	150.000 €
1.1.1.3	Climate neutrality transformation strategy - practical solutions for implementation	500.000 €
1.1.2	Measure: Comprehensive instruments for process control and initiation of projects	6.422.700 €
1.1.2.1	Updating the climate relevance assessment to prioritise climate-relevant decisions	-€
1.1.2.2	Introduction of climate funds	6.422.700 €
1.1.2.3	Comprehensive subsidy management	-€
1.1.3	Measure: Integrating the goal of climate neutrality into the structure of the municipal family	310.000 €
1.1.3.1	Introduce climate coordinators in all departments	10.000 €
1.1.3.2	Climate protection in and further adaptation of the infrastructure of the fire and rescue services and municipal operations	300.000 €
1.1.3.3	Agency for Climate, Energy and Sustainability	-€
1.1.4	Measure: Regional and supra-regional cooperation and networks	-€
1.1.4.1	CoLab pilot project	-€
1.1.5	Measure: Political influence for climate protection and sustainability	-€
1.2.	**Urban development as a climate management task**	**320.000 €**
1.2.1	Measure: Framework conditions for climate-adapted urban development	320.000 €
1.2.1.1	Establishment of an Urban Data Working Group - advertisement for an Urban Data Coordinator position to pool and analyse urban data	-€
1.2.1.2	Climate protection management for integrated urban development concepts and projects to redesign public spaces	320.000 €
1.3	**Communication**	**-€**
1.3.1	Measure: External communication campaigns for the public and business	- €
1.3.2	Measure: Offer and organise internal communication training courses	- €
1.4	**Transformation into civil society responsibility**	**75.000 €**
1.4.1	Measure: Citizen information and involvement	75.000 €
1.4.1.1	Citizen participation formats for climate neutrality	75.000 €
1.4.2	Measure: Create networks	-€
1.5	**Climate protection and social participation**	**667.500 €**
1.5.1	Measure: Neighbourhood management	667.500 €
1.5.1.1	Introduction of a municipal climate fee	667.500 €
1.6	**Climate and health**	**-€**
1.6.1	Measure: RWTH Health and Climate Research Co-operation	- €
1.6.2	Measure: Organisational unit for civil protection	- €

		Total total in €
2	**Energy supply**	**1.480.000 €**
2.	**1City as a role model: energy supply and generation**	**140.000 €**
2.1.1	Measure : Decarbonisation of the heat supply in the urban family	100.000 €
2.1.1.1	Climate-neutral electricity and heat supply for properties under municipal control	100.000 €
2.1.2	Measure : Expansion of renewable electricity generation in the urban family	40.000 €
2.1.2.1	Ground-mounted PV systems on urban areas	40.000 €
2.2	**Urban energy planning**	**500.000 €**
2.2.1	Measure : Integrated heat and energy planning	500.000 €
2.2.1.1	Masterplan - integrated, comprehensive energy planning	250.000 €
2.2.1.2	Heat planning	250.000 €
2.	**3Locally and renewably generated electricity**	**440.000 €**
2.3.1	Measure: Promoting participation and operator models	60.000 €
2.3.1.1	Energy in the hands of citizens	60.000 €
2.3.2	Measure: Tapping wind power potential	-€
2.3.2.1	Safeguarding / expansion of wind energy	-€
2.3.3	Measure : Expansion of photovoltaics on residential and non-residential buildings	300.000 €
2.3.3.1	Solar offensive on all suitable roof surfaces	300.000 €
2.3.4	Measure: Expand ground-mounted photovoltaics	80.000 €
2.3.4.1	Concept development: Identification and utilisation of PV open space potential	80.000 €
2.4	**Decarbonised heat supply**	**-€**
2.4.1	Measure: System and plant optimisation of the existing district heating system	- €
2.4.2	Measure: Expansion and decarbonisation of district heating	- €
2.4.3	Measure: Promote efficient decentralised heating systems with renewable energies	- €
2.	**5Security of supply and sector coupling**	**400.000 €**
2.5.1	Measure: Making grids fit for sector coupling	- €
2.5.2	Measure: Expansion of energy storage	- €
2.5.3	Measure: Control and storage of volatile power generation, grid-friendly energy tariffs and operator models	- €
2.5.4	Measure: Ensure the import and export of renewable electricity in line with demand	- €
2.5.5	Measure: Production and distribution of hydrogen, synthetic gases and fuels, infrastructure development	- €
2.5.6	Measure: Increasing the speed of implementation	400.000 €
2.5.6.1	Establishment of a city-wide pool of tradespeople and a platform including training opportunities	400.000 €

		Total total in €
3	**Building**	**3.480.000 €**
3.	**1City as a role model: municipal buildings**	**600.000 €**
3.1.1	Measure: Implementation of a climate-neutral and climate-adapted building stock of non-residential buildings	300.000 €
3.1.1.1	Refurbishment roadmap for municipal non-residential buildings	300.000 €
3.1.2	Measure: Implementation of a climate-neutral and climate-adapted building stock of residential buildings	300.000 €
3.1.2.1	Action plan for the energy-efficient refurbishment of municipal residential buildings	300.000 €
3.1.3	Measure: Climate-neutral new build	- €
3.1.4	Measure: Energy management systems	- €
3.	**2Climate-friendly and climate-adapted urban development**	**430.000 €**
3.2.1	Measure: Activation of vacant lots/area management	80.000 €
3.2.1.1	Breaking new ground - additional residential units in existing buildings and development of alternative, lifecycle-adaptable residential buildings	80.000 €
3.2.2	Measure: Climate-friendly urban planning	350.000 €
3.2.2.1	Energy-efficient monument conservation	350.000 €
3.2.2.9	Climate campaign for leasehold properties in the city	-€
3.3Existing	**residential buildings**	**2.450.000 €**
3.3.1	Measure: Modernisation of the single-family house stock	-€
3.3.2	Measure: Modernisation of the multi-family housing stock (privately and commercially rented, owners' associations)	350.000 €
3.3.2.1	Consultancy campaign: energy-efficient modernisation of the multi-family housing stock	350.000 €
3.3.	3Energetic neighbourhood development	2.100.000 €
3.3.3.1	Redevelopment model area: Eastern city centre	2.100.000 €
3.4New	**residential building**	**-€**
3.4.1	Measure: New construction of climate-neutral detached houses	- €
3.4.2	Measure: New construction of climate-neutral apartment blocks	- €
3.5	**Non-residential buildings**	**-€**
3.5.1	Measure: Realising the potential of commercial properties	-€

		Total total in €
4	**Mobility**	**6.970.000 €**
4.	**1City as a role model: mobile city group**	**-€**
4.1.1	Measure: Company mobility management	-€
4.1.1.1	BMM at the city administration of Aachen and at the municipal holding companies	-€
4.1.2	Climate-neutral vehicle fleet	-€
4.	**2Transport planning and mobility concepts**	**1.030.000 €**
4.2.1	Measure: Structural framework conditions	1.030.000 €
4.2.1.1	Binding mobility concepts for construction projects and events	980.000 €
4.2.1.2	Balancing and impact assessment of the mobility measures in the IKSK	50.000 €
4.2.1.4	City centre mobility for tomorrow	-€
4.2.1.5	Network Mobility Transition Aachen Region (NEMORA)	-€
4.2.1.6	Zero-emission zone	-€
4.	**3Avoidance and transfer of passenger transport**	**-€**
4.3.1	Measure: Expansion of public transport	- €
4.3.2	Measure: Cycling infrastructure and pedestrian traffic	- €
4.3.3	Measure: Multimodal mobility	- €
4.3.3.1	Promotion of sharing and multimodality	-€
4.3.4	Measure: Car park management	- €
4.3.5	Measure: Incentives for the switch	- €
4.	**4Avoidance and shifting of commercial traffic**	**-€**
4.4.1	Measure: Climate-friendly commercial transport and company mobility	- €
4.4.2	Measure: Company mobility management Company	- €
4.4.3	Measure: Strategies for the last mile	- €
4.5	**Climate-friendly drives and fuels**	**5.940.000 €**
4.5.1Measure	: Offers and infrastructure to promote e-mobility	5.940.000 €
4.5.1.1	Expansion of the charging infrastructure	5.940.000 €
4.5.2Measure	: Supply and infrastructure of synthetic fuels for forestry, agriculture and special-purpose vehicles	

		Total total in €
5	**Economy**	**1.259.000 €**
5.1	**City as a role model: climate-neutral administration**	**-€**
5.1.1	Measure: Climate-neutral equipment and procurement	-€
5.1.1.1	Sustainable procurement	-€
5.1.2	Measure: Climate-neutral IT infrastructure Leveraging	- €
5.1.3	Measure: behaviour-related savings potential Climate-	- €
5.1.4	Measure: friendly urban construction and building sites	- €
5.2	**Economic promotion and location development**	**300.000 €**
5.2.1	Measure: Economic development 4.0	300.000 €
5.2.1.1	"Sustainable and efficient economy" funding programme	300.000 €
5.2.2	Measure: Site development and infrastructure measures for sector coupling in industrial estates	-€
5.3	**Climate-neutral trade, commerce and services**	**-€**
5.3.1	Measure: Advice on energy supply and energy saving Promoting climate	- €
5.3.2	Measure: protection effectiveness in the workplace	- €
5.4	**Climate-neutral industry**	**240.000 €**
5.4.1	Measure: Sustainable production with renewable energies	240.000 €
5.4.1.1	Supporting companies in evaluating the switch to hydrogen technologies, providing information, advice and networking	240.000 €
5.4.2	Measure: Promoting climate protection effectiveness in the workplace	-€
5.5	**Waste and recycling management**	**220.000 €**
5.5.1	Measure: Promoting the recycling of products and materials	-€
5.5.1.1	Circular economy in practice: development of a building yard of the future for Aachen's municipal utility company	-€
5.5.2	Measure: Bringing NaWaRo into circulation as building materials Waste	- €
5.5.3	Measure: avoidance	- €
5.5.4	Measure: Establish and expand the circular economy in industry and the tertiary sector	- €
5.5.5	Measure: Circular economy in the construction industry	220.000 €
5.5.5.1	Component and resource warehouse	100.000 €
5.5.5.2	Circular economy in the construction industry	105.000 €
5.5.5.3	Develop criteria for a climate-neutral construction site	15.000 €
5.6	**Agriculture, food industry and regional trade structures**	**499.000 €**
5.6.1	Measure: Promote regional marketing, production and production in the area of sustainable nutrition	484.000 €
5.6.1.1	Regional BioHub - Sustainable food production and distribution	434.000 €
5.6.1.2	Strengthening local retail and sustainable transformation of the catering industry	50.000 €
5.6.2	Measure: Expansion of sustainably managed agriculture	15.000 €
5.6.2.1	Lease agreements of the city of Aachen are used to strengthen organic farming	-€
5.6.2.2	Pilot project in agroforestry	15.000 €

		Total total in €
6	**Social transformation**	**421.000 €**
6.1	**Climate awareness and transfer**	**75.000 €**
6.1.1	Measure : Promoting pioneers of change and opening up spaces for innovation and experience	75.000 €
6.1.1.1	Making climate neutrality tangible and best practice visible	75.000 €
6.2	**Climate-friendly living environment**	**-€**
6.2.1	Measure: Integrating climate protection into the urban living environment	
6.3	**Climate-friendly behaviour in everyday life**	**250.000 €**
6.3.1	Measure: Participatory campaign to activate and qualify the citizens of Aachen	250.000 €
6.3.1.1	Participatory campaign with volunteer climate trainers	250.000 €
6.4	**Climate and education**	**30.000 €**
6.4.1	Measure: Experience- and process-based environmental education for climate protection and sustainability	30.000 €
6.4.1.1	Monitoring and support of climate and sustainability activities at schools for structural change	30.000 €
6.5	**Climate protection in culture and leisure**	**66.000 €**
6.5.1	Measure: Promote providers of leisure facilities as multipliers for climate protection and sustainability	66.000 €
6.5.1.1	Structural changes with the handprint! - Workshops and support for implementation within the administration and with multipliers in associations	66.000 €
6.5.2	Measure: Promoting cultural professionals as multipliers for climate protection and sustainability	-€
7	**Compensation**	**440.000 €**
7.1	**Green infrastructure for CO2 sequestration**	**440.000 €**
7.1.1	Measure: Aachen forest in transition	-€
7.1.2	Measure: Development and protection of natural CO2 sinks	440.000 €
7.1.1.2	Increase the number of green spaces and tree plantations (natural CO2 sinks)	440.000 €
7.2	**Technical systems CO2 compensation and storage**	**-€**
7.2.1	Measure: Identify potential for technical compensation and CO2 storage	-€
Total	**All fields of action**	**22.675.200 €**

12.3. Overview of time expenditure

		Full-time equivalents/a
1	**Governance**	**22,25**
1.1	**City as a role model: transformation as a management task**	**15,25**
1.1.1	Measure: Set up multi-project management with monitoring and controlling	**7,00**
1.1.1.1	Introducing and anchoring multi-project management	2,00
1.1.1.2	Dashboard: Monitoring & controlling with balance sheet	1,00
1.1.1.3	Climate neutrality transformation strategy - practical solutions for implementation	4,00
1.1.2	Measure: Comprehensive instruments for process control and initiation of projects	**2,00**
1.1.2.1	Updating the climate relevance assessment to prioritise climate-relevant decisions	0,50
1.1.2.2	Introduction of climate funds	1,00
1.1.2.3	Comprehensive subsidy management	0,50
1.1.3	Measure: Integrating the goal of climate neutrality into the structure of the municipal family	**4,25**
1.1.3.1	Introduce climate coordinators in all departments	0,25
1.1.3.2	Climate protection in and further adaptation of the infrastructure of the fire and rescue services and municipal operations	1,00
1.1.3.3	Agency for Climate, Energy and Sustainability	3,00
1.1.4	Measure: Regional and supra-regional cooperation and networks	**2,00**
1.1.4.1	CoLab pilot project	2,00
1.1.5	Measure: Political influence for climate protection and sustainability	
1.2.	**Urban development as a climate management task**	**4,00**
1.2.1	Measure: Framework conditions for climate-adapted urban development	**4,00**
1.2.1.1	Establishment of an Urban Data Working Group - advertisement for an Urban Data Coordinator position to pool and analyse urban data	1,00
1.2.1.2	Climate protection management for integrated urban development concepts and projects to redesign public spaces	3,00
1.3	**Communication**	**0,00**
1.3.1	Measure: External communication campaigns for the public and business	
1.3.2	Measure: Offer and organise internal communication training courses	
1.4	**Transformation into civil society responsibility**	**1,00**
1.4.1	Measure: Citizen information and involvement	**1,00**
1.4.1.1	Citizen participation formats for climate neutrality	1,00
1.4.2	Measure: Create networks	
1.5	**Climate protection and social participation**	**2,00**
1.5.1	Measure: Neighbourhood management	**2,00**
1.5.1.1	Introduction of a municipal climate fee	2,00
1.6	**Climate and health**	**0,00**
1.6.1	Measure: RWTH Health and Climate Research Co-operation	
1.6.2	Measure: Organisational unit for civil protection	

		Full-time equivalents/a
2	**Energy supply**	**7,50**
2.1	**City as a role model: energy supply and generation**	**1,50**
2.1.1	Measure: Decarbonisation of the heat supply in the urban family	**1,00**
2.1.1.1	Climate-neutral electricity and heat supply for properties under municipal control	1,00
2.1.2	Measure: Expansion of renewable electricity generation in the urban family	**0,50**
2.1.2.1	Ground-mounted PV systems on urban areas	0,50
2.2	**Urban energy planning**	**2,00**
2.2.1	Measure: Integrated heat and energy planning	**2,00**
2.2.1.1	Masterplan - integrated, comprehensive energy planning	1,00
2.2.1.2	Heat planning	1,00
2.3	**Locally and renewably generated electricity**	**3,50**
2.3.1	Measure: Promoting participation and operator models	**1,00**
2.3.1.1	Energy in the hands of citizens	1,00
2.3.2	Measure: Tapping wind power potential	**0,50**
	Safeguarding / expansion of wind energy	0,50
2.3.3	Measure: Expansion of photovoltaics on residential and non-residential buildings	**1,00**
2.3.3.1	Solar offensive on all suitable roof surfaces	1,00
2.3.4	Measure: Expand ground-mounted photovoltaics	**1,00**
2.3.4.1	Concept development: Identification and utilisation of PV open space potential	1,00
2.4	**Decarbonised heat supply**	**0,00**
2.4.1	Measure: System and plant optimisation of the existing district heating system	
2.4.2	Measure: Expansion and decarbonisation of district heating	
2.4.3	Measure: Promote efficient decentralised heating systems with renewable energies	
2.5	**Security of supply and sector coupling**	**0,50**
2.5.1	Measure: Making grids fit for sector coupling	
2.5.2	Measure: Expansion of energy storage	
2.5.3	Measure: Control and storage of volatile power generation, grid-friendly energy tariffs and operator models	
2.5.4	Measure: Ensure the import and export of renewable electricity in line with demand	
2.5.5	Measure: Production and distribution of hydrogen, synthetic gases and fuels, infrastructure development	
2.5.6	Measure: Increasing the speed of implementation	**0,50**
2.5.6.1	Development of a city-wide pool of tradespeople and a platform including training opportunities	0,50

		Full-time equivalents/a
3	**Building**	**11,50**
3.1	**City as a role model: Municipal buildings**	**5,00**
3.1.1	Measure: Implementation of a climate-neutral and climate-adapted building stock of non-residential buildings	**3,00**
3.1.1.1	Refurbishment roadmap for municipal non-residential buildings	3,00
3.1.2	Measure: Implementation of a climate-neutral and climate-adapted building stock of residential buildings	**2,00**
3.1.2.1	Action plan for the energy-efficient refurbishment of municipal residential buildings	2,00
3.1.3	Measure: Climate-neutral new build	
3.1.4	Measure: Energy management systems	
3.2	**Climate-friendly and climate-adapted urban development**	**4,00**
3.2.1	Measure: Activation of vacant lots/area management	**2,00**
3.2.1.1	Breaking new ground - additional residential units in existing buildings and development of alternative, lifecycle-adaptable residential buildings	2,00
3.2.2	Measure: Climate-friendly urban planning	**2,00**
3.2.2.1	Energy-efficient monument conservation	1,00
3.2.2.9	Climate campaign for leasehold properties in the city	1,00
3.3	**Residential building stock**	**2,50**
3.3.1	Measure: Modernisation of the single-family house stock	
3.3.2	Measure: Modernisation of the multi-family housing stock (privately and commercially rented, owners' associations)	**0,50**
3.3.2.1	Consultancy campaign: energy-efficient modernisation of the multi-family housing stock	0,50
3.3.3	Energy-efficient neighbourhood development	**2,00**
3.3.3.1	Redevelopment model area: Eastern city centre	2,00
3.4	**New residential building**	**0,00**
3.4.1	Measure: New construction of climate-neutral detached houses	
3.4.2	Measure: New construction of climate-neutral apartment blocks	
3.5	**Non-residential buildings**	**0,00**
3.5.1	Measure: Realising the potential of commercial properties	

		Full-time equivalents/a
4	**Mobility**	**4,75**
4.1	**City as role model: Mobile city group**	**0,50**
4.1.1	Measure: Company mobility management	**0,50**
4.1.1.1	BMM at the city administration of Aachen and at the municipal holding companies	0,50
4.1.2	Climate-neutral vehicle fleet	
4.2	**Transport planning and mobility concepts**	**2,75**
4.2.1	Measure: Structural framework conditions	**2,75**
4.2.1.1	Binding mobility concepts for construction projects and events	1,00
4.2.1.2	Balancing and impact assessment of the mobility measures in the ICSK	0,00
4.2.1.4	City centre mobility for tomorrow	0,25
4.2.1.5	Network Mobility Transition Aachen Region (NEMORA)	0,00
4.2.1.6	Zero-emission zone	1,50
4.3	**Avoiding and shifting passenger transport**	**0,50**
4.3.1	Measure: Expansion of public transport	
4.3.2	Measure: Cycling infrastructure and pedestrian traffic	
4.3.3	Measure: Multimodal mobility	**0,50**
4.3.3.1	Promotion of sharing and multimodality	0,50
4.3.4	Measure: Car park management	
4.3.5	Measure: Incentives for the switch	
4.4	**Avoiding and shifting commercial traffic**	**0,00**
4.4.1	Measure: Climate-friendly commercial transport and company mobility	
4.4.2	Measure: Company mobility management Company	
4.4.3	Measure: Strategies for the last mile	
4.5	**Climate-friendly drives and fuels**	**1,00**
4.5.1	Measure: Offers and infrastructure to promote e-mobility	**1,00**
4.5.1.1	Expansion of the charging infrastructure	1,00

		Full-time equivalents/a
5	**Economy**	**10,75**
5.1	**City as a role model: climate-neutral administration**	**1,50**
5.1.1	Measure: Climate-neutral equipment and procurement	**1,50**
5.1.1.1	Sustainable procurement	1,50
5.1.2	Measure: Climate-neutral IT infrastructure	
5.1.3	Measure: Leverage behaviour-related savings potential	
5.1.4	Measure: climate-friendly urban construction and building sites	
5.2	**Economic promotion and location development**	**1,00**
5.2.1	Measure: Economic development 4.0	**1,00**
5.2.1.1	"Sustainable and efficient economy" funding programme	1,00
5.2.2	Measure: Site development and infrastructure measures for sector coupling in industrial estates	
5.3	**Climate-neutral trade, commerce and services**	**0,00**
5.3.1	Measure: Consultancy on energy supply and energy saving	
5.3.2	Measure: Promoting climate protection effectiveness in the workplace	
5.4	**Climate-neutral industry**	**1,00**
5.4.1	Measure: Sustainable production with renewable energies	**1,00**
5.4.1.1	Supporting companies in evaluating the switch to hydrogen technologies, providing information, advice and networking.	1,00
5.4.2	Measure: Promoting climate protection effectiveness in the workplace	
5.5	**Waste and recycling management**	**5,00**
5.5.1	Measure: Promote recycling of products and materials	**3,00**
5.5.1.1	Circular economy in practice: development of a building yard of the future for Aachen's municipal utility company	3,00
5.5.2	Measure: Disseminate NaWaRo as building materials	
5.5.3	Measure: Waste avoidance	
5.5.4	Measure: Establish and expand the circular economy in industry and the tertiary sector	
5.5.5	Measure: Circular economy in the construction industry	**2,00**
5.5.5.1	Component and resource warehouse	1,00
5.5.5.2	Circular economy in the construction industry	0,50
5.5.5.3	Develop criteria for a climate-neutral construction site	0,50
5.6	**Agriculture, food industry and regional trade structures**	**2,25**
5.6.1	Measure: Promote regional marketing, production and production in the area of sustainable nutrition	**1,50**
5.6.1.1	Regional BioHub - Sustainable food production and distribution	0,50
5.6.1.2	Strengthening local retail and sustainable transformation of the catering industry	1,00
5.6.2	Measure: Expansion of sustainably managed agriculture	**0,75**
5.6.2.1	Lease agreements of the city of Aachen are used to strengthen organic farming	0,25
5.6.2.2	Pilot project in agroforestry	0,50

		Full-time equivalents/a
6	**Social transformation**	**7,00**
6.1	**Climate awareness and transfer**	**2,00**
6.1.1	Measure: Promoting pioneers of change and opening up spaces for innovation and experience	**2,00**
6.1.1.1	Making climate neutrality tangible and best practice visible	2,00
6.2	**Climate-friendly living environment**	**0,00**
6.2.1	Measure: Integrating climate protection into the urban living environment	
6.3	**Climate-friendly behaviour in everyday life**	**2,00**
6.3.1	Measure: Participatory campaign to activate and qualify the citizens of Aachen	**2,00**
6.3.1.1	Participatory campaign with volunteer climate trainers	2,00
6.4	**Climate and education**	**1,00**
6.4.1	Measure: Experience- and process-based environmental education for climate protection and sustainability	**1,00**
6.4.1.1	Monitoring and support of climate and sustainability activities at schools for structural change	1,00
6.5	**Climate protection in culture and leisure**	**2,00**
6.5.1	Measure: Promote providers of leisure facilities as multipliers for climate protection and sustainability	**2,00**
6.5.1.1	Structural changes with the handprint! - Workshops and support for implementation within the administration and with multipliers in V	2,00
6.5.2	Measure: Promoting cultural professionals as multipliers for climate protection and sustainability	
7	**Compensation**	**2,00**
7.1	**Green infrastructure to bind CO2**	**2,00**
7.1.1	Measure: Aachen forest in transition	
7.1.2	Measure: Development and protection of natural CO2 sinks	**2,00**
7.1.1.2	Increase the number of green spaces and tree plantations (natural CO2 sinks)	2,00
7.2	**Technical systems CO2 compensation and storage**	**0,00**
7.2.1	Measure: Identify potential for technical compensation and CO2 storage	
Total	**All fields of action**	**65,75**

12.4. Overview of the schedules

		Start date	End date	2023	2024	2025	2026	2027	2028	2029	2030
1	**Governance**										
1.1	**City as a role model: transformation as a management task**										
1.1.1 Measure: Set up multi-project management with monitoring and controlling											
1.1.1.1	Introducing and anchoring multi-project management	2024	2030								
1.1.1.2	Dashboard: Monitoring & controlling with balance sheet	2024	2026								
1.1.1.3	Climate neutrality transformation strategy - practical solutions for implementation	2024	2026								
1.1.2 Measure: Comprehensive instruments for process control and initiation of projects											
1.1.2.1	Updating the climate relevance assessment to prioritise climate-relevant decisions	2024	2030								
1.1.2.2	Introduction of climate funds	2024	2027								
1.1.2.3	Comprehensive subsidy management	2024	2030								
1.1.3 Measure: Integrating the goal of climate neutrality into the structure of the municipal family											
1.1.3.1	Introduce climate coordinators in all departments	2024	2030								
1.1.3.2	Climate protection in and further adaptation of the infrastructure of the fire and rescue services and municipal operations	2024	2030								
1.1.3.3	Agency for Climate, Energy and Sustainability	2024	2030								
1.1.4 Measure: Regional and supra-regional co-operation and networks											
1.1.4.1	CoLab pilot project	2023	2030								
1.1.5 Measure: Political influence for climate protection and sustainability											
1.2.	**Urban development as a climate management task**										
1.2.1 Measure: Framework conditions for climate-adapted urban development											
1.2.1.1	Establishment of an Urban Data Working Group - advertisement for an Urban Data Coordinator position to pool and analyse urban data	2024	2024								
1.2.1.2	Climate protection management for integrated urban development concepts and projects to redesign public spaces	2023	2030								
1.3	**Communication**										
1.3.1	Measure: External communication campaigns for the public and business										
1.3.2	Measure: Offer and organise internal communication training courses										
1.4	**Transformation into civil society responsibility**										
1.4.1 Measure: Citizen information and involvement											
1.4.1.1	Citizen participation formats for climate neutrality	2024	2030								
1.4.2 Measure: Creating networks											
1.5	**Climate protection and social participation**										
1.5.1 Measure: Neighbourhood management											
1.5.1.1	Introduction of a municipal climate fee	2024	2026								
1.6	**Climate and health**										
1.6.1	Measure: RWTH Health and Climate Research Co-operation										
1.6.2	Measure: Organisational unit for civil protection										

		Start date	End date	2023	2024	2025	2026	2027	2028	2029	2030
2	**Energy supply**										
2.1	**City as a role model: energy supply and generation**										
2.1.1 Measure: Decarbonisation of the heat supply in the urban family											
2.1.1.1	Climate-neutral electricity and heat supply for properties under municipal control	2024	2030								
2.1.2 Measure: Expansion of renewable electricity generation in the urban family											
2.1.2.1	Ground-mounted PV systems on urban areas	2024	2025								
2.2	**Urban energy planning**										
2.2.1 Measure: Integrated heat and energy planning											
2.2.1.1	Masterplan - integrated, comprehensive energy planning	2024	2025								
2.2.1.2	Heat planning	2024	2026								
2.3	**Locally and renewably generated electricity**										
2.3.1 Measure: Promoting participation and operator models											
2.3.1.1	Energy in the hands of citizens	2024	2027								
2.3.2 Measure: Tapping wind power potential											
2.3.2.1	Safeguarding / expansion of wind energy	2024	2027								
2.3.3 Measure: Expansion of photovoltaics on residential and non-residential buildings											
2.3.3.1	Solar offensive on all suitable roof surfaces	2024	2026								
2.3.4 Measure: Expand ground-mounted photovoltaics											
2.3.4.1	Concept development: Identification and utilisation of PV open space potential	2024	2025								
2.4	**Decarbonised heat supply**										
2.4.1	Measure: System and plant optimisation of the existing district heating system										
2.4.2	Measure: Expansion and decarbonisation of district heating										
2.4.3	Measure: Promote efficient decentralised heating systems with renewable energies										
2.5	**Security of supply and sector coupling**										
2.5.1	Measure: Making grids fit for sector coupling										
2.5.2	Measure: Expansion of energy storage										
2.5.3	Measure: Control and storage of volatile electricity generation, grid-friendly energy tariffs and operator models										
2.5.4	Measure: Ensure the import and export of renewable electricity in line with demand										
2.5.5	Measure: Production and distribution of hydrogen, synthetic gases and fuels, infrastructure development										
2.5.6	Measure: Increasing the speed of implementation										
2.5.6.1	Development of a city-wide pool of tradespeople and a platform including training opportunities	2024	2030								

		Start date	End date	2023	2024	2025	2026	2027	2028	2029	2030
3	**Building**										
3.1	**City as a role model: Municipal buildings**										
3.1.1 Measure: Implementation of a climate-neutral and climate-adapted building stock of non-residential buildings											
3.1.1.1	Refurbishment roadmap for municipal non-residential buildings	2024	2030								
3.1.2 Measure: Realisation of a climate-neutral and climate-adapted building stock of residential buildings											
3.1.2.1	Action plan for the energy-efficient refurbishment of municipal residential buildings	2024	2030								
3.1.3	Measure: Climate-neutral new build										
3.1.4	Measure: Energy management systems										
3.2	**Climate-friendly and climate-adapted urban development**										
3.2.1 Measure: Activation of vacant lots/area management											
3.2.1.1	Breaking new ground - additional residential units in existing buildings and development of alternative, lifecycle-adaptable residential buildings	2024	2027								
3.2.2 Measure: Climate-friendly urban planning											
3.2.2.1	Energy-efficient monument conservation	2024	2030								
3.2.2.9	Climate campaign for leasehold properties in the city	2024	2026								
3.3	**Residential building stock**										
3.3.1	Measure: Modernisation of the single-family house stock										
3.3.2	Measure: Modernisation of the multi-family housing stock (privately and commercially rented, owners' associations)										
3.3.2.1	Consultancy campaign: energy-efficient modernisation of the multi-family housing stock	2024	2030								
3.3.3 Energy-efficient neighbourhood development											
3.3.3.1	Redevelopment model area: Eastern city centre	2024	2030								
3.4	**New residential building**										
3.4.1	Measure: New construction of climate-neutral detached houses										
3.4.2	Measure: New construction of climate-neutral apartment blocks										
3.5	**Non-residential buildings**										
3.5.1 Measure: Realising the potential of commercial properties											

		Start date	End date	2023	2024	2025	2026	2027	2028	2029	2030
4	**Mobility**										
4.1	**City as a role model: Mobile city group**										
4.1.1	Measure: Company mobility management										
4.1.1.1	BMM at the city administration of Aachen and at the municipal holding companies	2024	Establish long-term								
4.1.2	Climate-neutral vehicle fleet										
4.2	**Transport planning and mobility concepts**										
4.2.1	Measure: Structural framework conditions										
4.2.1.1	Binding mobility concepts for construction projects and events	2023	2029								
4.2.1.2	Balancing and impact assessment of the mobility measures in the ICSK	2024	2025								
4.2.1.4	City centre mobility for tomorrow	2024	Establish long-term								
4.2.1.5	Network Mobility Transition Aachen Region (NEMORA)	2024	Establish long-term								
4.2.1.6	Zero-emission zone	2024	Establish long-term								
4.3	**Avoiding and shifting passenger transport**										
4.3.1	Measure: Expansion of public transport										
4.3.2	Measure: Cycling infrastructure and pedestrian traffic										
4.3.3	Measure: Multimodal mobility										
4.3.3.1	Promotion of sharing and multimodality	2024	k. A.								
4.3.4	Measure: Car park management										
4.3.5	Measure: Incentives for the switch										
4.4	**Avoiding and shifting commercial traffic**										
4.4.1	Measure: Climate-friendly commercial transport and company mobility										
4.4.2	Measure: Company mobility management Company										
4.4.3	Measure: Strategies for the last mile										
4.5	**Climate-friendly drives and fuels**										
4.5.1	Measure: Offers and infrastructure to promote e-mobility										
4.5.1.1	Expansion of the charging infrastructure	2025	2030								
4.5.2	Measure: Supply and infrastructure of synthetic fuels for forestry, agriculture and special vehicles										

		Start date	End date	2023	2024	2025	2026	2027	2028	2029	2030
5	**Economy**										
5.1	**City as a role model: climate-neutral administration**										
5.1.1	Measure: Climate-neutral equipment and procurement										
5.1.1.1	Sustainable procurement	2024	Establish long-term								
5.1.2	Measure: Climate-neutral IT infrastructure										
5.1.3	Measure: Leverage behaviour-related savings potential										
5.1.4	Measure: climate-friendly urban construction and building sites										
5.2	**Economic promotion and location development**										
5.2.1	Measure: Economic development 4.0										
5.2.1.1	"Sustainable and efficient economy" funding programme	2024	2026								
5.2.2	Measure: Site development and infrastructure measures for sector coupling in industrial estates										
5.3	**Climate-neutral trade, commerce and services**										
5.3.1	Measure: Consultancy on energy supply and energy saving										
5.3.2	Measure: Promoting climate protection effectiveness in the workplace										
5.4	**Climate-neutral industry**										
5.4.1	Measure: Sustainable production with renewable energies										
5.4.1.1	Supporting companies in evaluating the switch to hydrogen technologies, providing information, advice and networking	2024	2026								
5.4.2	Measure: Promoting climate protection effectiveness in the workplace										
5.5	**Waste and recycling management**										
5.5.1	Measure: Promoting the recycling of products and materials										
5.5.1.1	Circular economy in practice: development of a building yard of the future for Aachen's municipal utility company	k. A.	k. A.								
5.5.2	Measure: Disseminate NaWaRo as building materials										
5.5.3	Measure: Waste avoidance										
5.5.4	Measure: Establish and expand the circular economy in industry and the tertiary sector										
5.5.5	Measure: Circular economy in the construction industry										
5.5.5.1	Component and resource warehouse	2024	2025								
5.5.5.2	Circular economy in the construction industry	2024	Establish long-term								
5.5.5.3	Develop criteria for a climate-neutral construction site	2024	Establish long-term								
5.6	**Agriculture, food industry and regional trade structures**										
5.6.1	Measure: Promote regional marketing, production and production in the area of sustainable nutrition										
5.6.1.1	Regional BioHub - Sustainable food production and distribution	2024	2030								
5.6.1.2	Strengthening local retail and sustainable transformation of the catering industry	2025	Establish long-term								
5.6.2	Measure: Expansion of sustainably managed agriculture										
5.6.2.1	Lease agreements of the city of Aachen are used to strengthen organic farming	2024	2035								
5.6.2.2	Pilot project in agroforestry	2024	2026								

		Start date	End date	2023	2024	2025	2026	2027	2028	2029	2030
6	**Social transformation**										
6.1	**Climate awareness and transfer**										
6.1.1	Measure: Promoting pioneers of change and opening up spaces for innovation and experience										
6.1.1.1	Making climate neutrality tangible and best practice visible	2024	2030								
6.2	**Climate-friendly living environment**										
6.2.1	Measure: Integrating climate protection into the urban environment										
6.3	**Climate-friendly behaviour in everyday life**										
6.3.1	Measure: Participatory campaign to activate and qualify Aachen's citizens										
6.3.1.1	Participatory campaign with volunteer climate trainers	2024	2030								
6.4	**Climate and education**										
6.4.1	Measure: Experience- and process-based environmental education for climate protection and sustainability										
6.4.1.1	Monitoring and support of climate and sustainability activities at schools for structural change	2024	2027								
6.5	**Climate protection in culture and leisure**										
6.5.1	Measure: Promote providers of leisure facilities as multipliers for climate protection and sustainability										
6.5.1.1	Structural changes with the handprint! - Workshops and support for implementation within the administration and with multipliers in associations	2023	2030								
6.5.2	Measure: Promoting creative artists as multipliers for climate protection and sustainability										

		Start date	End date	2023	2024	2025	2026	2027	2028	2029	2030
7	**Compensation**										
7.1	**Green infrastructure to bind CO2**										
7.1.1	Measure: Aachen forest in transition										
7.1.2	Measure: Development and protection of natural CO2 sinks										
7.1.1.2	Increase the number of green spaces and tree plantations (natural CO2 sinks)	2024	2027								
7.2	**Technical systems CO2 compensation and storage**										
7.2.1	Measure: Identify potential for technical compensation and CO2 storage										

13. Conclusion

A strategy describes the path to achieving a goal. The city of Aachen has set itself the goal of achieving climate neutrality by 2030. Climate neutrality here means that no more GHG emissions are emitted than can be offset by natural or technical sinks. The premise here is compliance with the Paris-compliant budget for the 1.5 degree target.

This strategy is not a rigid plan, but reflects a process that is already underway. By recording the current energy and GHG balances and deriving the 2030 target scenario, "Aachen's path to climate neutrality" lays the starting point for the creation of an operationalisable strategy for the entire city. This report has been drawn up in close cooperation with various stakeholder groups in the municipal family.

The transformation towards climate neutrality is an ambitious and holistic task. It encompasses not only technical and infrastructural aspects, but also extends to the procedural and social level. The report describes the relationships between the municipal family and other decision-making levels of the stakeholders in Aachen as well as the framework conditions at EU, federal and state level. Climate neutrality will only succeed if all decision-making levels work together. The further process therefore requires the intensive and active involvement of all stakeholders.

Various tasks need to be mastered in the process. These include the creation of governance structures to manage and coordinate the transformation and at the same time accelerate processes. The challenge is to act within the framework of social responsibility and to respect the natural limits of land and resources. Against this background, an energy and greenhouse gas balance sheet was drawn up for Aachen, supplemented by secondary balances on the compensation options for green infrastructure. The CO2 budget for Aachen was derived on this basis.

Scenarios describe possible ways of achieving climate neutrality. Scenarios are not forecasts. However, they describe a possible development, taking into account the assumptions made. Strategic recommendations for the implementation strategy are derived on the basis of the possible development paths. The key recommendations include firmly integrating the goal of "climate neutrality" into overarching urban development, increasing the refurbishment rate, expanding green district heating on the basis of municipal heating planning and stepping up strategic activities to strengthen cycling and the electrification of motorised private transport.

To this end, the report carries out in-depth technical analyses in the City of Aachen's existing fields of action (buildings, energy, mobility, economy), introduces governance, social transformation and compensation as new fields of action and adapts the target and measure levels with their municipal activities for the goal of climate neutrality by 2030. The key findings are

- **Governance:** The process towards climate neutrality cannot be managed "top-down". The path to climate neutrality is a systemic task and an agile process in which the city, citizens and stakeholders such as companies, associations and interest groups must be equally involved. Structural changes are required. Organisational brackets are needed to organise, communicate, control and bring about decisions on the path to climate neutrality. This applies both within the administration, within the municipal family, and externally, in relation to civil society and the business landscape. Urban development and climate protection must be strategically considered as a cross-sectional task across all fields of action.
- **Energy supply:** The energy transition is going electric: the goal of climate neutrality can only be achieved if fossil fuels are completely replaced by renewable energies using cross-sectoral approaches. Today, almost 1.2 million tonnes of CO2eq are emitted annually through electricity and heat generation in Aachen. More than 60 % of this can already be saved by switching energy sources.
- **Buildings:** The main task lies in existing buildings: more than a third of existing buildings need to be refurbished to a high standard of thermal insulation by 2030. Heat consumption must be reduced by around 25 % compared to 2020.

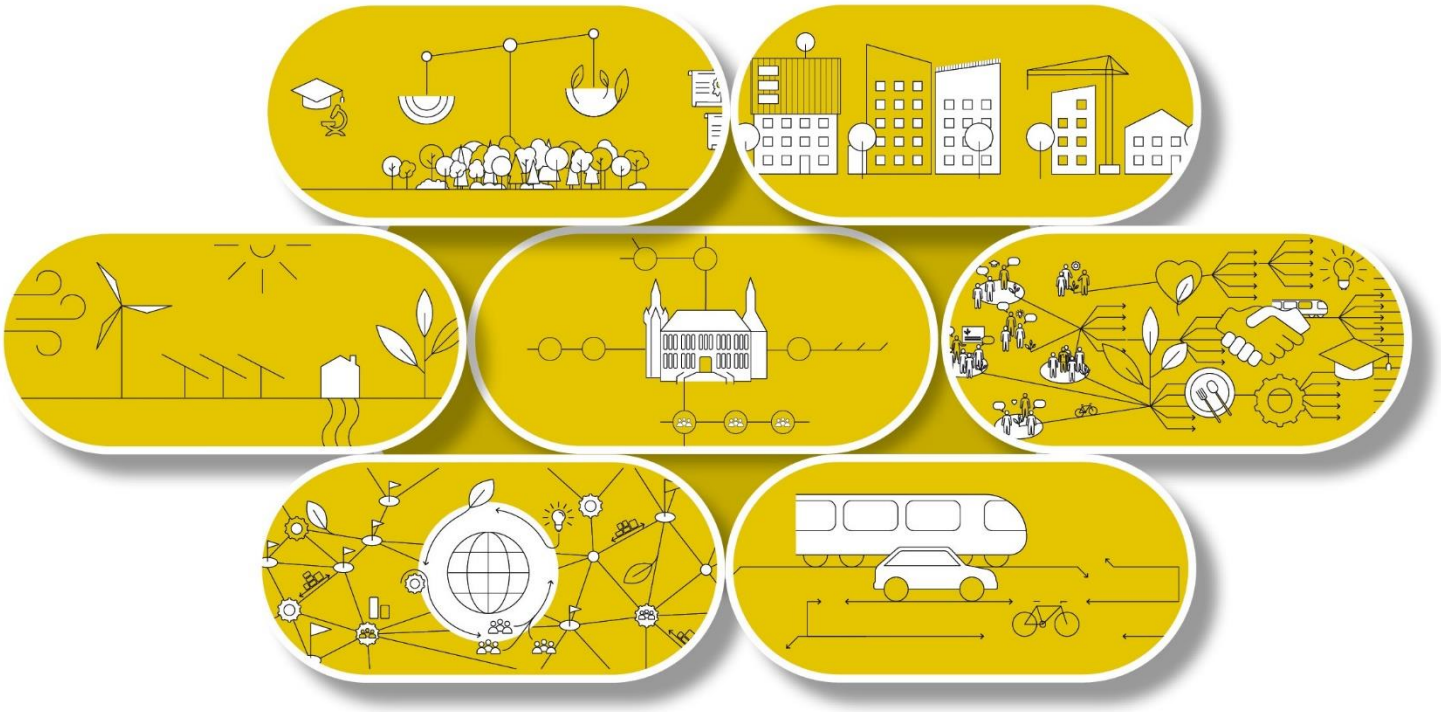
- **Mobility:** Avoiding, shifting and converting are the three key levers for reducing greenhouse gases in mobility. Around 330,000 tonnes of CO2eq. must be saved or avoided, among other things by strengthening eco-mobility and by changing drive systems.
- **Economy:** A significant part of the transformation task lies in the economic sectors. Around 122,000 tonnes of annual greenhouse gas emissions must be reduced in the economic sector by 2030 in order to achieve climate neutrality. Key activities include reducing current electricity and heating energy requirements and transforming the transport of goods and personnel.
- **Society:** Social transformation is a systemic task: although individual, smaller changes in behaviour contribute to climate protection, support is needed to bring about a broader, more fundamental change. Considering and taking into account the effects from and on social situations is a fundamental prerequisite for the success of the transformation to climate neutrality. Greenhouse gas savings can be achieved across all sectors through sufficiency, i.e. savings through reduced use or consumption due to changes in behaviour.
- **Offsetting**: As a mission city, the city of Aachen is in a special position - it can offset unavoidable emissions through emissions trading, expansion of its natural greenhouse gas sinks and technical solutions such as carbon capture and storage and offset them directly against its territorial balance.

The realisation of climate protection tasks is a particular challenge when financial and human resources are scarce. Cities in particular bear the burden of implementing climate protection measures locally. Only with external funding will it be possible to successfully and fully implement the measures of the city of Aachen and the urban community that will lead to climate neutrality by 2030. The challenges of the transformation require considerable investment in all fields of action. The prioritisation and selection of measures based solely on a simple consideration of the criterion of euros per tonne of CO2eq saved does not do justice to the complexity of the task. In addition to the costs of the transformation, it is necessary to clearly demonstrate the benefits of the transformation beyond the pure CO2eq reduction as a sound basis for decision-making. This consideration makes it clear:

Climate neutrality pays off!

Der Beitrag zum Klimastadtvertrag

Band 2 – Die Aktivitäten



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The IKSK "Aachen: The path to climate neutrality 2030" is the administration's contribution to the Climate City Contract

This Volume 2 of the ICSK 2019 update describes the administration's contribution to the Climate City Contract in the form of activities. It supplements Volume 1, which presents the path to climate neutrality by 2030 as part of the EU mission "100 Climate-Neutral and Smart Cities by 2030".

The climate neutrality strategy for the city of Aachen as a whole maps the first three levels, while the administration's contribution describes the fourth level (see Figure 1):

Illustration 1 Structure IKSK 2.0

Level 1 - Fields of action: The fields of action describe at an overarching level what needs to happen in order to achieve climate neutrality: Who can act, how can action be taken and by when must overarching goals be achieved? The fields of action formulate guidelines for greenhouse gas reduction.

Level 2 - Priorities for action: The action priorities concretise and describe what needs to be done. To this end, they formulate strategic objectives and name the key players and target groups involved in the key areas of action.

Level 3 - Measures: Measures specify who has to act and by when.

Level 4 - Activities: Activities formulate direct and indirect options for action by the core administration of the City of Aachen. These are described as profiles. In addition to the general description of the activity (objective and strategy, initial situation, description, first action steps), the profiles include the following evaluation criteria:

- Actors
- Target groups
- Duration of the activity
- Synergy effects
- Conflicting goals
- Success indicators/milestones
- Time required
- Material costs
- GHG savings

The three evaluation criteria of time expenditure, material costs and GHG savings are described in more detail below:

Time required

This criterion is used to map the time required to implement an activity in full-time equivalents. The time required can be solved through new task allocations with existing personnel capacities or through personnel positions to be created. It is not taken into account whether this time expenditure is distributed across several locations, e.g. in the municipal administration, municipal subsidiaries or service providers. The total working time of other actors, if their cooperation is a prerequisite for the implementation of the activity, is not taken into account here.

Material costs

The material costs quantify the costs to be incurred for the realisation of the activity.

GHG savings

For each activity, it is checked whether an energy reduction can be quantified in order to calculate the GHG reduction potential based on this. This is done according to the current state of knowledge and currently applicable framework conditions. The quantification is based on the results of current studies, evaluations and our own experience. The GHG savings are quantified in two variants. On the one hand, the reduction in the annual emissions level is stated for full implementation of the activities. On the other hand, the cumulative GHG savings are quantified, which includes a time component with the duration of the respective activity.

Priorities and focal points

Around 50 ideas were selected for the work programme from a total of 232 activities.

The activities were selected on the basis of three different focal points:

1. Large leverage effect GHG reduction
2. Structural change
3. Change through new paths

As a general rule, activities were prioritised if they were highly cost-effective and could be implemented against the background of the remaining GHG budget promise rapid realisability.

The priorities and focal points were based on the Climate City process so that the activities selected by the core administration are in line with the city-wide strategy.

Figure 2 Overview of prioritisation criteria

Governance

The path to climate neutrality is a systemic task and an agile process in which the city, citizens and stakeholders such as companies, associations and interest groups must be equally involved. The field of action aims to translate the findings of the administration (see Volume 1, Chapter 5) from the ICSK process into strong structures.

The following key areas of action are therefore at the centre of administrative action:

Transformation as a management task

Administration translates climate neutrality into an action-oriented idea; begins to set up new processes within itself, restructure old processes and reorganise them. The $CO_{2\,budget}$ for each field of action must not be burdened beyond a target value. Controlling and monitoring of the process is required to check, evaluate and readjust compliance with the development path as well as a binding mechanism for follow-up control.

Urban development as a climate management task

The planning and conceptual framework for these necessary developments is provided by integrated, climate-friendly and sustainable urban development. The city administration's actions always take into account the settlement areas for the city as a whole as well as potential land conflicts.

Communication

Change processes require active communication in order to deal with resistance and increase acceptance.
The transformation can be actively shaped through the type of communication, education, the creation of incentives for action and decision-making impulses as well as the consideration of behavioural characteristics. Good internal administrative communication and networking form the basis for accelerated and consistent implementation of the process towards climate neutrality. This includes clarity about the communication and decision-making channels for the implementation of climate protection measures, interdisciplinary dialogue between departments and learning from each other.

Transformation in civil society responsibility

In order to achieve the goal of climate neutrality by 2030, strong participation of the urban community is required. New ideas and projects are developed in direct dialogue with citizens. and further developed, accompanied and supported the implementation of projects, measures and activities.
Community action promotes social cohesion. Initiatives run open workshops, neighbourhood centres, online platforms for swapping, lending and co-creation.
Citizen participation should be organised on an ongoing basis. A hybrid approach that combines both analogue (e.g. project workshops, focus groups, citizens' councils) and digital formats (e.g. citizens' panels) makes sense.

Regional relations and cooperation

Administration needs strong contacts and players outside the administration; this requires networks and alliances between which paths can be established

Climate protection and social participation

Climate protection must go hand in hand with greater social justice. The fight against the climate crisis also means standing up for social and intergenerational change. Life satisfaction depends on the opportunity to participate. Strong communities build social capital and are stable in situations of crisis and change. Major differences and perceived injustices hinder transformation and lead to resistance. Combating inequality and strengthening the community is therefore a success factor.

Climate protection and health

The quality of life of Aachen's citizens is closely linked to the protection of health and the climate. From the prevention of heat stress to protection against the spread of pathogens. Climate change has a direct or indirect impact on the physiological and mental state of Aachen's citizens. In this respect, a city-wide strategy and targeted management of measures across various fields of action are required.

Figure 3 Excerpt from the governance portfolio plan (green star: activity with profiles)

These activities are described with a profile

These activities are described in brief:

Introducing and anchoring multi-project management

Thematic focus	Introduction	Development of effect	Sphere of influence
City as a role model: transformation as Management task	2024	Short term	Regulate

Goal and strategy

The aim of multi-project management is to control, coordinate and accelerate the implementation process of all sub-projects within the City of Aachen's GHG budget. In contrast to project management for the individual projects for the implementation of measures and activities, for example, multi-project management keeps an eye on the overall portfolio of activities as well as the structural framework conditions and ensures that adjustments are made in the event of delays or changes in the legal framework. In addition, multi-project management coordinates the process in all municipal facilities and departments in the long term. The basis for this is
including the introduction of multi-project management software in the City of Aachen Group.

Initial situation

At present, climate protection work is essentially the responsibility of Department 7 and Department 36. There is currently no cross-departmental multi-project management, or only a rudimentary one.

Description of the

In addition to coordinating and steering activities, multi-project management in the context of the climate neutrality target also includes managing the portfolio of municipal climate protection activities until the target is achieved. To this end, a process is to be defined through which new measures and projects can be added to the portfolio that support the achievement of the climate neutrality target in the medium to long term. In addition, a transparent presentation and communication of the portfolio, status reports and procedures for evaluating success and processes are to be developed. The tasks of multi-project management also include

- Establish impact monitoring and success control:
- Networking and knowledge management:
- Idea management:
- Strategic initiation of projects:

First steps for action

- Procurement or commissioning of multi-project management software
- Establish structures for networking and knowledge management in all departments and municipal holdings
- Gradually implement and anchor instruments in the departments and holdings, including follow-up mechanisms
- Evaluate management system, adapt and update if necessary

Actors

Lead: Dec. VII
Participants: FB 36

Target group

Core administration, investments and municipal companies, private companies, civil society organisations

Time required

time equivalents

Duration of the activity

2024 -2030

Material costs

Financing approach

Approx. 180,000 €	Budget and EU funds

GHG savings

Not quantifiable - no direct savings

Synergy effects

1.1.1.2. Dashboard: Monitoring & controlling with balance sheet
1.1.1.3. Climate neutrality transformation strategy - Practical solutions for implementation
1.1.2.3 Comprehensive funding management

Conflicting goals

Possible breaks during the implementation process, difficult handover in the event of staff changes, illness, etc.

Success indicators/milestones

Impact monitoring and success management are established, procurement of a Multi-project management software

Dashboard: Monitoring & controlling with balance sheet

Thematic focus	Introduction	Development of effect	Sphere of influence
City as a role model: Transformation as Management task	2024	Medium-term	Regulate

Goal and strategy

The aim is to strengthen multi-project management and the implementation of activities. To this end, monitoring and controlling will be introduced to monitor success. There is a standardised data structure (indicators) for recording the status of activities and a system for recording, evaluating and presenting the relevant indicator development. The results are made available for process control and communicated externally (dashboard). The basis is the regular GHG balancing (annual). In addition to energy-related emissions, this also includes other ancillary balances of non-energy-related emissions and offsetting. The data is recorded, analysed, interpreted and integrated into the performance review.

Initial situation

The initial prerequisites are the implementation of standardised accounting systems and indicators for activities, operations, non-energy emissions and offsetting in all responsible or affected areas of the administration and municipal holdings, including the technical infrastructure. An important factor here is the separate labelling of GHG offsetting via emissions certificate trading (see EU Info Kit).

Description of the

The City of Aachen (in particular the multi-project management) supports all affected departments and municipal holdings in the implementation of the indicator system and organises training for the accounting methods where necessary. With regard to non-energy greenhouse gas emissions and natural compensation, pioneering work is being carried out to set up our own monitoring systems. In addition to the monitoring dashboard, an explanation of the accounting methodology will be published and communicated. In the event that binding methodological framework conditions or assistance for the accounting of non-energy greenhouse gases are established by 2030, the multi-project management is responsible for adapting the accounting methodology.

First steps for action

- Definition of an indicator system for the energy-based GHG balance, non-energy emissions, natural and technical compensation
- Implementation of a standardised accounting system, including indicators and technical infrastructure in administration and municipal holdings
- Creation of a dashboard including the basics of communicating the results (FAQ for laypersons, etc.)

Actors

In charge: Dec. VII -FB 36
Participants: FB 14, Agency for Climate, Energy and Sustainability, Regio IT

Target group

Citizens, city administration, municipal holdings

Time required

-time equivalent

Duration of the activity

2024 - 2026

Material costs

)00 €

Financing approach

Budget funds

GHG savings

Not quantifiable, as no direct savings are achieved through monitoring.

Synergy effects

1.1.1.1 Introducing and anchoring multi-project management
1.1.2.2 Introduction of climate funds

Conflicting goals

Data availability and resources required for data collection in the municipal family

Success indicators/milestones

Processes for collecting and processing information have been introduced.
Technical system is in place, dashboard is active.
Data is used in the context of process control.

Climate neutrality transformation strategy - practical solutions for implementation

Thematic focus	Introduction	Development of effect	Sphere of influence
City as a role model: Transformation as Management task	2024	short term	Taxes/Offering

Goal and strategy

The transformation strategy should develop practical principles for urban action in order to accelerate the change process, improve the framework conditions for implementing projects and spread the transformation. The transformation of urban society towards climate neutrality must be understood as a systemic task for the city, citizens and companies and as an agile process. The activity is part of the measure "Overarching instruments for process control and initiation of projects".

Initial situation

The goal of achieving climate neutrality requires a better understanding of practical principles, strategies and instruments and the systemic interplay between the decision-making levels. This knowledge is often not available. The aim of the activity is to systematically work out the findings using the example of the implementation of concrete activities at the level of the municipal family and with actors from urban society or companies and to derive transferable recommendations from this. The recommendations are to be developed in dialogue and cooperation with international experts within the framework of technical and working meetings accompanying the process. Close cooperation with COLAB - Governance (Münster, Mannheim) can also take place here.

Description of the

Four dimensions of transformation are at the centre of the transformation strategy:

Governance: The key to successful implementation is the acceleration of decisions and their realisation. The transformation strategy must answer the following questions: How are decisions accelerated, implemented and enforced at all levels? What organisational and regulatory framework conditions are required?

Technology and infrastructure: The availability and low-threshold accessibility of technical solutions and infrastructure is the basic prerequisite. The key questions of the strategy are: How can the necessary resources be provided? Who can support and finance projects?

Society and economy: This dimension describes the influences of social transformation on the achievement of objectives with a more long-term effect (values level) and short-term effect (attitudes). Values and attitudes influence personal actions at an individual level and the actions of groups and organisations at a societal level. The economic framework conditions influence investment decisions in technologies and infrastructures, tariffs and subsidies and have a steering effect on climate-friendly decisions. The key question is: How can the change in society and the economy be spread?

Land and resources: Shaping the spatial transformation towards a climate-neutral city and the careful use of land and resources is a central task of sustainable urban development. A climate-neutral city requires the renegotiation of land use in order to minimise competition for space. This requires an interdisciplinary planning culture, space for innovation and solutions with impact. Planning topics include, for example Double inner development, mixed use in the neighbourhood, the promotion of communal forms of housing and living, social mixing, the reduction of land consumption, the planning of land use for renewable energies and infrastructures. The promotion of green spaces increases the CO_2 compensation potential, strengthens resistance to global warming and improves the quality of life. The key question of the strategy is: How can the limits of land and resource consumption be adhered to?

First steps for action

- Systematic recording of the requirements and needs of the stakeholders in Aachen.

- Selection of exemplary activities and measures from the ICSK and the city contract that represent the four dimensions of transformation mentioned above.
- Development of practical recommendations to accelerate implementation, creation of framework conditions to improve implementation and transferability with the aim of achieving a broad impact.
- Involvement of experts from EU mission cities, practitioners and academics in the development of recommendations.
- Preparation of the results and transfer to the implementation process in Aachen and communication as part of the exchange of expertise at EU mission level.

Actors

In charge: Dec. VII
Participants: Municipal family, citizens, companies, cities EU mission

Target group

Actors with responsibility for implementation, politics

Time required

time equivalents

Duration of the activity

2024 - 2026

Material costs

500,000 € for events, external experts, external consulting, evaluation

Financing approach

Budget, promotion

GHG savings

Not quantifiable as pure strategy. The scope and impact of implementation cannot yet be estimated.

Synergy effects

1.1.3.3 Agency for Climate, Energy and Sustainability
1.1.4.1 CoLab pilot project

Conflicting goals

None are expected

Success indicators/milestones

Selection of projects
Organising events with experts
Practical recommendations for action Application and transfer to other projects and stakeholders

Updating the climate relevance assessment to prioritise climate-relevant decisions

Thematic focus	Introduction	Development of effect	Sphere of influence
City as a role model: transformation as Management task	2024	Short term	Regulate

Goal and strategy

The aim of this activity consists of two sub-aspects:

The City of Aachen is revising the existing procedure "Climate relevance assessment for prioritising climate-relevant decisions" and updating it in line with the objectives of the climate neutrality strategy.

The City of Aachen is developing the most specific service instructions possible for the core administration that it needs to implement the Aachener Weg 2030.

The City of Aachen is also revising the existing municipal publications and decision-making aids to provide information on specific short and long-term climate impacts and environmental consequences of awards, procurements and contracts, and to facilitate internal and external communication.

Initial situation

For the update of the climate relevance assessment and the service instructions, the objectives of the Aachen Way must be summarised in instructions that are as specific as possible for the target group.

Description of the

Decision-makers, the administration and holdings will receive guidelines and instructions that correspond to the objectives of the "Aachen Way" and support the listed stakeholders in implementing the portfolio accordingly. In addition, the existing climate relevance assessment system will be adapted to these goals.

First steps for action

- Revision and adaptation of existing publications and instructions
- Annual agreements with the multi-project management regarding follow-up management

Actors

In charge: Dec. VII
Parties involved: FB 36, Procurement Office

Target group

City administration

Time required

ıll-time equivalents

Duration of the activity

2024 - 2030 (follow-up control)

Material costs

.....

Financing approach

Budget funds, if applicable

GHG savings

Not quantifiable, as it depends on the type and scope of the measure to be implemented.

Synergy effects

Conflicting goals

1.1.1.1 Introducing and anchoring multi-project management	None expected
1.1.3.1 Introduce climate coordinators in all departments	

Success indicators/milestones

The existing system for climate relevance assessment will be adapted to the target achievement corridor

Governance/ 1.1.2.2.

Introduction of climate fund

Thematic focus	Introduction	Development of effect	Sphere of influence
City as a role model: Transformation as Management task	2024	Medium-term	Taxes/Offering

Goal and strategy

The City of Aachen is setting up a fund to finance local climate protection projects, taking into account and supplementing existing funding programmes (e.g. the funding programme for companies of FB 02). Projects to be funded make a direct contribution to GHG reduction. The Climate Fund of the City of Aachen promotes local investments and innovations for greenhouse gas reduction across all fields of action and across all sectors. It is primarily aimed at projects supported by civil society with a strong impact and a collaborative approach. However, projects with an impact involving companies can also be supported. This fund provides flexible funding for the promotion of climate protection measures with a direct and long-term GHG reduction effect. The principle applies: money in return for CO_2 savings. The amount of funding for greenhouse gas reduction measures is based on the amount of emissions saved or offset. By linking the amount of funding to the CO_2 price, the direct consequences of one's own actions become clear. Criteria are being developed for this fund for the payment and promotion of climate protection measures (e.g. social impact).

Initial situation

The City of Aachen is involved in the regional energy cooperative Klima Region Aachen. The co-operative primarily invests in renewable energy generation plants and offers compensation options. The instrument of climate funds is comparatively new. There are role models in other cities: a local climate fund is currently being trialled in several municipalities (e.g. Bottrop).

Description of the

The contributions to the fund will initially only be made by the city and the City of Aachen Group. Citizens, interest groups, institutions and economic players can also contribute to the fund. Projects for the promotion of citizens, civil society organisations and companies can be submitted. The fund is managed by the multi-project management team. In this respect, the fund also serves as an instrument for activation and process control, as projects with different focal points can be supported flexibly and at different times.

"Funding decisions" with funds are given according to transparent criteria and decided, for example, by the climate protection conference. Possible sources for the seed capital could be, for example, pro rata income from property tax. A key aspect of the climate fund is that funds are only paid out if the measure achieves demonstrable CO_2 savings.

Promotion of CO_2 savings through funding from the Climate Fund

CO_2 savings premiums for investments: Aachen citizens, civil society organisations or companies receive a bonus of €237/tonne for every tonne of CO_2 per year that can be proven to have been saved, which is equivalent to the CO_2 costs recommended by the UBA. The bonus programme promotes investments in climate protection that lead to a reduction in annual emissions in the energy balance of the city of Aachen. The premium is based on the recommendations of the Federal Environment Agency in relation to the damage saved for people and the environment. At the end of the year, companies provide evidence of greenhouse gas savings on the basis of a (simplified) energy management system, together with a description of the measures implemented. Private households residing in Aachen can take advantage of the bonus programme by providing evidence of the measures implemented on the basis of a catalogue of measures - subject to a de minimis limit of < 10 tonnes/a. If measures are not included in the catalogue, they will be calculated separately. By linking to the CO_2 price, investment measures are subsidised within a range of approx. 3% to 10% of the investment sum. In order to achieve a high level of dynamic utilisation, the funding is to decrease within a time frame that has yet to be defined. For example, the subsidy could start at €237 per tonne in 2024 and then decrease by 10% each year until 2030. The amount of the investment subsidy should be flexibly adjustable as a control instrument depending on the results of the monitoring. It should follow the principle: The higher the reduction requirement per year, the higher the investment subsidy for the following year. In order to quickly achieve a high reduction in greenhouse gases and thus protect Aachen's CO_2 budget, an annual purchase of 10,000 tonnes of CO_2eq would be recommended. In the first year this would correspond to € 2,370,000. In the second year, following the assumed degression, this results in a value of

2,133,000, and a total of € 1,919,700 in the third year. Over a period of three years, this amounts to of € 6,422,000.

In the future, the existing funding programmes could be aligned with the above logic. Double funding must be ruled out in any case.

Fundraising for the climate fund

Initially in particular, the climate fund will have to be financed primarily through the municipal budget. In the future, one possibility for financing could be the use of voluntary levies in accordance with the EEG. For example, the EEG allows wind power operators to make direct payments of 0.2 cents per kWh generated to local authorities. As a further perspective possibility, a compensation offer can be created for Aachen companies, but also for citizens. The funds raised can be increased through sponsorship. Only local (innovation) projects for $CO_{2\ savings}$ are supported. The scope of the fund is determined at the beginning of each year and is determined by the projects that are "registered" with the fund for the respective year. Towards the end of each year, special appeals can be launched to support individual projects that have not yet been "fully financed" by then. The price for an offset certificate is based on market prices (e.g . Atmosfair) and is increased to e.g. €237 per tonne when projects are funded.

First steps for action

- Definition of criteria for when a project saves CO_2 and qualifies for climate fund funding
- Definition of criteria for prioritising projects requiring different levels of investment
- Definition of responsibilities for project applications within the administration
- Communication of the rules and participation opportunities to the public

Actors

Lead: FB 02 - Economy, FB 36 - Climate and Environment, Science, Digitalisation and Europe, FB 20 - Financial Management
Parties involved: FB 14 -Auditing, FB60 - Contract, award and subsidy management,

Target group

Citizens, interest groups, institutions, economic organisations

Time required

·time equivalent

Duration of the activity

2024 - 2027

Material costs

Approx. 6.4 million euros

Financing approach

Budget funds, possibly sponsorship by private and economic players

GHG savings

Over a period of 3 years, 10,000 tonnes of CO_2 will be purchased annually.

Reduction of the annual emission level (t/a):

10,000 tonnes of CO2eq per year

Cumulative GHG savings (tonnes):

Up to 30,000 tonnes of CO2eq

Synergy effects

1.1.3.3 Agency for Climate, Energy and Sustainability
1.2.1.2 Climate protection management for integrated Urban development concepts and projects to redesign public spaces

Conflicting goals

Potentially high time expenditure for the evaluation of funding decisions

Success indicators/milestones

Launch of the Climate Fund 2024;
funding for the first project

Comprehensive subsidy management

Thematic focus	Introduction	Development of effect	Sphere of influence
The city as a role model: transformation as Management task	2024	Short term	Regulate

Goal and strategy

The national and EU-wide funding landscape is to be systematically recorded with the help of a centralised and comprehensive funding management system. Based on this, the respective departments responsible for implementing the activity will be supported in identifying and applying for funding. Among other things, this is intended to minimise efficiency gaps in investment activities.

Initial situation

The basis for overarching funding management is that all departments and holdings are involved in the transformation process and can identify their efficiency gaps. Funding management also requires sufficient human resources to be able to provide proactive support. These positions must be created and filled.

Description of the

Funding management, departments and investments are in close consultation with regard to their implementation planning in order to make the best possible use of the funding opportunities, some of which can be applied for at relatively short notice. Accordingly, good communication channels should be established between the overarching funding management and the departments and participations. In the area of public participation and social transformation, the
a. support the Agency for Climate, Energy and Sustainability from the CoLab cooperation.

First steps for action

- Expansion of funding management to all fields of action of the Aachen Way
- Provision of one to two additional staff positions
- Cooperation between multi-project management/climate coordinators and the departments or participations in the development of an implementation plan and possible economic efficiency gaps

Actors

Lead: Department 60 - Contract, award and funding management
Parties involved: Department 20 - Financial Control, City Treasury

Target group

Municipal holdings, departments and specialist areas

Time required

ll-time equivalents

Duration of the activity

2024 - 2030

Material costs

Financing approach

Budget funds, possibly EU funding

GHG savings

Not quantifiable as no direct savings.

Synergy effects

Conflicting goals

1.1.1.1 Introducing and anchoring multi-project management	None Expected
1.1.3.1 Introduce climate coordinators in all departments	

Success indicators/milestones

Filling the additional staff positions

Introduce climate coordinators in all departments

Thematic focus	Introduction	Development of effect	Sphere of influence
The city as a role model: transformation as Management task	2024	Short term	Consumption / role model

Goal and strategy

The climate coordinators are agents of change and promote a cooperative management model. They are based in the respective departments. The task of the climate coordinators is to anchor the implementation of the climate goals in the departments and specialist areas and to disseminate them. They therefore act as change agents for the implementation process. The climate coordinators are the contact persons and interface between the departments and multi-project management. The transformation team, consisting of the climate coordinators, serves as a forum for dialogue, networking and promoting mutual learning (peer-to-peer).

Initial situation

Each department appoints an employee to take on the additional role of climate coordinator in the department and, if necessary, support the implementation of the multi-project management software and balance sheet-based monitoring tools.

Description of the

In coordination with the multi-project management and the Agency for Climate, Sustainability and Energy, climate coordinators are selected for each department and, if necessary, further education and training programmes are provided in order to make coordination and data collection processes as efficient as possible. The coordinators also act as an interface for further training programmes on climate protection for their respective departments.

First steps for action

- Establishment of a transformation team
- Appointment of climate coordinators within the departments
- Development of the necessary interaction and communication structures

Actors

In charge: Department VII, FB 36, FB 13
Participants:

Target group

Employees of the city administration

Time required

ull-time equivalents (per department)

Duration of the activity

2024 - 2030

Material costs

x. € 10,000 (2024)

Financing approach

Budget funds

GHG savings

Not quantifiable, as it depends on the type and scope of the measures implemented by the climate coordinators.

Synergy effects

1.1.1.1 Introducing and anchoring multi-project management

Conflicting goals

Lack of human resources

Success indicators/milestones

Designated climate coordinator in each department

Governance / 1.1.3.2.

Climate protection and further adaptation of the infrastructure of the fire and rescue services and municipal operations

Thematic focus	Introduction	Development of effect	Sphere of influence
City as a role model: Transformation as a management task	2024	Medium-term	Consume/ role model

Goal and strategy

The city of Aachen is integrating climate protection into the structures of the fire and rescue services. This activity includes five central building blocks:

- Conversion of the vehicle fleet and mobility behaviour
- Emphasising sustainability criteria for construction measures and the distribution of guards
- Strengthening environmental aspects in the procurement of materials
- Reduction of existing surface sealing, insofar as this is operationally possible. Examination of sustainability options for sealing requirements
- More efficient use of staff e.g. more emergency telemedicine services

Initial situation

The City of Aachen's facility management team already has experience in implementing sustainability criteria in construction projects.

Description of the

As fire and rescue services have special functionality requirements for vehicles, materials and buildings, a guideline for the transformation of the different requirement areas should first be drawn up. The German Society for Rescue Sciences can serve as a point of contact here. Building on a corresponding guideline, the procurement criteria should also be adapted in addition to the conversion of the vehicle pool. Another point is the adaptation of the deployment plans in order to save duplicate routes.

Where possible, sealed surfaces at the stations should be unsealed, for example with innovative grass blocks that have been approved for fire service access roads, among other things. The City of Aachen's building management can also provide support here, for example by drawing up an action plan for unsealing.

First steps for action

- Gradual conversion of the vehicle fleet
- Development of a guideline including criteria for procurement
- Development of an action plan for land unsealing

Actors

Lead: Department 37
Participants: Department V, E26

Target group

Fire brigade, rescue services, THW if necessary

Time required

1 full-time equivalent

Duration of the activity

2024 - 2030

Material costs

300.000 €

Financing approach

Budget funds

GHG savings

Not quantifiable, as dependent on the type and scope of the measures implemented and the service life of the e.g. B. new vehicles.

Synergy effects

-

Conflicting goals

Time may be required to find alternative materials and vehicles

Success indicators/milestones

Development of a special procurement guideline, replacement of 4 vehicles by the end of 2024.

Agency for Climate, Energy and Sustainability

Thematic focus	Introduction	Development of effect	Sphere of influence
City as a role model	2024	Short to medium term	Motivating and advising

Goal and strategy

Building on the "Climate-neutral Aachen 2030" office, which supports the implementation of the EU mission plan across departments by addressing and involving external stakeholders, the agency for climate, energy and sustainability to be established will fulfil the role of ambassador and mediator between various initiatives and stakeholder groups. The aim is to provide a place for enablers and users from urban society where holistic solutions to problems can be developed. The CoLab pilot project will serve as a testing ground for the agency.

Initial situation

The Agency for Climate, Energy and Sustainability will initially be run from the "Climate-neutral Aachen 2030" office. founded.

Description of the

The Agency for Climate Protection orients itself in the elaboration of its strategies and coordinates its activities with the findings from the participation processes in the partner cities of Mannheim and Münster. It creates suitable formats to accelerate processes initiated by the urban community, including evaluation and monitoring mechanisms.

First steps for action

- Foundation of the Agency for Climate, Energy and Sustainability
- Collaborative development of participation formats based on the CoLab project
- Development of evaluation and monitoring mechanisms for the participation formats

Actors

In charge: Climate Neutral Aachen 2030 office
Involved: FB 36 - Climate and Environment

Target group

Urban society, economic players

Time required

·time equivalents

Duration of the activity

2024 - 2030

Material costs

.....

Financing approach

Promotion with EU funds

GHG savings

Not quantifiable, as it depends on the type and scope of the measures managed by the agency.

Synergy effects

us activities in all fields of action

Conflicting goals

-

Success indicators/milestones

Foundation of the Agency for Climate, Energy and Sustainability

CoLab pilot project

Thematic focus	Introduction	Development of effect	Sphere of influence
The city as a role model: transformation as Management task	2023	Short to medium term	Advise and motivate

Goal and strategy

The pilot project CoLab (Comitted to Local Climate Action Building) of the cities of Aachen, Münster and Mannheim is intended to support the broadest possible and socially balanced commitment of urban society to achieving climate neutrality by, among other things, jointly investigating how the idea of transformation can be anchored in the population. The pilot project is intended to lay the foundation for the multi-project management and the Climate Agency to make the project permanent, which is why early networking should be sought.

Initial situation

The City of Aachen identifies the sub-areas and target groups of social transformation in which little interaction has been identified in past participation concepts.

Description of the

Together with the partner cities of Münster and Mannheim, the City of Aachen is designing different participation formats and testing which methods can be used to reach a broader, more socially balanced target group. In parallel to the participation formats, it is also developing methods for evaluation in order to identify incentives and obstacles for anchoring the idea of transformation across cities.

First steps for action

- Review of participation formats used in Aachen and their "gaps"
- Networking on thematic focal points and, if necessary, context-specific participation formats with the partner cities
- Development of evaluation criteria that ensure a certain degree of cross-city comparability

Actors

In charge: Climate Neutral Aachen office
Involved: FB 36 - Climate and Environment, FB 01 - Climate and Environment
Citizens' dialogue and administrative management

Target group

Citizens, providers in e.g. the mobility and food sectors, universities and colleges where applicable

Time required

time equivalents

Duration of the activity

2023 - 2030

Material costs

ditional costs expected

Financing approach

100 % funding approved with EU funds

GHG savings

Not quantifiable, as it depends on the savings achieved through the participation projects.

Synergy effects

Conflicting objectives

1.1.3.3 Agency for Climate, Energy and Sustainability 6.1.1.1 Making climate neutrality tangible and best practice visible	Company fatigue due to too much participation and too little visible impact

Success indicators/milestones

Identification of the "target groups", networking with Partner cities

Establishment of an Urban Data Working Group - advertisement for an Urban Data Coordinator position to pool and analyse urban data

Thematic focus	Introduction	Development of effect	Sphere of influence
Urban development as climate management	2024	Short term	Offer/supply

Goal and strategy

Urban data, which is already being collected and used in planning processes for mobility projects, for example, is to be increasingly utilised in urban and urban development planning. The data should be used to facilitate the development of a resource-conserving and demand-oriented mobility transition, district-based energy and heat supply planning and climate change adaptation planning. A corresponding staff position would collate, link and evaluate location-specific analysis requirements, existing data infrastructures and gaps.

Initial situation

The Digitisation Department (FB 61/300) can serve as a guide. However, the necessary coordinating office still needs to be set up.

Description of the

The basis for this is the establishment of an Urban Data Working Group. The working group is tasked with compiling urban data, closing gaps and promoting the digitalisation of necessary planning data across administrative boundaries. The working group also serves to speed up planning and approval processes. The appointment of an Urban Data Coordinator will provide the necessary human resources for implementation.

First steps for action

- Establishment of an urban data working group from existing departments
- Advertisement and filling of a position for the Urban Data
- Identification of inventories and gaps in urban data to be prioritised

Actors

Responsible: FB 61/100
Participants: Statistics Office, FB 02/200

Target group

Core administration

Time required

time equivalent

Duration of the activity

2024 - 2024

Material costs

Financing approach

-

GHG savings

Not quantifiable as no direct savings are achieved.

Synergy effects

Conflicting goals

1.2.1.2 Climate protection management for integrated urban development concepts and projects to redesign public spaces 4.2.1.4 City centre mobility for tomorrow	Responsibilities incomprehensible to third parties

Success indicators/milestones

Filling the position of Urban Data Coordinator

Climate protection management for integrated urban development concepts and projects to redesign public spaces

Thematic focus	Introduction	Development of effect	Sphere of influence
Urban development as a climate management task	2023	Short term	Advise and motivate

Goal and strategy

For specific individual projects to redesign public spaces throughout the city, an important contribution can be made to the consideration of climate protection issues in planning. The deployment of climate protection managers for the future focal points of urban development funding in the eastern city centre and Forst as well as other integrated district development concepts (e.g. Richterich) should effectively fill out the topic of climate protection in terms of content and be closely interlinked with the ongoing processes. This includes, for example, issues of social participation in the climate-friendly conversion of neighbourhoods and the mobility transition, aspects of health and communication in neighbourhoods.

Initial situation

The city of Aachen offers basic structures for climate protection management for integrated urban development concepts via district offices and five neighbourhood management offices as well as district conferences.

Description of the

The city of Aachen is setting up climate protection managers in the future priority areas of the eastern city centre, Forst and Richterich.

First steps for action

- Advertisement and filling of three climate protection management positions
- Development of evaluation processes incl. feedback loops in multi-project management

Actors

In charge: FB 61
Parties involved: FB 56, FB 36

Target group

Stakeholders, institutions in the neighbourhoods

Time required

time equivalents

Duration of the activity

2023 - 2030

Material costs

0 €/a

Financing approach

Budget funds

GHG savings

Not quantifiable, as it depends on the activities implemented in the neighbourhoods.

Synergy effects

Various activities in the fields of energy supply and buildings

Conflicting goals

-

Success indicators/milestones

Filling the climate protection management positions

-

Citizen participation formats for climate neutrality

Thematic focus	Introduction	Development of effect	Sphere of influence
Transformation in civil society	2024	Medium-term	Advise and motivate

Responsibility

Goal and strategy

Citizen participation is an important building block for robust and spatially and socially integrated climate protection activities and measures that are accepted and utilised by the population. Depending on the activity, suitable participation formats are therefore offered for the implementation process of the portfolio that address and involve all population groups.

Initial situation

The City of Aachen already offers citizens a number of participation formats, including the Citizens' Council, the Citizens' Forum and the Citizens' Meeting with Lord Mayor Sibylle Keupen, as well as neighbourhood-based offices and contact points for clubs, associations and initiatives.

Description of the

Participatory processes offer the opportunity to involve different groups in urban society with their individual challenges, needs, solution strategies and knowledge in the development and implementation of specific political projects. In this way, spaces for co-creation are created and participatory processes are successfully organised in a way that is both activating and highly relevant to the needs of those involved. The City of Aachen is expanding its existing cross-city and district-specific participation formats to include project-related participation programmes. These can be "climate" citizens' councils, focus or working groups, the "round table" format or project workshops with a thematic focus. By involving representatives on existing committees such as the citizens' council, developments in cross-city topics are brought to other committees.

First steps for action

- Drawing up a timetable for the participation offers according to the implementation prioritisation of the activities
- Develop a communication concept
- Criteria for weighting and implementing the proposals and changes from the participation process

Actors

Lead: Agency for Climate and Sustainability
Participants: FB 01 Citizens' dialogue and administrative management of the district offices

Target group

Citizens, associations and initiatives

Time required

-time equivalent

Duration of the activity

2024 - 2030

Material costs

0 €

Financing approach

Budget funds

GHG savings

Not quantifiable as no direct savings.

Synergy effects

1.1.2.2 Introduction of climate funds
6.3.1.1 Join-in campaign with volunteer climate trainers
6.5.1.1 Structural changes with the handprint! - Workshops and support for implementation within the administration and with multipliers in associations and initiatives

Citizens' Council/Citizens' Forum

Conflicting goals

Oversupply of participation offers without visible results

Success indicators/milestones

Preparation of the schedule, creation of a communication concept

Introduction of a municipal climate money

Thematic focus	Introduction	Development of effect	Sphere of influence
Climate protection and social participation	2024	Short term	Consume/ role model

Goal and strategy

As part of a pilot project, the city of Aachen is introducing a "municipal climate money" that will initially be issued to 1,000 Aachen Pass holders in the form of direct measures such as balcony solar systems. The aim is to proportionately compensate for social hardship caused by rising CO_2 prices.

As part of the pilot project, the impact of the measure and the necessary framework conditions for an expansion are to be identified and scientifically evaluated.

The activity is inspired by the so-called climate bonus, which was adopted and introduced in Austria in 2022 as compensation for CO_2 pricing. Although the climate bonus cannot be implemented in the same way, it is possible under certain circumstances to provide support based on housing criteria. The Aachen model will initially provide support in kind. The criteria of the place of residence are to be examined within the framework of the municipal climate money for Aachen and transferred if necessary. In this way, the support should be as targeted as possible.

Initial situation

The City of Aachen has comprehensive statistical data on the living situation of households in the city area. The Citizens' Service of the City of Aachen serves as a contact portal for citizens and can support the selection process of households. In addition, the city of Aachen already offers disadvantaged families the so-called Aachen Pass, which grants holders discounted access to city facilities and events. Currently, 40,000 Aachen residents receive the Aachen Pass.

Description of the

The pilot project is initially scheduled to run for three years. The city of Aachen will initially define the type and scope of the "municipal climate money", e.g. in the form of funding for balcony solar panels, energy-saving electrical appliances or energy consultations. The aim is to recruit 1,000 households for the pilot project via the recipients of the Aachen Pass. Before the project starts, the city is developing an evaluation process with scientific support.

First steps for action

- Definition of criteria for the implementation of municipal climate money (e.g. funding for balcony solar systems) and the selection of households
- Development of evaluation criteria and test period
- Provision of funds for scientific counselling
- Procurement of material resources, if necessary
- Selection of 1,000 households

Actors

Lead: Department 20 - Financial Management
Participants: Citizens' Service

Target group

Citizens - especially small incomes

Time required

time equivalents

Duration of the activity

2024 -2026

Material costs

Approx. € 30,000 for scientific evaluation
Costs for e.g. 750 balcony solar systems: approx. 637.000 €

Financing approach

Budget funds

GHG savings

Assumption based on the example of a balcony solar system: 750 out of 1,000 recipients live in flats whose orientation is suitable for a balcony solar system. The $CO_{2\ savings}$ of a 300 Wp solar system with a yield of 250 kWh/a are calculated compared to the regional electricity mix, which represents decarbonisation. from 369 g $CO_{2eq/kWh}$ to 83 $CO_{2eq/kWh}$. A household would save approx. 82kg CO_{2eq}. per year in 2021. In 2030 it would be approx. 11kg CO_{2eq}.

Synergy effects

Conflicting objectives

-

Success indicators/milestones

Definition of criteria; selection of 1,000 households for the pilot phase e.g. the Recipients of the Aachen Pass

Brief descriptions:

No.	Communication strategy
1.3.1.2.	A city-wide communication strategy is to be developed and implemented to support activities on the path to climate neutrality. The aim is to develop and implement identify and utilise suitable formats and communication channels for target groups.

Energy supply

A climate-neutral energy supply requires a fundamental reorganisation of energy generation, storage and distribution of electricity and heat from renewable energies.

The following key areas of action are therefore at the centre of administrative action:

City as a role model: energy supply and generation

In terms of setting an example, the aim is to decarbonise the electricity and heat supply of municipal buildings and facilities. In the heating sector, this is primarily achieved by converting the heating systems. In terms of electricity supply, the focus is on meeting demand with renewable energies, which are generated by the company's own plants wherever possible.

Locally and renewably generated electricity

The energy transition is going electric: the goal of climate neutrality can only be achieved if fossil fuels are completely replaced by renewable energies using cross-sectoral approaches. The increased use of electricity from renewable energies for heat generation and mobility will increase electricity consumption by a factor of 2.4. The expansion of renewable electricity generation from wind and solar power, the expansion of cross-sector supply concepts and the system integration of renewable energies are therefore key tasks for the City of Aachen's climate neutrality strategy.

Decarbonised heat supply

Heat supply becomes climate-neutral: The challenge of a climate-friendly supply of space heating and hot water as well as process heat in industry is particularly great in the area of heat supply. The Federal Government and the state governments have already has responded to this and set the framework for cities and municipalities with the laws on municipal heating planning. This means that large cities such as Aachen have until 31 December 2025 to submit a municipal heating plan that shows how a climate-neutral heating supply can be achieved. One core task is to expand green district heating: 17,500 households are already connected to district heating today. Decarbonisation and the expansion of district heating is a lever with which the climate-neutral conversion in the districts and neighbourhoods can also succeed in terms of a social and sustainable urban development strategy.

Security of supply and sector coupling

Infrastructure modernisation to secure supply is a priority task. The expansion of sector coupling requires the joint optimisation of electricity, gas and heating grids. So-called hybrid grids enable the consumption, storage and transport of energy in its current form or the conversion to another form of energy that can also be consumed, stored or transported. This means, for example, that if there is an oversupply of electricity from renewable sources, it can be utilised flexibly or, if there is an undersupply, other forms of energy can be used for reconversion.

Hydrogen is a rare commodity in the energy transition. Nevertheless, it will be required for industrial processes in particular.
Hydrogen is therefore an indispensable part of the energy supply strategy in the future.

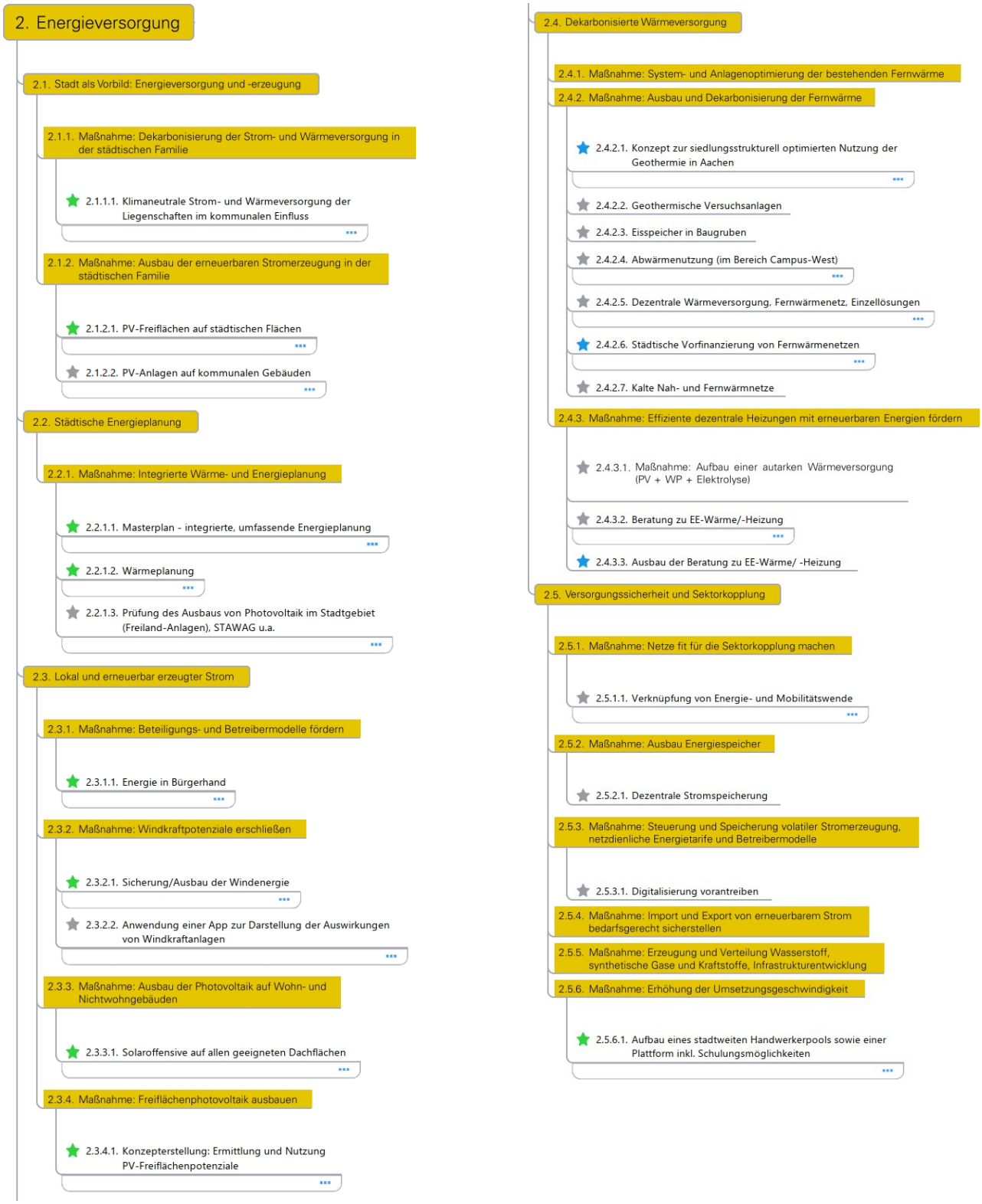

Figure 4 Section of the energy supply portfolio plan (green star: activity with profiles).

These activities are described with a profile

These activities are described in brief:

Climate-neutral electricity and heat supply for properties under municipal control

Thematic focus	Introduction	Development of effect	Sphere of influence
City as a role model: Energy supply and -production	2024	Medium and long term	Care/ role model

Goal and strategy

With the help of this activity, the conversion to a climate-neutral and therefore fossil-free electricity and heat supply for the properties of the municipal family Stadt Aachen is to be supported and the self-generation of electricity is to be accelerated through the expansion of photovoltaics.

Initial situation

In relation to the city of Aachen's total final energy consumption, the municipal sector accounts for less than 2 %, of which just under two-thirds is for the provision of space heating, mainly through district heating and natural gas. In connection with an imminent conversion of the city's heating supply without the use of fossil fuels, the city of Aachen has already analysed the challenges and opportunities in the city area together with STAWAG, RWTH, FH, Fraunhofer IEG and IHK and published the results in spring 2022 under the title "Wärmewende Aachen - Eckpfeiler für eine klimaneutrale Energieversorgung 2030". Based on this, it was decided to draw up a city-wide heating plan, which the city of Aachen - as a city with more than 100,000 inhabitants - would have to complete by 30 June 2026 if the federal government's current draft law comes into force.

The City of Aachen is already actively involved in the expansion of renewable electricity generation through wind power as well as ground-mounted and rooftop PV. As part of the determination of energy-related refurbishment requirements, suitable roof areas for PV expansion have already been identified and prioritised for municipal properties in order to increase the proportion of self-generated renewable electricity in the future.

Description of the

Against the backdrop of the City of Aachen Group's goal of climate neutrality, the current energy supply needs to be converted and buildings extensively renovated. The first priority is to carry out the refurbishments (see activities: 3.1.1.1. Refurbishment of municipal residential and non-residential buildings). The first priority is to carry out the refurbishments (see activities: 3.1.1.1. Refurbishment of municipal residential and non-residential buildings) in order to reduce energy requirements and then efficiently convert the reduced energy requirements. The electricity should be sourced entirely from renewable energy sources, ideally in part from the city's own rooftop photovoltaic systems. The choice of heat energy source should be made on the basis of municipal heat planning (see activity 2.2.1.2. Heat planning). Connection to local and district heating networks should be prioritised where possible. Municipal properties could, for example, serve as anchor customers for local and district heating networks and thus contribute to the conversion of the primary supply solution at neighbourhood level. The low percentage share of municipal properties in final energy consumption would therefore have an impact beyond sectoral boundaries. Further multiplier effects in society could be achieved by prioritising schools and daycare centres. The municipal group would set a good example and thus act as a role model.

By 2030, all municipal properties and the properties of companies under municipal control (City of Aachen Group) are to be converted to climate-neutral solutions wherever possible. This also includes Gewoge AG, which has considerable potential as the owner of more than 5,000 residential units in Aachen.

As massive investments will be required for the process, the development and implementation of an investment programme for the gradual conversion of the properties of the City of Aachen Group is recommended. The respective investment plans in all Group subsidiaries are based on individual action plans that are to be finalised by the end of 2025. The first selected measures should be started by then if possible. A cost-benefit analysis should also compare the annual energy savings for tenants - including tenant electricity - and the rent increases made possible by the refurbishment with the investment costs.

First steps for action

- Development of an investment programme with individual action plans

- Energy-efficient refurbishment of municipal properties (see 3.1.1.1. and 3.1.2.1.)
- Preparation of municipal heat planning
- Energy conversion based on municipal heat planning

Actors

Lead: Climate Agency, STAWAG
Participants: E2, FB 23, FB 36, Gewoge, Sparkasse

Target group

Municipal family City of Aachen

Time required

time equivalent

Duration of the activity

2024 - 2030

Material costs

100.000 €
for external support in the development of an investment programme including individual action plans;
Investment funds not quantifiable

Financing approach

Budget funds, possibly subsidies

GHG savings

Expansion potential for rooftop PV of 13.8 MWp exhausted by 2030
GHG savings from the heat conversion can only be quantified after the municipal heat planning has been drawn up

Reduction of the annual emission level (t/a):

4,000 tonnes CO2eq/a

Cumulative GHG savings (tonnes):

12,500 tonnes CO2eq

Synergy effects

2.1.1.1 Masterplan (concept plan) integrated, comprehensive energy planning,
2.3.3.1 Solar campaign on all suitable roof surfaces
3.1.1.1 Refurbishment roadmap for urban non-residential buildings,
2.2.1.2 Heat planning,
3.1.2.1 Action plan: Energy-efficient refurbishment of municipal residential buildings

Conflicting goals

Remaining useful life of installed heating systems, shortage of skilled labour

Success indicators/milestones

Investment programme has been launched, municipal heating planning has been completed, development of energy sources in municipal properties, development of
GHG emissions

Ground-mounted PV systems on urban areas

Thematic focus	Introduction	Development of effect	Sphere of influence
City as a role model: Energy supply and -production	2024	Medium and long term	Care/ role model

Goal and strategy

With the help of this activity, the realisation of ground-mounted PV systems is to be specifically promoted on areas owned by the City of Aachen in order to contribute to increasing the existing potential in the sense of setting an example.

Initial situation

The City of Aachen is active in the field of open-space PV planning and has already included a corresponding activity in the ICSK of 2020 to examine the potential identified from the "render" project with regard to legal implementation options and the use of buildable areas.

Description of the

Building on the potential study and the requirements of the IKSK from 2020, the expansion of photovoltaic systems on open urban spaces must be successively promoted and the potential identified and tapped. In doing so, it is important to take into account areas within and outside the EEG area framework. For the above-mentioned areas along motorways and railway lines, the city's own share must be determined and updated in accordance with the currently valid distance regulations. Suitable municipal areas for car parks and agricultural PV should also be identified and equipped with PV systems. However, the focus should initially be on open spaces in privileged areas along infrastructure routes, as no active urban land-use planning is required for these, meaning that open-space systems can be realised more quickly.

With this activity, the city of Aachen would not only contribute to the expansion of renewable energies, but also act as a role model for private property owners, among others. In addition, the City of Aachen could also campaign for better energy industry conditions at federal level in order to simplify and thus accelerate the expansion of renewable energies in the city.

First steps for action

- Updating and expanding the potential already identified (e.g. current distance calculations)
- Identification of potential areas owned by the City of Aachen
- Identification of support requirements and clarification of plant manufacturers (e.g. STAWAG)
- Discussions with the federal motorway and railway on specific areas
- Creation of area-related PV concepts

Actors

Lead: FB 61, FB 36 Participants: FB 23, STAWAG

Target group

Municipal family City of Aachen

Time required

ıll-time equivalents

Duration of the activity

2024 - 2025

Material costs

40.000 €
for area analysis and conceptual design
plus investment funds for the construction of the PV systems

Financing approach

Budget funds, subsidies

GHG savings

Preliminary assumption, as area screening is still pending:
Quantification in line with the previous target of 32 GWh/a by 2030, of which 5 % will be installed on municipally owned land

Reduction of the annual emissions level (t/a):	Cumulative GHG savings (tonnes):
500 tonnes CO2eq/a	1,650 tonnes CO2eq (by 2030)

Synergy effects

2.2.1.1 Masterplan - integrated, comprehensive energy planning
2.3.1.1 Energy in the hands of citizens
2.3.4.1 Concept development: Determination and utilisation of PV open space potentials

Conflicting goals

Shortage of skilled labour, competing uses (e.g. solar thermal energy, agriculture), nature conservation concerns

Success indicators/milestones

Successful agreements and planning for
Land utilisation, PV concepts created, Installed PV power

Masterplan - integrated, comprehensive energy planning

Thematic focus	Introduction	Development of effect	Sphere of influence
Urban energy planning	2024	Short term	Care/ role model

Goal and strategy

With the help of the masterplan, an integrated planning basis is to be created that considers different renewable energies, such as wind, PV and geothermal energy, together. Existing potential studies are to be bundled and expanded for this purpose.

Initial situation

As a result of the legal mandate for the energy and heating transition, the city of Aachen, like all other German cities and municipalities, is facing major challenges that need to be solved.

Together with STAWAG, RWTH, FH, Fraunhofer IEG and IHK, the city of Aachen has already worked on analysing these challenges with regard to the conversion of the heat supply in the city area and describing them in a report entitled "Aachen's heat transition - cornerstones for a climate-neutral energy supply in 2030". STAWAG's district heating campaign, which aims to drive forward the expansion of district heating, should be included here. There are also potential studies for the expansion of renewable energies, such as photovoltaics and wind power, which need to be considered in an integrated manner.

Description of the

In order to create an integrated concept as a basis for planning, it is first necessary to determine the status quo in order to determine the potential based on this. The legal basis should be checked and existing data researched. It is also advisable to enter into dialogue with other cities and municipalities in order to find out how similar issues are dealt with elsewhere.

For some areas, potentials are already available in varying degrees of detail, which have been created or commissioned by various stakeholders, such as the above-mentioned organisations or the LANUV. These need to be reviewed in accordance with current legislation and, if necessary, adapted or expanded in line with the criteria to be defined in order to ultimately create a comprehensive and integrated potential study for the expansion of renewable energies in the heating and electricity sector. Overlaps with other uses, such as residential, commercial, landscape conservation and nature and flood protection, must be taken into account.

Concrete measures for implementation are to be derived from a prioritisation of uses and included in an action plan. The masterplan should be drawn up in collaboration with external consultants. Appropriate consultancy services and existing funding opportunities should be examined. The subsequent implementation of the master plan ties in with many other points, such as integration into land management and land use planning, existing PV and wind planning or in development plans.

First steps for action

- Analysing the status quo
- Identification of potential including prioritisation
- Develop action plan
- Check funding opportunities and counselling services
- Implementation of the action plan

Actors

Lead: FB 61/100 Participants: FB 36, FB 61/200

Target group

Municipal family City of Aachen

Time required

time equivalent

Duration of the activity

2024 - 2025

Material costs

Financing approach

)00 €

Budget funds, subsidies

for the creation of a master plan by external consultants

GHG savings

No direct savings. Savings result from realising the potential identified.

Synergy effects

2.2.1.2 Heat planning
2.1.2.1 Ground-mounted PV systems on urban areas
2.3.1.1 Energy in the hands of citizens
2.4.2.1 Concept for the structurally optimised use of geothermal energy in Aachen

Conflicting goals

Land use conflicts, e.g: Residential, commercial, landscape conservation, nature conservation, flood protection

Success indicators/milestones

Potential study and action plan were development of the expansion of renewable energies

Heat planning

Thematic focus	Introduction	Development of effect	Sphere of influence
Urban energy planning	2024	Medium and long term	Supply/ offer

Goal and strategy

The aim of this activity is to create a central and reliable conceptual planning basis for the transformation to a decarbonised heat supply for the entire city. This should take an integrated view of the necessary reductions in demand and the adaptation of supply structures.

Initial situation

The heating sector accounts for the largest share of annual greenhouse gas emissions in Aachen and therefore also offers the greatest potential for reduction.

Together with STAWAG, RWTH, FH, Fraunhofer IEG and IHK, the city of Aachen has analysed the challenges associated with an imminent change in the city's heating supply. The results were published in spring 2022 under the title "Aachen's heating transition - cornerstones for a climate-neutral energy supply in 2030". The Aachen City Council subsequently decided to draw up a city-wide heating plan and made initial budget funds available for preparatory work.

According to the federal government's draft law on heat planning and the decarbonisation of heating networks, the city of Aachen - as a city with more than 100,000 inhabitants - would be obliged to complete this by 30.06.2026 when it comes into force.

Description of the

Converting the heating sector to a heat supply without fossil fuels is essential for achieving climate neutrality, meaning that municipal heating planning is a key management tool in the climate neutrality strategy.

Municipal heat planning should support this transformation process and provide the city of Aachen with a reliable planning basis that considers centralised and decentralised supply options, including storage, control and distribution, in an integrated manner. To this end, different and individual supply options for sub-areas of the city (neighbourhoods) are to be developed, while a further focus is on reducing energy demand. This is necessary in order to be able to cover future heating requirements with local and renewable energies. The reduction potentials must be worked out and visualised in terms of space and time. There is therefore a direct link between energy supply and urban development, including the urban refurbishment roadmap. Both focal points - supply solutions and demand reduction - must be considered in an integrated manner for a successful transformation.

Examples of specific projects in the area of heat supply include the utilisation of waste heat from the Aachen crematorium or the use of wood waste from the municipal enterprise. In the context of urban and landscape maintenance alone, the municipal enterprise produces over 2,000 tonnes of wood every year, as determined by the study "Rough concept - sustainability - Aachen municipal enterprise". These are currently disposed of for a fee, although alternative uses are conceivable that would allow the wood waste to be processed further and utilised for energy in the future.

External planners are to support the city of Aachen in the (conceptual) development of heat planning.

First steps for action

- Preparation of a bill of quantities
- Realisation of the tender
- Creation process with integrated consideration of urban development and energy supply

Actors

Lead: FB 61/100
Participants: FB 36

Target group

Municipal family City of Aachen

Time required

-time equivalent

Duration of the activity

2024 - 2026

Material costs

250.000 €
for the creation of a heating plan (concept) by external planners

Financing approach

Budget funds, subsidies

GHG savings

Currently not quantifiable. Savings result from switching to a fossil-free heat supply, taking alternative energy sources into account.

Synergy effects

2.2.1.1 Masterplan - integrated, comprehensive energy planning
3.1.1.1 Refurbishment roadmap for urban non-residential buildings
3.1.2.1 Action plan: Energy-efficient refurbishment of municipal residential buildings
3.2.2.1 Energy-efficient monument conservation
3.3.3.1 Redevelopment model area: Eastern city centre

Conflicting objectives

-

Success indicators/milestones

Municipal heat planning was created,
Reduction of GHG emissions in the heating sector

Energy in the hands of citizens

Thematic focus	Introduction	Development of effect	Sphere of influence
Local and renewable Electricity	2024	Short and medium term	Advise/ motivate

Goal and strategy

Community-organised energy projects, e.g. in the form of citizen energy cooperatives, should help to accelerate the expansion of renewable energies in the city of Aachen. The aim is to increase public awareness of such projects and to support them. Furthermore, investment funds, in cooperation with local banks, should offer citizens and companies the opportunity to participate financially in projects and increase the investment volume.

Initial situation

The number of community energy projects in the city of Aachen still has potential for growth. However, there are already committed citizens who, for example, are working within the framework of the Aachen Euregio regional group of Energiegewinner eG to drive forward the decentralised energy transition in Aachen. In addition, there is the local influence of the Aachen city region, for example with the Bürgerenergiegenossenschaft Nordeifel (Roetgen mach Watt e.V.).

Description of the

In order to achieve the desired climate neutrality, a rapid changeover in the energy supply and thus a significant expansion of renewable energies is required. Massive investments and the support of the population are essential for this. Both aspects can be combined by establishing and expanding forms of participation for different stakeholder groups. Community-organised energy projects or community energy plants can make a significant contribution, e.g. within the framework of community energy cooperatives. They realise the construction of renewable energy systems themselves and offer citizens who do not have the opportunity to install their own systems the chance to participate directly and actively in the energy transition.

The City of Aachen supports motivated citizens in setting up further energy cooperatives and community projects in the field of climate-neutral energy. To make citizens aware of these participation opportunities, an information and counselling service on the various possibilities of community energy projects should be developed. In addition to the benefits, information should also be provided on how to set up a project, on different operator models and financial participation options, as well as on legal issues. Through targeted public relations work, the city helps to network interested citizens and provides information material. Initial successes can then also be communicated and disseminated by the City of Aachen in various formats in order to attract further interested parties and increase the willingness to participate. Municipal premises could also be made available free of charge for project development meetings.

At the same time, investment funds initiated by the City of Aachen in cooperation with local banks can offer citizens and companies the opportunity to participate in the expansion of renewable energies at a low threshold. The investment capital can be used for the construction of renewable energy plants and the returns distributed to the investors. Further information on the introduction of this so-called climate fund can be found in the activity "Establishing a climate fund" (No. 1.1.2.2.).

First steps for action

- Action steps of activity 1.1.2.2. to set up the climate fund follow
- Development of low-threshold information and counselling services
- Effective publicity for the offers and events
- Evaluation and, if necessary, adaptation of the offers

Actors	Target group
Lead: Climate protection management	Citizens

Participants: Department 61 - Urban Development, Planning and Mobility, Department 62 - Geoinformation and Land readjustment, Energiegewinner eG

Time required

time equivalent

Duration of the activity

2024 - 2027

Material costs

60.000 € (15.000 €/a)
for public relations and start-up counselling

Financing approach

Budget funds

GHG savings

Not quantifiable

Synergy effects

1.1.2.2 Introduction of climate funds
2.1.2.1 Ground-mounted PV systems on urban areas
2.3.2.1 Safeguarding / expansion of wind energy
2.3.3.1 Solar campaign on all suitable roof surfaces
2.3.4.1 Concept development: Determination and utilisation of PV open space potentials

Conflicting objectives

-

Success indicators/milestones

Number of events and consultations organised, development of the community
Energy projects in the city of Aachen (number/ output)

Safeguarding / expansion of wind energy

Thematic focus	Introduction	Development of effect	Sphere of influence
Local and renewable Electricity	2024	Short and medium term	Advise/ motivate

Goal and strategy

With the help of this activity, the expansion of wind energy in Aachen is to be further promoted, both by STAWAG and within the framework of private organisations such as citizen energy cooperatives. The focus is on revising land use planning, accelerating approval procedures and increasing the acceptance of wind turbines.

Initial situation

The activity is the continuation of a revision of land use planning that has already begun, based on the changed legal framework conditions of the EEG 2023 and with a view to achieving the best possible balance of interests between climate and species protection. As part of the political consultations in the first quarter of 2023, an amendment to the "AACHEN*2030" land use plan has already been commissioned based on this, with the aim of so-called positive planning. Although the process has not yet been finalised, based on current knowledge, it can be assumed that wind turbines on city-owned land could increase the capacity by around 37 MW, for the expansion of which, according to the city, investors are already available. The expansion of wind energy also offers the city of Aachen a lucrative source of income.

Description of the

To achieve the goal of a climate-neutral electricity supply, the expansion of renewable energies is essential. Alongside PV, the expansion of wind energy offers the greatest local potential for generating electricity for the city of Aachen. However, acceptance problems and complex and lengthy approval processes often stand in the way of wind energy expansion.

The amended legal framework conditions of the EEG 2023 are accompanied by an expansion of potential areas for wind turbines. From mid-2024, accelerated approvals are to be granted within the newly designated "renewable energies" category for special areas with an earmarked purpose for installations that are used for research and development and for the use of renewable energies, in this case wind energy. These could, for example, be installations as part of community projects or community energy cooperatives as well as STAWAG's own installations.

In order to increase social acceptance and avoid headwinds in the approval process, it is important to involve the relevant stakeholders outside the city administration, such as nature conservation organisations and the population, especially local residents, in the process at an early stage. It is therefore the task of the City of Aachen to create transparency and make information available at a low threshold. The progress of the expansion and the displaced greenhouse gas emissions can be communicated to the public and opportunities for participation advertised by means of a website, for example by STAWAG. The effects of the construction and operation of wind turbines on nature and local residents, e.g. through light and noise emissions as well as visual effects on the landscape, can also be presented, thereby potentially eliminating doubts and fears.

First steps for action

- Finalise revision of land use planning and designate "renewable energies" special areas
- Establish accelerated authorisation procedure for corresponding areas
- Establish and expand STAWAG's Internet presence
- Carrying out public relations work to ensure acceptance and participation

Actors

Lead: Department 61 - Urban Development, Planning and Mobility Infrastructure, Department 36 - Climate and Environment
Participants: private actors, STAWAG, Department 7, FB 23 - Real Estate Management

Target group

Urban society (especially residents), energy suppliers (esp. STAWAG), community projects and community energy cooperatives, nature conservation organisations

Time required

ıll-time equivalents

Duration of the activity

2024 - 2027, establish in the long term

Material costs

See fact sheet 2.3.4.1 Concept development: Identification and utilisation of PV open space potentials

Financing approach

-

GHG savings

Exact estimation possible after completion of the area screening.
In relation to the provisional assumption of 37 MW that is potentially available as additional power from WTGs on urban areas, the activity shown has an impact of 40 % (15 MW). The remaining potential will be tapped in the further course.

Reduction in the annual level of emissions (t/a):

10,900 tonnes CO2eq/a

Cumulative GHG savings (tonnes):

34,800 tonnes CO2eq (by 2030)

Synergy effects

2.1.2.1 Ground-mounted PV systems on urban areas
2.2.1.1 Masterplan (concept plan) integrated, comprehensive energy planning
2.3.1.1 Energy in the hands of citizens
2.3.4.1 Concept development: Determination and utilisation of PV open space potentials
2.5.6.1 Establishment of a city-wide pool of tradespeople and a platform including training opportunities

Conflicting goals

Acceptance by urban society, environmental/species protection, land conflicts, political discussion

Success indicators/milestones

Area planning completed, information retrievals / page views (website), number of permits processed, number of permits issued
Wind turbines

Solar offensive on all suitable roof surfaces

Thematic focus	Introduction	Development of effect	Sphere of influence
Local and renewable Electricity	2024	Short term	Advise/ motivate

Goal and strategy

With the help of advisory services, building owners are to be supported in the realisation of PV systems on roof surfaces.

Initial situation

The city of Aachen has been running a funding programme for solar energy systems since 2020. The city's website (www.aachen.de/solar) provides information on the funding programme, including the funds available and general information on the topic of solar energy. By May 2023, almost 1,800 solar installations had been subsidised since the start of the funding programme in September 2020, with a funding volume of €1.6 million in 2023 alone.

Description of the

In order to promote the expansion of PV systems on roof surfaces, an activation campaign should be designed and implemented in addition to the funding. In addition to purely providing information, this should also include a target group-specific advisory programme for residential and non-residential buildings. Another component is a separate funding programme for preparatory investigations, for example in the area of structural analysis of buildings. Obstacles should be minimised at an early stage in order to accelerate and successively drive forward the expansion of PV.

First steps for action

- Identification of specific counselling needs and requirements for additional support
- Conception of the support services
- High-profile application
- Realisation of consultations and distribution of subsidies
- Evaluation and, if necessary, adaptation of the offers

Actors

Lead: Department 36 - Climate and Environment
Parties involved: FB 20 - Financial management
E 26 - Facility Management, FB 23 -
Property management, Gewoge, STAWAG,
Sparkasse

Target group

Building owners of residential and non-residential buildings

Time required

time equivalent

Duration of the activity

2024 - 2026

Material costs

300.000 € (150.000 €/a)
for subsidising consultant costs and promoting
e.g. structural analyses

Financing approach

Budget funds

GHG savings

Savings result from the realisation of the systems
Assumptions: Funding of 750 systems per year for the next 3 years (2026) with an average capacity of 16 kWp

Reduction of the annual emission level (t/a):

10,400 tonnes CO2eq/a

Cumulative GHG savings (tonnes):

20,800 tonnes CO2eq (until 2026)

Synergy effects

2.2.1.1 Masterplan (concept plan) integrated, comprehensive energy planning
2.3.1.1 Energy in the hands of citizens
2.5.6.1 Establishment of a city-wide pool of tradespeople and a platform including training opportunities
3.2.2.1 Energy-efficient monument conservation
3.3.2.1 Consultancy campaign: Energy-efficient modernisation of the multi-family housing stock (privately and commercially rented, owners' associations)
6.1.1.1 Making climate neutrality tangible and best practice visible

Conflicting goals

Possible conflicts regarding the permissibility of measures under building regulations, building planning law and monument law, solar thermal energy, greening, investment costs vs. rising rents and capacities in the trade, PV supply chain bottlenecks

Success indicators/milestones

Number of consultations carried out,
ırsed subsidies, installed capacity

Concept development: Determination and utilisation of PV open space potentials

Thematic focus	Introduction	Development of effect	Sphere of influence
Local and renewable Electricity	2024	Short and medium term	Advise/ motivate

Goal and strategy

The aim is to increase the proportion of renewable energies in the local electricity mix, including through the expansion of ground-mounted photovoltaic systems in the city of Aachen. In addition to the installation of systems on municipal land, e.g. by STAWAG, the expansion on private or private-sector land is also to be increased.

Initial situation

The City of Aachen already included an activity relating to PV planning on open spaces in the 2020 ICSK. This deals with the examination of the identified potential from the "render" project with regard to the legal implementation options and utilisation of the developable areas. The theoretical potential for the city as a whole is therefore 72.88 GWh/a on 166.2 ha of motorway areas and 38.18 GWh/a on 97.4 ha of railway areas. Around 32 GWh/a of this is to be developed by 2030. In addition, there are numerous private and industrial areas.

Description of the

Building on the potential study, the task now is to develop the identified and potentially available open spaces for the expansion of photovoltaics. In view of the changed legal framework conditions, particularly with regard to distance regulations, there is now a need to develop an updated concept that serves as a planning basis for the increased expansion of ground-mounted photovoltaics. This concept should also include prioritisation criteria that take into account land use as well as urban planning and thermal aspects. Particularly in the context of the new legal framework provided by the EEG 2023, areas along transport routes, brownfield sites and other sealed or contaminated areas such as landfills should be considered. This planning basis should serve to streamline and accelerate authorisation procedures in the future.

In addition to creating the legal basis for planning, it is necessary to activate private landowners and solve potential acceptance problems with regard to land use by involving them in planning at an early stage and providing them with extensive information and education. Furthermore, there should be opportunities for financial participation in the plants that are created, e.g. within the framework of citizen energy cooperatives, and these should be communicated accordingly.

First steps for action

- Updating the area analysis to identify suitable (private) open spaces
- Initiate procedure to create planning law
- Conceptualisation of public relations work
- Addressing the landowners
- Realisation of broad-based public relations work and information on possible participation models

Actors

In charge: FB 61/100
Involved: FB 36 - Climate and Environment

Target group

Landowners, companies, plant operators and local residents,
Citizens, STAWAG

Time required

1 full-time equivalen

Duration of the activity

2024 - 2025

Material costs

Financing approach

80.000 € (realisation of the area analysis)	Budget funds

GHG savings

By 2030, an additional approx. 10 GWh/a will be generated from ground-mounted photovoltaics

Reduction of the annual emission level (t/a):	Cumulative GHG savings (tonnes):
3,200 tonnes CO2eq/a	9,900 tonnes CO2eq (by 2030)

Synergy effects

2.1.2.1 Ground-mounted PV systems on urban areas
2.2.1.1 Masterplan (concept plan) integrated, comprehensive energy planning
2.3.1.1 Energy in the hands of citizens
2.3.2.1 Safeguarding / expansion of wind energy
2.5.6.1 Establishment of a city-wide Tradesman pools and a platform including training opportunities

Conflicting goals

Non-availability of private land, shortage of skilled labour, competing uses (e.g. solar thermal energy, agriculture), nature conservation concerns,

Success indicators/milestones

Successful agreements and plans for land utilisation, PV concepts created, installed PV power

Development of a city-wide pool of tradespeople and a platform including training opportunities

Thematic focus	Introduction	Development of effect	Sphere of influence
Security of supply and sector coupling	2024	Short and medium term	Advise/ motivate

Goal and strategy

This activity is intended to counteract the shortage of skilled labour and thus increase the speed at which technical construction measures are implemented as part of the goal of climate neutrality.

Initial situation

In accordance with the Paris Climate Agreement of 2015, global warming must be limited to well below 2°C, preferably below 1.5°C, compared to pre-industrial levels. Achieving this goal will require, among other things, a change in energy supply - without fossil fuels - which in turn can only be realised with a simultaneous reduction in demand, for example through renovations in the building sector. A large number of well-trained specialists from the skilled trades who work in a well-networked and mutually coordinated manner are absolutely essential for the comprehensive renovation work.

Description of the

In order to increase the speed of realisation of activities that require installation, assembly or construction work, the City of Aachen is initiating and supporting the establishment of a pool of tradespeople and setting up a platform for tradespeople. This platform can be used to exchange valuable expertise and arrange training opportunities. For example, training programmes on the installation and adjustment of heat pumps could be offered. Furthermore, important findings on innovative solutions could be circulated quickly and accessed quickly and easily in the event of customer enquiries, e.g. on recommended sustainable insulation materials for planned refurbishment projects.

First steps for action

- Drawing up a register of local craft businesses
- Conceptualisation of public relations work
- Establishment of a platform for craftspeople
- Realisation of public relations work, in particular addressing trainees
- Develop and provide training material

Actors

Lead: FB 02 - Economy, Knowledge, Digitalisation and Europe
Participants: Climate Agency, Aachen Chamber of Crafts, Chamber of Industry and Commerce

Target group

Craftspeople, craft businesses

Time required

ıll-time equivalents

Duration of the activity

2024 - 2030

Material costs

400.000 € (50.000 €/a)
for public relations, training, advertising for trainees

Financing approach

Budget funds

GHG savings

Not quantifiable

Synergy effects

Among other things:
2.1.2.1 Ground-mounted PV systems on urban areas
2.3.3.1 Solar campaign on all suitable roof surfaces
2.4.3.3 Expansion of advice on renewable heat/heating

Conflicting goals

-

Success indicators/milestones

Register of stakeholders created, number of participating companies, number of training courses offered/conducted

Brief descriptions

No.	Concept for the structurally optimised use of geothermal energy in Aachen
2.4.2.1.	The City of Aachen is working with STAWAG to develop a concept in which the potential of near-surface and deep geothermal energy is to be recorded and related to the differentiated, settlement-structural requirements. The identification of areas that are particularly suitable for efficient utilisation forms the basis for future settlement developments and the targeted conversion of existing buildings.

	Municipal pre-financing of district heating networks
2.4.2.6.	The expansion of local and district heating networks and their decarbonisation will require massive investment in the coming decades. New financing models are to be trialled and established in order to support energy suppliers in this task and quickly drive forward the implementation of municipal heating planning. This can be achieved, for example, by the City of Aachen pre-financing the district heating networks. The City of Aachen can take out loans on the capital market at favourable interest rates and lend these to municipal holdings such as STAWAG. By passing on the interest advantage, the financing costs for the realisation of the infrastructure measures can be reduced.

	Expansion of advice on renewable heat/heating
2.4.3.3.	The City of Aachen supports the existing counselling services offered by altbau plus e.V. on the topics of heat and heating from and with renewable energies. The activity includes the realisation of so-called showcase projects on the topic of 'heat pumps in existing buildings' and the Launch of a funding programme that enables specialist advice from external experts.

Building

In order to achieve climate neutrality by 2030, high energy and greenhouse gas savings must be achieved in the building sector. This concerns the building stock, which according to the City of Aachen's 2022 Housing Market Report comprised around 141,695 residential units in 2021, as well as new construction activities in the city of Aachen.

City as a role model: municipal buildings and facilities

The city of Aachen is leading by example. It is endeavouring to renovate its own building stock and make its non-residential and residential building stock climate-neutral. As of April 2022, the City of Aachen's building management is responsible for 860 properties in approx. 622 properties of various uses. One positive example is the refurbishment of roofs, e.g. on the gymnasiums of municipal schools. Six locations have already been identified and are also to be equipped with a PV system[1].

In addition, the city has around 10,000 publicly subsidised housing units, of which 5,577 flats will no longer be subject to rent and occupancy restrictions by 2029. The city has a direct influence on around 5 % of the flats in Aachen[2]. There are refurbishment plans for these residential buildings as of 2022.

Climate-friendly and adapted urban development

Promoting sustainable urban neighbourhoods: This is one of the goals of climate-friendly urban development. In order to leverage the potential in existing buildings, an integrated approach at neighbourhood level is required. The neighbourhood level also makes it possible to examine property-independent, residential value-enhancing factors with an indirect influence on energy-efficient refurbishment (living environment, local amenities, mobility options) in an integrated manner. Urban areas that are comparatively homogeneous in terms of building age, building fabric and technical equipment are considered neighbourhoods in terms of energy-efficient refurbishment. They have a comparable need for refurbishment and similar energy saving potential. At 95 %, the proportion of private homeowners in Aachen is high[3], so this target group must be mobilised with attractive offers. The primary target groups in this field of action are

- Private homeowners (owner-occupiers, private landlords, homeowners' associations)
- Tenants
- Housing associations
- Commercial owners
- Developers and operators or property managers

These target groups can be addressed as part of neighbourhood redevelopment projects. The city of Aachen has currently defined or is already active in several redevelopment areas, including Aachen North, Aachen Central Station and Burtscheid, or Beverau[4]

New buildings must no longer be a burden on the CO_2 budget: New buildings must not be an additional burden on the residual CO_2 budget. This makes it necessary to introduce nationwide efficiency standards for buildings that are at least greenhouse gas-neutral in terms of their carbon footprint. In this context, the selection of sustainable building materials and the establishment of innovative forms of living that are implemented in a way that conserves space and resources are also crucial. Even with very high climate protection standards, new construction is always associated with a certain amount of new sealing. For this reason, the German government has formulated the 30-hectare target in the national sustainability strategy. The city of Aachen also has to manage its land accordingly. The planning and conceptual framework for these necessary developments is provided by integrated, climate-friendly and sustainable urban development. The actions of the city administration always take into account the settlement areas for the city as a whole as well as potential land conflicts.

Residential building stock

The main task lies in the existing building stock. The aim is to refurbish around 36% of existing buildings to a high standard of thermal insulation by 2030. The aim is to reduce heat consumption by around 25 % compared to 2021.
This is linked to the goal of increasing the renovation rate to 4% per year. Remaining energy requirements for space heating, hot water and electricity must be covered by 100 % renewable energies. This results in a close link between the buildings area of action and the measures and activities of the

[1] City of Aachen (2022): Aachen climate-neutral 2030: Rough outline for Aachen's path to 2030 S. 15

[2] City of Aachen (2021). Housing action plan - integrated housing strategy.

[3] City of Aachen 2020 Housing market report, p. 11.

[4] Council system of the City of Aachen.(2023) Available at: https://www.aachen.de/de/stadt_buerger/politik_verwaltung/stadtrecht/bauwesen/index.html

energy supply field of action, so that these must be considered in an integrated manner. The reduction in energy consumption must also be responded to with customised energy infrastructure and energy services. It is therefore necessary to closely dovetail the strategy for refurbishing existing buildings with the energy field of action. Further energy savings can be achieved through the behaviour of residents as building users, which creates additional points of contact with the social transformation field of action.

Non-residential buildings

As with residential buildings, the focus for non-residential buildings is on existing buildings. Here too, around 36% of buildings need to be refurbished to a high standard of thermal insulation by 2030. However, the structure and utilisation of the buildings differ greatly in some cases and range from smaller production buildings to larger office and cultural buildings and large industrial halls. This challenge is being met with the help of binding standards and strategic concepts.

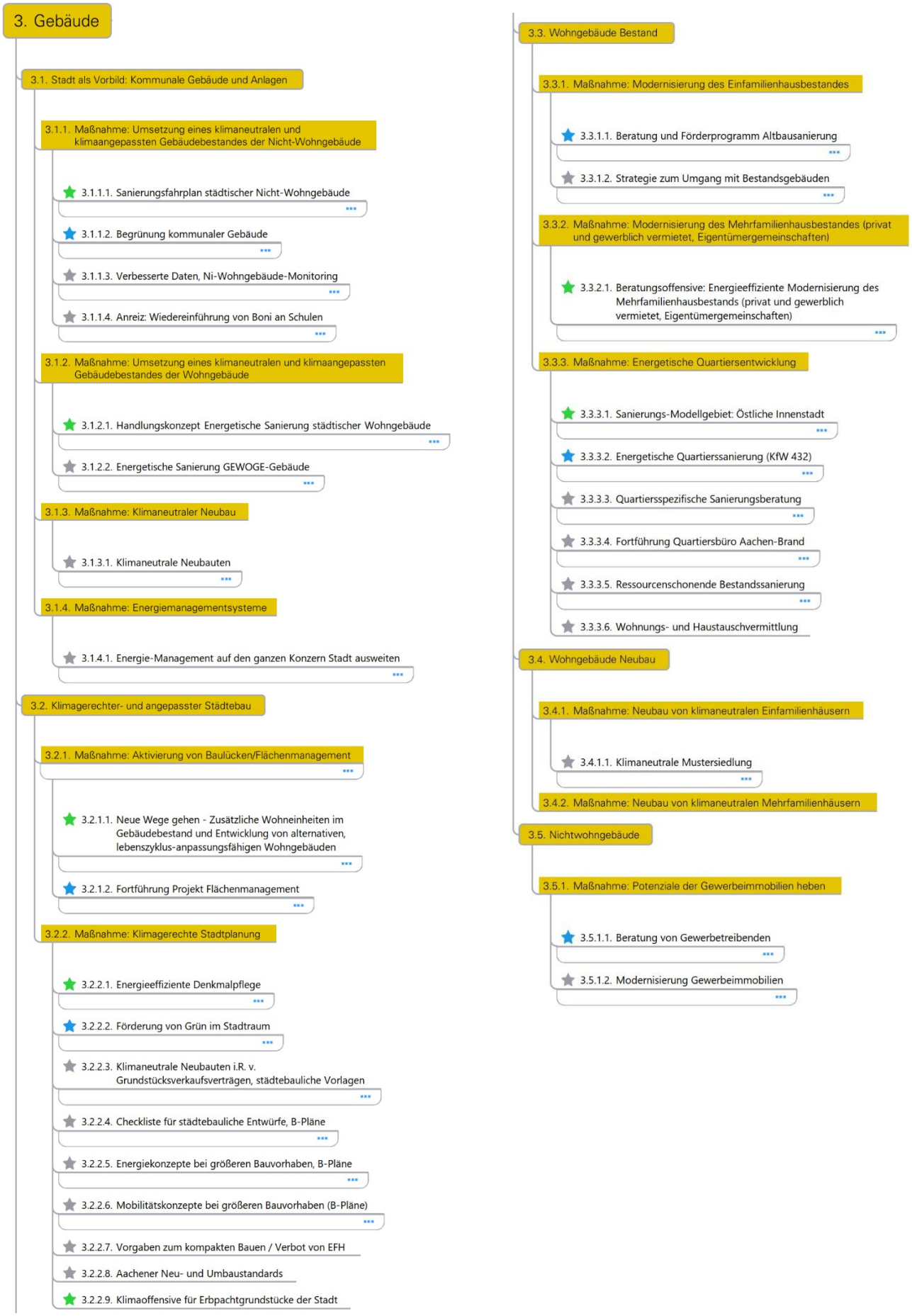

Figure 5 Section of the portfolio plan for buildings (green star: activity with profiles)

These activities are described with a profile

These activities are described in brief:

Refurbishment roadmap for municipal Non-residential buildings

Thematic focus	Introduction	Development of effect	Sphere of influence
City as a role model: Municipal buildings	2024	Medium term	Consume/ role model

Goal and strategy

This activity is intended to further pursue the goal of operating the city's building stock in a climate-neutral manner in the future. The focus here is on the non-residential buildings of the City of Aachen Group, such as administrative buildings, daycare centres, schools, sports facilities and clinics. All relevant aspects with regard to increasing efficiency, expanding renewable energies and modernisation are to be considered in an integrated manner.

Initial situation

The energy-efficient refurbishment of municipal non-residential buildings in the city of Aachen was already addressed in the ICSK action programme from 2020, including initial recommendations for action. As part of this programme, the consumption and emission parameters of the building stock were analysed with regard to thermal energy refurbishment. Based on this, a refurbishment strategy for various climate neutrality targets was derived, with the result that the refurbishment rate of 2% targeted to date is not sufficient to achieve sectoral climate neutrality by 2030.

In addition to refurbishments to reduce space heating requirements, buildings also need to be refurbished on the electricity side to reduce consumption. This primarily includes the areas of lighting, ventilation and cooling. Lighting, especially older light sources, accounts for a large proportion of total electricity consumption, which is why the City of Aachen is aiming to switch to LED technology with daylight-dependent control in all municipal buildings by 2030.

In connection with the identified refurbishment requirements and the resulting construction measures, some of which are costly, it is definitely advisable to also consider the planned expansion of rooftop PV on municipal buildings to utilise electricity. In response to the recommendation for action in the 2020 ICSK, the roofs have already been examined, including with regard to statics, shading and upcoming roof renovations, so that all roofs of municipal buildings that are suitable for solar utilisation have already been identified. A prioritisation list was drawn up and the first PV systems have already been installed, albeit slowed down by a shortage of skilled workers and delivery difficulties. In cooperation with STAWAG, a concept for regional direct marketing for the self-supply of electricity to municipal buildings was developed and implemented.

Description of the

Municipal buildings and facilities are subject to the direct influence of the municipal family with regard to achieving the climate neutrality target that has been set. The development of a strategy is recommended as a basis for the gradual and structured conversion of the building stock, which includes the creation or updating of existing strategic guidelines, such as the refurbishment strategy and an implementation roadmap - taking into account specific requirements (e.g. monument protection, critical infrastructure). The focus here is on refurbishments on the heat and electricity side to reduce energy consumption. The requirements for the use of renewable energies with regard to the provision of electricity, heating and cooling should always be considered in an integrated manner. The first step is to refurbish the energy efficiency of the building envelope in order to cover any remaining energy requirements from renewable or existing sources such as waste heat. From this perspective, it is still advisable to first prioritise the renovation of roofs that are suitable for the installation of photovoltaic systems.

The current applications of the individual buildings need to be reviewed and a mandatory implementation created for the entire city group, including the group subsidiaries. The following points should be included in the implementation roadmap:

- Strategic approach (e.g. complete refurbishment vs. component refurbishment)
- Organisation (e.g. conversion of existing buildings in use vs. provision of replacement buildings)
- Resource requirements (personnel, investments)
- Responsibility (control against the background of different responsibilities)

A corresponding political decision is required to make the strategy more enforceable, among other things with regard to higher investment costs with good economic efficiency over the life cycle. Synergies with other Activities, such as the establishment of a pool of craftsmen, must also be taken into account and expanded, since independent

The possible speed of implementation is determined by the capacities available on the market.

An ambitious approach on the part of the city of Aachen sets an example for the necessary overall refurbishment measures.

First steps for action

- Inventory of refurbishments and PV installations already carried out
- Examination and, if necessary, adjustment of the existing reorganisation strategy
- Examination and, if necessary, adjustment of the existing prioritisation list for PV expansion
- Development of the implementation roadmap (target year 2030)
- Political decision
- Realisation
- Monitoring and controlling the implementation
- If necessary, adaptation to changing framework conditions (e.g. legislation)

Actors

E 26 - Facility Management

Target group

Municipal family City of Aachen

Time required

time equivalents

Duration of the activity

2024 - 2030

Material costs

300.000 €
for external support in strategy development

Financing approach

Budget funds

GHG savings

The building stock of the City of Aachen (core administration) comprises 675 non-residential properties and approx. 450 residential units. Taking into account the heated areas, a share of 80 % of the final energy demand of the municipal facilities is assumed for the non-residential buildings

Reduction of the annual emission level (t/a):

12,300 tonnes CO2eq/a

Cumulative GHG savings (tonnes):

38,800 tonnes CO2eq (by 2030)

Synergy effects

2.3.3.1 Solar campaign on all suitable roof surfaces
2.5.6.1 Establishment of a city-wide pool of tradespeople and a platform including training opportunities
3.2.2.1 Energy-efficient monument conservation
6.1.1.1 Making climate neutrality tangible and best practice visible

Conflicting goals

Lack of skilled labour / resources

Success indicators/milestones

Strategy has been adopted and is being implemented, Political decision, Number of implemented
Refurbishments, development of energy consumption and GHG emissions

Action plan for the energy-efficient refurbishment of municipal residential buildings

Thematic focus	Introduction	Development of effect	Sphere of influence
City as a role model: Municipal buildings	2024	Medium term	Consume/ role model

Goal and strategy

As with the non-residential building stock, this activity aims to pursue the goal of operating the municipal residential building stock in a climate-neutral manner in the future. All relevant aspects with regard to increasing efficiency, expanding renewable energies and modernisation are to be considered in an integrated manner.

Initial situation

The energy-efficient refurbishment of municipal residential buildings in the city of Aachen was already addressed in the ICSK action programme from 2020, with the recommendation to carry out an analysis of the condition of the buildings and to draw up a list of priorities. This was implemented and, based on this, a refurbishment strategy for various climate neutrality targets was derived, with the result that the refurbishment rate of 2% targeted to date is not sufficient to achieve sectoral climate neutrality by 2030. The focus here is on a reduction in space heating and hot water requirements as well as a reduction in consumption through refurbishments on the electricity side, for example in the areas of lighting, ventilation and cooling.

As an integrated approach between the identified refurbishment measures, which are usually costly to implement, and the expansion of rooftop PV on municipal buildings for the use of electricity is definitely advisable, an examination of the roofs has already been carried out in response to the recommendation for action in the 2020 ICSK, including with regard to statics, shading and upcoming roof refurbishments. As a result, all roofs of municipal buildings that are suitable for solar use have already been identified and prioritised. The first PV systems were installed and, in collaboration with STAWAG, a concept for regional direct marketing for the municipal buildings' own electricity supply was developed and implemented.

Description of the

In terms of achieving the climate neutrality target, municipal buildings are subject to the direct sphere of influence of the City of Aachen Group. In the residential building sector, this is largely limited to the building envelope, energy supply and general transport routes. Further savings by the tenants themselves can only be achieved through targeted educational work.

In order to successively modernise the existing building stock, it is advisable to develop a comprehensive strategy that includes the creation or updating of existing strategic guidelines and a concrete implementation plan. Specific requirements, such as monument protection, must be taken into account. The focus is on improving energy efficiency in terms of both heat and electricity. It is crucial to take into account the requirements regarding renewable energies for the provision of electricity, heating and cooling in a holistic approach. Firstly, however, energy refurbishment measures should be carried out on the building envelope in order to subsequently cover any remaining energy requirements from renewable resources or existing sources such as waste heat. In this context, it is also advisable to prioritise the refurbishment of roofs that are suitable for the installation of photovoltaic systems and can be implemented in parallel with active tenancies.

Refurbishment work can conflict with the temporary habitability of individual (parts of) buildings. Nevertheless, it is important to develop a binding implementation schedule that takes the following points into account:

- Strategic approach (e.g. complete refurbishment vs. component refurbishment)
- Organisation (e.g. conversion of existing buildings in use vs. provision of replacement buildings)
- Resource requirements (personnel, investments)
- Responsibility (control against the background of different responsibilities)

In order to make the strategy more enforceable, a corresponding political decision is required, among other things with regard to higher investment costs with good economic efficiency over the life cycle. It is particularly important to ensure that the activity conflicts with the provision of affordable housing in terms of both ecological and economic efficiency.
is also designed to be socially sustainable. It is important to create synergies with other activities, such as the development of

The speed of implementation depends not only on the financial provision, but also on the capacities available on the market.

With its ambitious approach, the city of Aachen is acting as a role model for the necessary city-wide refurbishment measures.

First steps for action

- Inventory of refurbishments and PV installations already carried out
- Examination and, if necessary, adjustment of the existing reorganisation strategy
- Examination and, if necessary, adjustment of the existing prioritisation list for PV expansion
- Development of the implementation roadmap (target year 2030)
- Political decision
- Realisation
- Monitoring and controlling the implementation
- If necessary, adaptation to changing framework conditions (e.g. legislation)

Actors

Lead: E 26 - Facility Management Participants: Gewoge, altbauplus

Target group

Municipal family City of Aachen, tenants

Time required

time equivalents

Duration of the activity

2024 - 2030

Material costs

300.000 €
(external support for strategy development)

Financing approach

Budget funds

GHG savings

The building stock of the City of Aachen (core administration) comprises 675 non-residential properties and approx. 450 residential units. Taking into account the heated areas, a share of 20 % of the final energy demand of the municipal facilities is assumed for the residential buildings

Reduction in the annual level of emissions (t/a):

3,100 tonnes CO2eq/a

Cumulative GHG savings (tonnes):

9,700 tonnes CO2eq (by 2030)

Synergy effects

2.3.3.1 Solar campaign on all suitable roof surfaces
2.5.6.1 Establishment of a city-wide pool of tradespeople and a platform including training opportunities
3.2.2.1 Energy-efficient monument conservation
6.1.1.1 Making climate neutrality tangible and best practice visible

Conflicting goals

Lack of skilled labour / resources

Success indicators/milestones

Strategy has been adopted and is being implemented, political decision, number of refurbishments carried out, development of energy consumption
and GHG emissions

Breaking new ground - Additional residential units in existing buildings and development of alternative, lifecycle-adaptable residential buildings

Thematic focus	Introduction	Development of effect	Sphere of influence
Climate-friendly and Adapted urban developme	2024	Short and medium term	Advise/ motivate

Goal and strategy

The aim of the initiative is to optimise the use of the limited living space available and to develop a long-term sustainable situation on the housing market in the city of Aachen, taking into account various starting points for space-saving and energy-efficient living in existing buildings.

Initial situation

In 2022, the "Housing Action Concept - Integrated Housing Strategy" was developed based on a report by the Chair of Planning Theory and Urban Development at RWTH Aachen University. This concept was developed in specialist forums together with experts from the housing industry, administration and politics. Existing challenges in Aachen's housing market were discussed and solutions were developed in the form of specific housing-related instruments. The inventory analysis is one of the measures initiated as part of this concept.

One specific example can be found in Richtericher Dell. This area represents the last significant reserve area for residential construction in Aachen and is to be developed in terms of urban planning in order to meet the existing high demand for affordable housing. In addition, there are also private areas in Richterich that are earmarked for a new use, although the type of subsequent use has not yet been determined. At the same time, there are many existing buildings in Richterich, especially detached houses, whose residents may be interested in reducing their living space. This opens up the potential for previously unused living space.

Description of the

Sufficiency and efficiency play a central role in achieving sustainability and climate protection goals. In the context of existing residential buildings, this primarily means that existing structures should be used again, better, differently or multiple times. By optimising the use of existing infrastructure and increasing the utilisation of areas already in use, as well as the resulting avoidance of new development areas in previously untouched areas, the potential for internal development that is still likely to exist in Aachen's residential sector can be used more effectively.

In Aachen, as in many other municipalities, many people live in large houses or flats that no longer suit their current living conditions. However, due to a lack of alternatives and support services, they are reluctant to consider moving or repurposing. Here, appropriate offers could serve as an incentive to rethink and possibly change their living situation. In addition to the ecological aspects, this could also help to ease the financial burden and improve the physical quality of life. The city of Aachen is therefore sensitising tenants and owners to question their current housing situation with the help of advisory services. These are intended to highlight the possibilities and advantages of different forms of housing change, such as moving to a smaller flat or shared form of housing, subletting with and without structural changes or exchanging flats. To this end, a housing advice agency will be set up as a central point of contact for enquiries relating to housing sufficiency. It will provide support in arranging home exchange projects and offer specialist advice on creating additional living space in existing buildings. This includes topics such as tenancy agreements for flat swaps, requirements for subletting and restructuring when selling a house, including structural measures such as flat divisions, loft conversions or extensions.

Development of alternative, lifecycle-adaptable residential buildings for (older) residents in Richterich:

The aim is to activate the existing potential in the housing stock in Richterich and to create a sustainable housing situation on the housing market in the long term. This requires both strategic and structural measures are required. The structural measures include the provision of attractive a l t e r n a t i v e

housing options, particularly for older residents, and the creation of flexible residential buildings that can be adapted to the different life cycles of residents. The successful implementation and acceptance of these measures depend largely on the strategic approach and counselling of residents, as already offered by Department 56.

- The creation of attractive alternative housing options for (older) residents in Richterich who are looking to downsize while remaining in their familiar neighbourhood plays a crucial role. This makes it possible to free up existing residential buildings, which can then be used by new residents, especially young families. This creates a sensible alternative to new-build single-family homes ("housing revenge"). The promotion of these alternative housing offers should be considered both in the area of the Richtericher Dell, which is still to be developed, and in the existing settlement area of Richterich. The City of Aachen should play an active role here and promote these initiatives.

The creation of flexible residential buildings in Richterich that are adaptable to different life cycles is of great importance in order to meet the long-term challenge of "underutilised" residential buildings while at the same time meeting the high demand for affordable housing. The ability to adapt to different life phases should be taken into account both in the construction of new residential buildings in the Richterich Dell and, as far as possible, in the conversion of existing residential buildings and the construction of new buildings in the existing settlement area of Richterich.
The implementation of these measures enables a significant reduction in the construction of new residential buildings, especially single-family homes, and the associated infrastructure. This leads to a reduction in land and resource consumption, CO_2 emissions and soil sealing.

Further strategic steps play a decisive role in ensuring the successful implementation and acceptance of these measures. Addressing and advising residents is of great importance here. The existing counselling services offered by Department 56, in particular the "Ageing in Aachen" control centre, should therefore be closely interlinked with the aforementioned measures at an early stage. The social planning and empirical social research activities of Department 56, such as the demographic concept and small-scale neighbourhood analyses, should be integrated into the structure of the project in a targeted manner.

First steps for action

- Continuation and, if necessary, expansion of the systematic inventory analysis
- Identification of unutilised potential
- Establishment of a housing counselling agency

Actors

Lead organisation: altbau plus e.V.
Parties involved: FB 56 - Housing, Social Affairs and Integration, Department 61 - Urban Development, Planning and Mobility Infrastructure

Target group

Building owners, tenants, housing industry

Time required

time equivalents

Duration of the activity

2024 - 2027

Material costs

80.000 € (20.000 €/a)
for external consultants

Financing approach

Budget funds

GHG savings

Not quantifiable

Synergy effects

2.5.6.1 Establishment of a city-wide pool of tradespeople and a platform including training opportunities
3.1.2.1 Energy efficiency action plan
Refurbishment of municipal residential buildings
3.2.2.1 Energy-efficient monument conservation

Conflicting goals

Acceptance by the public

3.3.2.1 Advice campaign: Energy-efficient modernisation of the multi-family housing stock (privately and commercially rented, owners' associations)
6.3.1.1 Participatory campaign with volunteer climate trainers
6.5.1.1 Structural changes with the handprint! - Workshops and support for the Implementation within the administration and with multipliers in associations and initiatives

Success indicators/milestones

Potentials were determined, number of consultations, number of residents who have downsized / shared their living space

Energy-efficient monument preservation

Thematic focus	Introduction	Development of effect	Sphere of influence
Climate-friendly and Adapted urban developme	2024	Short and medium term	Advise/ motivate

Goal and strategy

The activity is aimed at the energy-efficient refurbishment of listed buildings. Through a combined consideration of climate protection and monument preservation, potentials are to be utilised and target-oriented solutions for the upgrading of listed buildings are to be developed.

Initial situation

On 6 April 2022, the North Rhine-Westphalian state parliament passed an amendment to the North Rhine-Westphalia Monument Protection Act (DSchG NRW), which for the first time explicitly enshrined climate protection concerns and the use of renewable energies in the DSchG. This is of particular importance, as climate protection and monument protection are two public concerns worthy of protection, which in practice are often in a strong state of tension and frequently mutually exclusive. Accordingly, Section 9 (3) states: "In particular, the interests of the [...] climate and the use of renewable energies [...] must be given appropriate consideration in the decision."

The city of Aachen is endeavouring to meet its own high standards on the way to becoming a climate-neutral city. In addition, the city has seen an increase in enquiries from monument owners who are not only interested in clear information about the upcoming steps, but are also keen to make their monuments energy-efficient. This increased demand has already had a noticeable effect on the practical preservation of historical monuments in the city of Aachen, with at least 75% of consultations and licences being granted in connection with the changes to the legal situation. The granting of licences takes particular account of housing, climate, the use of renewable energies and accessibility. Climate issues include both climate protection and climate adaptation measures.

Description of the

In order to successfully implement the energy transition, cities with a historic building stock, such as the city of Aachen, must find ways to realise energy savings and at the same time tap into renewable energy sources. The challenge is to fulfil both the energy requirements and the core concept of monument protection. In the course of general technological development, the development of technologies and methods in this area is also progressing rapidly. One example of this is roof-integrated photovoltaic systems with special polymer coatings. However, upgrading the energy efficiency of monuments does not always mean installing photovoltaic systems as the sole or best solution in the overall context. The decision must always be made on an individual basis, depending on factors such as the size, utilisation and protected status of the building. The aim is to improve the overall energy balance without compromising the historic fabric of the building. This can be achieved, for example, by using efficient heating technology to compensate for the often inadequate insulation properties of the building envelope. Not every façade can be insulated. In general, energy measures, including insulation and optimisation of window and door systems, should be developed in accordance with the principles of monument protection. As the design of such measures is the responsibility of the local authority, the city of Aachen has clearly positioned itself in this regard and offers support in the form of funding programmes and campaigns.

The City of Aachen is also expanding its information and advisory services on the subject of climate protection and energy efficiency in listed buildings. To this end, both the staff and the budget for advising building owners on the changed legal framework conditions, e.g. with regard to photovoltaic systems on listed buildings, will be increased. This also includes the provision of training programmes for employees on innovative forms of PV technology implementation and the provision of renewable heat. Advice is offered on options for a self-sufficient heat supply, particularly in peripheral districts.

First steps for action

- Expansion of existing counselling services
- Targeted employee training on innovative solutions
- Conceptualisation of low-threshold information opportunities
- Effective publicity for the offers

Evaluation and, if necessary, adaptation of the offers

Actors

In charge: Department 61/600 - Monument preservation and urban archaeology
Participants: FB 36 - Environment and Climate, altbau plus e.V.

Target group

Municipality of the City of Aachen, Department of Urban Development, Planning and Mobility Infrastructure

Time required

time equivalent

Duration of the activity

2024 - 2030

Material costs

350,000 € or 50,000 €/a
(Information material and public relations)

Financing approach

Budget funds

GHG savings

Not quantifiable

Synergy effects

2.1.1.1 Climate-neutral electricity and heat supply for properties under municipal control
2.2.1.2 Heat planning
2.3.3.1 Solar campaign on all suitable roof surfaces
3.1.1.1 Refurbishment roadmap for urban non-residential buildings
3.1.2.1 Action plan for the energy-efficient refurbishment of municipal residential buildings
3.3.2.1 Consultancy campaign: Energy-efficient modernisation of the multi-family housing stock (privately and commercially rented), communities of owners)

Conflicting goals

Acceptance by citizens, acceptance by building owners, changes to the cityscape, aesthetics, monument protection vs.
Climate protection

Success indicators/milestones

Number of counselling sessions held, number of employee training sessions held,
Realised refurbishment projects

Climate campaign for leasehold properties in the city

Thematic focus	Introduction	Development of effect	Sphere of influence
Climate-friendly and adapted urban development	2024	Medium term	Regulate

Goal and strategy

The aim of this activity is to accelerate the refurbishment of the leasehold building stock in the city of Aachen and to make the buildings as climate-neutral as possible.

Initial situation

Leaseholds grant individuals or organisations the right to use a specific plot of land for a fixed period of time without actually owning it. This is done under a lease agreement, which allows the leaseholders to develop the land in question and erect buildings. At the end of the agreed lease term, the land reverts to the landowner unless an extension of the contract has been agreed. The City of Aachen has around 1,200 heritable building rights. Many of these are in the residential building sector. A fundamental problem is that the willingness of leasehold owners to renovate buildings decreases as the term of the leasehold progresses. In this respect, energy-efficient refurbishment needs to be incentivised.

Description of the

Two strategic approaches are envisaged:

Early extension of the leasehold: Leaseholders with a remaining leasehold term of less than 50 years receive an early extension of the leasehold. This gives them greater planning security and longer amortisation periods for the implementation of comprehensive measures.

Offer to buy: For leasehold properties that are of little relevance to the city's housing supply and where there are no urban planning reasons not to do so, a sensible measure could be to sell these properties to the respective leaseholders and thus current building owners. This approach would be particularly applicable to detached houses.

For both approaches, the leaseholders are obliged in return to carry out the energy-efficient refurbishment of the buildings to a specified standard. This would increase the energy efficiency of existing buildings and reduce energy consumption, making an important contribution to the city of Aachen's climate neutrality target.

First steps for action

- Development of criteria for the sale of leasehold properties
- Identification and categorisation of the properties with regard to
  - a possible sale of land
  - Offering an early contract extension
  - Offering a reduction in the ground rent
- Writing to tenants and offering individual consultations

Actors

In charge: Department 23 - Real Estate Management Participants: Department 36 - Environment and Climate, Department 20 - Environmental Management
Financial management

Target group

Leaseholders of leasehold properties, building owners

Time required

1 full-time equivalent

Duration of the activity

2024 - 2026

Material costs

Iditional costs

Financing approach

-

GHG savings

By 2030, half of the existing leasehold buildings (approx. 600) will have undergone energy-efficient refurbishment. Average building areas of 100 ^{m2} and savings of 100 kWh/m²a are assumed.

Reduction in the annual level of emissions (t/a):

9,400 tonnes CO2eq/a

Cumulative GHG savings (tonnes):

29,400 tonnes CO2eq (by 2030)

Synergy effects

2.3.3.1 Solar campaign on all suitable roof surfaces
3.3.2.1 Consultancy campaign: Energy-efficient modernisation of the multi-family housing stock (privately and commercially rented), communities of owners)

Conflicting goals

Urban housing supply, urban development planning

Success indicators/milestones

Overview of the properties including categorisation created, number of tenants contacted, number of consultations carried out,
Number of refurbishment measures implemented

Advisory campaign: Energy-efficient modernisation of the multi-family housing stock (privately and commercially rented, owners' associations)

Thematic focus	Introduction	Development of effect	Sphere of influence
Residential building stock	2024	Short and medium term	Advise/ motivate

Goal and strategy

The aim of this activity is to increase the refurbishment rate in existing residential buildings through targeted advisory services for private and commercial landlords and owners' associations.

Initial situation

The Aachen funding programmes "Energy-saving measures in buildings", "Funding for roof/facade greening" and solar funding have been very well received and have multiplied the renovation rate in Aachen in recent years. Currently, altbau plus e.V. in particular acts as a point of contact for building owners and provides information and further advice.

Description of the

This activity is aimed at owners of apartment blocks in Aachen, in particular owners' associations as well as private and commercial landlords. The aim is to create an advisory service for them that provides information on the various options for energy-efficient refurbishment, suitable specialist companies and available funding opportunities. This project can be bundled with the services for owners of single-family homes. Furthermore, the municipal funding programme for renovating old buildings is to be evaluated, expanded and established on a permanent basis, with altbau plus e.V. reviewing and advising on the funding programmes. The prerequisite for this is that the existing funding programmes of the City of Aachen are maintained.

In addition, the introduction of a subsidy programme that rewards the reduction of CO_2 emissions would be desirable. For each planned refurbishment measure, a heating load calculation must be carried out room by room to determine the current energy requirement and the CO_2 equivalent. This data is used to calculate the potential CO_2 savings, which in turn determines the amount of the subsidy. The advantage of this approach is that refurbishment measures are subsidised solely on the basis of the actual CO_2 savings achieved. This makes it much easier to monitor progress towards climate protection targets.

First steps for action

- Evaluation, expansion and permanent establishment of the municipal funding programme for renovating old buildings
- Expansion of the counselling services
- Public relations work to promote the funding programme and the advisory services
- Development of further funding criteria / programmes
- Evaluation and adjustment if necessary

Actors

Lead: Department 36 - Environment and Climate
ipants: altbau plus e.V.

Target group

Building owners/
Communities of owners

Time required

ll-time equivalents

Duration of the activity

2024 - 2030

Material costs

350.000 € (50.000 €/a)
unselling services and public relations

Financing approach

Budget funds

GHG savings

The savings result from the renovation of living space supported by initial consultations

Reduction of the annual emission level (t/a):

2,400 tonnes CO2eq/a

Cumulative GHG savings (tonnes):

7,500 tonnes CO2eq

Synergy effects

1.1.2.2 Introduction of climate funds
2.3.3.1 Solar campaign on all suitable roof surfaces
2.5.6.1 Establishment of a city-wide pool of tradespeople and a platform including training opportunities
3.2.1.1 Breaking new ground - additional residential units in existing buildings and development of alternative, lifecycle-adaptable residential buildings
3.2.2.1 Energy-efficient monument conservation
3.3.3.1 Redevelopment model area: Eastern city centre

Conflicting objectives

High personnel and financial expenditure, lack of skilled labour / resources

Success indicators/milestones

Additional advice centre(s), number of information and advisory activities, number of subsidies and total amount of subsidies paid out per year, refurbishments initiated and supported, energy and GHG savings achieved.
Total savings

Redevelopment model area: Eastern city centre

Thematic focus	Introduction	Development of effect	Sphere of influence
Residential building stock	2024	Short and medium term	Advise/ motivate

Goal and strategy

With the help of this activity, an alternative approach to increasing the refurbishment rate is to be tested in a model area, which could possibly serve as a blueprint for other projects and neighbourhoods.

Initial situation

Developments in Aachen in recent years, particularly in the eastern part of the city centre, have raised the question of urbanity. Retail use has declined and private transport has characterised the structure. High pedestrian numbers on the main streets, combined with vacant, inflexible retail properties and a transport system that offers little space for encounters, culture and leisure, illustrate the existing challenges. The majority of private property owners are no longer involved in urban development. Reasons for this could be, for example, the physical distance of the owners or speculation on increases in value by leaving properties lying around.

In order to meet these challenges, the eastern city centre needs a transformation geared towards the common good. In addition to a more diverse usage programme, more sustainable mobility adapted to climate change, a future-oriented development of public and private space and the involvement of private property owners are required. It is clear that these goals cannot be achieved through appeals and dialogue alone. In order to ensure the city's ability to act in this transformation process, it will be examined by mid-2024 whether additional instruments of special urban development law can be sensibly used that go beyond the existing "city centre" redevelopment area and the associated city centre concept of 2022. To this end, the planning committee decided to initiate preparatory studies in November 2021.

Description of the

An approach for increasing the redevelopment rate is to be tested in a selected model area, the eastern city centre. Two key elements form the core of the approach, namely the use of a right of first refusal by the city in the context of redevelopment areas and the creation of a municipal redevelopment company. The right of first refusal enables the city to actively intervene in the property purchase process and thus to act strategically on the property market and control the redevelopment process. The existing Städtische Entwicklungsgesellschaft Aachen GmbH & Co KG (SEGA) could provide a suitable starting point for the redevelopment company, which could play a key role in the implementation of the redevelopment projects. It would be responsible for the coordination, planning and implementation of the redevelopment measures in the model area.

In addition to these main elements, the concept would include a pool of craftsmen (see activity 2.5.6.1.) and a special support programme for private owners who do not wish to sell their buildings. The pool of tradespeople would ensure that qualified specialists are available for the refurbishment work, while the support programme would create incentives for owners to refurbish their properties and thus contribute to the sustainable development of the model area.

Alternative approaches focussing on climate-neutral refurbishment of buildings should also be examined as part of the concept. This could include the integrated consideration of innovative technologies and materials, the use of renewable energies and the implementation of energy concepts. The aim is to realise a future-oriented, sustainable and socially acceptable refurbishment in the model area.

First steps for action

- Finalise inventory and analysis of potential land purchases
- Creation of an urban redevelopment company
- Develop redevelopment goals and need for action
- Conception of the action programme for the refurbishment measures
- Preparation of a results report and reorganisation statutes
- Develop a consulting and communication concept with the help of external consultants
- Conception of suitable information materials
- Introduction of a funding pot

Actors

Lead: Department 61 - Urban development, planning and mobility infrastructure
ipants: altbau plus e.V.

Target group

Citizens, local businesses, trade / commerce / service providers, building owners
Communities of owners, administration

Time required

time equivalents

Duration of the activity

2024 - 2030

Material costs

2.100.000 €. (300.000 €/a)
for public relations work; external consulting or concept development and funding

Financing approach

Budget funds

GHG savings

Not quantifiable

Synergy effects

2.3.3.1 Solar campaign on all suitable roof surfaces
2.5.6.1 Establishment of a city-wide Tradesman pools and a platform including training opportunities

Conflicting goals

High personnel and financial expenditure, lack of skilled labour / resources, increased number of construction measures, acceptance of property / building owners

Success indicators/milestones

Completion of the inventory, finalisation of a refurbishment concept,
Number of space purchases, number of Information and counselling activities, number of grants and total amount of grants distributed per year, initiated and accompanied Refurbishments, total energy and GHG savings achieved

Brief descriptions:

No.	Greening of municipal buildings
3.1.1.2.	The city of Aachen has already started greening municipal buildings and is planning to green roofs - where possible in combination with PV systems - as part of refurbishment measures at at least three other locations. In addition to the greening of roofs, more facades of new buildings are also to be greened in future. In order to extend the positive effect of green roofs and façades, larger existing buildings such as the administration building at Marschiertor should also be considered. Greening measures should be linked to refurbishment processes, e.g. to take account of the structural requirements of green roofs.
	Continuation of space management project
3.2.1.2.	To continue the land management project, the City of Aachen is establishing a strategic land management programme with the following components: Creation of a land concept, development of a digital land management data platform, land audits, activation of internal development potential, development of incentive systems for private property owners, organisation of specialist conferences with external expertise, design, management and support of participation processes, creation of information material and advisory services.
	Promotion of greenery in the urban area
3.2.2.2.	The city of Aachen has already launched a funding programme for green roofs and façades in urban areas in 2022. In addition, knowledge and tips on the benefits of urban greening such as front garden design, insect and biodiversity protection are now to be shared in cooperation with the Aachen Adult Education Centre.
	Advice and funding programme for renovating old buildings
3.3.1.1.	The city of Aachen has been offering a funding programme for the renovation of old buildings since May 2021. In 2022, 410 applications for funding have already been submitted to the city. In the course of the activity, an initial evaluation of the programme is to be carried out in order to make any necessary optimisations. Furthermore, the available funds are to be increased and the programme made permanent. In addition, a complementary advisory service should be established to provide information on the various options for energy-efficient refurbishment and to provide specialist companies and funding opportunities. For example, in the form of a "Beratungsmobil altbau plus e.V." in cooperation with the "Rollendes Rathaus" programme.
	Energy-efficient neighbourhood refurbishment (KfW 432)
3.3.3.2.	The city of Aachen is developing integrated energy neighbourhood concepts for selected existing neighbourhoods on the basis of the KfW 432 programme. Based on a comprehensive inventory and potential analysis, the neighbourhood concepts show which measures can be used to achieve a comprehensive, effective energy-efficient refurbishment of existing residential buildings.
	Advice for traders
3.5.1.1.	In order to realise a climate-neutral building stock in the future, non-residential buildings in the city of Aachen that are not directly under the city's control must also be made more energy-efficient. The target group here are the companies and owners of commercial properties, who should be informed about the possibilities of refurbishment. Available subsidies and trade companies are also to be organised. In contrast to office buildings, which have similar characteristics to residential buildings, many warehouses or production halls are of lightweight construction, so that other measures must be used here.

Mobility

A successful mobility transition plays a decisive role in achieving climate neutrality for the entire city of Aachen. The mobility transition in Aachen is aimed at a transport system that protects the climate and people's health, is socially just and guarantees the quality of life in the city and region.

The following key areas of action are therefore at the centre of administrative action:

City as a role model: Mobile city group

The municipal family is leading by example and gradually converting its own vehicle fleet to climate-neutral drive systems. The conversion of the entire fleet in the city of Aachen is being actively supported.

Transport planning and mobility concepts

The city of Aachen pursues the strategy of a city of short distances. Schools and kindergartens as well as facilities for daily needs are close to where people live, and the routes to training centres and workplaces are easily accessible with alternatives to the car. This avoids journeys and reduces the environmental impact of motorised private transport.

Avoiding and shifting passenger transport

The aim is to organise comfortable walking and safe cycling. Mobility should be organised flexibly and cost-effectively, children and the elderly, working people and visitors should be able to move around independently, healthily, safely and in an environmentally friendly way. Traffic will be quiet and with greatly reduced emissions. The city gains space for play, recreation, greenery and catering.

Climate-friendly drives and fuel

For motorised transport that cannot be avoided or shifted to more climate-friendly modes of transport, energy consumption and the resulting emissions per kilometre travelled must be reduced as far as possible and fossil fuels substituted (efficiency and consistency).

Figure 6 Extract from the mobility portfolio plan (green star: activity with fact sheets)

These activities are described with a profile

These activities are described in brief:

BMM at the city administration of Aachen and at the municipal holding companies

Thematic focus	Introduction	Development of effect	Sphere of influence
City as a role model: Mobile City Group	2024	Short to medium term	Offer and supply

Goal and strategy

The expansion of operational mobility management in the municipal family aims to reduce, shift and handle transport in the most climate-friendly way possible. The expansion of existing services is intended to further improve mobility behaviour.

Initial situation

With almost 6,000 employees, the City of Aachen has a great responsibility to organise sustainable mobility for its employees. So far, the first major steps have been taken with the introduction of the employee job ticket and the soon to be available company bike leasing scheme. In other areas, such as car park management or the creation of secure bicycle parking spaces, there have been few successes. However, the potential is great if the appropriate incentives and framework conditions are created. Successes in this area will also have a positive impact on employer attractiveness, which is an important parameter in times of a shortage of skilled labour. The role model function vis-à-vis the municipal holding companies and other state authorities is also very high and has already been addressed by politicians as a field of action in the area of mobility management.

Description of the

The City of Aachen is significantly expanding its concept for corporate mobility management within the administration and is also actively supporting the municipal subsidiaries in following this example. It is conceivable that this could be managed using climate protection-related target indicators (key performance indicators), the achievement of which should be evaluated annually. The KPIs could include, for example Proportion of employees in the department who travel to work by eco-mobility or measures implemented in their own area of responsibility that relate to climate protection. At the same time, the municipal subsidiaries (e.g. STAWAG, ASEAG, APAG...) are also being persuaded to introduce company mobility management. Encouraging competition between the individual organisations in terms of the modal split achieved or car kilometres saved per year could serve as an incentive for special efforts at all levels.

First steps for action

- Conception and realisation of further offers
- Establishment and regular collection of climate protection-related target indicators
- Direct approach of the municipal holding companies and, if necessary, conceptualisation of a competition
- Evaluation of the target indicators and adjustment of the offers if necessary

Actors

Lead: Purchasing and Technology - Vehicle Fleet and Equipment Management E 18/221
Parties involved: Department 61 - Urban development, planning and mobility infrastructure, Department 60 - Contracts
Procurement and Funding Management, FB 01 - Citizens' dialogue and administrative management, FB 11
- Human Resources, Organisation, E-Government and Information Technology, E 26 - Facility management, other users

Target group

City administration and municipal affiliated companies

Time required

Duration of the

activity

ll-time equivalents

Establish in the long term

Material costs

Not quantifiable, depending on the new offers

Financing approach

-

GHG savings

Currently not quantifiable. Estimation possible using the new balancing methodology (see activity 4.2.1.2. Balancing and impact assessment of mobility measures in the ICSK)

Synergy effects

us activities in the field of action

Conflicting goals

-

Success indicators/milestones

Modal split of the city administration and municipal family, evaluation of target indicators

Binding mobility concepts for construction projects and events

Thematic focus	Introduction	Development of effect	Sphere of influence
Transport planning and mobility concepts	2023	Medium to long term	Offer and supply

Goal and strategy

Mobility concepts for construction projects and events can have a high level of acceptance and therefore a great impact if they are designed specifically for the location. Mobility impacts on the surrounding area can be avoided, added value created for the respective project and surrounding neighbourhoods and emissions reduced. The effect results from a reduction in the number of cars required, the number of kilometres driven and the establishment of electric mobility.

Initial situation

-

Description of the

Mobility concepts are to be systematically developed for construction projects and discussed with the city. Suitable mobility management measures are defined in binding, emission-reducing mobility concepts and their implementation is monitored. The revised parking space statutes work even more towards creating suitable sustainable mobility options and reducing the amount of motorised traffic caused by the building. In addition, efforts are being made to ensure that private spaces can be used for sustainable mobility options, including sharing, and that developers also take on the task of communicating with users.

The city administration offers advice on suitable measures and workable solutions for building owners and event organisers. Information packages are compiled for event organisers and advisory services are provided. Low-emission mobility options and solutions are systematically made available. Good practice examples of sustainable events are collected and presented. For major events in the city of Aachen, low-emission mobility concepts will be introduced as a mandatory part of the traffic and safety concept.

First steps for action

- Burggrafenstrasse mobile station business model
- Establishing the visibility of mobile stations at 25 stations as part of #AachenMooVe!

Actors

In charge: FB 20, FB 61
Parties involved: FB 32 (security concept for events)

Target group

Citizens

Time required

-time equivalent

Duration of the activity

7 years

Material costs

ox. 140,000 €/a

Financing approach

Budget funds

GHG savings

Not quantifiable

Synergy effects

us activities in the field of action

Conflicting goals

-

Success indicators/milestones

Development of passenger numbers, development of modal split

Balancing and impact assessment of the mobility measures in the ICSK

Thematic focus	Introduction	Development of effect	Sphere of influence
Transport planning and mobility concepts	2024	Medium-term, long-term	Offer and supply

Goal and strategy

The activity aims to adapt and expand the accounting methodology for estimating $CO_{2\ emissions}$ in the mobility sector.

Initial situation

To date, the city of Aachen has applied the polluter pays principle when balancing the city's $CO_{2\ emissions}$ from transport.

Description of the

For the IKSK 2020, the polluter-pays principle was supplemented by a territorial estimate of $CO_{2\ emissions}$ in the city of Aachen, as is also used in the EU mission as the basis for understanding municipal climate neutrality. This methodology must be refined with external support so that it can be used as a new accounting method in the future. It is also necessary to harmonise a methodology in order to be able to estimate the effects of the measures or packages of measures in the mobility sector in terms of their $CO_{2\ impact.}$ This is a necessary basis for carrying out a cost-benefit analysis in the field of mobility.

First steps for action

- Placing an order

Actors

Lead: Department 61 - Urban development, planning and mobility infrastructure
Parties involved: Transport development planning steering group

Target group

City administration

Time required

Duration of the activity

2 years

Material costs

0 €/a

Financing approach

-

GHG savings

No direct savings

Synergy effects

us activities in the field of action

Conflicting goals

Lack of data

Success indicators/milestones

Accounting method was adjusted and is applied

City centre mobility for tomorrow

Thematic focus	Introduction	Development of effect	Sphere of influence
Transport planning and mobility concepts	2024	Medium-term, long-term	Offer and supply

Goal and strategy

The activity aims to make the city centre more accessible and safer for all road users.

Initial situation

A network interruption for car traffic on the Grabenring was installed at Elisenbrunnen back in the 1990s. In 2021, a further network interruption was added at Templergraben via a real-world laboratory, the continuation of which was decided in 2023. In November 2023, the decision on three further "control points" for car traffic is pending. At the same time, this decision marks the start of the transformation of the Grabenring into a cycle distribution ring as a connecting element of the priority cycle routes leading to the city centre, which was already announced in 2019.

Description of the

With the help of an overall concept that follows three central objectives, this city-friendly and safe accessibility of the city centre is to be ensured for all road users:

- Easily accessible city centre: Everyone can easily reach the cultural, gastronomic, educational and shopping facilities in the heart of Aachen. The city centre is easily accessible by all modes of transport.
- Fair and safe traffic: The interaction is considerate and relaxed.
- Good neighbourhoods: Neighbourhoods are quiet, the quality of life is enhanced and people can enjoy each other's company.

In order to achieve these overarching goals, measures were developed for the individual modes of transport. For each mode of transport, the measures are aimed at different sub-goals, which are presented below:

- Strengthen walking, improve quality of stay
- Making car traffic compatible with the city
- Enabling safe cycling
- Improve public transport

The concept also includes measures for the following areas

- Strengthening consideration,
- Networking of mobility services and
- Making urban transport climate-neutral.

The implementation of the changed traffic routing is currently planned for 2024. This new routing of car traffic will prevent through traffic in the city centre by dividing the area into five zones with defined access points. The overall city centre mobility concept for tomorrow clearly shows how the reduction of the car traffic share of the modal split in the city centre is to be reduced from 46% to 36% by 2030: Reduced space requirements for car traffic will be used to make eco-mobility more attractive.

First steps for action

- The implementation of the changed traffic routing is currently planned for 2024.

Actors

Lead: Department 61 - Urban development, planning and mobility infrastructure
Participants: -

Target group

Citizens

Time required

0.25 Full-time

Duration of the activity

Establish in the long

equivalents

term

Material costs

uantifiable

Financing approach

-

GHG savings

Currently not quantifiable. Estimation possible using the new balancing methodology (see activity 4.2.1.2. Balancing and impact assessment of mobility measures in the ICSK)

Synergy effects

3 Mobility management for visitors

Conflicting goals

Feedback from citizens

Success indicators/milestones

Development of the modal split

Network Mobility Transition Aachen Region (NEMORA)

Thematic focus	Introduction	Development of effect	Sphere of influence
Transport planning and mobility concepts	2024	Medium-term, long-term	Offer and supply

Goal and strategy

The mobility transition in the region is to be organised in close cooperation with the StädteRegion Aachen and the municipalities belonging to the region.

Initial situation

The network began its activities in spring 2022 and spent the first project phase in 2023 fine-tuning its content and developing objectives, standards, evaluation criteria and basic concepts in working groups, which are to be implemented as the project progresses. Public relations issues have also been addressed.

Description of the

The cooperation in NEMORA is currently focussing on the regional future fields of "strong public transport axes", "Mobile stations and multimodality" and "regional cycling infrastructure" were each developed further in independent working groups. All working groups have defined content and binding goals that are to be implemented and achieved as part of the work. New topics (e.g. mobility and traffic management) are to be added from 2024. The regional perspective will promote structures for climate-friendly settlement and mobility development at an early stage and create alternatives for commuter transport to and from Aachen.

First steps for action

- Development of further projects in new subject areas
- Realisation of projects and ongoing adaptation

Actors

In charge: City of Aachen, Dec 3, FB 61/300
Participants: StädteRegion Aachen, all municipalities in the region, AVV, ASEAG

Target group

Aachen city region

Time required

uantifiable

Duration of the activity

Establish in the long term

Material costs

uantifiable

Financing approach

-

GHG savings

Not quantifiable

Synergy effects

us activities in the field of action

Conflicting goals

-

Success indicators/milestones

Development of the modal split

Zero-emission zone

Thematic focus	Introduction	Development of effect	Sphere of influence
Transport planning and Mobility concepts	2024	Medium-term, long-term	Offer and supply

Goal and strategy

The aim of the activity is to develop solutions for setting up zero-emission zones so that from this point onwards only locally emission-free cars are allowed to drive there.

Initial situation

The EU has set itself the goal of becoming climate-neutral by 2045. According to the City of Aachen's technical understanding, climate-neutral transport requires the complete elimination of the use of fossil fuels. To achieve this goal, the EU decided in 2022 that vehicles powered by conventional petroleum products would no longer be allowed to be registered from 2035. To date, the average lifespan of passenger cars is 15 to 20 years; a vehicle purchased in 2034 is therefore expected to reach the end of its service life between 2049 and 2054. For the acceptance of a ban on the use of such vehicles, it would be very important for people who are about to make a purchase decision to know how long this vehicle may be used in their home region. Such a ban should therefore include a sufficient lead time that takes the service life into account. It is irrelevant for the amount of CO_2 emissions - which alone is decisive worldwide - whether the CO_2 emissions of a vehicle are released into the atmosphere in Aachen or elsewhere for any remaining time until the end of its service life. Whether the EU intends to achieve the goal of climate-neutral transport in 2045 by banning the use of such vehicles is still open.

In the past, the city of Aachen has always favoured solutions that prioritise a voluntary changeover. When this was no longer legally possible, it was decided in 2019 to establish an environmental zone for Aachen within the outer ring road.

Description of the

With this activity, the City of Aachen undertakes to work with other pioneering cities and the EU Commission to coordinate the possibilities of introducing a zero-emission zone in Aachen. If this possibility exists, it would be highly recommended to reach an agreement with the surrounding area on at least an (EU) regional or nationwide solution.

First steps for action

- Foundation of a working group
- Development of solutions
- Prospective establishment of zero-emission zones

Actors

In charge: FB 61
es involved: Legal depar

Target group

City of Aachen, other pioneering cities and EU Commission

Time required

ull-time equivalents

Duration of the activity

Establish in the long term

Material costs

uantifiable

Financing approach

Budget funds

GHG savings

Currently not quantifiable. Estimation possible using the new balancing methodology (see activity 4.2.1.2. Balancing and impact assessment of mobility measures in the ICSK)

Synergy effects

-

Conflicting goals

Legal framework conditions and control options, acceptance of the Citizens

Success indicators/milestones

Solution approaches have been developed, zero emission zone has been established

Promotion of sharing and multimodality

Thematic focus	Introduction	Development of effect	Sphere of influence
Avoidance and relocation of Passenger transport	2024	Medium-term, long-term	Offer and supply

Goal and strategy

On the one hand, the activity aims to expand the range of sharing and multimodal services and, on the other, to secure funding for these services.

Initial situation

Aachen already has a large number of car and bike sharing stations, and there are currently 3 e-scooter providers operating in the city. With the expansion of the mobility transition endeavours to the entire Aachen city region, the topic of shared mobility is also becoming increasingly important in the Aachen city region. In order to achieve the highest possible number of users, optimal integration with public transport and a wide range of services, good organisation and user communication of the sharing system is required.

Description of the

Shared mobility follows the principle that means of transport are available to users when they need them (flexibility), but are available to other users at other times.

In combination with public transport, shared mobility offers the opportunity to make it so attractive that it is possible to do without a personal car. This is because places that are difficult to reach by public transport can be reached with car sharing or bike sharing and the last mile from the bus stop to the destination can be covered quickly and easily with e-scooter sharing or bike sharing (reliability, accessibility).

The promotion of sharing and multimodality is therefore an important building block in Aachen's climate neutrality programme. In addition, the expansion of sharing offers reduces land consumption, as these vehicles are available to several people throughout the day.

The activity includes the acquisition of new users for the various sharing offers (e.g. through integrated or new tariff products (such as subscriptions incl. basic sharing fee or public transport day pass incl. Velocity), communication, use on long journeys in the case of car sharing). In addition, the offer should be further expanded, e.g. at P+R car parks, peripheral districts.

In order to finance the operation of the sharing offer in the long term, larger employers in Aachen must be systematically involved in financing the sharing offer, either by setting up and financing sharing stations on their own premises and concluding purchase agreements for employees or by means of a levy that is used to finance the operation of the city-wide sharing system.

The aim is also for public transport operators and Deutsche Bahn to co-finance the sharing offer (e.g. integration into the city fare for train tickets), as the sharing offer benefits public transport. In addition, sharing providers will pay special usage fees to the city.

First steps for action

- Attracting new users for the various sharing offers
- Conception of (participation) models for financing the offers
- Addressing companies directly

Actors

In charge: FB 61
Participants: FB 32, ASEAG, avv, FB 02, other mobility service providers

Target group

Citizens

Time required

0.5 full-time equivalents

Duration of the activity

k. A.

Material costs

uantifiable

Financing approach

-

GHG savings

Currently not quantifiable

Synergy effects

us activities in the field of action

Conflicting objectives

Response from the companies

Success indicators/milestones

Offer has been expanded, utilisation of offers

Expansion of the charging infrastructure

Thematic focus	Introduction	Development of effect	Sphere of influence
Climate-friendly drives and fuels	2025	Medium-term, long-term	Offer and supply

Goal and strategy

The city of Aachen has a great interest in realising its climate targets by 2030, which is why it should promote the development of charging infrastructure. In order to achieve the aforementioned target of approx. 2,400 charging points by 2030, extensive advisory services are required for entrepreneurs and owners of parking spaces, e.g. in finding and selecting suitable funding programmes and identifying potential operators.

Initial situation

As at 31 August 2023, 4,741 electric vehicles and 3,233 plug hybrid vehicles were registered in Aachen. These vehicles make up 6.77% of the total fleet. The German government has set a target of 15 million fully electric cars being registered nationwide by 2030 and around one million public charging points being available. If these figures are broken down for the city of Aachen, assuming a total of approx. 117,000 cars, there will be approx. 35,000 e-vehicles and approx. 2,400 charging points. There are currently around 540 publicly accessible charging points available in Aachen, over 300 of which were installed as part of the ALigN project.

Description of the

In order to reach the number of charging points determined in this way, further locations for the charging infrastructure must be found in order to achieve the climate policy targets and generally make the switch to e-vehicles attractive. The next step should therefore be to address vehicle operators, e.g. taxi companies and car-sharing companies, who are frequently on the move in the city and for whom a switch to locally emission-free vehicles therefore has a disproportionately favourable effect on inner-city emissions. Furthermore, charging points (AC/DC/HPC) could be installed in various private parking spaces, e.g. at retail companies and in multi-storey car parks. Based on the charging points already installed, it is assumed that around 1,800 new charging points will need to be installed by 2030. The costs per charging point (AC/DC/HPC), including connection costs, are estimated at an average of €27,500, resulting in a total investment volume of €49,500,000.

The city of Aachen has a great interest in realising its climate targets by 2030, which is why it should support the development of the charging infrastructure. Based on a funding requirement of 30% of the new charging points to be installed and a subsidy of 40%, the total funding requirement for the period 2025 to 2030 is approx. 5,940,000 and a staff requirement of one 50 % position.

First steps for action

- Identification of further locations for the charging infrastructure
- Addressing vehicle operators, e.g. taxi companies and car-sharing companies that are frequently on the road in the city
- Creation of charging points in various private parking areas, e.g. at retail companies and in multi-storey car parks

Actors

In charge: FB 61/320
Participants: -

Target group

Logistics, courier/express and parcel service providers (CEP), craft businesses, politics

Time required

1 full-time equivalent

Duration of the activity

6 years

Material costs

approx. € 5,940,000 for the funding programme

Financing approach

Budget funds, electric mobility funding if necessary

GHG savings

Currently not quantifiable. Estimation possible using the new balancing methodology (see activity 4.2.1.2. Balancing and impact assessment of mobility measures in the ICSK)

Synergy effects

hbourhood car parks and neighbourhood mobile station

Conflicting goals

-

Success indicators/milestones

Number of additional charging points

Brief descriptions

No.	Electrification of urban vehicles
4.1.2.2.	In order to make the municipal vehicle fleet climate-neutral, combustion vehicles in the municipal vehicle fleet are being replaced by vehicles with electric drives. The only exceptions are emergency vehicles for the fire brigade. The main basis for this activity is equipping the municipal sites with charging infrastructure.

No.	Scientific support for the mobility transition
4.2.1.3.	The mobility transition in Aachen is to be scientifically monitored and evaluated. The central points of the scientific monitoring of measures are the shift from motorised private transport to public transport and cycling, the acceleration of the mobility transition and the integration of climate-friendly changes into the regional transport structure.

No.	Create a catalogue of incentives to reduce motorised private transport
4.3.5.4.	The aim of the activity is to reduce motorised private transport (MIT) through incentives and restrictions. Two ways of achieving this are the introduction of special rights for cars with at least two passengers, e.g. the use of HVO lanes or the adaptation of the regulations around Residents' parking and parking tariffs.

Economy

The Economy field of action addresses all companies and workplaces in the city of Aachen. This includes small and medium-sized enterprises (SMEs), large and industrial companies, agricultural businesses as well as the city's own companies and municipal holdings. The field of action encompasses a very diverse and varied target group. Accordingly, the measures that need to be implemented by local companies in order to move towards climate neutrality are challenging in different ways. In this field of action, the focus is on the direct and indirect areas in which the city group exerts influence. The aim is to motivate and activate these groups through municipal initiatives to implement climate protection measures in their own area of responsibility.

The field of action addresses all companies in the city of Aachen: small and medium-sized enterprises (SMEs) as well as large and industrial companies, the manufacturing industry as well as the service sector, the skilled trades, the self-employed as well as salaried employees and - last but not least - the city's own companies. This makes it clear that the target group is extremely diverse and varied, which is why a broad spectrum of measures is required.

The following key areas of action are therefore at the centre of administrative action:

City as a role model: climate-neutral administration

Climate-neutral administration is the goal by 2030. In addition, the City of Aachen can actively implement the ambitious climate neutrality goals with its own companies and holdings and at the same time create exemplary measures and success stories.

Economic promotion and location development

The transformation of the existing economy (trade, commerce and industry) towards climate neutrality and the establishment of climate-neutral and sustainable companies in Aachen is one of the tasks of economic development and location development. Economic development is increasingly taking on the systematic promotion of co-operative and sustainable forms of business.

Climate-neutral business

Climate neutrality is a business issue for trade, commerce and services as well as for industry. Climate change harbours a variety of risks for business locations. As a result of climate change, supply routes can be disrupted, affecting the supply of raw materials, but also intermediate production or the transport of goods[5], and the security of supply of electricity from renewable energies becomes a location factor.
Companies are increasingly facing up to their social responsibility and fulfilling the demands of their customers, employees, investors and partners for more climate protection and sustainability. Eco-efficient (better production) and eco-Effective (cradle-to-cradle) product development offers opportunities for positioning on the market. Climate neutrality in the commercial, trade and services and industrial sectors are therefore key areas of action for the ICSK.

Waste and circular economy

The limits of resource consumption have already been reached in many cases in view of the ecological limits.
Sustainable production and consumption patterns must therefore be promoted and the demand for resources reduced. In Aachen, the growth in consumption is therefore to be decoupled from the consumption of non-renewable raw materials by establishing a consistent circular economy.

Agriculture: Food industry and regional trade structures

Regional trade structures promote regional value creation and minimise greenhouse gas emissions through short distances. The city of Aachen has a direct influence on the agricultural use of urban farmland in the supply of food by regulating the leasing of land accordingly. The city of Aachen can influence the proportion of regional and sustainable production by utilising its own demand potential in the context of municipal communal catering and indirectly by supporting sustainable production and trade processes. Finally, the city can influence consumer behaviour by advising, activating and qualifying citizens

[5] Source: German Adaptation Strategy (DAS).

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Figure 7 Excerpt from the portfolio plan Economy (green star: activity with profiles)

These activities are described with a profile

These activities are described in brief:

Sustainable procurement

Thematic focus	Introduction	Development of effect	Sphere of influence
City as a role model: The Climate-neutral administration	2024	Short term	Consume/ role model

Goal and strategy

The activity aims to increase the proportion of sustainable products and services in municipal procurement that fulfil both social and environmental criteria.

Initial situation

-

Description of the

In order to make procurement in the city administration of Aachen more sustainable, appropriate criteria and instructions are required that centrally regulate the topic of sustainability. These regulations should address all procurement processes, regardless of size.

This requires the following elements, among others:

- Establishment and stabilisation of an exchange of experience between procurement officers in the various specialist areas
- Identification of good practice examples
- Definition of key sustainability criteria and standards (e.g. organic, regional, fair trade, working conditions, recyclability, ease of repair, plastic content)
- Simplification of the award regulations for climate neutrality
- Introduction of instructions for awarding contracts in accordance with sustainability criteria

First steps for action

- Establishment of an exchange of experience
- Collection of good examples
- Definition of key sustainability criteria
- Decision on the criteria and transfer to a service directive
- Application of the criteria
- Evaluation and regular updating of the criteria

Actors

Lead: Contract, award and funding management (Department 60)
Participants: Department 36 (Climate and Environment);
E 18, FB 37

Target group

City administration

Time required

ıll-time equivalent

Duration of the activity

Establish in the long term

Material costs

Financing approach

-

GHG savings

Not quantifiable

Synergy effects

4.1.1.1 BMM at the Aachen city administration and the municipal affiliated companies
5.5.1.1 Circular economy in practice: development of a building yard of the future for Aachen's municipal operations

Conflicting goals

Possibly higher procurement costs

Success indicators/milestones

Development of the share of sustainable products, back from business and administration

Economy/ 5.2.1.1.

"Sustainable and efficient economy" funding programme

Thematic focus	Introduction	Development of effect	Sphere of influence
Economic development and location development	2024	Short to medium term	Advise and motivate

Goal and strategy

The "Sustainable and efficient economy" programme promotes consulting services and investments in the areas of sustainable economy, energy and material efficiency as well as renewable energy generation plants. The aims of the programme include increasing energy and material efficiency, expanding renewable energies and generally securing the future of Aachen companies.

Initial situation

A wide range of advisory services for companies are already being implemented in the StädteRegion Aachen. The "Sustainable and efficient economy" funding programme aims to focus even more strongly on climate neutrality and sustainability.

Description of the

With the "Sustainable and Efficient Economy" funding programme, the City of Aachen ensures access to advice and funding with short processing times, simple and uncomplicated application procedures and incentives for short-term and immediately effective measures. The topics are deliberately broadly selected in order to take into account the individual needs of Aachen's diverse economic landscape. An attractive funding rate is intended to incentivise investment.

First steps for action

- Establish a funding programme for consulting and investment in the areas of sustainable business, energy and material efficiency and renewable energies.
- Establish criteria for the award. The criteria are feasibility, effectiveness, financial viability, innovation, implementation period and sustainability.

Actors

Lead: Economy, science, Digitalisation and Europe (FB 02)
Participants:

Target group

The company

Time required

time equivalent

Duration of the activity

3 years

Material costs

)00 € (100.000 €/a)

Financing approach

Budget funds

GHG savings

Savings through consulting and innovation support

Reduction in the annual level of emissions (t/a):	Cumulative GHG savings (tonnes):
3,000 tonnes CO2eq/a	6,100 tonnes CO2eq/

Synergy effects

1.1.2.2 Introduction of climate funds: through the combination of subsidies

Conflicting goals

-

Success indicators/milestones

Number of consultations
Investments realised

Supporting companies in evaluating the switch to hydrogen technologies, providing information, advice and networking

Thematic focus	Introduction	Development of effect	Sphere of influence
Climate-neutral industry	2024	long-term	Supply

Goal and strategy

The provision of climate-neutral hydrogen for the manufacturing sector and industry is an important pillar for achieving the climate neutrality targets in the business sector. The development of an infrastructure is the central prerequisite for this. The City of Aachen and StädteRegion Aachen are already active in this area. To accompany this, the City of Aachen can set the course by supporting companies in Aachen in switching to hydrogen by providing information, organising advice and networking.

Initial situation

Together with the StädteRegion Aachen, the districts of Düren, Euskirchen and Heinsberg, the city of Aachen has organised the
"Hydrogen Hub" was founded. One of the aims of the project, which is coordinated by the Aachen Chamber of Industry and Commerce, is to develop a hydrogen infrastructure including regional production from renewable energies. The aim is to create favourable conditions for companies in particular to switch to hydrogen. RWE is examining a site in Weisweiler for a gas-fired power plant suitable for hydrogen, which is to be connected to the international H2ercules infrastructure project of RWE and OGE. The latter is intended to secure the supply of hydrogen in Germany. a. via a long-distance pipeline to Belgium via the greater Aachen area. According to initial plans, the city itself is to be connected to this pipeline.

Description of the

The City of Aachen is consolidating its involvement in the Hydrogen Hub and is also establishing a network to provide companies with information and advice. This can be organised as a peer-to-peer network, allowing companies to gradually benefit from the experience of other players in Aachen and the city region.

First steps for action

- Create a counselling concept
- Initiate network
- Realisation of consulting services

Actors

Lead: FB 02
Participants:
STAWAG

Target group

Manufacturing/industry

Time required

-time equivalent

Duration of the activity

3 years

Material costs

00 €/a

Financing approach

Budget funds

GHG savings

Indirect effect of the consultation, savings Proportional conversion of process energy to 50 % hydrogen results in a savings potential of 33,900 t/a

Synergy effects

The activity has synergies with the HF Energy and in particular with the
Focus of action: sector coupling and security of supply

Conflicting goals

Depends heavily on the creation of infrastructure at EU, federal and state level. Strong time dependency.

Success indicators/milestones

Number of consultations

Circular economy in practice: developing a building yard of the future for Aachen's municipal services

Thematic focus	Introduction	Development of effect	Sphere of influence
Waste and circular economy	n.a.	Medium-term	Consume

Goal and strategy

Large quantities of greenhouse gases are used for the production of building materials (grey energy). The recycling of building materials is therefore an important contribution to the conservation of resources and the reduction of greenhouse gases that would otherwise be generated by the production of new building materials. The aim of the activity is to create the framework conditions for an improved circular economy in Aachen. In particular, this includes saving grey energy, reducing transport energy and conserving resources by reusing components and/or using/producing secondary materials such as recycled aggregate for R-concrete.

Initial situation

Aachener Stadtbetrieb is an in-house organisation of the City of Aachen that bundles central services. These include, for example, green space maintenance and waste disposal. In this context, the municipal company operates two recycling centres.

Description of the

The specific aim is to develop a "building yard of the future". Aachen's municipal services are aiming for centralisation at the Madrider Ring/Freunder Weg sites. The Freunder Weg property is being redesigned and developed into the "building yard of the future". The aim is to create a sustainable and climate-neutral site, taking into account a modern and flexible working environment, occupational health and safety, resource recycling management and the redevelopment of the neighbouring "Rothe Erde" industrial estate (Continental's departure). An initial cost estimate of around 15 million euros is available for the project, although this is still subject to uncertainties.

First steps for action

- Ongoing planning and feasibility checks

Actors

Lead: E 18, E2 6
Parties involved: Dec. VII - FB 36

Target group

Building trade, building materials industry

Time required

time equivalents

Duration of the activity

k. A.

Material costs

The necessary investment and planning costs are taken into account in the budget of Aachener Stadtbetrieb

Financing approach

k. A.

GHG savings

Not quantifiable

Synergy effects

Conflicting goals

5.5.5.1. Component and resource warehouse 5.5.5.2. Circular economy in the construction industry	The preservation of building fabric binds grey energy and is a contribution to Conservation of resources
5.5.5.3 Develop criteria for climate-neutral construction sites	

Success indicators/milestones

Realisation and construction of the building yard

Component and resource warehouse

Thematic focus	Introduction	Development of effect	Sphere of influence
Waste and recycling management	2024	Short term	Consume

Goal and strategy

Produce, use and throw away describes the linear logic that still largely prevails in the construction industry. The recycling of building materials breaks through this logic and opens up potential for saving resources. In order to be able to utilise the potential for recycling in the future and also achieve positive regional employment effects, it is recommended that the development of a recycling infrastructure be initiated.

Initial situation

The "Bauteilnetz Deutschland" can serve as a model: The initiative is supported by the non-profit organisation Baueilnetz Deutschland e.V. and aims to establish a nationwide cooperative network for the reuse of well-preserved, used components. This is linked to positive employment effects through the establishment of component exchanges. They take over the removal of components, refurbish them and store them until they can be resold. Resale is promoted via a central internet platform.

Description of the

A component and resource warehouse is to be developed and set up in Aachen. The aim of the component and resource warehouse is to save grey energy by reusing building materials, for example. The component and resource warehouse enables the reuse or recycling of building materials on the construction site for new construction projects or the refurbishment of existing buildings. It handles the inventory of building materials, (online) brokerage, the removal of building materials in demand, temporary storage, sale and removal. It also provides services and qualifications for reuse for the construction industry and private construction companies.

First steps for action

- Development of a concept
- Examination of the location issue
- Realisation

Actors

Lead: E 26 - Facility Management Participants: BLB NRW, E 18 - Aachener Stadtbetrieb

Target group

Construction industry, private households

Time required

1 full-time equivalent

Duration of the activity

2 years

Material costs

100.000 € for concept development

Financing approach

Budget funds

GHG savings

Not quantifiable, as outside the current balance sheet limits.

Synergy effects

Conflicting goals

in particular with 5.5.1.1. Circular economy in practice: developing a building yard of the future for Aachen's municipal services	None, conserves resources through reuse

Success indicators/milestones

Successful concept development and clarification of the location issue, implementation of the concept

Circular economy in the construction industry

Thematic focus	Introduction	Development of effect	Sphere of influence
Waste and circular economy	2024	Medium to long term	Regulate

Goal and strategy

The aim of the activity is to reduce resource consumption and the associated GHG emissions in new builds and refurbishments through binding specifications and criteria.

Initial situation

Factor X is a successfully applied method for (measurable) $CO_{2\ savings}$ in new buildings. There is a much greater need for advice on how to use this method successfully, both for those wishing to build and for families and planning offices wishing to renovate. The newly established Climate Agency (KENA) can become an advice centre for the topic of Factor X.

Description of the

The use of resource-saving materials plays a key role in achieving climate protection targets in the building sector. Resource-saving materials can significantly reduce the $CO_{2\ footprint}$ both in the refurbishment of existing buildings and in new builds. In order to achieve this, the Factor X method should be applied as widely as possible in the new construction sector and a comparable catalogue of criteria should be developed and introduced for the refurbishment of existing buildings. The Factor X method refers to the intelligent, efficient and environmentally friendly utilisation of natural resources. The aim is to increase resource efficiency by a factor of X. A funding programme can provide additional incentives. Here, the city as developer and the municipal companies can make particular use of their role model function and actively promote the method.

First steps for action

- Setting up a support programme for the Factor X method
- Draw up and apply a catalogue for resource-efficient refurbishment of existing buildings
- Establish the Climate Agency (KENA) as a contact point for advice on the Factor X method

Actors

Lead organisation: altbau plus e.V.
Participants: FB 36/700, E1 8, Gewoge, STAWAG, Regionetz, KENA

Target group

Construction industry, private builders, planning offices

Time required

time equivalent

Duration of the activity

Establish in the long term

Material costs

105,000 € (100,000 € for a first funding programme)

Financing approach

Budget funds

GHG savings

Not quantifiable

Synergy effects

Conflicting goals

Synergies in new construction and refurbishment -

Success indicators/milestones

Proportion of resource-saving materials used
Building materials, sales of resource-conserving building materials

Develop criteria for climate-neutral construction site

Thematic focus	Introduction	Development of effect	Sphere of influence
City as a role model: The Climate-neutral administration	2024	Short term	Regulate

Goal and strategy

The activity aims to achieve climate-neutral operation of building and civil engineering construction sites of the Aachen city administration. In this way, both energy and non-energy emissions as well as the consumption of resources are to be reduced.

Initial situation

To date, the city of Aachen has no corresponding criteria or guidelines.

Description of the

In order to operate building and civil engineering construction sites of the Aachen city administration in a climate-neutral manner, the development of criteria is initially recommended. In addition to minimum requirements, this catalogue should also include exemplary measures to reduce emissions and resources and thus comply with the criteria.

One starting point that should be considered is the energy used on site. This can either be generated renewably on the construction site (e.g. photovoltaics on construction containers) or ensured by purchasing renewable energy for the operation of the construction site and construction machinery. Further emissions can be saved through organisational measures to speed up the construction process (shortening construction time) and reducing transport routes. The reuse of excavated soil in road construction measures also reduces upstream emissions and saves resources. Road construction measures offer high optimisation potential overall, including with regard to resource efficiency and emissions reduction (see activity 4.2.1.10 Climate-friendly road construction in the thematic repository). In addition, a minimum proportion of recycled materials should be used in the construction of roads.

In addition, the inclusion of criteria from the field of climate adaptation is a good idea. For example, roads should be built according to climate adaptation criteria. This includes the use of light-coloured materials for road surfaces or charcoal as carbon storage.

While the criteria are being trialled on the city's own building and civil engineering construction sites, the extension of the scope of application to third-party building and civil engineering construction sites should be examined. Based on the experience gained from the trial, a catalogue of criteria and measures should be drawn up for implementation using representative construction processes, including an impact assessment, which will serve as the basis for the requirements.

First steps for action

- Establishment of criteria and development of exemplary measures
- Testing on the city's own building and civil engineering construction sites
- Check extension to third-party building and civil engineering construction sites
- Evaluation and adaptation of the criteria, creation of a catalogue of criteria and measures including impact assessment
- Introduction and regular review and adjustment if necessary

Actors

In charge: Dec. III + Dec. VII
es involved: E18, E 26, FB 36

Target group

Aachen city administration, expand in perspective to external companies

Time required

Duration of the activity

ll-time equivalents

Establish in the long term

Material costs

0 € for an information campaign

Financing approach

Budget funds

GHG savings

Not quantifiable

Synergy effects

5.5.1.1 Circular economy in practice: developing a building yard of the future for Aachen's municipal operations
4.2.1.10 Climate-friendly road construction and the circular economy as a whole

Conflicting goals

-

Success indicators/milestones

Criteria were established and tested, a binding catalogue of criteria and measures was introduced, the development of emissions and the Resource consumption

Regional BioHub - Sustainable food production and distribution

Thematic focus	Introduction	Development of effect	Sphere of influence
Agriculture, the food industry and regional Trading structures	2024	Short to medium term	Offer and supply

Goal and strategy

The aim is to give small and medium-sized sustainably producing farmers from the StädteRegion Aachen in particular access to the larger market in Aachen by 2030. This will strengthen regional and local food chains in the StädteRegion Aachen. To this end, a so-called food hub will be created and promoted as a central transhipment and processing centre to optimise trade flows. This reduces traffic flows and cuts GHG emissions. It also builds on existing organic markets and weekly markets, through which goods are sold from the hub to individual consumers.

Initial situation

The basis for the development of the regional BioHubs is a distance definition that qualifies providers for participation. In the absence of a national definition, a radius to the city of Aachen should be defined here. Depending on the season, experience has shown that a certain proportion of "imported goods" will also be represented in the vegetable sector, for example, or that the proportion of regional products in processed products such as soup cannot be transparently traced. Regionality seals such as the "regional window" can provide support here, but should be linked to a support/advice programme for producers. Contact persons should also be available for additional food safety checks, products from transitional areas, payment processing options and similar issues.

Description of the

Unless they are processed or packaged via a centralised system, regional foods generally have shorter transport routes and are generally trusted by consumers. Regional trading locations are also suitable for addressing issues such as seasonality and "food waste" as well as the loss of genetic biodiversity.

The regional BioHub serves as a distribution centre for sustainable food distribution and marketing. It supports the production and distribution of sustainably produced food in the region and promotes the conversion of catering in municipal canteens and supply and catering facilities to plant-based and organic fair and regional food. At the same time, regional value creation structures are strengthened by, among other things, bringing caterers together with producers in a targeted manner. The core functions are

- Compilation of products from different suppliers/companies for distribution via a single channel
- Storage of products and transport to the customer
- Find buyers, advertise and sell products and promote the brand identity of businesses

First steps for action

- Definition of the terms "local" and "regional" in distance criteria (e.g. within the city limits of Aachen = local)
- Acquisition and procurement of funding for implementation
- Acquisition and application of providers
- Identification of suitable locations for a trading centre
- Promotion of markets with regional offerings

Actors

In charge: FB 02/000

Target group

Consumers, catering, farmers, City marketing

Participants: Agriculture and forestry working group of the Climate Emergency Round Table

Time required

ıll-time equivalents

Duration of the activity

2024 - 2030

Material costs

Establishment and lease of a regional trading centre (hub): approx. 60,000 €/a; 2,000 €/a for communication and campaign work
Total: € 434,000

Financing approach

Budget funds, funding programmes (possibly EAFRD funds)

GHG savings

Assumption: By establishing the central trading location, transport emissions and long storage times for non-seasonal vegetables are avoided.

Reduction of the annual emission level (t/a):

Approx. 800 tonnes CO2eq/a

Cumulative GHG savings (tonnes):

Approx. 5,400 tonnes CO2eq/a by 2030

Synergy effects

5.6.2.1 Lease agreements of the City of Aachen are used to strengthen organic farming

Conflicting goals

Possible competition with existing organic markets

Success indicators/milestones

Establishment of the first BioHub in Aachen; start of the application process; meeting of restaurateurs and producers

Support processes for urban activities

Strengthening the local retail trade and sustainable transformation of the catering trade

Thematic focus	Introduction	Development of effect	Sphere of influence
Agriculture, the food industry and regional Trading structures	2025	Short to medium term	Advise and motivate

Goal and strategy

The aim of the activity is to strengthen and reorient local retail as a regional, more sustainable sales platform to reduce GHG emissions through mail order.

Initial situation

The retail and catering sectors in Aachen are also confronted with complex problems, one of which is climate protection. Even if there is already broad interest in adapting business and working models accordingly, there is often a lack of time to deal with the issues that arise in depth. Appropriate counselling and support services can provide important assistance here.

The shift from everyday consumption to online retail is leading to rising GHG emissions, particularly from transport.

Description of the

The activity can be divided into two thematic focuses, which address local retail on the one hand and local catering on the other. These are briefly described below.

The first focus is on strengthening and reorganising local retail as a regional, more sustainable sales platform. Examples of starting points include click & collect offers, stronger marketing of local products and raising consumer awareness. Centralised pick-up lockers or a "smart shopping" platform for local retailers are examples of click & collect offers. The establishment of a regional shop, on the other hand, promotes the marketing of local products.

The second focus is on the local catering industry. In order to support them, needs-based series of events and advisory services are to be created to help them reorganise their offerings and structures. This should enable restaurateurs to analyse and evaluate their own offerings and, in particular, their supply chains (e.g. "menu check").

This also reveals synergy effects with local retailers, which is why the relevant stakeholders should be networked with the help of appropriate programmes. The establishment of an advisory board or round table on "sustainable retail" is a good way to achieve this. In addition to exchanging experiences, the following are some of the specific tasks of the advisory board:

- Exchange of information on ongoing administrative projects
- Developing and testing new ideas and projects
- Qualitative analyses using interviews and surveys and provision of data
- Evaluation of processes and new developments
- Topic-related specialist forums, e.g. for the city centre

First steps for action

- Analysing the initial situation and requirements
- Establishment of an advisory board/round table
- Conceptualisation and implementation of specific offers
- Evaluation and, if necessary, adaptation of the offers

Actors

In charge: FB 02, PB 61/100

Target group

Local retail and catering, Citizens

Participants for the advisory board/round table:
external expertise: Aachen Chamber of Industry and Commerce, NRW Trade Association, Aachen tourist service, possibly other MAC (markets and Aktionskreis City e.V.), political representatives, Aachen (retail) traders,
Other players, if applicable

Time required

time equivalent

Duration of the activity

Establish in the long term

Material costs

0 € for a campaign

Financing approach

Budget funds

GHG savings

Not quantifiable

Synergy effects

5.6.1.1 Regional BioHub - sustainable food production and distribution
5.6.2.1 Lease agreements of the City of Aachen are used to strengthen organic farming.
utilised

Conflicting goals

No conflicts of objectives are expected

Success indicators/milestones

Advisory board/round table was founded, response of retailers/restaurateurs and citizens, development of sales of local products

Lease agreements of the city of Aachen are used to strengthen organic farming

Thematic focus	Introduction	Development of effect	Sphere of influence
Agriculture, the food industry and regional Trading structures	2024	Medium-term	Regulate

Goal and strategy

The City of Aachen uses its role as landlord to initiate criteria, support services and an implementation framework for the long-term ecological management of urban agricultural land in cooperation with farmers and associations. In addition, the adaptation of multiple land use with Agri-PV, climate impact adaptation, regional marketing concepts as well as evaluation and follow-up mechanisms are to be initiated.

Initial situation

The lease agreements that the City of Aachen has concluded for its land have different terms, meaning that the activity can only be implemented gradually and over an extended period up to 2035. The basis for successfully strengthening organic farming is legal certainty in future lease agreements. In addition to pure agricultural use, dual use should also be considered, e.g. in combination with agri-PV or agroforestry. A guideline for implementation in lease agreements may be necessary here.

Description of the

The city of Aachen is developing criteria and the legal basis for anchoring organic farming on city-owned land in lease agreements. This also includes a regulation for the five-year transition period until the areas in transition are certified, during which the yield cannot yet be sold as organic and therefore often represents a loss for the farmers. In order to utilise particularly productive land primarily for food production, it is advisable to consider not only land values but also, for example, applications for direct payments under the CAP.

First steps for action

- Development of criteria that tenants must fulfil in addition to organic farming methods (e.g. social sustainability, use of seed-resistant varieties)
- Creation of a guideline to be able to consider dual utilisation through agro-PV and agroforestry in lease agreements
- Preparation of a timetable for expiring leases

Actors

In charge: FB 23
Participants: Agriculture and Forestry Working Group of the Climate Emergency Round Table, Department 36/400

Target group

Tenants of the city of Aachen,

Time required

Full-time equivalents

Duration of the activity

2024 - 2035

Material costs

expected

Financing approach

-

GHG savings

Can only be quantified to a limited extent, as it depends on the size of the area and crops. Assumption: The conversion of leased land to organic farming eliminates emissions from nitrogen fertiliser. By 2035 a penetration rate of 50 % is achieved.

Reduction in the annual level of emissions (t/a):

Average of 18 tonnes per year with increasing penetration rate by 2030 (25 %)

Cumulative GHG savings (tonnes):

Approx. 400 tonnes by 2035.

Synergy effects

5.6.1.1 Regional BioHub - Sustainable production and distribution

Conflicting goals

Land conflicts with other forms of utilisation such as Open-space PV, tenants for e.g. horse keeping

Success indicators/milestones

Adaptation and awarding of the first leases according to organic cultivation criteria

Pilot project in agroforestry

Thematic focus	Introduction	Development of effect	Sphere of influence
Agriculture, the food industry and regional trade structures	2024	Medium to long term	Advise and motivate

Goal and strategy

As a pilot project, the city of Aachen is supporting the establishment and expansion of agrofrost systems on city-owned land in order to strengthen the green infrastructure and create natural CO2 reservoirs and habitats.

Agroforestry systems are relatively uncommon in Germany, but by combining woody plants with arable crops, livestock or horticultural crops, they offer advantages for the preservation of biodiversity, water and nutrient supply and the landscape. The agroforestry systems are adapted to the respective agricultural production technology in order to enable economically competitive production. Agroforestry systems are particularly suitable for increasing yields and protecting livestock and erosion on land used for livestock farming or for shading larger areas at risk of drought. Valuable and fruit trees in particular serve as natural CO2 reservoirs in the medium to long term, while shrubs and hedgerows can be used regularly for biogas production. As agroforestry systems entail higher establishment and operating costs and can limit the operational flexibility of the land6 , the leased land of the city of Aachen, which is mainly used for livestock farming, should be considered for agroforestry systems where appropriate.

Initial situation

The basis for the expansion of agroforestry systems is the provision of information and advice to farmers and tenants on the advantages and disadvantages of the system, planning security with regard to municipal lease agreements and a review of the city of Aachen's landscape plan, which is currently under revision, with regard to the possible dual use of land.

Description of the

In cooperation with the Chamber of Agriculture of North Rhine-Westphalia, the City of Aachen organises information and advisory services for farmers and land leaseholders in the city of Aachen on the topic of agroforestry systems and includes the topic in its funding advice. The city is also examining the extent to which the implementation of agroforestry systems on city-owned land can be included in new lease agreements. This will start with a smaller pilot area (approx. 2-5 ha) and will be continuously monitored (e.g. biodiversity, groundwater enrichment, biomass growth).

First steps for action

- Research and acquisition of funding
- Organisation of information events and consultation contingents
- Comparison of the new landscape plan with regard to possible dual use of areas
- Examination of the extent to which lease agreements for urban agricultural land can be adapted in future

Actors

Lead: Department - 36 Climate and Environment Participants: Agriculture and Forestry Working Group of the Climate Emergency Round Table

Target group

Farmers in the Aachen urban area

Time required

0.5 full-time equivalents

Duration of the activity

2024 -2026

[6] Federal Information Centre for Agriculture, 2023. carbon sinks in agriculture. Agroforestry - ecologically and economically promising. [online] Available at: https://www.praxis-agrar.de/pflanze/ackerbau/agroforstwirtschaft (Last accessed: 25 October 2023, 13:20).

Material costs

ultancy costs approx. 5,000 €/a, if applicable

Financing approach

Federal funding if applicable (announcement 13.01.2021)

GHG savings

Not quantifiable, as it depends on the age and health of the trees and the type of utilisation (e.g. hedgerows for bioenergy production)

Synergy effects

5.6.2.1 Lease agreements of the City of Aachen are used to strengthen organic farming.
utilised

Conflicting goals

Flexible use of space is restricted

Success indicators/milestones

Full use of the counselling services

Brief descriptions:

No.	Real-world laboratories "Climate-friendly behaviour in the workplace" Employee activation and qualification, training of multipliers
5.1.3.1.	The aim is to increase the individual behaviour-related GHG reduction potential of employees in the administration. In a first step, seven real-world laboratories are being set up in each department. "Climate trainers" are trained who, in a second step, work with small groups in the departments to develop and jointly implement reduction potential. The participants are given a time quota for this as part of their working hours. The results are evaluated and communicated within the administration. If the system is successful, it will be made permanent and further climate trainers will be trained in order to accelerate the sustainable development of the administration.

No.	Sustainable site development (industrial estates)
5.2.2.6.	The City of Aachen is working closely with owners, investors and tenants to develop action plans for the sustainable and climate-neutral development of commercial spaces. These action plans are based on a well-founded analysis of the current situation, which identifies energy consumption and material flows, for example. The transformation to sustainable site development can be accompanied by comprehensive business park management.

No.	Climate networks in the industrial estates
5.2.2.7.	In order to be able to provide regional and individual answers to the questions of climate neutrality in the individual business parks, networks and interest groups are needed for Aachen's business parks. The aim of the networks can be, for example, the establishment of purchasing groups, the provision of information and the development of individual solutions. The networks should be closely supported in the development and implementation of individual measures. The support includes the planning and organisation of network meetings, advice on content-related issues and support as a guide to the authorities. Another important component will be the dissemination of information on urban developments and requirements to entrepreneurs in the G commercial areas in order to synchronise climate neutrality efforts.

No.	Support programmes to increase energy efficiency
5.3.1.1.	Energy efficiency counselling for Aachen companies should be continued and intensified. The existing series of events "Energy-efficient companies" should be continued in this context. The companies are given individual advice in order to implement low-threshold measures. In addition, contacts and other information centres are provided. Consultancy services should be expanded to include the use of renewable energies. In order to increase energy efficiency in Aachen companies and to support companies in the implementation of savings measures, formats such as business breakfasts in different companies, industrial estate tours to present best practices and a mentoring programme in which pioneering companies pass on their experiences should be established. Wherever possible, the programmes should be thematically focused in order to highlight topics such as renewable energies or green IT and highlight specific options for action.

No.	**Driving forward resource recycling**
5.5.1.2.	The aim of the activity is to improve the material and energy utilisation of post-consumer products such as waste wood, electrical appliances and biowaste by improving recycling structures. For example, the quality of biowaste is to be checked during collection and, if necessary, channelled out in order to increase the production of biogas (1 %/a in relation to the ZEW quality classification). In addition, the city should announce regular "collection days" on which waste wood (or industrial waste wood and used wood respectively) and electrical appliances can also be collected directly from households or companies in order to reach people who do not have the opportunity to receive them.

recyclables to appropriate collection centres. In addition, the sorting processes for these raw materials in the waste management companies must also be adapted.

No.	Continuation of the "Sustainable Agriculture and Food" Round Table
5.6.2.4.	The Round Table, which has already been established, can bring together the various activities in the field of agriculture and nutrition, provide new impetus and prepare suitable measures. Many of the issues addressed by the Round Table have a direct impact on nutritional behaviour and an indirect impact on climate neutrality. Last but not least, the cultivation of the fields has a major influence here.

Social transformation

The goal of climate neutrality also requires a comprehensive transformation in society as a whole. In terms of climate protection, this can be understood as a change in awareness in all parts of society.

The following key areas of action are therefore at the centre of administrative action:

Climate awareness and transfer

It is crucial that climate-friendly behaviour is enabled and promoted equally in all parts of society.
Determining factors for the penetration of the population can be, for example, age, level of education, language skills and economic opportunities. The following building blocks can be part of a strategic approach to the population: activate, encourage, qualify and multiply.

Climate-friendly living environment

Improving the quality of life of all people in Aachen in the face of climate change and the associated challenges is an integrated task of urban development.

Climate protection in everyday life

Personal behaviour and individual decision-making routines determine everyday actions and therefore the ecological footprint of every citizen. The teaching and practical application of climate-friendly behavioural routines are successes in everyday life that strengthen self-efficacy, activate people to take further steps and also motivate others.

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Climate protection and education

Education is a key factor in achieving climate protection goals. Sustainability and climate protection are lifelong educational topics. Education for sustainable development (ESD) shows ways in which our own actions and climate-friendly lifestyles can have an impact on the environment. This not only strengthens the individual's sense of self-efficacy, but also has positive consequences for others. Aachen pursues a broad approach in the sense of an ESD educational landscape and educational offensive on sustainability topics. The anchoring and implementation of Education for Sustainable Development (ESD) should therefore be ensured in cooperation with all education providers and stakeholders.

Climate protection in culture and leisure

Social transformation processes begin with people willing to change as pioneers and role models. Aachen has a broad cultural scene and is known worldwide as a tourist destination. The culture, leisure and tourism sectors therefore offer great potential to promote sustainability and climate protection issues in Aachen and beyond the city's borders as role models and multipliers.

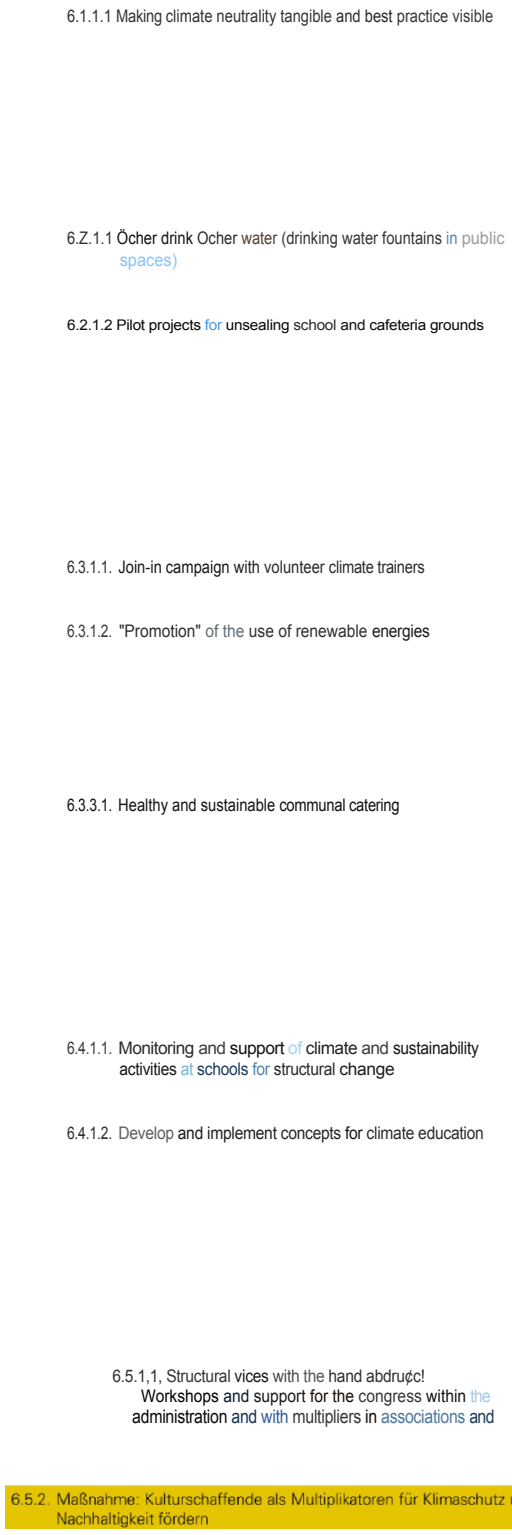

Figure 8 Section of the portfolio plan for social transformation (green star: activity with fact sheets)

These activities are described with a profile

These activities are described in brief:

Making climate neutrality tangible and best practice visible

Thematic focus	Introduction	Development of effect	Sphere of influence
Climate awareness and Transfer	2024	Short to medium term	Offer and supply

Goal and strategy

The aim is to make the topic of sustainability more tangible, visible and possibly also more measurable for the citizens of Aachen and for tourists. A greater understanding and acceptance of sustainability indirectly supports the climate targets through changes in behaviour and more climate-friendly consumption options. An expansion of the Aachen app, which lists sustainability locations in terms of the 17 sustainability goals (green spaces/public gardens, second-hand shops, cycle streets, places of sustainable consumption, women-run businesses, food sharing stations...) and explains the connection to climate protection, would be a good idea. Alternatively, a (digital) sustainability route could be developed in Aachen.

Regensburg has developed a so-called future barometer. Here, citizens can interactively view the current progress of the 17 sustainability goals in Regensburg - https://zukunft.regensburg.de/. An adaptation for the city of Aachen is to be examined. The establishment of a sustainability week would also support public relations work.

Initial situation

The starting point for the activity is knowledge of best practice examples in Aachen. The digital map of the "One World Forum Aachen" can be used for this purpose, but the city should also nominate and communicate a contact person for new sustainability initiatives. In addition to the sustainability aspects of offers, it is also advisable to describe the climate impact in order to familiarise citizens with the synergy points.

Description of the

The City of Aachen is developing a concept for adapting and expanding the Aachen App in order to be able to include sustainable initiatives and offers at short notice. It is also linking the app with city marketing services and the tourism strategy in order to advertise offers such as a sustainability route comprehensively and effectively to the public. The city is also examining the extent to which it is feasible to adapt the Regensburg Future Barometer for Aachen.

First steps for action

- Funding research and acquisition
- Development of a publicity campaign to promote initiatives and offers in line with the 17 SDGs and the synergy points for climate protection
- Development of a sustainability route together with city marketing (e.g. adaptation of existing tourist routes)

Actors

In charge: Department 36 Climate and Environment, Department 13 Communication and City Marketing
Involved: FB 02 Economy, Science, Digitalisation and Europe

Target group

Citizens of the city of Aachen, visitors (tourism); entrepreneurs

Time required

l-time equivalent

Duration of the activity

2024 - 2030

Material costs

Financing approach

Approx. € 75,000 for concept development and Customisation of the Aachen app (2024/2025)	Budget funds, possibly subsidies

GHG savings

Not quantifiable, as dependent on the type and scope of offers and behavioural changes

Synergy effects

6.3.1.1 Join-in campaign with volunteer climate trainers

Conflicting goals

Little distinction between sustainability and climate protection - conflicts in the Provision of resources

Success indicators/milestones

Adaptation of the Aachen app

Participatory campaign with volunteer climate trainers

Thematic focus	Introduction	Development of effect	Sphere of influence
Climate-friendly Behaviour in everyday life	2024	Short term	Offer and supply

Goal and strategy

Climate-friendly behaviour in everyday life requires a favourable environment for climate-friendly decisions with suitable and attractive benefits. The participatory campaign gives Aachen's citizens a low-threshold introduction to climate-friendly behaviour in everyday life by allowing them to try out and consolidate individually developed measures in a moderated process. Climate training is at the centre of the campaign.

The approach of ClimateTraining is to bring together providers of climate-friendly products and services with potential customers who are willing to change. Participants (trainees) are given attractive opportunities to try out and test climate-friendly products and services. Providers receive important tips for the further development of existing offers or the initiation of new projects.

Initial situation

The basic operating principle of climate training is an efficient and well-structured process that motivates citizens to be willing to change, equips them with the necessary tools for this transformation and turns participants into multipliers. The ClimateTrainings can be carried out as "face-to-face training" in a group or as "online training" individually or alone.

Description of the

The city of Aachen is supporting the social transformation process by designing and launching a city-wide participatory campaign. To this end, it is promoting the project within the municipal family and local companies with climate-friendly offers. The activity will be organised as a multi-cycle offer in order to spread the transformation process. When selecting the household, care should be taken to ensure that the group of future climate trainers is as representative as possible. Once the pilot phase has been completed, the climate training will also be carried out at schools, vocational schools, companies and leisure facilities in order to generate as many multipliers as possible.

First steps for action

- Research and acquisition of funding
- Tender for the development of the climate training concept
- Tender for the creation of a digital booking platform
- Promotion of the project and acquisition of "trial offers"
- Selection of households as the first "multiplier generation"
- Application for a second project round with the participants of the first project round as volunteer climate trainers

Actors

In charge: Department VII, Division 36 - Climate and environment
Participants: Adult education centre, climate agency

Target group

Citizens of the City of Aachen, companies and municipal holdings (providers)

Time required

-time equivalents

Duration of the activity

2024 - 2030

Material costs

00 € (approx. 100,000 € for digital platform)

Financing approach

Subsidies, if applicable

GHG savings

Assumption: 1.5 tonnes of jump-in per year and person with a total of 10,750 people participating by 2030

Reduction in the annual level of emissions (t/a):

16,100 tonnes CO2eq/a

Cumulative GHG savings (tonnes):

45,800 tonnes $_{CO2eq}$.

Synergy effects

1.4.1.1 Citizen participation formats for climate neutrality

Conflicting goals

None Expected

Success indicators/milestones

ept development, start of application Households

Monitoring and support for climate and sustainability activities at schools to bring about structural change

Thematic focus	Introduction	Development of effect	Sphere of influence
Climate and education	2024	Short term	Offer and supply

Goal and strategy

The city of Aachen is working on the Active for Future school programme and supports motivated school members in anchoring climate and sustainability activities in schools. Workshop modules are used to teach methods of effective project management and focus on structural change measures in line with the handprint. Adult education should also be addressed.

Example project: Teaching energy efficiency and renewable energies in schools as "hands-on material": The topics of energy efficiency and renewable energies are easy to illustrate and can be done through extracurricular events and lecturers. The aim is to raise awareness of the topic and impart knowledge so that young people can develop their own attitudes and act as multipliers in their social environment.

Initial situation

With the Department 36/100 "Education for Sustainable Development", the City of Aachen has already laid the foundations for anchoring climate protection and sustainability activities in schools. The remit of the environmental information department may need to be expanded, and this should be examined. Another prerequisite is funding and personnel to involve as many schools as possible in the workshop modules and to integrate visits to extracurricular learning centres into physics or science lessons, for example.

Description of the

Together with schools and extracurricular places of learning in and around the city of Aachen, the Department 36/100 organises a workshop module catalogue for various age groups and adult education.

First steps for action

- Evaluation of existing programmes and extracurricular learning venues in and around

Aachen Development of supplementary workshop modules
Development of a digital booking platform

Actors

Lead: Department 36 - Climate and Environment Department 36/100 - Education for Sustainable Development Participants: Active for Future; if applicable altbau plus e.V. VZ NRW

Target group

Teaching staff, pupils, vocational students

Time required

time equivalent

Duration of the activity

2024 - 2027

Material costs

ca. 10,000 €/a

Financing approach

Budget funds

GHG savings

Not quantifiable, as it depends on the type and scope of the offer.

Synergy effects

Conflicting goals

Structural changes with the handprint	Lack of staff, high time pressure in curricula

Success indicators/milestones

Expansion of workshop modules by 25 % Offers for vocational schools
Launch of the booking platform

Structural changes with the handprint! - Workshops and support for implementation within the administration and with multipliers in associations and initiatives

Thematic focus	Introduction	Development of effect	Sphere of influence
Climate protection and leisure	2023	Medium-term	Advise and motivate

Goal and strategy

The handprint concept was developed by the non-profit organisation Germanwatch e.V. as a supplement to the ecological footprint. It is a means of ESD (education for sustainable development) and aims to change the (local) structural social framework conditions through active engagement in associations or initiatives in such a way that climate-friendly behaviour becomes the "most obvious" and most favourable option7. The concept of the handprint is still relatively unknown and should therefore initially be publicised in workshops.

Initial situation

With Department 12 and the Citizens' Council, the City of Aachen already has some experience and structures in relation to citizen participation formats that can be built on.

Description of the

The first handprint workshops have already taken place, but the format is to be expanded in future and equipped with additional human and financial resources. In addition to administrative staff, the target group for further workshops includes multipliers in associations and interest groups as well as potential new civil society initiatives.

First steps for action

- Organisation of training courses for multipliers and administrative staff on how to use the handprint

Provision of additional human and financial resources

Cyclical expansion of the workshops

Actors

Lead: Agency for Climate, Energy and Sustainability, Department 12 - Citizen Services, Department 36 - Climate and Environment
Participants: Citizens' Council, FB 61 - Urban Development, -
Planning and mobility infrastructure

Target group

Departments/employees of the administration, multipliers in associations, civil society initiatives

Time required

-time equivalents

Duration of the activity

2023 - 20230

Material costs

50,000 € (2023/2024) for concept/ external Support, approx. 2,000 €/a for public relations, room hire, catering

Financing approach

Household costs

GHG savings

Not quantifiable, as it depends on the type and scope of activities.

[7] https://www.germanwatch.org/de/handprint

Synergy effects

1.4.1.1 Citizen participation formats for climate neutrality
3.2.1.1 Breaking new ground - additional residential units in existing buildings and development of alternative, lifecycle-adaptable residential buildings
6.4.1.1 Monitoring and supporting climate and sustainability activities at schools to bring about structural change

Conflicting goals

-

Success indicators/milestones

Organisation of employee training courses.
Creation of a timetable for the expansion of the Workshops

Brief descriptions

No.	Pilot pr ojects for unsealing school and nursery grounds
6.2.1.2.	Natural areas on the grounds of schools and daycare centres contribute to a positive learning and recreational atmosphere. More nature and less paved areas also have positive effects on the local microclimate, e.g. in terms of rainwater absorption capacity/sponge function of the soil and temperature regulation. As the degree of sealing is very high in some Aachen schools and day-care centres, pilot projects are to be used to implement unsealing measures and thus gather good practice experience that can then be rolled out to other facilities. In educational institutions, a nature-oriented design of the grounds always offers learning opportunities, e.g. in the form of a green classroom or a school garden that can be used by all school members.

No.	Healthy and sustainable communal catering
6.3.3.1.	The city of Aachen is establishing the quality standards of the German Nutrition Society as a binding requirement in all municipal communal catering facilities such as daycare centres, schools, hospitals and company canteens. In a second step, pilot facilities will be selected to organise their catering according to the Planetary Health Diet and evaluate the process. To this end, a comprehensive, permanent training programme, e.g. on climate-friendly purchasing, labelling and avoiding food waste, should be introduced for all employees of communal catering facilities, which should also be open to non-urban facilities, parents and other interested parties. In the daycare centre area, caterers are already ordered by the parents' council.

No.	Develop and implement climate education concepts
6.4.1.2.	The city of Aachen is developing a concept for climate education in order to link actions in the sense of education for sustainable development at a higher level and to systematically integrate them into various (life) areas of many citizens. The concept could include: larger networking and participatory events every few years, close contact with educational institutions on the topic of education for sustainable development, regular newsletters and information letters, close contact and dialogue with citizens. If possible, the content should be linked to the content of the other participation formats.

Compensation

Offsetting should only be considered when a further reduction in greenhouse gases is no longer possible. Depending on the sector, this point will be reached sooner or later. For example, it is not possible to operate agriculture without emissions - however, no longer operating agriculture in the city of Aachen would only shift the emissions and cause additional emissions due to the longer transport route. Accordingly, according to the Mission City contract, the city of Aachen has three options for offsetting, which are implemented jointly by the administration as the process-controlling body, as well as by stakeholders from business, agriculture, forestry and research via the measures and activities.

The following key areas of action are therefore at the centre of administrative action:

Green infrastructure to bind CO_2

The preservation and expansion of areas that can permanently store carbon from the atmosphere in biomass and soils due to the way they are used is the first choice when it comes to the question of compensation. Green infrastructure primarily includes forest areas, agricultural areas and green and recreational areas. In particular, vegetation areas such as agricultural, forest and wooded areas play a central role in reducing CO_2 due to their ability to remove carbon dioxide from the atmosphere and store it as carbon in their biomass.

Compensation at company level and through the purchase of emission certificates

CO_2 emissions generated by Aachen-based companies that cannot be completely eliminated through technical, organisational or other measures have the possibility of achieving climate neutrality through the purchase of certificates. Municipal companies and companies from the trade, commerce and industry sectors must be advised and supported in the selection process.

Technical systems for CO_2 compensation and storage

In addition to the purchase of certificates, possible approaches include the technical compensation of emissions by storing them and the permanent storage of emissions in green infrastructure or biomass. The avoidance of GHG emissions is also the top priority in terms of the precautionary principle in environmental and climate protection and is clearly prioritised for the implementation of climate neutrality. Ongoing research must be closely monitored in order to identify the potential for Aachen at an early stage, to examine the potential for the technical utilisation of CO_2 compensation and to formulate concrete recommendations for its use.

7. Compensation

7.1. Green infrastructure to bind CO2

7.1.1. Measure: Aachen forest in transition

7.1.2. Measure: Development and protection of natural CO2 sinks

7.1.2.1. Increase the number of green spaces and tree plantations (natural CO2 sinks)

7.1.3. Measure: Soil protection

7.2. Compensation at company level

7.2.1. Measure: Establish uniform purchasing and reporting standards for emission certificates

7.2.1.1. Consultancy services for Aachen companies on compensation options

7.3. Technical systems CO2 compensation and storage

7.3.1. Measure: Identify potential for technical compensation and CO2 storage

7.3.1.1. Potential study on technical CO2 compensation

Figure 9 Compensation portfolio plan. (Green star: activity with profiles)

These activities are described with a profile

These activities are described in brief:

Increase the number of green spaces and tree plantations (natural CO_2 sinks)

Thematic focus	Introduction	Development of effect	Sphere of influence
Green infrastructure for CO_2 binding	2024	Medium to long term	Regulate

Goal and strategy

Green infrastructure in the form of urban forests, urban trees, hedges and green spaces such as parks and gardens sequester carbon in biomass and soil through photosynthesis, thereby contributing to climate protection. As an EU Mission City, the city of Aachen also has the opportunity to offset some of the emissions in the urban area, e.g. from agriculture, by creating additional green infrastructure. A bioeconomy that utilises solid wood in buildings or furniture, for example, is essential for the long-term storage of sequestered carbon. Green infrastructure also provides important ecosystem services, such as temperature equalisation, recreational areas, air purification and rain buffers, which contribute to the quality of life and stay of the residents of the city of Aachen. Increasing the number of green spaces and trees in the city and unsealing areas, especially around daycare centres, schoolyards and retirement homes, therefore serves both to achieve the goal of climate neutrality and as a pilot project for climate change adaptation in the city of Aachen.

Initial situation

The city of Aachen has around 20,000 street trees, 400 hectares of parks and green spaces with a further 95,000 trees. There are also large contiguous areas of forest, particularly on the border with Belgium and in the south, which need to be preserved. The Aachen Forestry Office manages the urban areas according to FSC sustainability criteria and in co-operation with local construction projects. In the coming financial year, the City of Aachen is making 1 million euros available for the planting of additional street trees in the urban area in order to create a positive tree balance in public urban spaces and increase the proportion of greenery.

Description of the

Urban land-use planning is an instrument for the expansion of green spaces in the city of Aachen. Successful examples (books) can be utilised here. In addition, the unsealing of surfaces in areas important for cold air flows and in the vicinity of critical social infrastructure such as schools, day-care centres, hospitals, nursing homes and retirement homes should be systematically implemented, e.g. as part of pilot projects. In street areas, cemeteries and private properties, unsealing and tree planting can also be supported through tree sponsorships or funding. Experience from the urban green space sponsorship programme can be drawn on here.

First steps for action

- Launch of pilot projects to unseal areas of critical infrastructure, e.g. two daycare centres, two school playgrounds and two care facilities under municipal sponsorship
- Provision of further resources for and by the Aachen municipal garden centre in combination with tree planting campaigns and further green space sponsorships
- Strengthening the local wood-based bioeconomy with a focus on long-term use in urban construction projects
- Provision of additional financial and human resources for the Aachen Forestry Office with a focus on comprehensive climate adaptation of Aachen's forests

Actors

Lead: E 18, Department 36
Participants: Department VII, Department 20

Target group

Citizens, local interest groups

Time required

Duration of the activity

time equivalents	2024 - 2027

Material costs

1 million for street trees
220,000 €/a for reforestation projects (2024/2025) of the Aachen city forest

Financing approach

1 million euros planned in the budget

GHG savings

Not quantifiable, as it depends on the extent and health of the additional green infrastructure

Synergy effects

Conflicting goals

-

Success indicators/milestones

Start of tree planting in the Aachen city area, call-off of 100 % of the funds provided
Medium

Brief descriptions

No.	Potential study he technical CO_2 compensation
7.3.1.1.	The avoidance of GHG emissions is the top priority in terms of the precautionary principle in environmental and climate protection and is clearly prioritised for the implementation of climate neutrality. However, it is not possible to completely avoid GHG emissions (e.g. unavoidable emissions from production processes). In order to achieve the goal of greenhouse gas neutrality, additional compensation measures or "negative emissions" must therefore be taken into account. In this respect, the City of Aachen is preparing a potential study to determine the technical potential for storage and CO_2 Storage.

Integriertes Klimaschutz-konzept

Strategiekonzept 2030 mit Handlungs-programm bis 2025

www.aachen.de/klimaschutz

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List of abbreviations

a	Year
Fig.	Illustration
EE	Renewable energies
eea	European Energy Award®
EPA	Energy policy work programme
against	opposite
Gt	Gigatonnes
GW	Gigawatt
GWh	Gigawatt hours
ha	hectare
HF	Field of action
IKSK	Integrated climate protection concept
kg	Kilogramme
KS	Climate protection
CHP	Combined heat and power generation
LCA	Life Cycle Assessment
MÄ	Employee equivalent
million	million
MIV	Motorised private transport
MP	Action plan
MW	megawatt
MWh	Megawatt hours
PV	Photovoltaics
SDG	Sustainable Development Goal
t	tonnes
Tab.	Table
GHG	Greenhouse gas
WKA	Wind turbine

1. Reason for the concept

The global mean temperature is currently rising by 0.2 °C per decade. If there is no radical turnaround, the Earth will be 1.5 °C hotter than in pre-industrial times by 2040 - 60 years earlier than envisaged in the Paris Climate Agreement (COP 21, 2015). As temperatures rise, so does the risk of so-called tipping points being reached in the climate system. If these thresholds are exceeded, self-reinforcing, potentially irreversible processes will occur, leading to even more warming. In the scientific journal "Nature", researchers from the Potsdam Institute for Climate Impact Research, among others, explicitly warn of these tipping points. According to the scientists, this theoretical possibility alone already constitutes a "planetary emergency" and an "existential threat to civilisation".

Climate change is not just an environmental problem: it is an economic, security, health and species protection problem and a threat to peace. Scientists are issuing increasingly urgent warnings: the window of opportunity we have left to secure our livelihoods in the long term is closing rapidly. In the interests of intergenerational justice, it is therefore imperative to achieve major emission reductions as quickly as possible. The Fridays4Future movement triggered by Greta Thunberg's school strike in 2018 has led to broad public awareness and a great deal of support from the scientific community and civil society to call for swift action against further greenhouse gas emissions.

According to the UN Environment Programme, if governments do not take massive action, 50% more oil, coal and gas will be extracted and burned by 2030 than would be required to achieve the 2°C target and more than twice as much as would be permitted for the 1.5°C target.[1]

The EU and Germany have set themselves the goal of being climate-neutral by 2050. The reduction pathway on the way there alone allows greenhouse gas emissions to be too high to remain below the 2-degree target set in Paris. Scientists, including the German Advisory Council on the Environment, pointed this out to the German government when it presented its Climate Protection Act in September 2019.[2] Based on the UN Intergovernmental Panel on Climate Change (IPCC) Special Report (2018, global warming of 1.5 degrees), the Environmental Council describes a remaining national $CO_{2\ budget}$ that would have been used up in 8 years at current national emissions and that more and more effective measures would therefore have to be taken.

Despite almost 30 years of commitment and many pioneering roles in climate protection, the city of Aachen is likely to miss its 2020 climate protection target by half. The priorities of municipal action were therefore redefined in June 2019 with a resolution on the climate emergency. A new climate protection target was adopted in January 2020: The city of Aachen is the first city in Germany to explicitly take into account its share of the remaining greenhouse gas budget to keep global warming below two degrees. In order to meet this ambitious target, an enormous acceleration of planned measures, new activities and unconventional approaches are required. This concept sets out the strategic goals and priority areas for accelerated greenhouse gas reduction and describes the first steps to be taken by 2025.

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[1] Der Spiegel No. 50 / 07.12.2019

[2] Open letter from the German Advisory Council on the Environment, 16 September 2019, https://www.umweltrat.de/SharedDocs/Downloads/DE/04_Stellungnahmen/2016_2020/2019_09_Brief_Klimakabinett.pdf? blob=publicationFile&v=5

2. Summary

On 19 June 2019, the City Council of Aachen adopted the climate emergency and at the same time commissioned the development of an integrated climate protection concept (IKSK). Previous successes and failures were to be analysed, strategic steps to accelerate the reduction of CO_2 emissions defined and promising measures developed.

Goals

The Integrated Climate Protection Concept (IKSK) of the City of Aachen builds on the strategy developed in 2014 to reduce CO_2 emissions in two time horizons, by 40 % from 1990 to 2020 and by 50 % from 1990 to 2030. The resolution passed parallel to the concept development on 22 January 2020 to comply with the proportionate residual budget of CO_2 emissions that can still be emitted in the city of Aachen - while adhering to the Paris targets (staying below 2 degrees global warming) - is taken as a basis in the sense of a milestone target within the framework of the ICSK (see Chapter 4.2). Taking into account the 22% reduction in CO_2 already achieved since 1990, this leaves a CO_2 quantity of 768,500 tonnes that must be saved by 2030 (around 76,900 per year). Of this, 398,000 tonnes are attributable to the transport sector, which has seen a 19% increase in CO_2 since 1990. In the other sectors, where CO_2 emissions have fallen by 33% since 1990, the following reductions must be achieved by 2030
370,500 tonnes could be avoided (see Table 9).
The aim of the ICSK is to identify the areas with the greatest potential for reduction and also to identify the most promising measures - also from a cost-benefit perspective.

Participation

The IKSK was created in a process lasting a good year with many participants. The development of the 2030 Strategy and the 2025 action plan was carried out by a large number of stakeholders. The Climate Emergency Round Table was also involved in several rounds of talks. A large number of suggestions were analysed in the course of developing the concept and in many cases specifically incorporated, e.g. in the planning of measures. Participation is described in detail in chapter 6.2.

Potential for CO_2 reduction

In line with the previous climate protection concepts, the strategically most important areas include efficient energy generation using renewable energies (RE), the energy refurbishment of existing buildings using efficient building technology and optimisation of the building envelope, the commercial and industrial sector, in particular the use of efficient technologies, and the transport sector with a focus on car volumes in urban and regional transport and vehicle technology/emissions.

First, an analysis of the status quo and impact of the existing 2030 climate protection strategy and the 2020 action programme, which was drawn up in 2014, was carried out. The main aspect of the analysis was to determine the degree of realisation of the reduction potential developed in 2014 - the transport sector was not considered at that time. The remaining potential for halving CO_2 emissions was derived from this and updated to take account of new concepts (section 4.3). These CO_2 reduction potentials, adjusted through strategic consideration of the focal areas and in accordance with the implementation status, were then analysed.

The reduction potential without transport is around 363,000 tonnes by 2030 (see Table 13), or 36,280 tonnes per year. If the climate protection target alone is taken as the starting point, the reduction target is 370,500 tonnes of CO_2 for the areas excluding transport. The potential analysis therefore represents 98% of the required reduction in these 3 areas - excluding transport (see Table 9). In addition, this possible reduction quantity determined by the potential analysis corresponds to 47 % of the total emissions reduction required in accordance with the climate protection target.
In the transport sector, a potential for $CO2_{reduction}$ of 83,000 tonnes by 2030 can be identified at municipal level, 8,300 tonnes per year, which corresponds to a share of just under 21% of the reduction target for the transport sector (83,000 tonnes of 398,000 tonnes of CO_2). According to the potential analysis, the transport sector can theoretically contribute 11% to achieving the overall climate protection target.

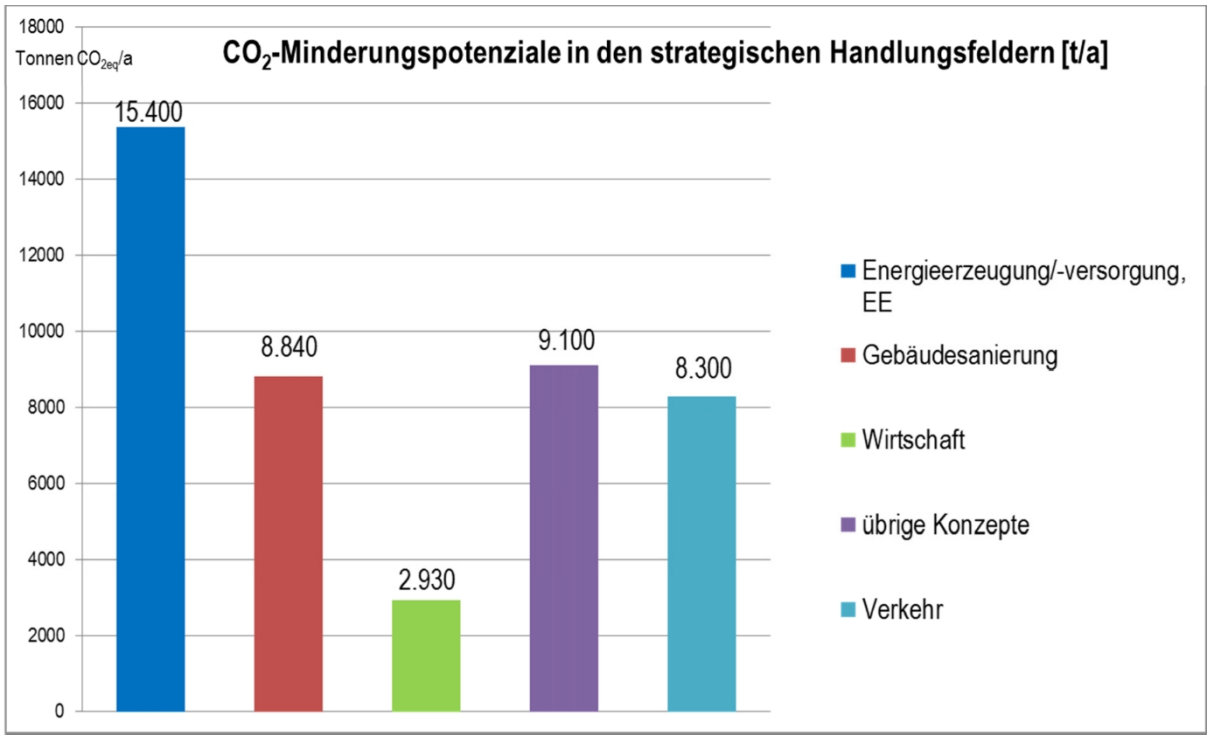

Figure 1: CO_2 reduction potential in the strategic fields of action

The potential is distributed across the municipal fields of action as shown in Figure 1. The potential from 2020 to 2030 is shown here as an annual share, distributed linearly over the 10 years.
The fields of action of energy generation/supply/ RE, building refurbishment and the economy together have the potential to $reduce$ $CO2_{emissions}$ by 271,700 tonnes (2020 to 2030), and even 362,700 tonnes if potentials based on existing concepts are taken into account (see Table 1), corresponding to 98% of the emissions reduction of 370,500 tonnes required for the climate protection target in all areas except transport.

Overall, the reduction potential in all areas for the city of Aachen is therefore around 445,700 tonnes of CO_2. This corresponds to 58% of the amount of CO_2 (769,000 tonnes) that must be saved to achieve the city's climate protection target from today until 2030. This represents the proportion that can theoretically be achieved by the municipality (see Chapter 4.2.2.).
In the transport sector in particular, the scope for municipal action is extremely limited. While the energy, buildings and industry sectors can contribute 98% to the sectoral reduction target, the

only 21% of the necessary $CO_{2\ reductions}$ in the transport sector can be achieved at municipal level. The transport sector can only contribute 11% to the climate protection target locally, the other sectors 47%.

Action programme 2025

With the climate protection target in mind and knowing the existing potential for $CO_{2\ reduction}$ as a framework, it was now necessary to draw up a programme of action to tap into this potential. Firstly, measures that are listed in various existing concepts and have not yet been implemented (see Chapter 4.1) were compiled. The programme of action in Chapter 5 takes into account, for example, the energy
political work programme from the European Energy Award process. In addition, a 5-year plan with around 70 new measures was developed as part of a participation process (see Chapter 6.2) in order to accelerate climate protection in the city of Aachen in an initial phase up to 2025. The following table compares the reduction potential in the strategic focus areas of $CO_{2\ reduction}$ that can be achieved by implementing measures in the action programme. In addition, where available
- costs are listed. Above all, the share that the area of measures has in achieving the reduction target of 769,000 tonnes by 2030 can be seen. A linear reduction trend over 10 years was assumed for this purpose, i.e. the share of the climate protection target accounted for by the measures in relation to annual emission values. In this respect, a particularly large effect can be seen in the subsidy programmes for both PV systems and building refurbishment.

If the entire 2025 action plan (Chapter 5.3) were implemented, a good 47% of the CO_2 reduction target (30,130 tonnes of 76,900 tonnes of CO2) could be achieved. Taking into account the measures that are already included in other concepts such as the energy policy work programme, 59% of the climate protection target can be achieved.
With reference to the calculated $CO_{2\ reduction\ potential}$ of 445,700 tonnes, 44,570 t/a, the action programme represents a range of measures with which 45,430 t CO2/a can be reduced. This means that the entire reduction potential can be tapped by implementing the action programme, in particular the action plan, by 2025.

In the energy generation/supply/EE field of action, the action plan shows 21,153 tonnes of CO_2 reduction through the implementation of measures compared to a reduction potential of 15,400 tonnes of CO2/year. The high figure for realisation results from findings in project 3.4 (section 5.4.3), which were not yet available at the time of the potential analysis. In the building renovation field of action, the reduction potential amounts to 8,840 tonnes of $CO_{2/year}$. In contrast, implementing the measures described in the 2025 action plan in this area of action could result in savings of 10,897 tonnes of CO_2. The fact that the action plan contains a higher CO_2 reduction than the potential analysis is due to the fact that the potential analysis was based on the private housing stock, while the action plan also includes the refurbishment of municipal non-residential buildings and municipal residential buildings. In the economic sector, where 2,930 tonnes of $CO_{2\ are}$ to be saved annually, 2,200 tonnes can be represented using conservative assumptions, although these may also be exceeded. In the transport sector, the assumptions in the action plan are initially cautious, as the measures often have a long lead time. The potential and likelihood of implementation are higher in the second half of the 2020-2030 decade (Chapter 4.3.3.).

Strategic areas Measures	Target: CO_2 reduction by 2030 according to strategy [tonnes]	Annual share of the reduction target by 2030 [tonnes of CO_2]	In the action plan (MP) until 2025 Mapped reduction [t $CO_{2/a}$]	Costs for the city per year [€]	% share of the MP in the required CO2 reduction of 769,000 tonnes by 2030
Energy generation, energy supply, RE utilisation					
PV:	60.700	6.070			
PV subsidy programme			**6.070**	**1.980.000**	**7,9**
PV Comm. Building, E 26			**982**	**3.160.000**	1,3
PV open spaces			500	0	0,7
Solar thermal energy	4.700	470	470	0	0,6
Wind power expansion	68.600	6.860	4.431	0	5,8
CHP expansion	20.000	2.000	8.200	0	10,7
Waste heat Campus W			500	0	0,7
Subtotal	154.000	15.400	21.153	5.140.000	27,5
Building refurbishment	88.400	*8.840*			
Comm. Building, E 26			**928**	**5.740.000**	1,2
urban. flats			**800**	**4.000.000**	1,0
gewoge flats			400	0	0,5
En.manag. Group			180	0	0,2
Bonuses at schools			350	40.000	0,5
Green roofs E 26			1,8	100.000	0,0
VDI clients, RechenZ			143	running costs	0,2
Support programme			**7.200**	**3.760.000**	**9,4**
Consultancy expansion div.			894	323.000	1,2
Subtotal	88.400	8.840	10.897	13.963.000	14,2
Economy	29.300	2.930	2.200	390.800	2,9
Planning			not quantifiable	215.000	
Communication			not quantifiable	180.000	
Subtotal	271.700	27.170	34.250		44,5
Remaining potential from other concepts	91.000	9.100	9.100		11,8
Total without traffic	362.700	36.270	43.350	19.888.800	56,4
Traffic *	83.000	8.300	2.080	15.041.333	2,7
action plan only			36.330		47,2
TOTAL	445.700	44.570	45.430	34.930.133	59,1
TARGET	769.000	76.900			

*The potential in the area of transport is presented in detail in section 4.3.3

Table 1: Existing $CO_{2\ reduction}$ potential and the reduction that can be achieved by implementing measures, as well as their share in achieving the climate protection target - by area of action

The following figure shows how much annual $CO2_{reduction}$ can be achieved by implementing the action programme in the individual fields of action and how high the proportion of this reduction is in relation to the climate protection target (76,900 t_{CO2} per year). Theoretically, 59% of the required greenhouse gas reduction can be achieved by implementing the action programme.

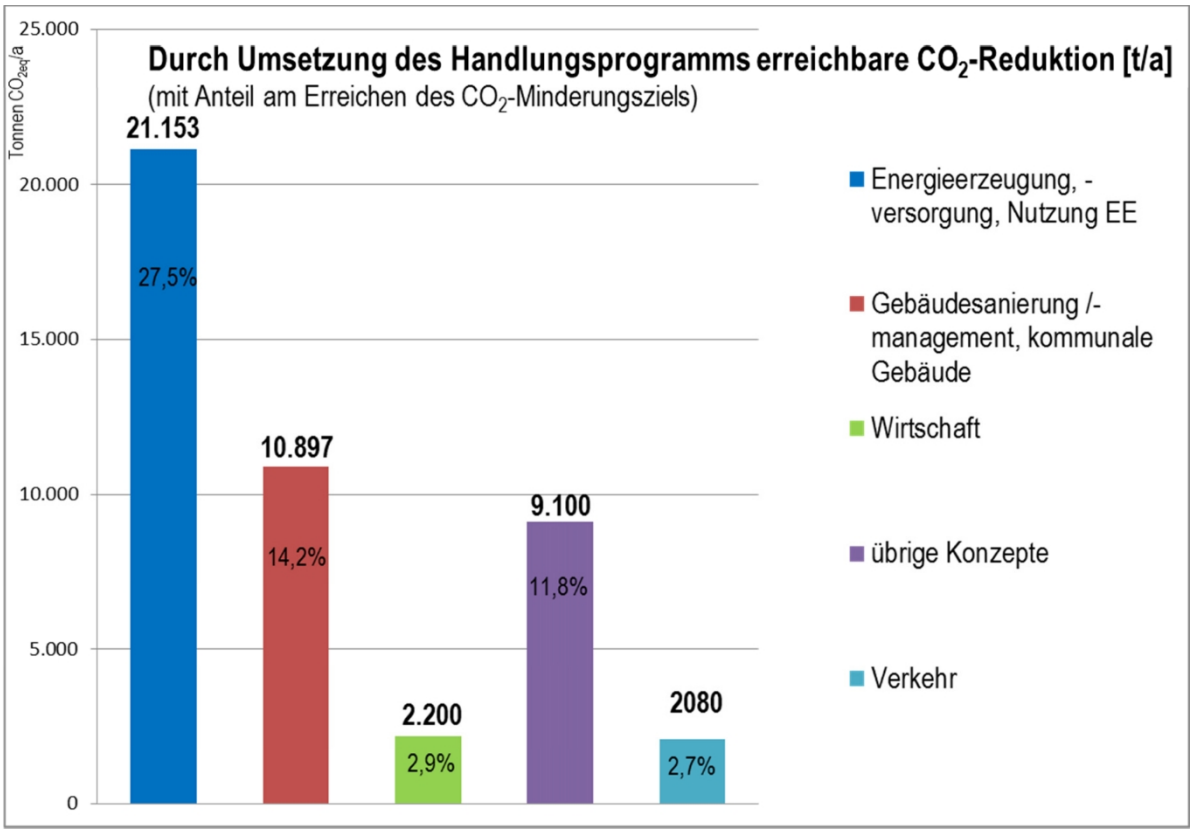

Figure 2: Distribution of $CO2_{reduction}$ through implementation of measures in the fields of action

The 2025 action plan is structured according to the system of the European Energy Award (EEA) climate protection management system, which has been in use for many years. The most strategically important measures for climate protection in the city of Aachen include the refurbishment of municipal buildings, residential and non-residential buildings as well as a funding programme for building refurbishment for private individuals and businesses. A subsidy programme for the mobilisation of PV systems and the installation of PV systems on municipal buildings are equally important. The task of subsidiaries such as STAWAG, gewoge, ASEAG and private investors is to refurbish flats, build wind turbines, rebuild the district heating network and drive forward the mobility transition.

Strategically important priority measures are shown in Table 2.

The urban measures cost around EUR 35 million per year, of which a good EUR 15 million is attributable to the mobility sector and just under EUR 20 million to the energy/EE, building refurbishment and business sectors, see Table 2.

The annex to the ICSK contains an overview of all measures.

Selected key measures from the ICSK action plan (MP)	Total costs (municipal. expenditure) [€/a]	Costs comm. Investment company [€/a]	CO_2 savings [t/a]	Costs in relation to emission reduction Euro/t CO *$_2$	Share of the required emissions reduction [%]
Refurbishment of municipal non-residential buildings	5.740.000	0	928	6.185	1,2
Energy-efficient refurbishment of municipal residential buildings	4.000.000	0	800	5.000	1,0
PV systems on municipal buildings (E 26)	3.160.000	0	982	3.218	1,3
Subsidy programme for small private & commercial solar systems	1.980.000	0	6.540	303	8,5
Funding programme for private & small commercial renovation of old buildings	3.760.000	0	7.200	522	9,4
Energy-efficient refurbishment of GEWOGE buildings	0	2.000.000	400	5.000	0,5
Expansion of wind energy in the urban area	0	not specified	4.430	not ascertainable	5,8
District heating network conversion to CHP or RE, STAWAG	0	not specified	8.200	not ascertainable	10,7
Subtotal buildings/energy sectors	18.640.000	2.000.000	29.480		38,3
Urban measures in the mobility transition scenario	15.041.333	0	2.080	not ascertainable	2,7
ASEAG measures in the mobility transition scenario	0	30.334.000		not ascertainable	
Subtotal Priority measures all sectors	33.681.333	32.334.000	31.560		41
Costs and CO2 reduction including further measures in MP 2025	35.000.000	32.364.000	36.330		47
CO_2 reduction, taking into account existing MPs			45.430		59

* These are not CO_2 avoidance costs, as savings effects have not been factored in. PV and wind power plants, for example, are economical.

Table 2: Outstanding climate protection measures in the city and their share of the climate protection target

Conclusion

The IKSK is a framework concept that describes the strategically important areas of action on the way to halving $CO2_{emissions}$ from 1990 to 2030 and takes a differentiated look at the corresponding potential. The latter amount to 363,000 tonnes by 2030 in the areas of energy/energy, building renovation and trade/industry and 83,000 tonnes in the transport sector. Potentials with a share of 21% of the $CO2_{reductions}$ required to achieve the climate protection target can be found at municipal level in the transport sector, while in the energy/RE, building refurbishment and commercial/industrial sectors there is a 98% reduction potential on the way to achieving the climate protection target.

In order to tap into this potential, new measures were developed and described in detail in addition to existing action programmes. With this new action plan alone, almost 47% of the $CO2$ reduction required to achieve the target by 2025 can be mapped, 36,330 of 76,900 tonnes of $CO2$ per year. Taking into account all the action plans now available in the ICSK action programme, 59% of the $CO2$ reduction required by the climate protection target can theoretically be achieved through corresponding practical implementation. Measured against the identified potential for local $CO2_{reductions}$, this can be fully tapped by implementing the programme of action.

The remaining part of the path to halving $CO2_{emissions}$ (1990 - 2030) in the city is not within the municipal sphere of influence, but must be activated by corresponding political regulations at state and federal level (see chapter 4.2.2). This applies in particular to the transport sector.

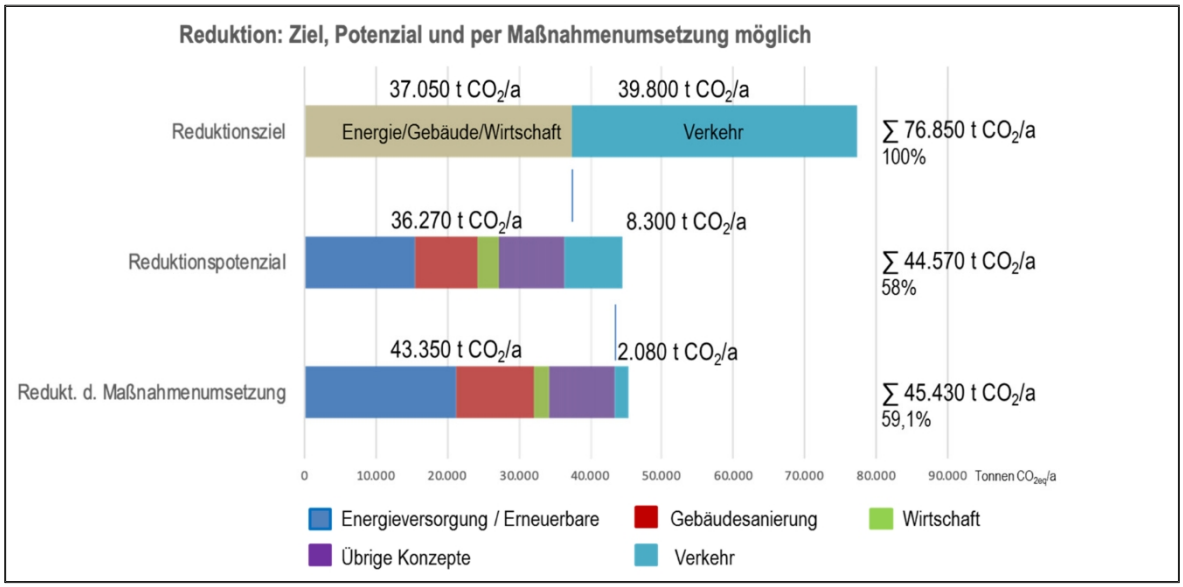

Figure 3: Overview of the CO2 reduction target, the CO2 reduction potential and the implementation options according to the action programme

3. Description of the Initial situation

3.1. Where does Aachen stand on climate protection?

General conditions

The City of Aachen joined the European Climate Alliance in 1992 and since then has actively pursued municipal climate protection in various areas. In accordance with the Climate Alliance goals, the City of Aachen has The city has committed to reducing $CO_{2\ emissions}$ by half by 2030 at the latest (base year 1990). The city is also a member of the EU Commission's "Covenant of Mayors" climate protection initiative for European cities and has committed itself to climate impact adaptation as part of the "Mayors Adapt" programme. In October 2011, the city council adopted the climate protection target of reducing $CO_{2\ emissions}$ by 40 % by 2020 (compared to the base year 1990). In the 1990s, the administration introduced structures for interdisciplinary cooperation in the interests of sustainable urban development (Eco-logical City of the Future project) and set the strategic and conceptual course. The first climate protection concept, "Climate Protection Action Plan 2010", was drawn up in 1998, supplemented by a study on transport-related $CO_{2\ emissions}$ in 1999. Detailed analyses of the potential for climate protection measures followed and were successively integrated into the overall strategy (see section 3.2.2).
The most up-to-date strategic core statements are set out in the Climate Protection Strategy 2030 (with action programme 2020) from 2014. The main focus was on the areas of energy-efficient building renovation, renewable energies and energy efficiency in the commercial sector. The strategically very important topic of mobility was and is dealt with separately in the transport development planning process.
The current, adopted Energy Policy Work Programme (EPP) 2019-2022 contains the measures for implementing the strategy and describes these in accordance with the European Energy Award (eea) system in the fields of urban planning, energy supply, municipal buildings, mobility and cooperation (resolutions of the Planning Committee on 10 January 2019, the Mobility Committee on 13 December 2018 and the Committee for Environmental and Climate Protection on 11 December 2018). At the same time, targets and indicators were described as part of the Mobility Strategy 2030. The city has been using the European Energy Award® (eea) municipal management system to review its climate protection targets since 2009 and carries out an annual carbon $_{footprint\ assessment.}$ As a European energy and climate protection municipality, Aachen was honoured with the European Energy Award® in gold in 2011, 2015 and 2019.

Current objectives - climate emergency resolution

Since 1990, $CO_{2\ emissions}$ in the city had only been reduced by 22 per cent by 2018 - contrary to the 40 per cent target by 2020. This failure to meet the target led, among other things, to the declaration of a climate emergency in June 2019. The administration used the subsequent general mood of optimism for a broad internal and external participation process. On the one hand, all administrative areas were informed,

The local population was sensitised and involved in the realignment of the climate protection strategy and the development of measures, while suggestions and proposals from initiatives, associations and institutions were also taken into account.
With the climate emergency, politicians also called for a reorientation of the city's climate protection target in line with the scientific findings on global warming, in particular to meet the UN Paris targets. The Aachen City Council has consistently responded to the dependence of global warming on the absolute amount of greenhouse gases in the atmosphere and decided in January 2020 that the City of Aachen will limit its local greenhouse gas emissions - within the scope of municipal possibilities - to the remaining $CO_{2\ budget}$ in relation to the global $CO_{2\ residual\ budget}$, which is permissible for global warming of less than 2 degrees.

3.2. Inventory

3.2.1. Framework conditions and Mission statement

Climate protection target - 22 January 2020

In 2018, the UN Intergovernmental Panel on Climate Change (IPCC) presented its special report on how much $CO2_{emissions}$ humanity can still produce in order to stay within the limits of 1.5 and 2 degrees of global warming: globally 420 gigatonnes (Gt) for 1.5 degrees and 1170 Gt for 2 degrees. The world currently emits 42 Gt annually - and the trend is rising. If emissions remain the same, the remaining budget to limit global warming to 1.5 degrees would be used up in ten years.
In its special report, the German Advisory Council on the Environment (advisory body to the German government) averages the IPCC figures to a maximum temperature rise of 1.75°C compared to pre-industrial levels and a remaining global CO_2 emissions budget of 800 Gt. This results in a remaining national $CO2_{budget}$ for Germany of 6.6 Gt or 6,600 million tonnes of CO_2 from 2020 onwards - disregarding historical emissions and assuming an even distribution among the world's population.[3]
In Aachen, $CO2_{emissions}$ amounted to 2.139 million tonnes in 2018. If these quantities are added to the comparable CO2 emissions in Germany as a whole, the total amount of CO_2 still permitted to be emitted in order to meet the Paris targets is 16.3 million tonnes in absolute terms for the city of Aachen. In January 2020, the Aachen City Council adopted this remaining budget as a new municipal climate protection target.

Aachen* 2030 Masterplan

The master plan, which was adopted in December 2012, represents the framework plan for urban development in Aachen and was created in an intensive dialogue and with extensive participation. Drawn up as the basis for the redrafting of the Aachen*2030 land use plan, it is the first part of the AACHEN* 2030 process and was approved by the City Council of Aachen as a key element to be taken into account in urban land-use planning. ----------

[3] Open letter 16 September 2019, https://www.umweltrat.de/SharedDocs/Downloads/DE/04_Stellungnahmen/2016_2020/2019_09_Brief_Klimakabinett.pdf? blob=publicationFile&v=5

informal planning of the city. The masterplan describes the perspectives and guidelines for the spatial development of the city, visualises measures in context, sets spatial priorities and identifies strategic flagship projects. Eleven guidelines and ten fields of action structure the urban development tasks described in the masterplan.

With regard to climate protection and climate adaptation, the masterplan sets out the following goals and priorities:

- the energy-efficient modernisation of the existing building stock while preserving the architectural quality and unalterability of buildings that characterise the cityscape,
- limiting the amount of traffic by introducing a campus railway[4] in conjunction with a system of networked local mobility,
- the accelerated expansion of renewable energies on the basis of an overall concept coordinated with the region, and
- Strategies and measures to mitigate the negative effects of climate change.

3.2.2. Overview of strategic concepts

In over 25 years, various strategic and programmatic concepts and action programmes have been initiated and implemented, both in the areas of energy and climate protection as well as mobility. The most important strategy papers from the last 10 years are listed below. Descriptions can be found in chapter 4.1.

- Energy efficiency concept with 5-year plan 2006-2010
- Integrated Clean Air and Action Plan from 2009, updated in 2015 and 2019
- 2012 Masterplan Aachen*2030
- Traffic development planning (VEP) Aachen as a permanent process since 2012
- Energy policy work programme European Energy Award® (eea), 2010, 2015 and 2019
- Sectoral specialised planning in the areas of wind, solar, biomass or district heating
- CHP expansion concept "CHP Initiative Aachen 2014 - 2017"
- Climate protection strategy concept 2030 with action programme 2020 from 2014
- Implementation strategy #AachenMooVe! ("Model city without emissions in transport")
- Climate impact adaptation concept with implementation roadmap 2017-2021
- Aachen 2030 regional energy plan from 2018

The concepts developed up to 2013 were analysed and taken into account in the 2030 strategy concept (completed in 2014) in terms of their degree of implementation and remaining potential.

There are also numerous pioneering campaigns and advisory projects such as altbau plus, ACtiv für's Klima, energieeffizienzFACHBETRIEB, Aachen clever mobil and many more.

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[4] The plans to build a light railway from Aachen-Brand to Campus Melaten under the name "Campusbahn" were ended in 2013 by a referendum.

3.2.3. Milestones in the projects

The following measures can be regarded as milestones of the last 20 years:

- 2009 Promotion of electric vehicles (STAWAG), five electric charging stations
- 2010 Aachen standard for the construction and refurbishment of municipal buildings
- 2011 Solar roof register
- 2011 First nationwide, fully automated DB e-Call-a-Bike station in Aachen
- 2012 difu competition for municipal climate protection, award winner with E-View - The Energy Scoreboard
- 2012 100 kWp PV system Ludwig Forum
- 2012 ASEAG hybrid bus in regular service
- 2013 Designation of wind concentration areas
- 2013 ACtiv for the climate at Aachen schools and daycare centres 2010-2013
- 2013 EU-GUGLE, refurbishment of municipal housing by 2018
- 2014 Adoption of the Vision Mobility 2050 in the VEP Aachen
- 2014 Decision on Mayors Adapt
- 2014 render - innovation group, regional energy dialogue until 2018
- 2015 Re-certification FSC Aachen Forest and subsequent years
- 2015 ASEAG, self-converted electric bus in regular service
- 2016 Introduction of an environmental zone
- 2016 Energy service directive - rules of behaviour for users
- 2016 First mobility station (Campus Melaten)
- 2017 Green and design statutes
- 2017 Introduction of Mobility Broker and eTicket from ASEAG
- 2017 New regulation for business trips incl. access to Mobility Broker
- 2017 Top 3 among major cities, German Sustainability Award 2018
- 2018 Award for the #AachenMooVe! project in the Municipal Climate Protection.NRW "Emission-free city centre" competition
- 2018 Expansion of Vetschau/Aachen-Nord-West wind farm, 5 turbines connected to the grid
- 2018 Completion of the Aachen-Brand refurbishment roadmap
- 2018 10-megawatt CHP plant Campus Melaten
- 2019 Re-certification European Energy Award
- 2019 Mobility Strategy 2030, Part 1 (mandate & structure of the VEP) adopted
- 2019 "Aachen cycling decision" carried out and decided
- 2019 Wind turbines in Münsterwald, 7 turbines in 2018/19
- 2020 Mobility Strategy 2030 Part 2 (objectives & indicators of the VEP) adopted

3.3. Impact analysis

3.3.1. Method and framework conditions for municipal greenhouse gas balancing

The municipal greenhouse gas balance sheet for the city of Aachen includes all emissions caused by energy consumption in the areas of private households (electricity and heat generation), mobility (fuel consumption), industry (energy consumption) and transport.

and commerce, trade and services (energy consumption for electricity, heat and processes) and municipal administration (energy consumption for electricity and heat) in Aachen.
Greenhouse gas balancing is carried out for locally consumed energy sources (electricity and heat) according to the territorial principle. Methodologically, a basic framework of statistical data (inhabitants, registered vehicles, employees) is determined using the top-down principle, and energy consumption is then recorded using the bottom-up principle. STAWAG's consumption data for electricity, gas and district heating are included in the balance sheet. Energy sources that are not grid-bound are recorded as far as possible or extrapolated with the help of statistical data (e.g. NRW Energy Atlas, ecoRegion data subscription). Based on this data, a final energy balance (IPCC principle) is calculated and, building on this, a primary energy balance (LCA). Finally, the $CO_{2\ emissions}$ are calculated using national and Aachen-specific factors (e.g. for district heating).
By using an average national emission factor for electricity (federal mix), the additions of renewable electricity generation in the urban area (PV and wind power) are only recognised to a limited extent, indirectly through lower electricity consumption from the grid due to own use of PV electricity and directly through known feed-in quantities from local producers in the urban area. The systems for PV, wind power plants, heat pumps and biogas recorded in the system register of Energieatlas NRW (based on reporting data from the grid operators) are used as a basis. Solar thermal energy is based on BAFA data. PV systems for own electricity use are not included in the statistics.
Greenhouse gases such as methane, nitrous oxide etc. are not included in the balance. $CO_{2\ sinks}$ in nature - e.g. tree and forest stands - are also not included in the GHG balance.

3.3.2. Final energy and greenhouse gas balancing

CO_2 emissions have been reduced by 22 per cent since 1990 (weather-corrected data). Per capita CO_2 emissions have fallen from 10.8 to 8.3 tonnes.

Final energy balance 2018

The final energy demand for 2018 is broken down by consumer group within the city of Aachen (geographical city boundary).

- At 6,857 gigawatt hours (GWh), the final energy demand aggregated across all consumer sectors is almost stagnant compared to 2017. Compared to the base year 1990, this value fell by a moderate 4.8 %. After weather correction (for natural gas and district heating), final energy consumption actually increased by 1.5% year-on-year to 7,101 GWh in 2018.
- For the heat and electricity sectors - i.e. excluding transport - final energy consumption adjusted for weather conditions stagnated compared to the previous year; in real terms, it fell slightly by just under 80 GWh to 4,741 GWh (minus 1.6 %) in 2018 due to the warm year (see Table 3).
- The total amount of electricity fed into Aachen's electricity grid in 2018 was only 1,160 GWh, down 37 GWh on the previous year (minus 3.1%). Thanks to the further expansion of wind energy, this figure now includes 92 GWh of renewable energy (7.7%), which is now being generated and fed into the Aachen city area (medium-voltage level).
- Combined heat and power generation (natural gas, biogas) was further expanded in 2018. STAWAG's CHP plant at the Melaten site (10 MW), which went into operation at the turn of 2018/2019, will save approx.

58 % of $CO_{2\ emissions}$ compared to separate heat and power generation (source: STAWAG). Further plants in the city are planned for the future and will also make a positive contribution to the carbon footprint.

Primary energy balance 2018

The primary energy balance (LCA) includes the energy requirements for production, conversion and transport of the respective final energy sources (upstream chain shares) and thus extends beyond the "city" balancing area.
The primary energy can be calculated from the final energy demand using specific primary energy factors. The climate-relevant $CO_{2\ balance}$ is derived from the primary energy balance using specific emission factors for individual energy sources. The primary energy balance without weather correction shows a slight increase compared to the previous year; with weather correction, primary energy demand even rose by a significant 2.4% to 9,302 GWh compared to 2017. Demand in the road transport sub-sector rose only slightly to 1,772 GWh. The following table provides an overview of the current balancing data.

Energy consumption and CO2 emissions	1990	2017	2018	Change 2017/2018	Change 1990/2018
Final energy [GWh] without transport	5470	4758	4741	-0,3%	-13,3%
Final energy (total) [GWh]	7200	6678	6857	+2,7%	-4,8%
Primary energy [GWh]	10.562	8638	9025	+4,5%	-14,6%
$CO_{2\ emissions}$ [1000 tonnes]	2.693	2051	2082	+1,5%	-22,7%
Weather-corrected values	**1990**	**2017**	**2018**	**Change 2017/2018**	**Change 1990/2018**
Final energy [GWh]	7.385	6997	7101	+1,5%	-3,8%
Primary energy [GWh]	10.776	9084	9302	+2,4%	-13,7%
$CO_{2\ emissions}$ [1000 tonnes]	2741	2136	2139	+0,2%	-22,0%
$CO_{2\ emissions}$ [tonnes/inhab.]	10,8	8,35	8,32	-0,3%	-22,9%

Table 3: Carbon $_{footprint}$ of the city of Aachen

$CO_{2\ emissions}$ 2018

- Due to another very warm year in 2018, the absolute emissions resulting from the primary energy balance fell slightly year-on-year from 2.108 million tonnes to 2.082 million tonnes. Taking into account a weather correction, however, 2.139 million tonnes of CO_2 were released, which corresponds to a slight increase of 0.2 % compared to 2017.

- The reduction in emissions since 1990 is only minus 22.0 % for 2018 (see Table 3), after a higher reduction of 24.9 % had already been achieved by 2015.
- The electricity and heating sector continues to show the most significant reduction in emissions since 1990, with a decrease of 30 % (maximum was 34 % in 2016).
- Weather-adjusted emissions per inhabitant in 2018 were 8.32 tonnes of $_{CO2}$ (1990: 10.8 tonnes of $_{CO2}$ per inhabitant) and therefore slightly below those of the previous year (8.35 tonnes in 2017); compared to the base year 1990, the reduction is now just under 23%.

The following graph shows the development of emissions since 1990.

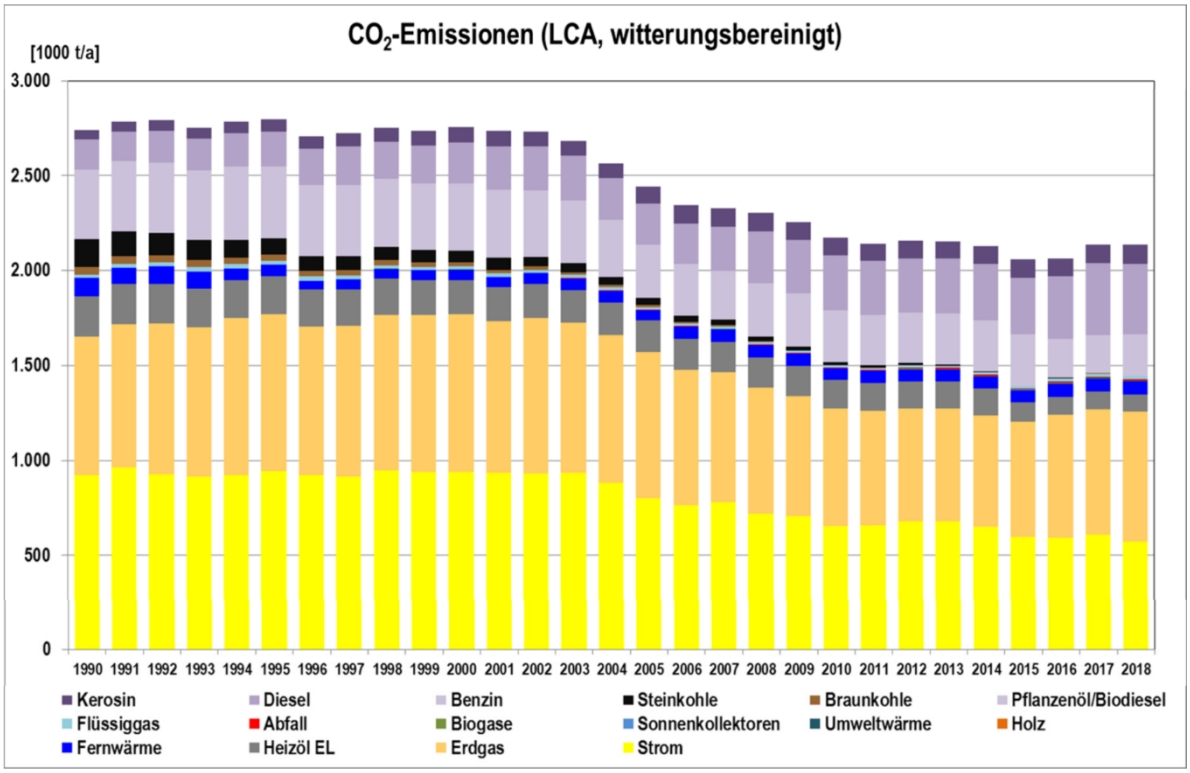

Figure 4: $_{CO2}$ emissions in 2018 on a primary energy basis (weather-corrected)

Analysing the sectoral distribution is important for determining the polluters. Most CO2 emissions come from the transport sector, followed by the commercial sector. The third largest sector is households (see Figure 5).

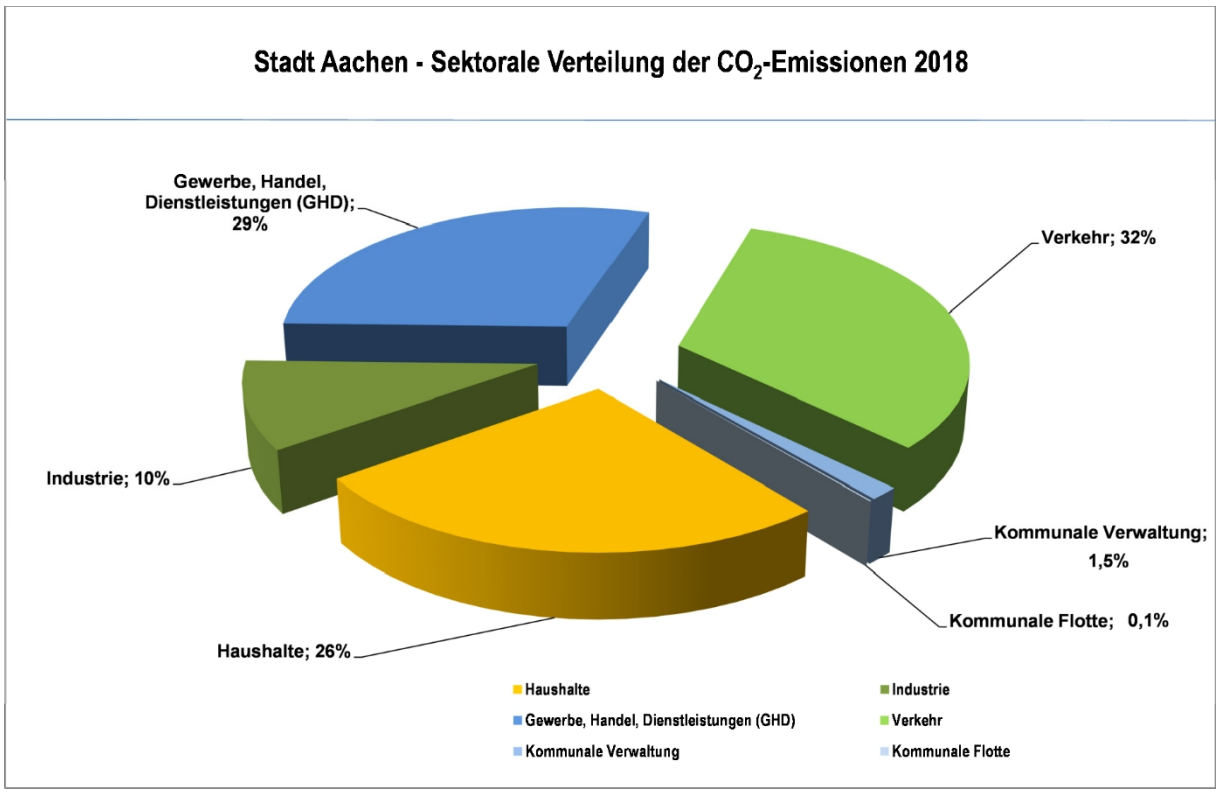

Figure 5: Sectoral distribution of CO2 emissions (reference year 2018)

The distribution across the heating, electricity and transport sectors is also important for the development of the strategic areas of action. While CO2 emissions have been reduced in the heating sector (by 29 %) and the electricity sector (by 38 %), emissions in the transport sector have increased by 19 % since 1990 (see Figure 6). As of 2018, however, most emissions still come from the provision of heat. The transport sector is in second place ahead of the electricity sector, which nevertheless enjoys a higher priority in the public perception than the heating sector.

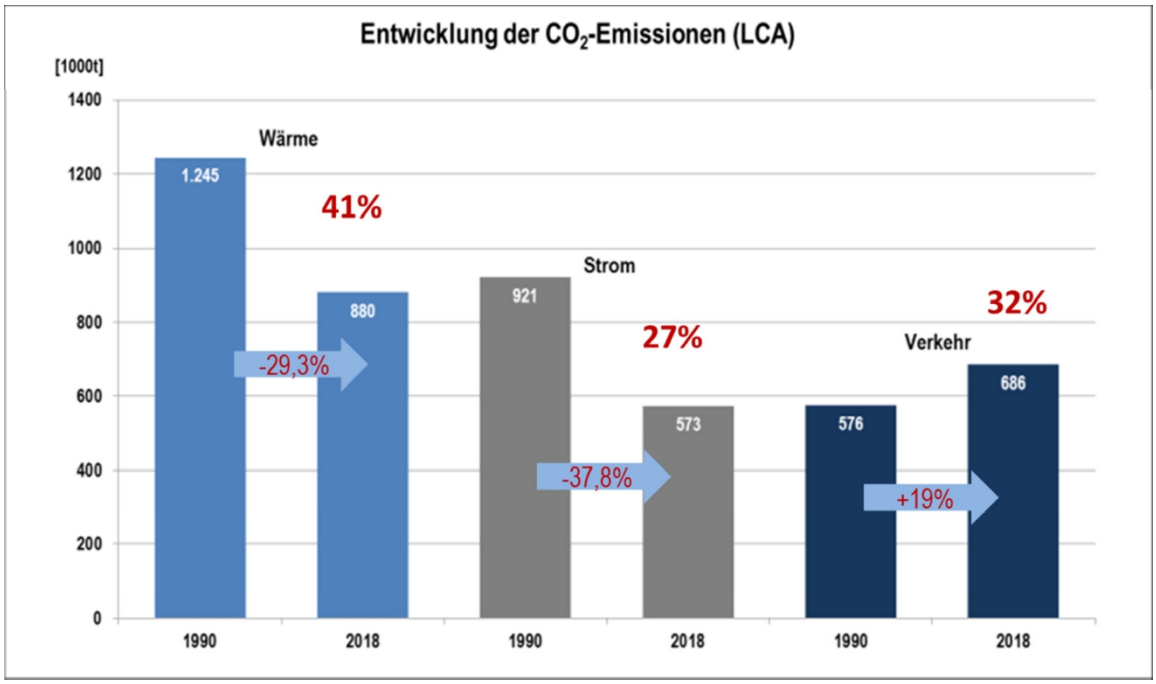

Figure 6: Distribution of CO2 emissions between the heat, electricity and transport sectors

Aachen balance sheet taking into account the STAWAG electricity mix

STAWAG has its own electricity mix for its electricity products, which is strongly characterised by renewable energies (share: approx. 79% of Aachen's grid feed-in). If this electricity mix is taken into account in the balance sheet, the city's emissions fall from 2.082 million tonnes to 1.954 million tonnes of CO_2. This corresponds to a reduction of minus 28.7 % compared to 1990. The expansion of STAWAG's climate-friendly production and supply portfolio thus makes an important contribution to climate protection in the city of Aachen.

3.3.3. Changes to the accounting system

In 2014/15, there was a break in the accounting system for municipal GHG balances, as the Ecospeed accounting programme introduced new primary energy and LCA emission factors.
In particular, the change in emission factors due to the reassessment of upstream chain shares led to significantly higher GHG emissions in some cases. For 1990 and the following years alone, the factor adjustment resulted in an increase in GHG emissions of approx. 250,000 tonnes per year. The following figure provides an overview of the changes in emission factors.

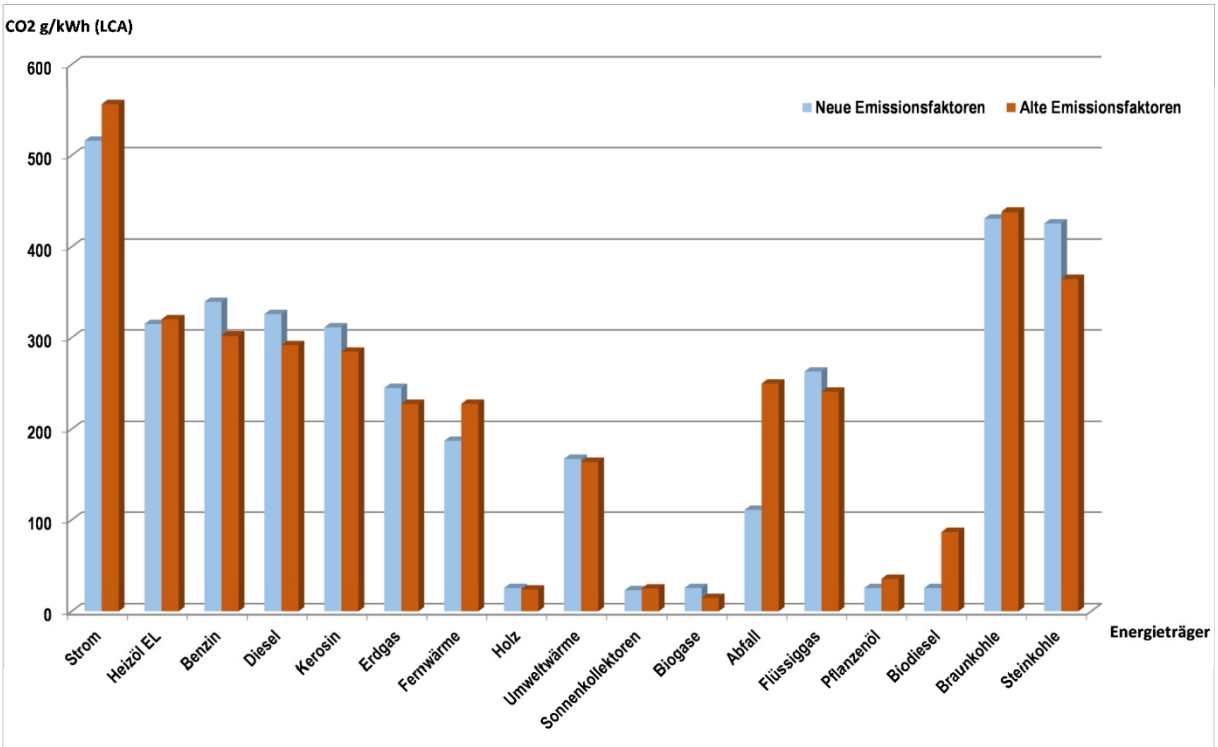

Figure 7: Overview of the changes in emission factors in 2014/2015

In 2016, the option of balancing according to the BISKO standard followed, which enables higher data quality. Previously, the City of Aachen's balance sheets were not prepared using this method, as this requires significantly more effort to obtain data and the factors and data bases provided by the IFEU Institute for Energy and Environmental Research are often difficult to understand.
In order to achieve comparability with the balances and potentials of the 2014 strategy concept, the comparative values for 1990 and 2010 in sections 4.2 and 4.3 were taken from the 2014 strategy concept, although the described adjustments to the emission factors have led to retrospective changes. The following table shows the values for 1990 and 2010 in accordance with the accounting used in the 2014 strategy concept and the methodology currently applied.

		Total balance [tonnes]	Balance without sec- tor transport [tonnes]	Transport sector balance [tonnes]
1990	Strategy concept 2014	2.497.000	1.960.000	537.000
	Current accounting method	2.741.000	2.165.000	576.000
2010	Strategy concept 2014	2.177.000	1.570.000	607.000
	Current accounting method	2.173.000	1.510.000	654.000
2018	Current accounting method	2.139.000	1.453.000	686.000

Table 4: Comparison of the carbon $_{\text{footprint}}$ of the new and old calculation methods

3.3.4. Balancing of traffic-related emissions for Aachen

3.3.4.1. Accounting for mobility to date

The assessment of emissions in the mobility sector in the city of Aachen has so far deviated from the territorial principle (data inventory was previously insufficient) according to the polluter pays principle. $CO2_{emissions}$ are calculated on the basis of parameters (number of vehicles, average mileage, vehicle class, drive type, etc.). The number and class of vehicles is based on data reported by the road traffic authorities, taking into account the drive types. The average mileage is generated from federal and regional figures. For example, an average car travelling 12,000 km per year emits approx. 2.6 tonnes of CO_2 per year[5] .
Based on these assumptions, road transport in Aachen totalled 586 thousand tonnes in 2018, 215 thousand tonnes of which came from the
consumption of petrol and 371 thousand tonnes from the consumption of diesel fuel. This is 62 thousand tonnes or 12% more than in the reference year 1990.
Due to the calculation according to the polluter pays principle, the city of Aachen's emissions from air traffic are added to the energy sources on a pro rata basis; these amounted to 100 thousand tonnes per year in 2018 alone.
Almost twice as much as in 1990 (+ 48 thousand tonnes per year).
Overall, transport-related emissions have thus risen by 19 % since 1990, from 576 to 686.

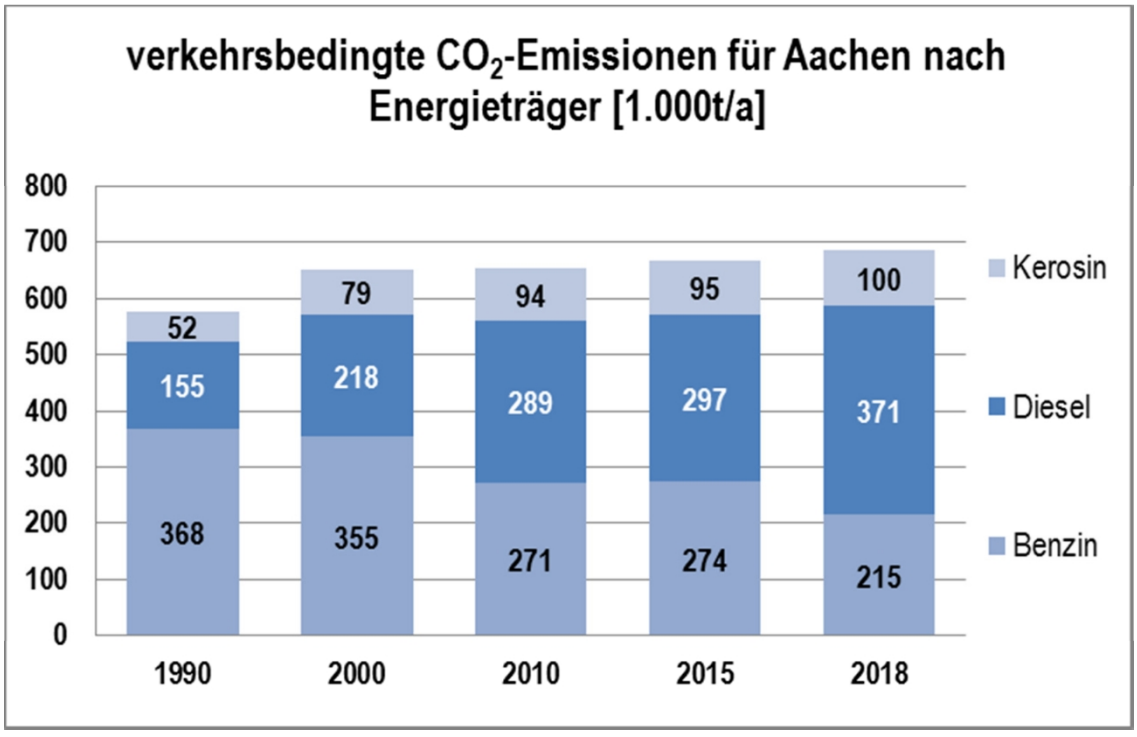

Figure 8: Development of transport-related $CO2_{emissions}$ in Aachen since 1990 (Source: City of Aachen]

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[5] The average $CO2_{emissions}$ for passenger cars for 2018 are reported as 148 g per passenger kilometre and 1.5 persons/car. This value is 220 g/km per car. The Federal Environment Agency takes into account the "direct emissions including evaporative emissions and those emissions that arise in the process chain upstream of final energy consumption". https://www.umweltbundesamt.de/themen/verkehr-laerm/emissionsdaten?sprungmarke=verkehrsmittelvergleich_personenverkehr#verkehrsmittelvergleich_personenverkehr

3.3.4.2. CO_2 emissions in the city's sphere of influence Aachen

The CO_2 calculation described above, as used by the city of Aachen, is useful for a city comparison due to the easily obtainable data. However, this calculation has the disadvantage that it cannot depict the effect of many local measures because local data is not included or is not available in sufficient detail. Furthermore, a very large proportion of emissions cannot be influenced by local measures.
In order to better illustrate the effectiveness of measures at local level, an alternative calculation is carried out according to the "territorial principle". The emissions caused by Aachen residents in long-distance transport are removed and the reduction effects on commuter traffic in the city of Aachen are added.
For the mobility analysis in the climate protection strategy, four sectors are considered in the analysis and - with the exception of long-distance transport - in the impact assessment:

1. City traffic
   - Car journeys of Aachen residents as drivers up to 10 km
2. Regional transport
   - Car journeys of Aachen residents as drivers of 10 - 50 km
   - Car journeys by commuters in the city of Aachen
   - Car journeys by visitors in the city of Aachen
3. Commercial vehicles and vehicle-related measures in passenger car traffic
   - Bus transport
   - Commercial vehicles (region)
   - Vehicle-related measures in car traffic
4. Long-distance transport
   - Car journeys over 50 km by Aachen drivers
   - Commercial vehicles (long-distance transport)
   - Air transport

Passenger transport

Representative data from the 2017 "Mobility in Germany" study is available for the journeys made by Aachen's population:

- The average number of journeys is 3.5 per inhabitant per day.
- The average daily distance is 41.6 km per person.
- The average distance travelled per year thus adds up to around 15,000 km per inhabitant.
- 893,000 paths and
- 10,600,000 million kilometres.

The journeys made by Aachen residents are available for 2017, broken down by distance class.

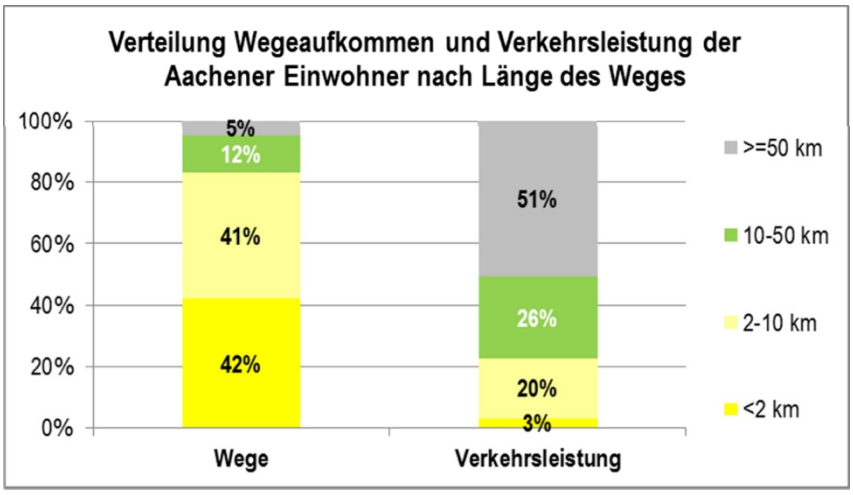

Figure 9: Journeys and mileage of Aachen residents (source MiD for Aachen 2017)

Figure 9 shows that 42% of journeys made by Aachen residents are within the distance range of up to 2 km. A further 41 % are travelled between 2 and 10 km. In simplified terms, these 83 % of journeys are regarded as "**urban transport for Aachen residents**". The city of Aachen has a great deal of room for manoeuvre here. However, this area only accounts for **23% of the transport performance**, i.e. the kilometres travelled by Aachen's population.
A further 12% of Aachen residents' journeys are made between 10 and 50 kilometres (**regional transport for Aachen residents**). Here, the city of Aachen is involved in regional decisions and projects and has an indirect influence on the framework conditions for mobility. These journeys account for **26% of transport performance**.

Long-distance journeys by Aachen residents (> 50 km) account for **51% of transport performance** and thus also of CO2 emissions. This accounts for 5 % of all journeys made. Regulations for long-distance road and rail transport are outside the sphere of influence of the City of Aachen. Therefore, no measures are proposed here and reference is made to the responsibility of the state, federal government and EU for the creation of appropriate framework conditions to reduce CO_2 emissions from transport.
This total traffic performance - combined with the shares of motorised private transport (MIT, drivers) in the trips in the four selected trip length ranges - results in the traffic performance in car traffic shown in Table 5: 19 % of the traffic performance of MIT in Aachen is generated in urban traffic up to 10 km, 28 % in regional traffic from 10 to 50 km.

Path length range	Transport performance		Share of the	Transport performance MIV		CO2 emissions
	[km/d]	*%*	MIV	*[km/d]*	*%*	*[1000t/a]*
<2 km	339.009	3%	20%	67.802	1%	5
2-10 km	2.074.317	20%	43%	891.956	18%	72
10-50 km	2.801.928	26%	50%	1.400.964	28%	112
>=50 km	5.392.746	51%	50%	2.696.373	53%	217
Car traffic in Aachen	10.608.000	100%		5.057.095	100%	406

Table 5: Determination of car traffic performance in Aachen

With $CO_{2\ emissions}$ of 220 g / km car journeys, this results in 406 thousand tonnes of CO_2 from motorised private transport in Aachen, 47 % or 190 thousand tonnes of which are in the range up to 50 km.

Other transport services

In order to complete the transport "in Aachen" for the climate balance according to the territorial view, the following transport must be added:

a) Bus transport
b) Commuter traffic
c) Visitor traffic
d) Freight transport with "light" commercial vehicles
e) Freight transport with "heavy" commercial vehicles
f) Air transport

The respective $CO2_{emissions}$ for this are shown in the following table, divided into four sectors.
The $CO2_{emissions}$ for these sectors were roughly estimated for the 2020 climate protection concept. The exact data must be determined in a more detailed analysis.
In total, this results in transport-related CO_2 emissions for Aachen of **740 thousand tonnes.** This results from the traffic of the residents of Aachen of 686 thousand tonnes - according to the previously used CO_2 accounting - and the traffic of commuters and visitors to Aachen of around 54 thousand tonnes of $CO_{2/a}$.

CO_2 emissions for Aachen by transport sector

estimated values (!)

Transport sector	Hint	Vehicles	km/vehicle	km/d	d/a	g/km	1000 t/a	% total
City traffic				959.758			77	10%
City traffic d. AC w. Car	0-10 km	*110.000*	*n.a.*	959.758	365	220	77	10%
Regional transport				2.371.164			166	22%
Regional sales of AC w. Car	10-50 km	*110.000*	*n.a.*	1.400.964	365	220	112	15%
Commuters by car	Traffic in AC	54.000	14	756.000	220	220	37	5%
Visitors by car	Traffic in AC	15.300	14	214.200	365	220	17	2%
Commercial vehicles				1.055.000			144	19%
light commercial vehicles (region)	50 km/d	20.000	50	1.000.000	300	400	120	16%
Bus transport	ASEAG	220	250	55.000	365	1200	24	3%
Can be influenced by AC				4.385.922			387	52%
Long-distance transport				2.796.373			353	48%
Long-distance transport by car	> 50 km	*110.000*	*n.a.*	2.696.373	365	220	217	29%
Heavy commercial vehicles (long-distance)	> 50 km/d	200	500	100.000	300	1200	36	5%
Air transport				nn			100	14%
Total							740	100%
of which car traffic				5.057.095			406	55%

Table 6: Estimate of $CO2_{emissions}$ by transport sector for 2018

According to the introductory explanation, **only half of the emissions shown here (387,000 tonnes) can be indirectly influenced by the City of Aachen**!
Or to put it another way: 387,000 tonnes of $CO_{2\ reduction}$ is the **maximum savings potential** for local measures.
The graphical breakdown shown in the following figure is as follows: urban transport contributes 20 %, regional transport 43 %, commercial vehicles 31 % and bus transport 6 %.

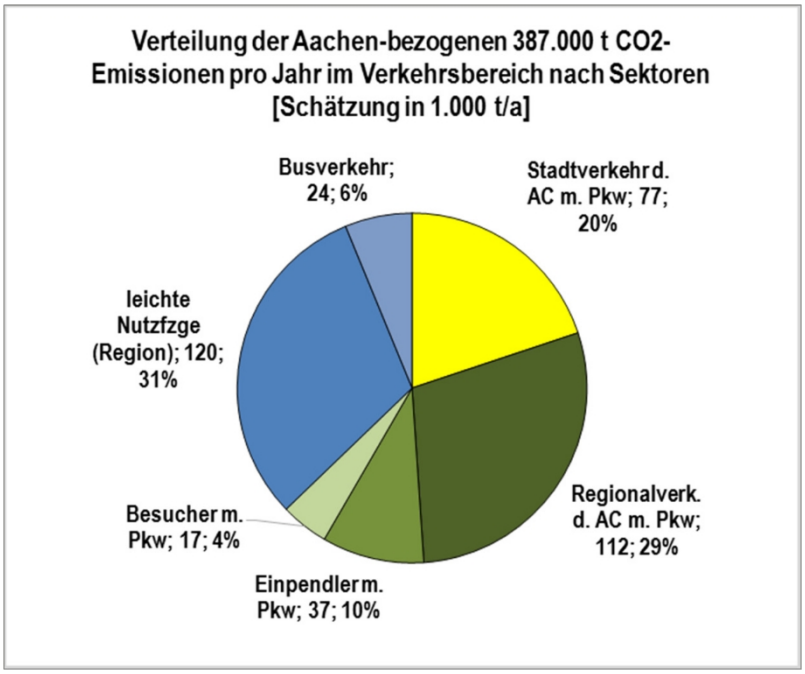

Figure 10: CO_2 reduction $_{potential}$ for mobility measures in Aachen

For this breakdown by sector, it was estimated for 2018 how the 19 % increase in $CO_{2\ emissions}$ since 1990 in transport for Aachen, calculated using a different method, is distributed across the sectors due to more vehicles and higher mileage.
The increase of 19 % is mainly due to an increase in air traffic and long-distance transport, whose growth was estimated at 40 %.
A reduction of 10 % was assumed for urban transport in line with the decline in the proportion of motor vehicles in the modal split. Regional transport was left unchanged. An increase of 20 % was attributed to the commercial vehicle sector due to growth in delivery traffic.
With these assumptions, the local $CO_{2\ emissions}$ related to Aachen would only have increased slightly by 4 % since 1990.

CO2 emissions in thousand tonnes per year			
Sector	**1990**	**Change**	**2018**
City traffic	86	-10%	77
Regional transport	166		166
Commercial vehicles	120	20%	144
Aachen traffic	**372**	4%	**387**
Long-distance transport d. Aachener	252	40%	353
Total traffic	624	19%	740

Table 7: Estimate of the distribution of emissions growth in transport since 1990 by sector

4. Overall strategy
Climate protection Aachen 2030

4.1. Pioneering strategies in existing concepts and action plans

The large number of existing concepts of the City of Aachen (see section 3.2.2) shows the structured strategic action of the city in the area of climate protection. The concepts contain strategic statements on increasing climate protection with different focal points. The following list provides an overview of the currently relevant concepts and strategic statements.

Name of the concept	Time horizon	Time of completion	Responsible
Strategy concept 2030 with action programme 2020	2030 (strategy), 2020 (action programme)	November 2014	City of Aachen
Regional Energy Plan Aachen 2030 (REPAC), recommendations for action for the expansion of renewables (project render)	2030	September 2018	Innovation group regional energy transition dialogue (ren- der)
Energy policy work programme (EPA, European Energy Award Management), Action plan	2019-2022	2019	City of Aachen
Sustainability Strategy City of Aachen: Agenda 2030 - Goals for sustainable development, Sustainable Development Goals (SDGs), priority topics incl. Measures	2030	July 2018	City of Aachen
Adaptation to the consequences of climate change - city-wide concept with Work programme and action plan	2017-2021 (Implementation timetable)	Jan. 2019	City of Aachen
Clean air plan for the city of Aachen - 2nd update 2019	2020 ff	January 2019	Cologne district government
Mobility Strategy Aachen 2030, Part 1 + 2	2030	2019 + 2020	City of Aachen
Green City Plan #AachenMooVe! (Emissi-free city centre), action plan	2021	2019	City of Aachen

Table 8: Overview of concepts and action plans relevant to climate protection

Strategy concept 2030

The strategy concept, the first version of which was finalised in 2014 on the basis of data from 2010/11, specifies GHG reduction targets and provides an overview of the potential in various action areas for achieving the targets by 2020 and 2030 (see also sections 4.2 and 4.3).

Regional Energy Plan Aachen 2030

The Regional Energy Plan Aachen (REPAC), which was developed as part of the render project, analyses the current status quo and the expansion potential of renewable energies in the Aachen city region. The basis for the study is the goal of the Aachen city region to increase the share of renewable energies in electricity consumption to 75 % by 2030.
The analyses of the energy plan show that the amount of electricity generated from renewable energies is currently 16 % of total electricity consumption. Based on the analyses, renewable electricity generation plants with an annual electricity generation of 1,750 GWh/a must be installed by 2030 in order to achieve the target of 75% renewable energies in the electricity sector.
Against this backdrop, the concept analyses various expansion options ("Continue as before", "We'll make an effort" and "We'll reach the target") up to 2030, focusing on the expansion of wind energy and rooftop and ground-mounted PV. Biomass and sewage gas are also included in the analyses. In addition to the theoretical analyses, the acceptance of the expansion of renewable energies was determined through population surveys. Based on the expansion options and surveys, the Aachen Regional Energy Plan (REPAC) identifies recommendations for action.

European Energy Award®

The City of Aachen has been participating in the international quality management and certification system European Energy Award® (eea) since 2009. This means that progress in the area of energy and climate protection is analysed on an annual basis, measures are recorded, strengths and weaknesses are examined and new projects are developed. Every four years, the administration undergoes certification by an external assessor and, following the audit, is compared with other eea-certified cities on a national and international level as part of the eea benchmarking process.
As part of the eea, the city has carried out a comprehensive inventory of all energy-relevant measures and developed a large number of future-oriented projects, e.g. for greater energy efficiency, energy savings and renewable energies. These are summarised in an energy policy work programme. It thus represents an overall view of the planned activities of the City of Aachen to achieve the climate protection targets over a 4-year period, which are already being prepared or implemented independently of this strategy concept.
The city of Aachen was last audited in 2019 in the eea certification process, receiving the eea Gold Award for 84% of the achievable points. In the benchmark of over 300 German eea cities over 100,000 inhabitants, Aachen was in second place behind Münster.

Sustainability Strategy City of Aachen: Agenda 2030 - Goals for sustainable development, Sustainable Development Goals (SDGs)

The basis for the implementation of the SDGs in Germany is the German Sustainable Development Strategy adopted by the Federal Government in January 2017. It is the most comprehensive further development of the federal strategy since its creation in 2002 and concretises the United Nations SDGs for Germany. The core idea of the guiding principle of sustainable development is that the global community must not live at the expense of future generations, and individual societies must not consume at the expense of people in other regions of the world. Even if the city of Aachen is already acting in line with the sustainability goals in many areas, there is still potential for optimisation. This applies, for example, to the topics of consumption, health and sustainability in digitalisation. The involvement of children and young people in sustainability processes was described at the "Together for Sustainability" event organised by LAG 21 on 28 February 2018 as still having room for improvement, as was sustainability in housing and neighbourhood development. The latter can be exercised by the administration within the scope of its financial capacity, particularly in the case of its own upcoming new construction projects. The involvement of civic engagement is just as important as the role model function of the city administration.
The following strategic priority topics related to climate protection were adopted by the City Council on 11 July 2018 (the target numbering refers to the SDGs)
Goal 3 Health and well-being: Clean air plan, low-emission city centre action plan; noise action plan to reduce pollution, particularly from motorised private transport; emission-free city centre action plan
Goal 7 Sustainable energy: Linking the energy and mobility transition by utilising renewable energies for e-mobility and increasingly coupling own power generation from renewables with storage systems
Goal 9 Sustainable industrialisation, innovation and infrastructure: sustainable structures / digitalisation
e.g. to reduce emissions in the mobility sector. This includes, for example, networked mobility services such as Mobility Broker or the time- and distance-saving eGovernment of the city administration.
Objective 11 Sustainable cities: Implementation of the concept for the further development of neighbourhood management, particularly with regard to locations with social challenges and with a focus on networking work
Objective 12 Sustainable consumption: Make the Fairtrade city better known in order to raise awareness and motivate people to get involved; campaign and action days together with the stakeholders, organise sustainability festival/action day with all stakeholders for the citizens.
Goal 13 Climate protection and combating climate change:

- Implement climate adaptation work programme and strategic roadmap, e.g. inform property owners about the dangers of heavy rainfall
- Information on the importance of green spaces / unsealing
- Campaign for a more beautiful schoolyard with partial unsealing and tree planting
- Anchoring and implementing sustainability criteria for new construction and renovation of municipal buildings in the planning guidelines of building management, e.g. as part of the Zollamtstrasse new construction planning (in addition to high energy standards - such as those achieved with the Plus-Energy Youth Centre building).

and Sandhäuschen day-care centre - sustainability criteria are to be added to the planning guidelines).

Objective 15 Land ecosystem protection: The redrafting of the landscape plan is underway. As part of this, the concept for the promotion of biodiversity in agriculture presented to the Environment Committee in March 2018 is to be implemented.

Goal 17 Global partnerships for sustainable development: Aachen-Cape Town partnership, support for the partnership association, exchange project with Cape Town "Learning from each other"

Adaptation to the consequences of climate change - city-wide concept with implementation roadmap

Based on previous experience and an inventory and analysis of the potential for optimisation, an overall strategy will be developed as part of the concept that illustrates the City of Aachen's priorities in dealing with the consequences of climate change and forms the framework for action for the coming years. The overall strategy identifies the specific fields of action, prioritises the identified impacts of climate change according to their significance for the municipality and sets targets.

In accordance with the main areas of impact for the city of Aachen, extreme/heavy rainfall and heat, the implementation roadmap contains measures in the following priority areas:

- Measures against the dangers of extreme/heavy rainfall
  - Hazard analysis and derivation of measures against heavy rainfall
  - General water-sensitive planning
- Measures against the effects of heat
  - Securing fresh air pathways
  - General measures against heating
- Environmental assessment, B-planning, project-related planning
- Green planning

Clean air plan of the city of Aachen

The aim of the clean air plan is to reduce compliance with the applicable limit values - in particular particulate matter and nitrogen dioxide emissions - through targeted measures. This was achieved through a variety of measures, particularly in the area of transport, such as promoting cycling, electrification of transport, reducing emissions by retrofitting filters in public transport, increasing parking charges, extending the 30 km/h speed limit, digitalisation and networking. Some of the measures were taken from existing concepts and some were specifically reorganised.

Mobility Strategy Aachen 2030 in the Transport Development Plan (VEP) process

The Mobility Strategy 2030 is the core component of transport development planning. It defines the challenges, structures, goals and strategies.

In January 2020, the "Objectives and indicators of transport development planning" section was adopted. The objectives were concretised for six overall objectives:

- High road safety
- Environmentally and socially compatible mobility
- City of short distances
- Good accessibility
- Reliable and convenient mobility services
- Efficient and affordable mobility for the city and its citizens

For climate protection, it was determined that $CO_{2\ emissions\ should}$ be reduced by 2030 compared to 1990 by

- 20 - 39 % as a slight improvement
- 40 - 55 % as a medium improvement and
- more than 55 % (in line with the general climate protection target for Germany) can be seen as a significant improvement.

Implementation strategy in the #AachenMooVe project!

In 2016, the city of Aachen was awarded the **#AachenMooVe!**[6] project in the state competition "Emission-free city centre" within the climate protection programme of the state of NRW. The topics

1) Expansion of footpath and cycle path network
2) Mobile stations
3) Mobility management
4) Emission-free urban logistics and
5) Electromobility programme

are being addressed with key projects. The project is anchored in the budget of the city of Aachen with around € 15 million in expenditure over 3 years and around € 12 million in funding. As part of the project application, a $CO_{2\ reduction}$ potential of 10 thousand tonnes per year was determined. This corresponds to 1.5 % of CO_2 emissions in the transport sector according to the carbon footprint (686 thousand tonnes per year, see Table 9) or 2.6% of the $CO_{2\ emissions}$ that can be influenced by Aachen (387 thousand tonnes per year).

4.2. Adopted targets, target achievement and target paths

4.2.1. Reduction targets and Target achievement

The 2030 strategy concept, the first version of which was finalised in 2014, considers two key climate protection targets for the city of Aachen. Firstly, the city of Aachen has committed to reducing $CO_{2\ emissions}$ by 40 % by 2020 compared to the base year 1990 (City Council 12 October 2011).

The second climate protection target considered in the concept is to halve per capita emissions by 2030 compared to 1990. This target definition is based on the City of Aachen's membership of the European Climate Alliance (Council resolution of 30 January 1991), to whose goals the city has committed itself by joining. Be-

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[6] Brief description of the project at www.aachen.de/aachenmoove

Based on the 1990 baseline of 10.8 tonnes of CO_2 per inhabitant, the target is 5.4 tonnes by 2030. In 2018, per capita CO_2 emissions in the city of Aachen amounted to 8.32 tonnes. The recommendations for action as part of the update of the Climate Protection Strategy 2030 are geared towards achieving this 50% reduction target for 2030 - now based on the 1990 emission values. In the following analysis, the absolute CO_2 emission values serve as the basis, not the per capita emissions.

In contrast, the federal government aims to reduce GHG emissions by 55% by 2030. The following figure shows the different target horizons.

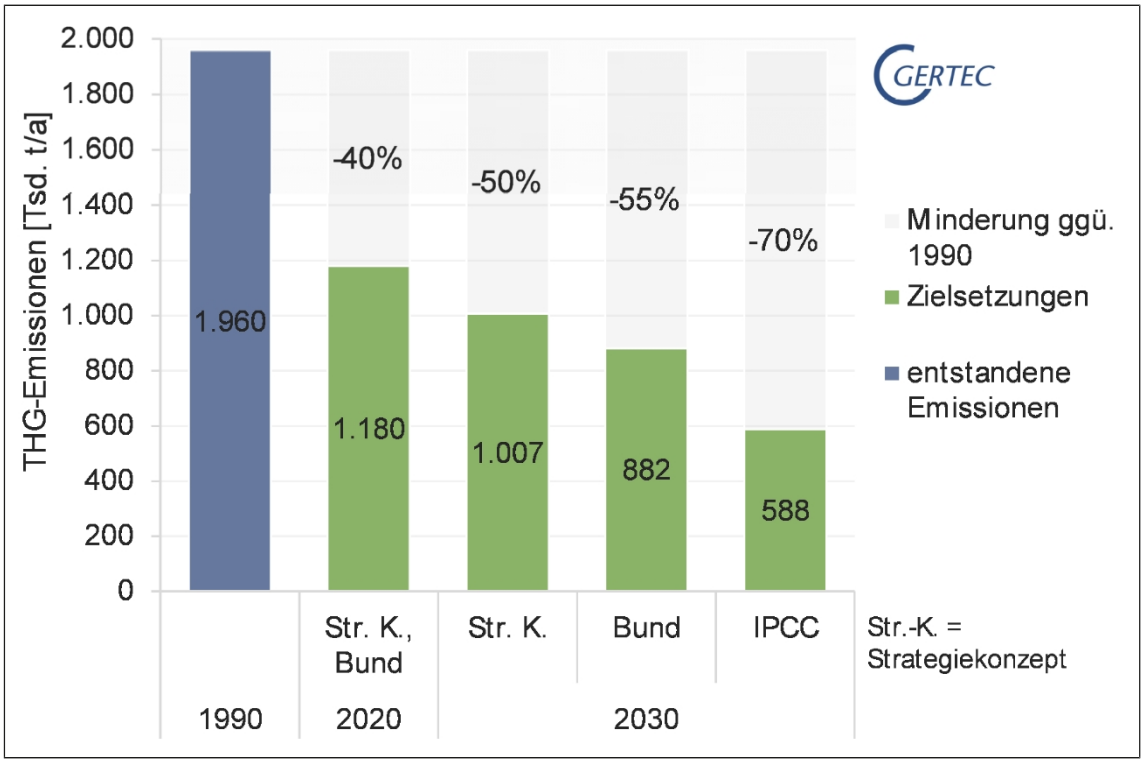

Figure 11: Reduction targets for 2020 and 2030 - Aachen, Germany, IPCC

The most recent city-wide carbon footprint for 2018 shows a reduction of 22 per cent compared to 1990. As emissions have actually increased in the last two years, it is unlikely that the 40 per cent target will be achieved; instead, it can be assumed that this target will be missed by almost half in 2020.
Transport was excluded from the presentation of the CO_2 reduction strategy in 2014, as the process of developing the transport development plan (VEP) had just begun. The transport sector, which is responsible for 32% of GHG emissions (see Figure 6), is included in the current adaptation of the 2030 climate protection strategy presented here. The following table therefore shows the target values overall and differentiated according to the transport sector and the other sectors. The target corridor, actual development in CO_2 emissions and the resulting gap are shown in each case.

	1990	2018	Amendment	Target 2030 (50 from 1990)	Difference to the 2030 target
	[t/a]	[t/a]	[%]	[t/a]	[t/a]
Total CO_2	2.741	2.139	-22	1.371	769
CO_2 without transport	2.165	1.453	-33	1.083	370,5
CO_2 Transport	576	686	19	288	398

Table 9: CO_2 emissions, reduction targets and difference to target achievement in 2030

The different emission values for 1990 in this table compared to the previous figure are due to the change in the accounting method. This is explained in chapter 3.3.3. As CO_2 emissions in the transport sector have increased by 19 %, whereas a reduction of 33 % can be seen in the other sectors, the difference to the 2030 target value is particularly high in this sector. Compared to the baseline value, the target and reality are particularly far apart here. Although emissions from transport currently account for 32% (see Figure 6), the absolute quantities that need to be reduced by the 2030 target are of a similar order of magnitude to the other sectors.
The large deviation of the actual CO_2 emission values from the target set for 2020, a reduction of 22% instead of 40%, was one of the reasons why the Aachen City Council declared a climate emergency on 19 June 2019. With the climate emergency, politicians called for a reorientation of the city's climate protection target in line with the scientific findings on global warming, in particular to meet the UN targets of
Paris. The Aachen City Council has consistently responded to the dependence of global warming on the absolute amount of greenhouse gases in the atmosphere and redefined the city's climate protection target on 22 January 2020. The City of Aachen is the first city in Germany to take into account its share of the remaining greenhouse gas budget in order to keep global warming below two degrees.
In 2018, the UN Intergovernmental Panel on Climate Change (IPCC) presented its special report on how much CO2 emissions humanity can still produce in order to stay within the limits of 1.5 and 2 degrees of global warming: 420 gigatonnes (Gt) globally for 1.5 degrees and 1170 Gt for 2 degrees. The world currently emits 42 Gt annually - and the trend is rising. If emissions remain the same, the remaining budget to limit global warming to 1.5 degrees would be used up in ten years.
The German Advisory Council on the Environment (advisory body to the German government) averages the IPCC's figures in its special report to a maximum temperature rise of 1.75°C and a remaining global CO_2 emissions budget of 800 Gt. This results in a remaining national CO_2 budget for Germany of 6.6 Gt or 6,600 million tonnes of CO_2 from 2020 onwards - disregarding historical emissions and assuming an even distribution among the world's population. Greenhouse gas emissions in Germany currently amount to 866 million tonnes per year.[7]

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[7] Open letter 16 September 2019, https://www.umweltrat.de/SharedDocs/Downloads/DE/04_Stellungnahmen/2016_2020/2019_09_Brief_Klimakabinett.pdf? blob=publicationFile&v=5

The permissible residual budget of CO2 emissions for the city of Aachen

In order to break down the still permissible CO2 budget of the Federal Republic of Germany to the city of Aachen, the basis of the balance must be adjusted. While the city's CO2 balance includes emissions from combustion, the Federal Republic's balance also includes the polluters agriculture, industrial processes and waste management. This share (15 %) must be deducted from the transfer to the city. This leaves 5,610 Gt CO2 of the 6,600 Gt CO2 from incineration nationwide to meet the Paris targets (average of 1.75 degrees).
CO2 emissions in Aachen amounted to 2.139 million tonnes in 2018.[8] If these quantities are set in relation to the comparable CO2 emissions in Germany as a whole, the total amount of CO2 still permitted to be emitted in order to meet the Paris targets is 16.3 million tonnes in absolute terms for the city of Aachen. The city intends to comply with the remaining CO2 budget of 16.3 million tonnes in relation to the global residual CO2 budget (IPCC) within the scope of its municipal possibilities. In the last 10 years alone, 21.42 million tonnes of CO2 have been emitted in the city of Aachen.

	Current annual CO2 emissions of all polluters	**Current annual CO2 emissions less 15% (agriculture, industrial processes, waste management) partnership)**	**Total amount of CO2 permitted by 2050 (all polluters)**	**Permissible amount less 15% (agriculture, industrial processes, waste management)**	**From 2020 until Quantity still permitted per year in 2050**
	[million tonnes]	[million tonnes]	[million tonnes]	[million tonnes of CO2]	[million tonnes of CO2]
Germany	866	736	6.600	5.610	220
Aachen		2,139		**16,30**	**0,543**

Table 10: Determining the amount of CO2 still permitted to meet the 1.75-degree Paris target

The climate protection strategy of the City of Aachen presented in this paper is based on halving CO2 emissions from 1990 to 2030, i.e. a target value of 1,370,000 tonnes of CO2 in 2030. This means a difference of 768,500 tonnes compared to "today" (assumption 2020), as shown in the following table.

emissions 1990	**Emissions 2018 Assumption as in 2020**	**2030, 50% reduction tion since 1990**	**Difference 2020 until 2030**	**that would be a reduction every year for 10 years by 76,900 tonnes**
[tonnes of CO2]	[tonnes of CO2]	[tonnes of CO2]	[tonnes of CO2]	[tonnes of CO2]
2.741.000	2.139.000	1.370.000	768.500	76.850

Table 11: Target visualisation 2030 according to 50 % reduction compared to 1990

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[8] This includes transport emissions of 686 thousand tonnes per year.

The total permissible emissions of 16.3 million tonnes of CO_2 would be reached at the 50% reduction rate in 2028, and the $CO2_{budget}$ under the Paris Agreement would be exhausted. This illustrates the difference between percentage reduction targets and absolute emission levels, which is why scientists are currently pushing for fixed budgets to be set in the debate.[9]

For the City of Aachen's Climate Protection Strategy 2030, the climate protection goal of complying with the residual $CO2$ budget in accordance with the Paris targets means that scenarios will be developed as quickly as possible in parallel with the implementation of the reduction by half (1990 as the basis), which means climate neutrality for the City of Aachen in individual fields of action from 2030 at the latest. An update of the integrated climate protection concept presented here - as of 2020 - will have to follow in this sense.

The figures on the $_{remaining}$ local $CO2_{budget}$ are scrutinised below to determine what emission-reducing measures are feasible at municipal level. On the one hand, a limited urban territory restricts the use of renewable energies, while on the other hand the municipal competence for legal regulations is limited.

Target analysis in the area of mobility

The reduction of emissions in the transport sector has been a central goal in Aachen's transport planning for many years. In the "Vision Mobility 2050" and the currently developed "Mobility Strategy 2030", this goal was described in detail and operationalised using various indicators.

The Mobility Committee of the City of Aachen assessed **a reduction in transport-related $CO2_{emissions}$ by 2030 of more than 55% compared to 1990 as a significant improvement.** However, there is no explicit decision by the Mobility Committee as to whether the target will be achieved.

One focus at the measure level is to make eco-mobility more attractive. With the 2017 mobility survey, it was possible for the first time to document a reduction in the proportion of motorised private transport to 46% of all journeys made by Aachen residents (33.6% as drivers and 12.6% as passengers) compared to the 51% recorded in 1990 and 2011 with a representative survey.

Furthermore, the expansion of electromobility has long been pursued to reduce emissions from car traffic.

The Aachen "Vision Mobility 2050" refers in its environmental policy objectives to the EU's 2011 "White Paper on Transport", which formulated the European goal of achieving emission-free or climate-neutral transport by 2050.

In 2019, the German government decided in its Climate Action Plan 2050 that emissions in the transport sector should fall by 40 - 42 % by 2030. According to a recent publication, the Federal Environment Agency only considers this to be feasible[10] if, among other things

- the permissible emissions from new cars and commercial vehicles are to be greatly reduced,
- a mandatory quota for the proportion of zero-emission vehicles is introduced and
- an increase in the cost of motorised traffic and a reduction in government incentives for car traffic.

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[9] https://taz.de/CO2-Budget-fuer-Deutschland/!5642592/

[10] Federal Environment Agency (2019): "No reason for a gap", https://www.umweltbundesamt.de/publikationen/kein-grund-zur-luecke

The reduction in emissions is the result of a decrease in emissions per kilometre driven by lower-emission new vehicles and a decrease in mileage by owners of existing vehicles.

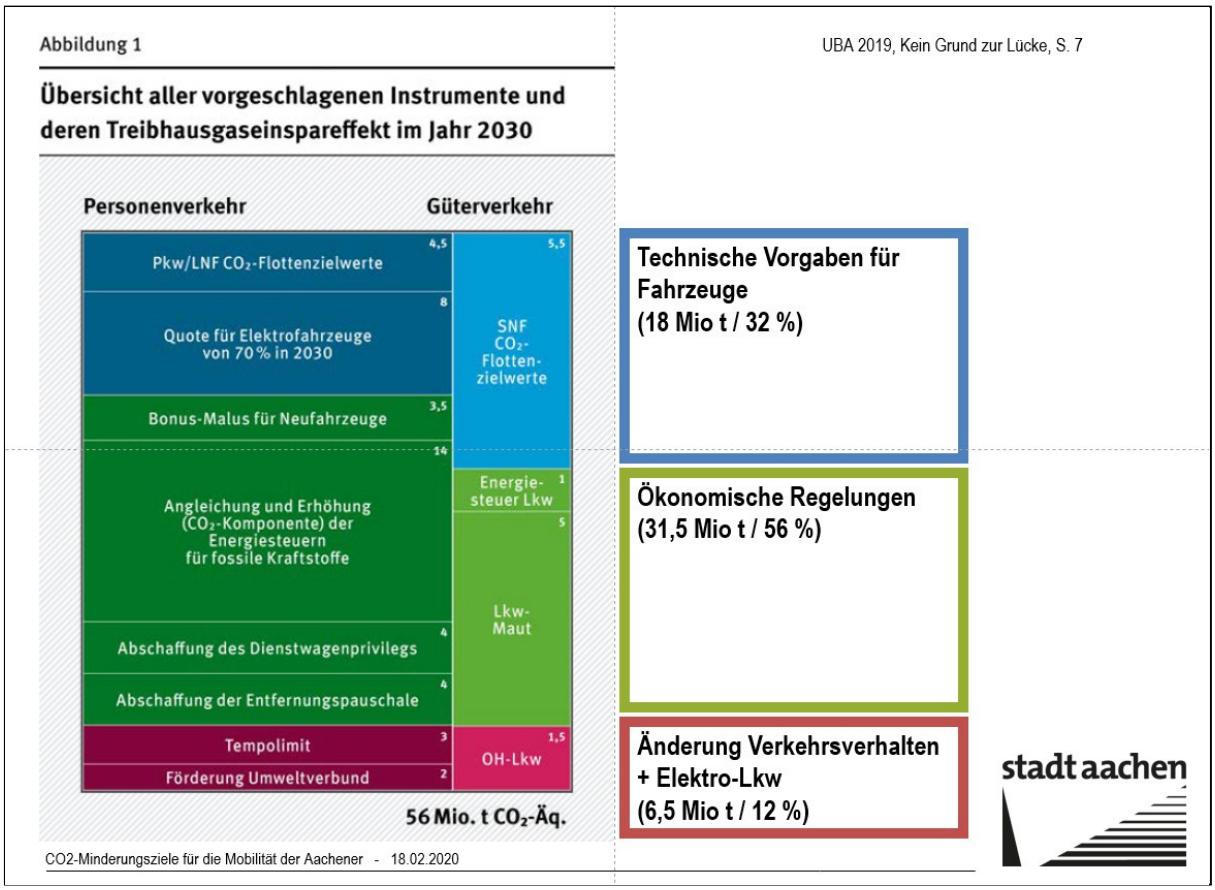

Figure 12: Package of measures proposed by the Federal Environment Agency to reduce transport-related emissions by 40 - 42 % by 2030

The city of Aachen considers itself to be well on the way to achieving city-compatible and low-emission transport in Aachen. Many efforts have already been made in the past to emphasise this claim:
Among other things, an "Emission-free mobility" staff unit was set up at the Lord Mayor's office in 2016, a GreenCity Masterplan was developed and numerous projects to promote environmentally friendly mobility were acquired. Particularly noteworthy is the award of the #AachenMooVe! project in the state competition "Emission-free city centre" within the climate protection programme of the state of NRW. The topics

1) Expansion of footpath and cycle path network
2) Mobile stations
3) Mobility management
4) Emission-free urban logistics and
5) Electromobility programme

are being worked on with significant projects. The project is anchored in the budget of the City of Aachen with expenditure totalling around € 15 million over 3 years and funding of around € 12 million. Creating the conditions for 100% electrification of the ASEAG fleet was part of the first project outline submitted to the state. This part had to be removed from the application for funding reasons. In the

As part of the project application, a CO_2 reduction potential of 10 thousand tonnes per year was determined. This corresponds to 1.5 % of the CO_2 emissions in transport according to the climate balance (686 thousand tonnes per year, see Table 9) or 2.6 % of the CO_2 emissions that can be influenced by Aachen (387 thousand tonnes per year, see Chapter 3.3.4.2).
In October 2019, the representatives of the majority factions on Aachen City Council publicly expressed their desire for an expansion of rail transport ("RegioTram"), among other things, in advance of which a massive expansion of bus transport by "100 - 200 additional buses" is desired.
In December 2019, the municipal transport company ASEAG published a "Vision 2027", which outlines ways to make bus transport more attractive. It proposes a 30% increase in public transport services, an expansion of bus lanes ("strong axes"), the expansion of mobile stations and networked mobility services. ASEAG estimates the additional financial requirement at € 30 - 40 million per year.
In order to expand cycling, the city administration has developed a priority cycle route concept that provides for the development of primarily radial cycle connections from the city districts and the region to the city centre. Cyclists should be able to travel safely and comfortably on 10 routes covering around 60 kilometres on high-quality infrastructure.
In November 2019, the Aachen City Council approved the objectives of the cycling referendum, which go far beyond the previously formulated objectives of the City of Aachen. The administration determined and communicated an estimated cost volume of €91.2 million for the referendum during the process. The costs of around €10 million
per year corresponds to a value of € 40 per year and inhabitant compared to around € 4 per inhabitant and year in Aachen.
In view of these new developments, there is justified confidence that a further significant shift from car journeys to eco-mobility in Aachen and the surrounding area can be achieved by 2030. In the Mobility Strategy 2030, an increase in the proportion of journeys made by Aachen residents using eco-mobility from 54% to 64% was defined as a "strong improvement".

4.2.2. Possibilities and limits of municipal action against climate change

The contribution of municipalities and cities is essential when it comes to climate protection. Although most of the targets and tasks are set at national or international level, the implementation of these targets and guidelines takes place primarily at municipal level. The city of Aachen therefore also has a responsibility to implement the proclaimed goals in the form of measures and targets in order to make a contribution to climate protection. The municipalities also have a role model and model function, because without committed municipalities it is not possible to achieve the climate protection goals that have been set.

Direct influence of the City of Aachen

In the area of energy planning, the city has the opportunity to develop areas for a sustainable energy supply, e.g. for the utilisation of renewable energies or for CHP plants. Together with its municipal utilities, it can analyse and initiate potential for more renewable heat supply.

In the transport sector, it can accelerate the switch to climate-friendly mobility through infrastructural measures that improve the quality for pedestrians, cyclists and bus users. Car park management and subsidies, such as for cargo bikes, have a reducing effect on car traffic.
A major building block is the city's role model effect. If the city of Aachen shows its citizens what is possible and sets a good example in climate protection, the measures presented become credible and can encourage residents to take action. The municipal administration can serve as a role model for many stakeholders by taking measures in its own properties, in procurement and by changing the user behaviour of its employees. Some cities in NRW are currently having corresponding master plans developed to achieve a climate-neutral municipal building stock. On the one hand, to save costs in the long term and relieve the burden on the municipal budget and, on the other, to show what is technically possible and to set a positive example in climate protection.

Examples from the programme of measures for Aachen include the following measures

- Renovation of municipal buildings
- Utilisation of solar energy, i.e. installation of PV systems on municipal buildings
- Mobility management (job ticket, e-vehicle fleet)

In addition to setting an example, the city can have a guiding effect within the framework of municipal planning sovereignty, e.g. through specifications in binding urban land-use planning (in development plans or urban development contracts and implementation agreements) or in purchase and leasehold agreements. The mandatory use of renewable energies can also be stipulated. Furthermore, the option of stipulating the obligation to connect to and use local and district heating lines should be examined. The obligation to connect leads to higher capacity utilisation and thus also the calculability of the network.

Indirect influence of the City of Aachen

Municipal climate protection activities are generally characterised by the fact that the municipality - often in cooperation with the local municipal utilities - takes on the role of initiator, supporting changes towards more climate protection in civil society and in companies. Here, too, the measures are diverse: in Aachen, advisory centres such as altbau plus and effeff.ac are now well established. The possibilities for motivating action through information range from information campaigns for citizens to events for companies or networking opportunities for various stakeholders. Municipal funding programmes can also be used to initiate measures for implementation.
The strategy concept for the city of Aachen has developed a wide range of measures aimed at achieving these indirect effects. Examples include

- Subsidy programme for renovating old buildings and for PV systems
- Bonuses to reward savings in schools
- Advice modules such as renovation advice in neighbourhoods, advice on the use of renewable heat or for businesses

The extent to which the estimated quantitative effects actually materialise depends on numerous overarching framework conditions, which the city can only partially influence positively itself.
In general, the acceptance of municipal planning by the public is of crucial importance. Success also depends on how municipal action and measures are communicated in society,

is discussed and successfully implemented. However, aspects such as the administration's commitment to the topic of climate protection and the quality of the individual measures also influence the success of the measures to achieve the climate protection targets.
It is therefore necessary for the topic of climate protection to be strongly integrated into municipal administrative processes, also in order to give the topic the necessary weight in decision-making.

Can global climate protection targets be transferred 1:1 to the city of Aachen? - The influence is limited

It is difficult to predict the extent to which the municipal influence on the city as a whole will have an impact over a long period of time. The direct possibilities for influencing the city of Aachen's greenhouse gas emissions with full controllability and responsibility are very limited to around 2 % of the city's total emissions, see figure.

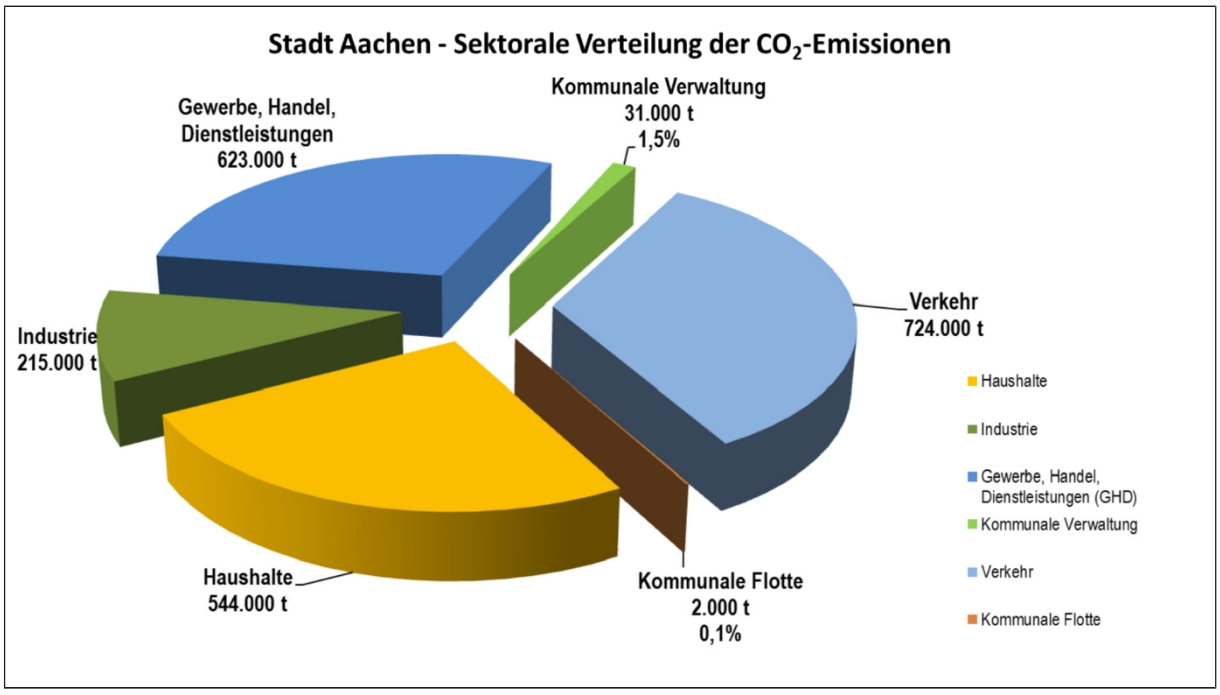

Figure 13: Sectoral distribution of $CO2_{emissions}$ in the city of Aachen

However, even in the areas of action in civil society and companies that can be indirectly influenced by the city, a large number of overarching factors influence the success of municipal action, which cannot be changed by the city, but only at state, federal and EU level. Some aspects have been decided since the deliberations on the Climate Protection Act, others are still under discussion.
The effectiveness of municipal measures depends to a large extent on the outcome of political decisions.
Examples of this are

- The determination of the $CO2_{price}$, which has an incentivising effect on energy saving.
- The regulations in the Renewable Energy Sources Act (EEG) have just as much influence on the expansion of solar and wind energy utilisation as the distance regulations for wind turbines.
- The ban on installing oil heating systems has a climate impact that could not be realised at municipal level alone.

- The Building Energy Act will redefine the framework conditions for standards in new construction and refurbishment. Tax incentives for refurbishments and increased subsidies have been introduced or amended at federal level in order to increase the refurbishment rate. Compulsory energy counselling for changes of ownership is also very helpful for local authorities.
- Requirements for fleet consumption and emission standards for new vehicles are just as important framework conditions as the acceleration of planning procedures and approvals for rail transport projects. The Federal Government's toolbox for the mobility transition is diverse: vehicle tax assessment based on CO_2 emissions, company car regulations, tax breaks for charging infrastructure for employers, etc.

Initial rough estimates from Münster and Düsseldorf show that - even with similarly comprehensive action programmes as have now been developed for the city of Aachen - the municipal sphere of influence for achieving the climate protection targets set (excluding the transport sector) is limited to 25 - 35 %.
However, the extent to which the municipal influence is reflected is being systematically analysed in the current project "Impact potential of municipal measures for national climate protection" by the IFEU Institute.

4.3. Existing potential

4.3.1. Potential in the 2030 strategy concept - status 2014

In 2013/14, all existing concepts were analysed to determine what options they offered for reducing CO_2 emissions. The transport sector was excluded from the analysis at that time, as an independent process (VEP) had already been launched in parallel. The potentials and potential comparisons presented below in this chapter and in chapter 4.3.2 therefore relate to the CO_2 emissions situation without the transport sector. The latter is dealt with in Chapter 4.3.3.
The data for 1990 and 2010 from the 2012 CO_2 calculation were used as the base values. These deviations due to the now changed accounting methodology are explained in sections 3.3.3 and 4.
The identified potentials were summarised. The implementation status of the existing concepts was then analysed, i.e. the activities carried out up to that point were evaluated, the reduction effects achieved were balanced on the basis of the 2010 and 2011 emissions data and the remaining potential was added up. The existing action plans were analysed to determine how much they contribute to tapping the potential (around 10 % by 2020, 20 % by 2030) and the result was included in the CO_2 reduction in terms of the remaining savings potential.
Based on the potential analysis, the areas with the greatest CO_2 reduction potential were identified. They continue to be designated as the central focal points for action. Specific CO_2 reductions achievable by 2020 and 2030 were determined for each of these areas, differentiated according to potential from energy generation and energy efficiency. The key areas of action and their respective reduction potential, which were developed in the concept in 2014, are shown in the following table. The greatest savings effects can be achieved through the expansion of wind energy utilisation, the expansion of combined heat and power generation and energy efficiency measures in residential construction.

	Potential by 2020 [thousand tonnes per year]	Potential by 2030 [thousand tonnes per year]
Generation area		
CHP	93,6	20,0
Wind energy	57,0	57,0
Solar energy	23,3	49,2
Efficiency area		
Residential construction	53,0	59,0
Economy (GHD)	21,0	22,0
SUM	**247,9**	**207,2**

Table 12: Priority areas of action of the 2030 strategy concept with potential (as at 2014)

The $CO_{2\ reduction}$ potential in the key areas of action was compared in a scenario analysis with the quantities of CO_2 that would have to be saved by 2020 and 2030:

- by 2020: 394,000 tonnes,
- by 2030: 563,000 tonnes.

The scenarios showed that 63% of the $CO2_{reduction}$ could be achieved in the key areas of action by 2020 and 81% by 2030. If the remaining potential savings from existing programmes of measures are taken into account, i.e. if all potential savings possible by 2020 (key areas of action and remaining potential) are added up, the reduction amounts to only 311,000 tonnes and the "2020 target" is missed by 83,000 tonnes of CO_2, according to the assumption in the 2014 concept. The "2030 target" is achieved by implementing all possible reduction potential amounting to 567,000 tonnes of CO_2 (even exceeded by around 4,000 tonnes of carbon dioxide).

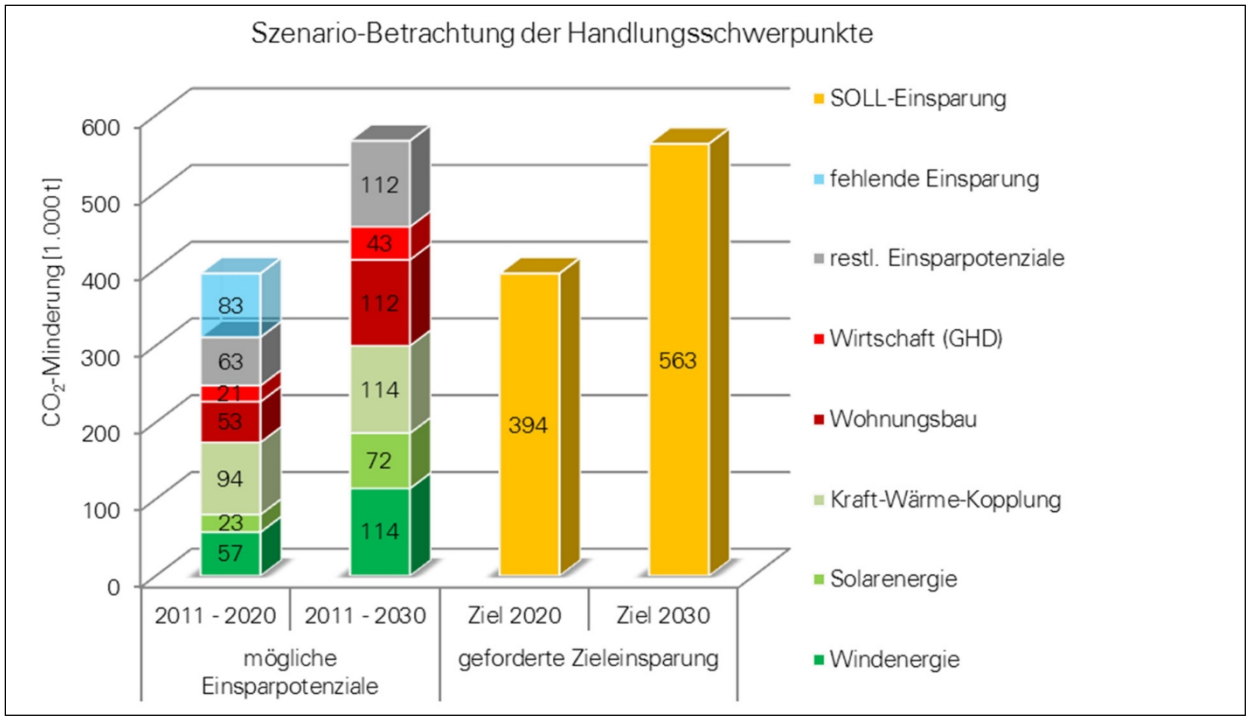

Figure 14: Scenario analysis of $CO2_{reduction}$ (as at 2014)

In order to activate the potential in the key areas of action, an action programme with measures up to 2020 was developed in 2014. A total of 24 measures were described in the areas on the basis of fact sheets and the cost and impact of the measures were specified. However, this package of measures was only partially implemented, partly due to a lack of necessary resolutions and partly due to a lack of capacity or resources.

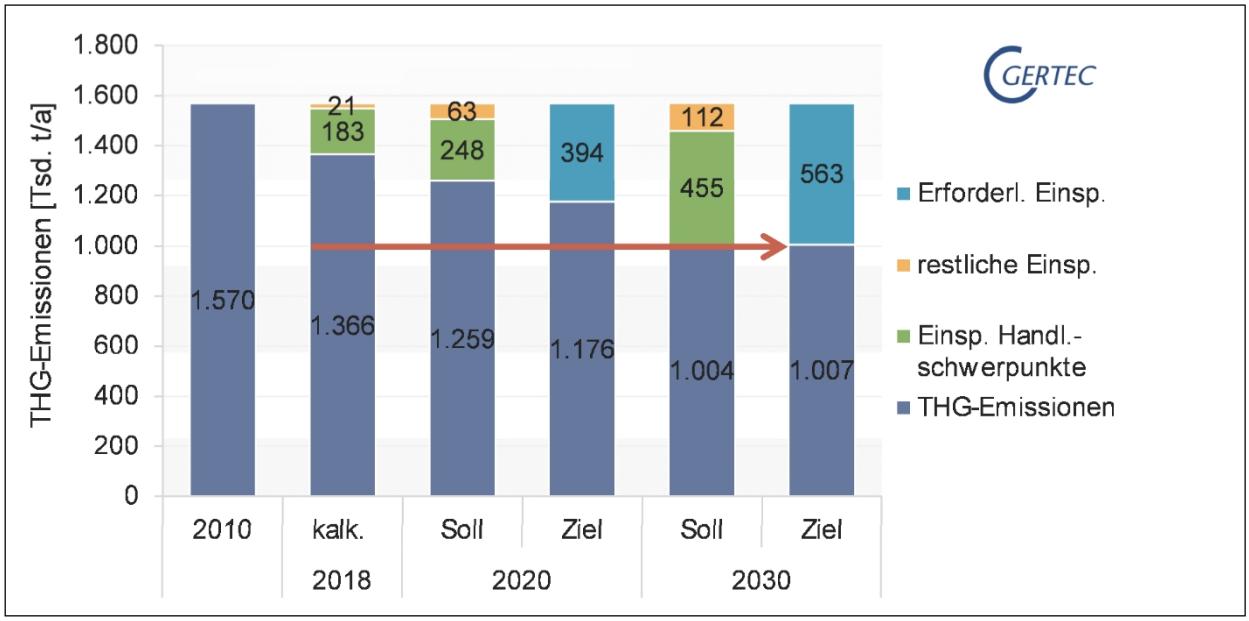

Figure 15: GHG reduction potential compared to the targets of the 2014 strategy concept

4.3.2. Update of the calculations in 2019

In order to achieve the targets, this concept continues to focus on the key areas of action in the fields of generation and efficiency, which can make a significant contribution to reducing GHG emissions, and quantifies the respective $CO2_{\text{reduction potential}}$ by 2030.

For this purpose, it was first necessary to check the extent to which the reduction potentials up to 2020, which were developed in 2014, were actually achieved in the aforementioned key areas of action. The calculations were carried out using the following data for the period 2011 to 2018 and their further development up to 2020 was estimated:

- Wind power: Data on the electricity feed-in of wind turbines in the urban area
- PV: Data on the electricity feed-in of PV systems in the urban area
- Solar thermal energy: Data on heat generation from Ecospeed (balancing programme)
- CHP: Data from municipal records, e.g. via BImSch authorisations
- Energy-efficient refurbishment and replacement of heat generators in the residential sector: Data from analyses of energy consultations and customer surveys by altbau plus as well as data on the residential sector from Ecospeed
- Economy: Number of employees subject to social insurance contributions from IT.NRW and specific key figures from the energy and climate balance sheet calculation model of the render project

The calculations are presented in detail below.

Wind power

The GHG reduction resulting from the expansion of wind power in the city is calculated on the basis of data on the amount of electricity fed into the grid by wind turbines in the city from 2010 to 2018. Taking into account the emission factor of wind power compared to the emission factor of the federal electricity mix, this results in a GHG reduction of approx. 45.4 thousand tonnes of CO2eq due to the expansion of wind power.
The calculated GHG reduction is lower than the potential identified in the 2014 strategy concept. For the period up to 2030, a further GHG reduction of approx. 68.6 thousand tonnes of CO2eq is required (see Figure 16).
To achieve this GHG reduction, an additional 126 GWh/a of electricity generation from wind turbines would have to be achieved in the city of Aachen by 2030. (In the render project, between 104 and 131 GWh were worked out depending on the expansion option). This requires a total output of approx. 46 MW. With turbine outputs of 3 MW, this would correspond to approx. 15 wind turbines that would have to be added by 2030. At an average cost of EUR 1,800/kW, this would require an investment of around EUR 83.6 million.

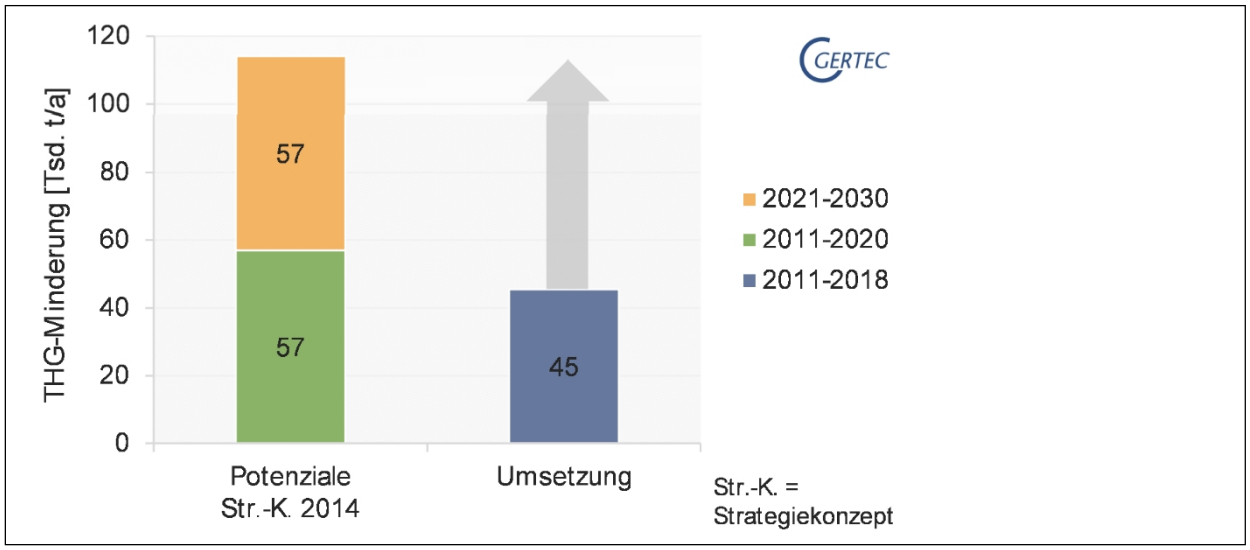

Figure 16: Potential for the expansion of wind power plants compared to implementation from 2011 to 2018

Photovoltaics

The calculation of the GHG reduction due to the expansion of PV is based on data on the amount of electricity fed into the grid by PV systems in the city from 2010 to 2018. Taking into account the emission factor of PV compared to the emission factor of the federal electricity mix, this results in a GHG reduction of approx. 6.5 thousand tonnes of CO2eq due to the expansion of PV from 2011 to 2018.
The calculated GHG reduction corresponds to only around a third of the potential identified in the 2014 strategy concept, which increases the further GHG reduction required for the period up to 2030 to around 61 thousand tonnes of CO2eq (see Figure 17).

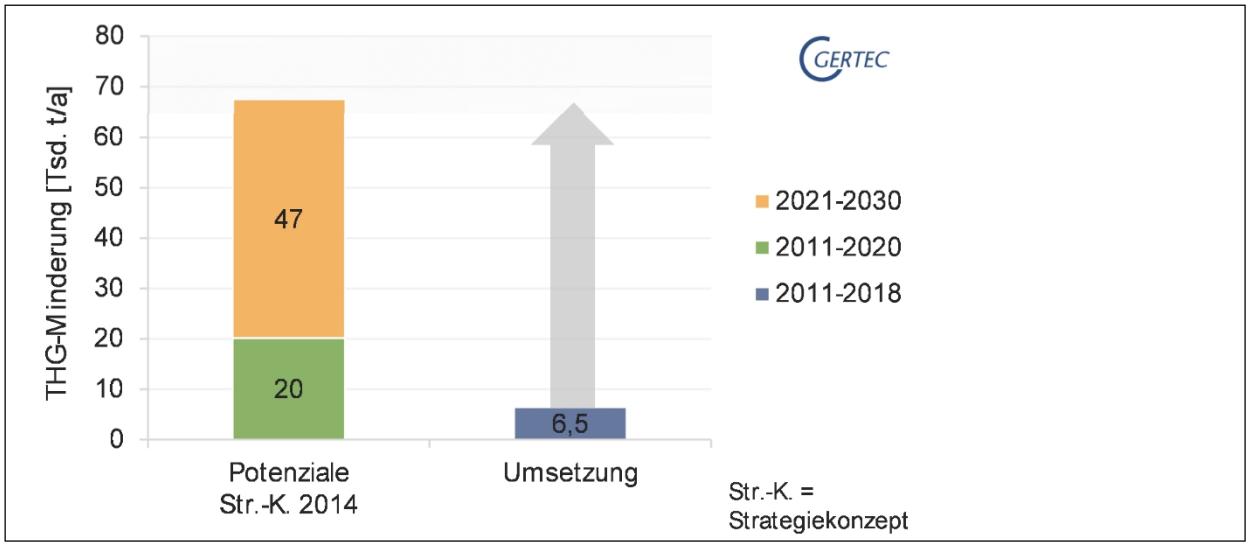

Figure 17: Potential for PV expansion compared to implementation from 2011 to 2018

To achieve this GHG reduction, approx. 124 GWh/a of additional PV electricity generation would have to be achieved in the city of Aachen by 2030. This would require a total output of approx. 146 MWp. With an average module area of 40 m² per system and an average system output of
5 kWp, this would correspond to around 29,200 systems that would have to be installed in the city by 2030 - i.e. an expansion of 2,920 systems per year.
With investment costs of approx. 1,300 EUR/kWp, the required expansion results in total investments of approx. 190 million EUR, resulting in corresponding regional added value. If the city of Aachen were to implement a municipal funding programme with funding of 10 % of the total amount to achieve the expansion targets, around EUR 1.9 million would have to be provided annually by the city of Aachen to promote PV expansion. The success of start-up funding was demonstrated by the Düren district's 1000 Roofs Programme in 2019. In the "1000x1000" programme, 1000 systems were subsidised with EUR 1000. The programme is combined with a favourable loan from Sparkasse Düren, interest rate 0.89 % over 10 years.
The 1000-roof mark was reached after just six months.

Solar thermal energy

The calculation of the GHG reduction through the expansion of solar thermal energy is based on the Ecospeed data sets for the years 2010 to 2018. Assuming that the use of solar thermal energy substitutes natural gas consumption, the GHG reduction is calculated taking into account the emission factor of solar thermal energy compared to the emission factor of natural gas. This results in a GHG reduction of 279 tonnes CO2eq through the expansion of solar thermal energy.
The calculated GHG reduction corresponds to only around 10 % of the potential identified in the 2014 strategy concept, which increases the required further GHG reduction to around 4.7 thousand tonnes of CO2eq for the period up to 2030 (see Figure 18).

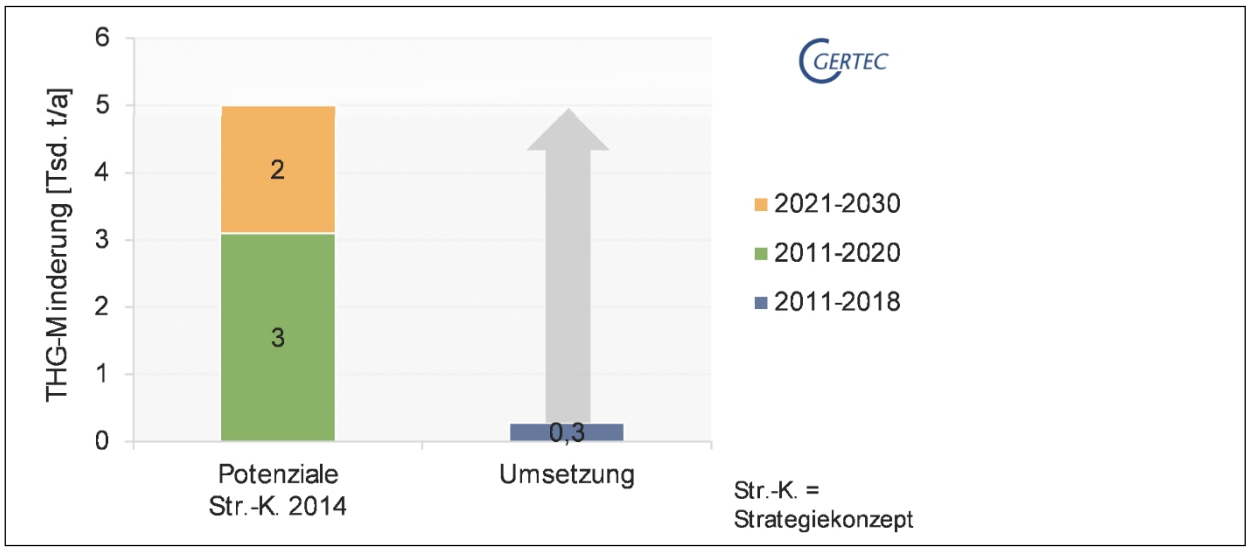

Figure 18: Potential for solar thermal expansion compared to implementation from 2011 to 2018

CHP

In the area of combined heat and power generation, expansion has taken place in accordance with the potential of the 2014 strategy concept and the detailed concept of the 2014-2017 Aachen CHP initiative. A corresponding GHG reduction of 94 thousand tonnes of CO_2eq is therefore assumed. The potential for the period up to 2030, as described in the 2014 strategy concept, is a further reduction of 20 thousand tonnes of CO_{2eq}.

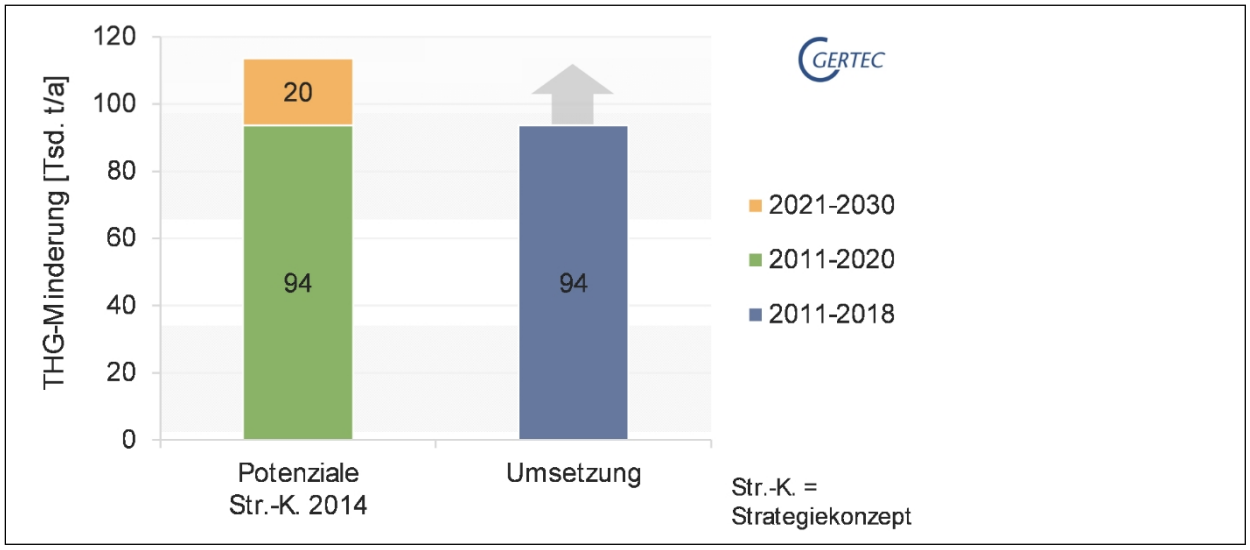

Figure 19: Potential for the expansion of CHP compared to implementation from 2011 to 2018

Energy-efficient refurbishment of residential buildings

Two comparative calculations were carried out to analyse the GHG reductions resulting from climate protection measures in existing residential buildings.
On the one hand, the GHG reduction of the measures was balanced on the basis of approximate characteristic values based on the energy consultations carried out (evaluation of the consultations by altbau plus). It was assumed that measures were implemented after one third of the consultations - with an average

investment of EUR 30,000 and an average GHG reduction of 0.2 kg/EUR. Based on a total of 10,133 consultations from 2011 to 2018, these assumptions result in a GHG reduction of approx. 20.3 thousand tonnes of CO_{2eq}.
The development of GHG emissions from the Ecospeed CO2 balancing programme is used as a comparative value for this relatively rough estimate. This results in a GHG reduction of approx. 26.8 thousand tonnes of CO_{2eq} due to the GHG emissions of the residential sector from 2010 to 2018.
The further analyses are based on an average of these two calculations (23.5 thousand tonnes of CO_{2eq}). The breakdown of measures for the energy-efficient refurbishment of the building envelope and the replacement of heat generators is based on the proportion of consultations carried out on the topics of heating energy generation (one quarter) and refurbishment measures on the building envelope (three quarters). This results in GHG reductions in the residential sector of 17.7 thousand tonnes of CO2eq through energy-efficient refurbishment and 5.9 thousand tonnes of CO2eq through the replacement of heat generators.
A comparison with the potentials of the 2014 strategy concept shows that the potentials in both areas cannot be achieved through implementation. This results in a target of 30.8 thousand tonnes of CO2eq by 2030 for the energy-efficient refurbishment of the envelope surfaces of residential buildings, while the replacement of heat generators must contribute to the 2030 target value with a further GHG reduction of 57.6 thousand tonnes of CO2eq (see Figure 20).
A funding programme can make a major contribution to tapping the potential of a total of 84.4 thousand tonnes of CO2eq in the building sector. Experience with a funding programme that was implemented as part of the energy efficiency concept and evaluated by the IFEU Institute allows this conclusion to be drawn (see section 5.4.5, measure 5.1).

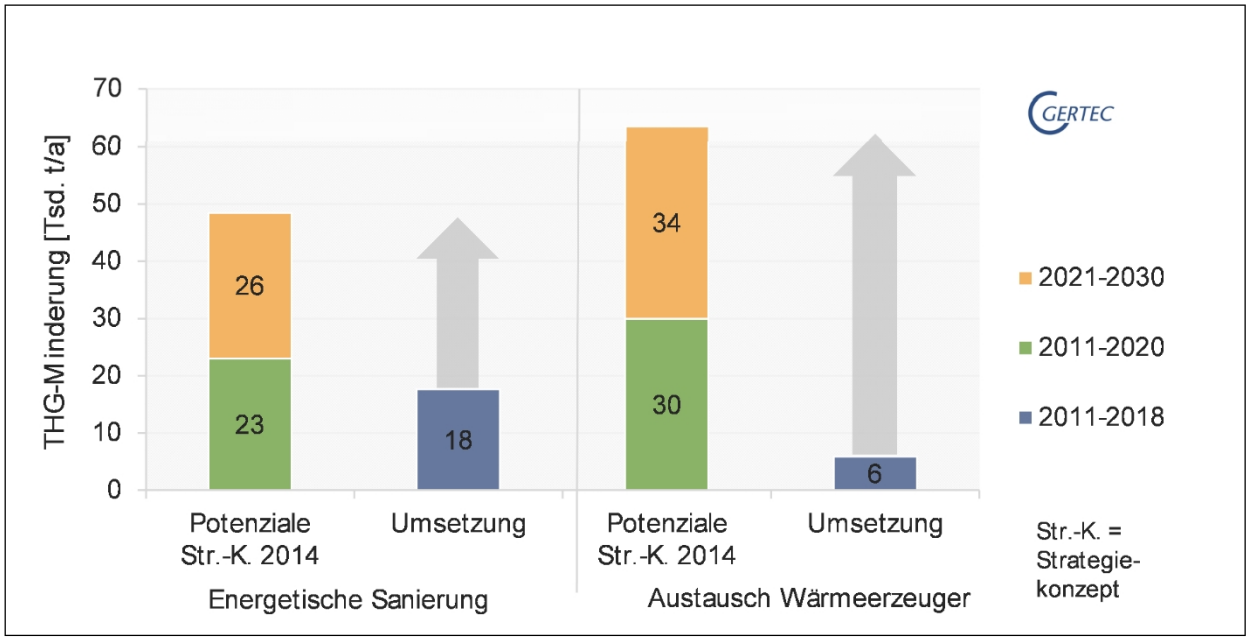

Figure 20: Potential for climate protection measures in existing residential buildings compared to implementation from 2011 to 2018

Economy

The calculations of the GHG reduction by the economy were based on the data in the Statistical Yearbooks of the City of Aachen on electricity and gas consumption for the years 2010 to 2018. The consumption

The data for other energy sources were taken from Ecospeed. Due to an incomprehensible development, hard coal was not taken into account when analysing the data. The data shows GHG reductions of approx. 13.7 thousand tonnes $_{of}$ CO2eq between 2011 and 2018 (see Figure 21).
The GHG reductions are not exclusively the result of efficiency measures in the economic sector. A comparison of the employment figures from 2011 and 2018 shows that the sectors in the economy are developing differently. Overall, the number of people in employment increased by 20 % during this period. There was a particularly strong absolute increase in the service sectors (especially healthcare and social work, provision of professional, scientific and technical services and information and communication). In contrast, absolute growth is below average, particularly in some areas of the secondary sector (e.g. water supply, sewage and waste disposal and removal of environmental pollution, trade, maintenance and repair of motor vehicles and mining and quarrying). It can be assumed that this development towards more service industries will reduce energy consumption and contribute to the reduction of GHG emissions in the economic sector. Accordingly, it must be assumed that the calculated reduction in GHG emissions is not exclusively attributable to climate protection measures.

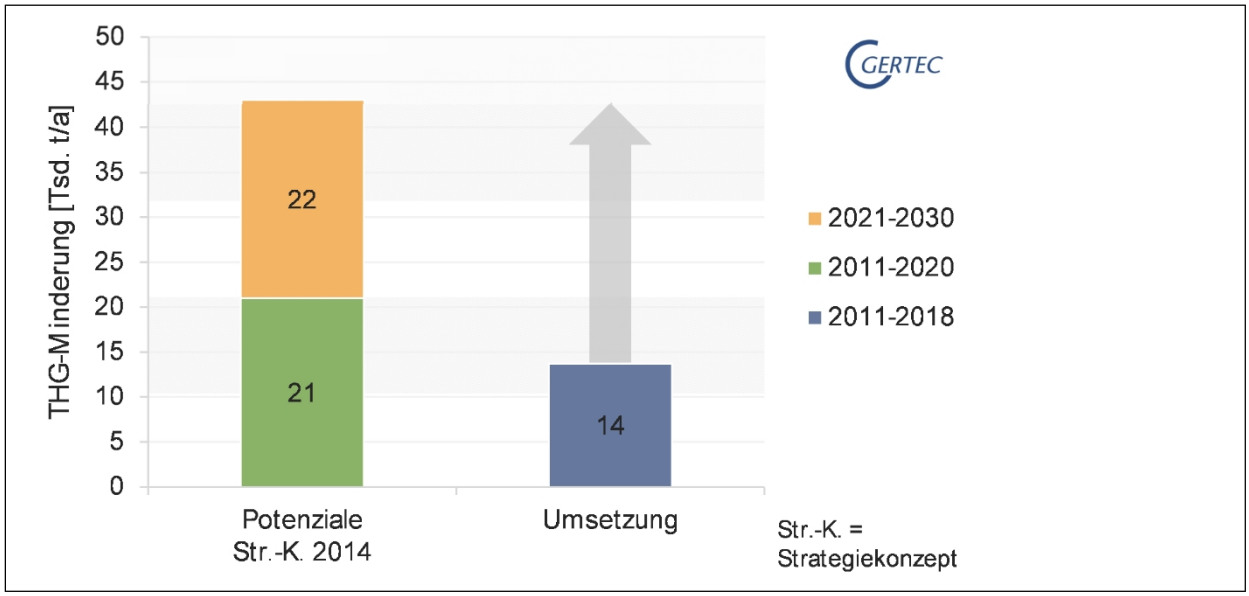

Figure 21: Potential of climate protection measures in the economy compared to GHG reduction 2011 to 2018

Summary of the results of the potential adjustment compared to 2014

It can be seen that the potential identified in 2014 for 2020 has not been realised, particularly in the areas of PV and building refurbishment (changing heat generators) (see Figure 22). This deficit in unrealised GHG reductions of around 107 thousand tonnes must also be taken into account when considering the reduction target for 2030. (see Figure 23).

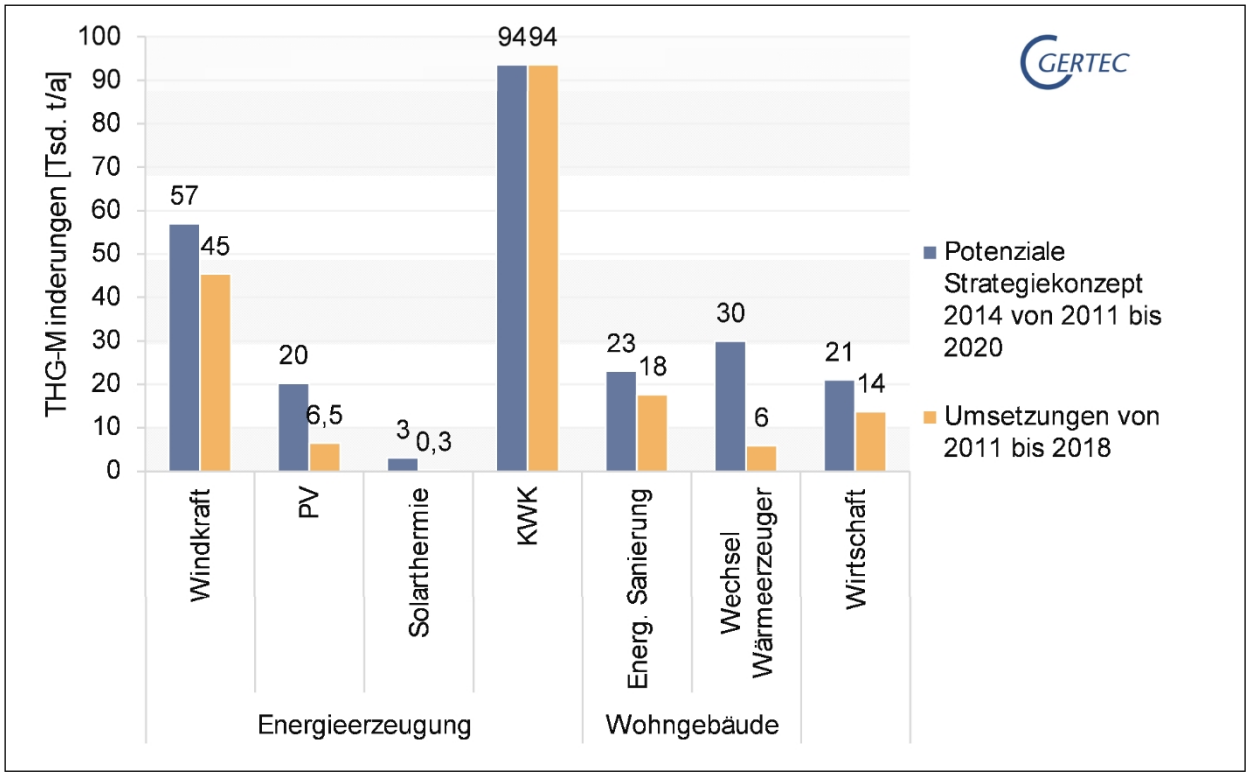

Figure 22: GHG reductions actually achieved in the key areas of action compared to the potentials presented in 2014 by 2020

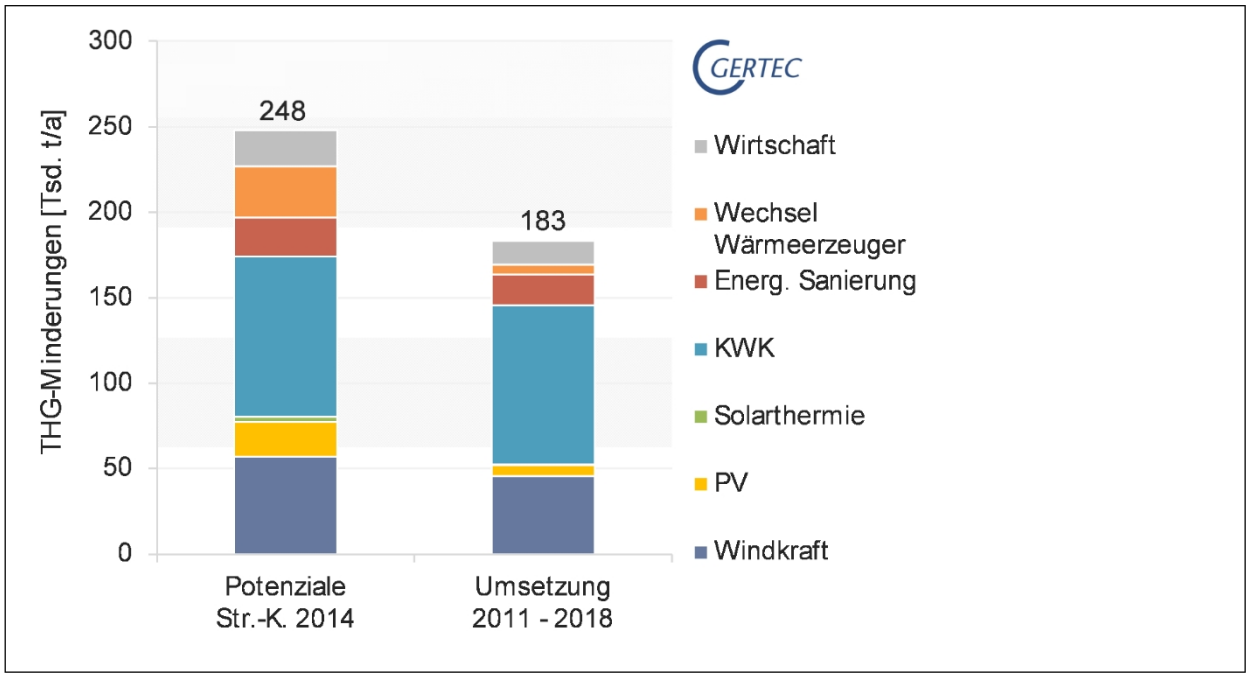

Figure 23: Illustration of the GHG reduction achieved through the implementation of measures compared to the potentials presented in 2014 in the key action areas

Remaining savings potential until 2020

Instead of a reduction of 248,000 tonnes, only 183,000 tonnes of greenhouse gas emissions were actually achieved in the key areas for action. There is therefore currently a deficit in these areas of 65,000 tonnes that must be implemented to achieve the target by 2020. In addition, the target scenario (as at 2014) identified 63,000 tonnes of remaining savings potential from other action plans that must be tapped into.

The eea's energy policy work programme can serve as a basis for estimating the current status of the implementation of these measures. The 2014 strategy concept listed important measures to be implemented, some of which have been completed. The important measures of the energy policy work programme that are still outstanding are summarised in the tables in section 5.2. According to the current analysis of implementation, it can be assumed that around a third of the remaining savings potential from the 2014 strategy concept has been realised. In the area of "remaining savings potential", there is therefore a deficit of approx. 42,000 t/a GHG reduction (see Figure 24).

The implementation deficits from the priority measures and the remaining savings opportunities add up to around 107,000 tonnes $_{of\ CO2eq}$. As it was already assumed in 2014 that around 83,000 tonnes would be missing to achieve the 2020 target ("missing savings", see Figure 14), the total deficit for the 2020 target amounts to around 190,000 tonnes of $_{CO2eq}$.

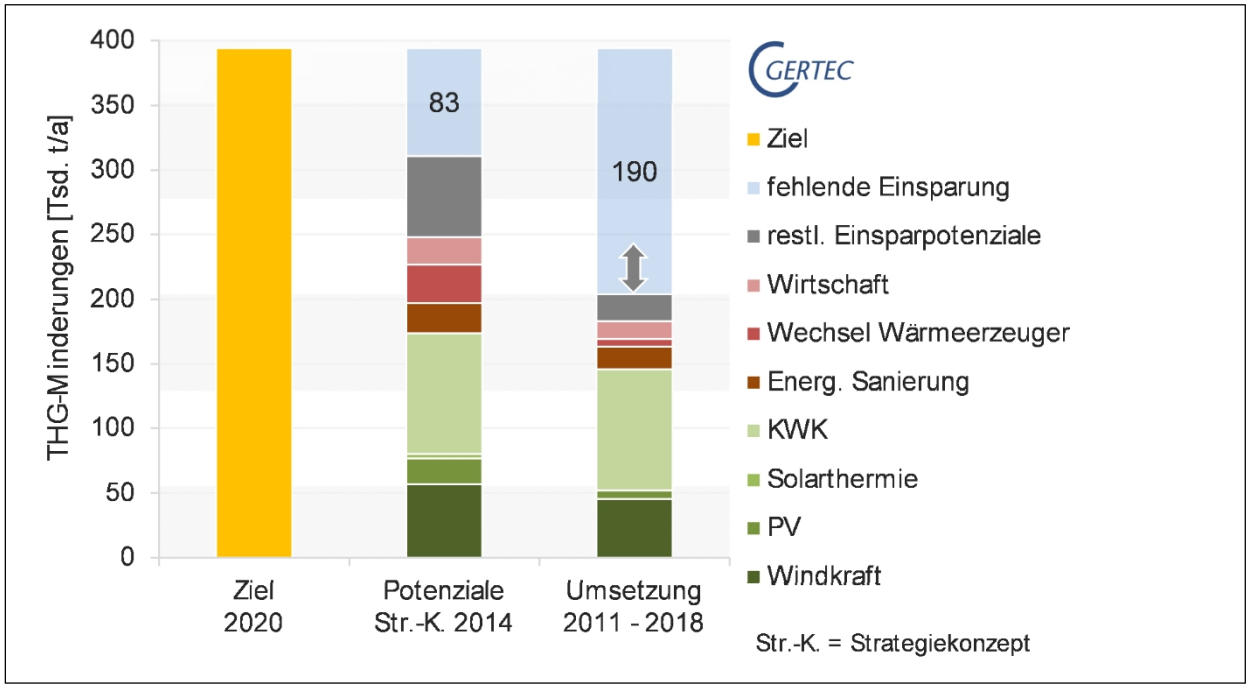

Figure 24: Gap in target achievement in 2020 (excluding transport)

Conclusion regarding the realisation of the potential of the 2020 target and effects on the 2030 target

The 2020 target has been missed by a considerable margin: The potential of 310,900 tonnes identified in 2014, which was supposed to be achievable by 2020, was only partially tapped. The shortfall is around 106,800 tonnes compared to the $CO2_{reduction}$ by 2020 planned in 2014.

This means achieving the 2030 target:

- While it could be assumed in 2014 that the 2030 target is achievable, the current savings deficits must be made up. It is therefore not enough to activate the potentials for 2030 (256,200 tonnes) identified in the 2014 strategy concept; the current deficit in $CO2_{reduction}$ must also be compensated for in 2030 compared to the target assumptions in the 2014 strategy concept.
- In order to halve $CO2_{emissions}$ since 1990, 363,000 tonnes - excluding transport - must be saved.
- The planned measures in the other concepts need to be implemented more quickly (residual savings potential).
- Additional measures must be mobilised to achieve the objectives.

The following table provides an overview of the potential and deficits in GHG reduction. The remaining potential that needs to be realised in the individual areas by 2030 is listed as a "target" in the last column.

Range	Potentials	Realisation	Failure to realise potential	Potentials	Potentials totalled	Remaining as target until 2030
	2011-2020	2011-2018	2011-2018	2021-2030	2011-2030	2019-2030
	[t/a]	[t/a]	[t/a]	[t/a]	[t/a]	[t/a]
CHP	93,6	93,6	0,0	20,0	113,6	20,0
Wind power	57,0	45,4	11,6	57,0	114,0	68,6
PV	20,2	6,5	13,7	47,3	67,5	61,0
Solar thermal energy	3,1	0,3	2,8	1,9	5,0	4,7
Refurbishment of the building envelope	23,0	17,7	5,3	25,5	48,5	30,8
Building technology	30,0	5,9	24,1	33,5	63,5	57,6
Economy	21,0	13,7	7,3	22,0	43,0	29,3
Residual savings potential	63,0	21,0	42,0	49,0	112,0	91,0
TOTAL	310,9	204,1	106,8	256,2	567,1	363,0
DEFICIT			106,8			**363,0**

Table 13: GHG reduction potentials and deficits by 2030 according to priority areas

4.3.3. Potentials and scenarios for the transport sector

With the Mobility Committee's resolution on the objectives of transport development planning in January 2020, it was agreed that a reduction in $CO_{2\ emissions}$ of 40-55% by 2030 would be regarded as a medium improvement and more than 55% as a very ambitious and significant improvement in this indicator. This is in line with the German government's goal in the Climate Action Plan 2050 to reduce emissions by 55%, with a reduction of 40-42% by 2030 compared to 1990 levels being pursued for the transport sector.

When determining the potential, it is also important to note that transport-related CO2 emissions in Germany in 2014 were roughly the same as in 199011. A reduction of 40 % compared to 1990 is therefore equivalent in absolute terms to a reduction compared to 2014.

With the new climate target for Aachen adopted on 22 January 2020, climate neutrality has effectively been achieved by 2030. To make this possible, massive interventions are also required in the mobility system. This far-reaching goal goes well beyond the targets previously formulated in Aachen and the Federal Republic of Germany, but is in line with the UN Paris Agreement.

The emissions reduction target for transport in Aachen for 2030 is between 40 % and 100 %. Scenarios were developed to illustrate the range of measures that would be required at local level in addition to the measures at national and European level in order to achieve the targets formulated to date. The following scenarios were formulated:

a) Scenario A: "Strengthening the environmental network" (corresponding to a "medium reduction" in CO2 emissions according to the Mobility Strategy 2030)
b) Scenario B: "Mobility turnaround" (corresponds to the "strong reduction" in $CO_{2\ emissions}$ according to the 2030 mobility strategy)
c) Scenario C: "Climate neutrality" (in accordance with Council resolution 22 January 2020).

The scenarios relate to "Aachen transport" in accordance with Chapter 3.3.4 with the three sectors

a) City traffic
b) Regional transport and
c) Commercial vehicles and vehicle-related measures in passenger car traffic

They therefore comprise 387 thousand tonnes of $_{CO2}$ / a. Long-distance transport with its 353 thousand tonnes per year was excluded from the scenarios due to a lack of accessibility for the city of Aachen.

In all three scenarios, it is assumed that federal measures will lead to a general reduction in $CO_{2\ emissions}$ of 40% in Aachen transport and long-distance transport by 2030. As long-distance transport must reflect the federal trend well, it is assumed that the percentage reduction relates to emissions in 2018.

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[11] Climate Protection Plan 2050, p. 49, available at: https://www.bmu.de/publikation/klimaschutzplan-2050/

CO2 emissions in thousand tonnes per year					
Sector	**1990**	**Change**	**2018**	**Effect of the Federal measures**	**2030**
Transport in Aachen	372	4%	387	-40%	232
Long-distance transport d. Aachener	252	40%	353	-40%	212
Total traffic	624	19%	740	-40%	444

Table 14: Estimated change in $CO2_{emissions}$ 1990-2018 and estimated reduction effects from federal measures by 2030

Assuming that the federal measures achieve the intended effects and that they are equally effective in regional and long-distance transport, traffic emissions in Aachen would be reduced from 387,000 tonnes per year to 232,000 tonnes per year without any further activities by the City of Aachen.

However, as the federal government's measures will only partially result in reduced vehicle emissions, the eco-mobility system must be expanded at local level to compensate for the lack of car journeys if people's mobility is to be guaranteed. This is where the three scenarios come in.

In all scenarios, the fields of action

- Reduction of car traffic in urban areas (HF1),
- Reduction of car traffic in regional transport (HF2) and
- Reduction of vehicle emissions (HF3)

The scenarios are differentiated analogue to the sectoral impact analysis. The scenarios differ both in terms of the financial resources deployed and their restrictive interventions.

The financial estimates are based on the assumption that expenditure on cycling has already been budgeted for. Only the estimates for expenditure are available, but not the possible income from contributions, subsidies and fees/tariff income.

- **Scenario A "Strengthening eco-mobility"** emphasises the expansion of eco-mobility with very few restrictions for car traffic. It comprises 18 core measures in the three fields of action; these include a moderate promotion of walking and cycling (e.g. premium paths, priority cycle routes in side streets, bicycle car parks), a moderate expansion of public transport by extending the range of services, a freeze on public transport fares and additional express bus services, a continuation of the approaches of the #AachenMooVe! project, measures to liquefy traffic, to further regulate parking space offers, an adapted programme to change the vehicle fleet and measures to channel freight traffic.

  A $CO2_{reduction}$ of 42 % or 171 thousand tonnes per year to 216 thousand tonnes per year is expected compared to 1990. The federal government's 40 % is assumed to be 155 thousand tonnes per year in relation to 2018.

  The impact by 2025 is estimated at 25% of the impact in 2030, i.e. 43 thousand tonnes per year. The costs are estimated at 159 million euros by 2025 or approx. 29 million euros per year from 2026.

- **In Scenario B "Mobility turnaround",** a significantly stronger expansion of the eco-mobility is tackled, for which more significant restrictions on moving and stationary car traffic are required for reasons of space and cost. It comprises 22 core measures in the three fields of action. Key measures include a massive expansion of cycle paths (the complete and consistent implementation of the cycling decision), a stronger expansion of public transport services in line with ASEAG's Vision 2027 with 30% more capacity, a halving of public transport fares, a significant expansion of express bus services and the infrastructural implementation of bus lanes on "strong axes", an expansion of the approaches of the project

#AachenMooVe! and a practical implementation of the relocation of on-street parking spaces to multi-modal neighbourhood car parks that are also bicycle parking, car sharing and e-charging stations. For regional transport, the expansion of P+R/mobility hub facilities and the construction of the RegioTram are key. Compared to 1990, a $CO2_{reduction}$ of 60% or 238 thousand tonnes per year to 149 thousand tonnes per year is expected. The federal government's 40 % is assumed to be 155 thousand tonnes per year in relation to 2018.

The impact by 2025 is estimated at 25% of the impact in 2030, i.e. 60 thousand tonnes per year. The costs are estimated at 272 million euros by 2025 or approx. 113 million euros per year from 2026.

- **Scenario C "Climate neutrality"** assumes that it is necessary for all buses, delivery vehicles and cars travelling in Aachen to have climate-neutral drive systems. Aachen would then become an emission-free city or a zero-emission zone. In addition, the measures from scenario B are intensified to include free public transport and large mobility hubs on all Aachen's access roads. The expansion of neighbourhood parking will also be significantly stepped up in order to create even better conditions for eco-mobility. 21 core measures are included here.

  Compared to 1990, a $CO2_{reduction}$ of 100 % or 387 thousand tonnes per year to 0 thousand tonnes per year is expected. The federal government's 40 % is assumed to be 155 thousand tonnes per year in relation to 2018.

  The impact by 2025 is estimated at 25% of the impact in 2030, i.e. 79 thousand tonnes per year. The costs are estimated at 449 million euros by 2025, or approx. 171 million euros per year from 2026.

The table compares the estimated costs and effects:

	Scenario	Total 2020-2025 [1000 €]	Costs / year [1000 €]	Ongoing additional costs / year from 2026 [1000 €]	CO_2 emissions		CO_2 reduction	
					[1000 t/a]	% to 1990	% to 1990	**% to 2018**
	Traffic 1990				372	100%		
	Transport 2018				**387**	104%	4%	**0%**
	- 40 % by the federal government	-	-	-	**232**			**-40%**
A	**Strengthening the environmental network**	159.460	26.577	28.910	**216**	58%	-42%	**-44%**
B	**Mobility turnaround**	272.250	45.375	112.775	**149**	40%	-60%	**-62%**
C	**Climate neutrality**	448.950	74.825	170.925	**0**	0%	-100%	**-100%**

Table 15: Estimated costs and effects of the mobility scenarios up to 2030

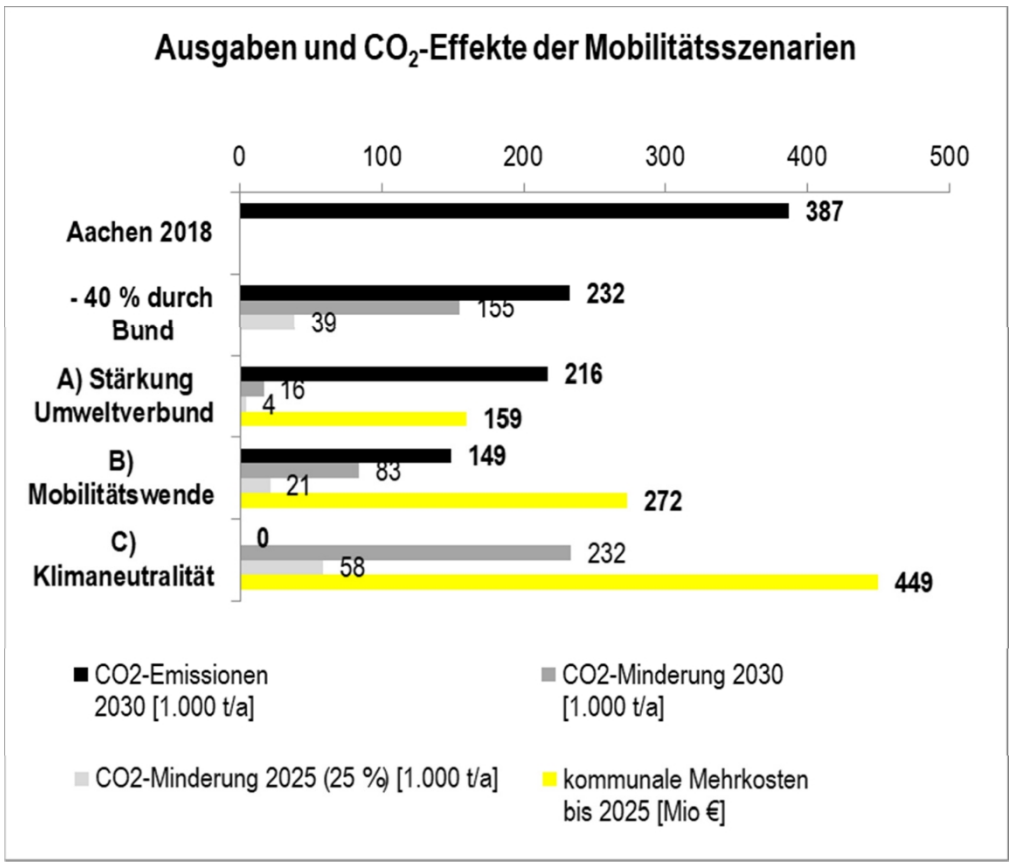


Figure 25: Illustration of $CO2_{effects}$ up to 2025 and 2030 and expenditure up to 2025

The impact of the effects for 2030 is simplified to 25 % for the year 2025, as the majority of the effects are only expected after the implementation of the measures up to 2025.

5. Action programme with Overview of measures 2025

5.1. Presentation of the adopted action plans in various concepts

The existing concepts described above (chapters 3.2.2 and 4.1) include a wide range of action plans, some of which cover identical topics. Depending on the focal points and objectives of the concepts, the measures are divided into different fields of action. Table 16 provides an overview of the fields of action of the most important concepts. Over 200 measures are included in the various concepts. The largest and most up-to-date compilation is contained in the energy policy work programme.

Strategy concept 2030 - Action concept 2020	Energy policy work programme, eea	render REPAC	Masterplan Aachen* 2030	Clean air plan	Pollution-free city centre #Aachen MooVe
Development planning, regional planning	Concepts, strategy				
	Internal organisation				
Municipal buildings, facilities	Municipal buildings, facilities				
	Mobility		Limitation of traffic volume		
Communication, co-operation	Communication, co-operation	Coordinated cooperation between the han-actors			
Supply and disposal	Supply, disposal				
Expansion of wind energy		Expansion of wind energy and ground-mounted PV	Accelerated expansion of renewable energies		
Expansion of solar energy	PV systems on comm. buildings etc	Expansion of rooftop PV and CHP			
Aachen CHP Initiative					
Energy efficiency in the economy	Ecoprofit				

District heating supply for the city of Aachen	Update of FW expansion				
Energy-efficient refurbishment of buildings	Counselling and targeted approach		Energy-efficient modernisation of the building stock		
Cycling infrastructure	Pedestrian and cycle traffic sweeping		Pedestrian and cycle traffic sweeping	Cycling infrastructure	Pedestrian and cycle traffic sweeping
Stationary traffic	Stationary traffic			Stationary traffic	
PUBLIC TRANSPORT	PUBLIC TRANSPORT		Public transport & rail	PUBLIC TRANSPORT	
Delivery traffic				Delivery traffic	City Logistics
	Electromobility		E-mobility		Electromobility
	Mobility management				Mobility management
			Transfer point.		Mobile stations

Table 16: Fields of action in action plans of existing concepts

5.2. Important measures of the energy policy work programme

Since 2009, the City of Aachen has drawn up an energy policy work programme every four years. From this work programme, which was adopted in January 2019, the strategically important measures listed in the following tables are currently being implemented or are in preparation.

The following tables show an excerpt from the current energy policy work programme with the allocation of measures to the key areas of action (HaSchP) of combined heat and power (CHP), wind and solar energy (RE), housing (Wo) and mobility (Mob). The list is structured in areas 1 to 6 according to the eea system. Area 5, internal organisation, has been omitted due to its low relevance.

The entire energy policy work programme and the evaluation of all energy-related measures already underway can be found in the 2019 eea report.

eea no.	Measure	Responsibility	Priority	HaSchP
1.1.1	Climate strategy			
	Implementation of the clean air plan	FB 61	1	EE, Mob
	Redrafting of the land use plan (FNP)	FB 61	1	EE, Where
1.2.1	Municipal energy planning			
	Update of district heating expansion concept	STAWAG	1	CHP
	Expansion of CHP plants in the urban area	STAWAG	1	CHP
	Linking the energy and mobility transition	FB 36, FB 61, STAWAG	1	EE, Mob

Table 17: Important eea measures proposed in area 1, development planning

eea no.	Measure	Responsibility	Priority	HaSchP
2.1.4	Reorganisation planning / concept			
	Refurbishment of Einhard-Gymnasium, Laurensberg school centre, Inda Gymnasium	E 26	1	Where
	PV systems for own use of electricity	E 26	1	EE
2.2.3	Energy efficiency heat			
	Measures to improve energy efficiency	E 26	1	Where
2.2.4	Energy efficiency Electricity			
	Lighting refurbishment	E 26	2	Where

Table 18: eea measure proposals in area 2, municipal buildings, facilities

eea no.	Measure	Responsibility	Priority	HaSchP
3.2.1	Product range and service offering			
	Updating the STAWAG funding programmes	STAWAG	3	EE
3.2.2	Sale of electricity from renewable sources in the urban area			
	Consistent expansion of the share of green electricity in STAWAG's procurement portfolio	STAWAG	1	EE
3.2.3	Influencing customer behaviour and consumption			
	Customer support for the use of renewable energies	STAWAG	2	EE
3.3.1	Industrial waste heat			
	Testing the utilisation of industrial waste heat	STAWAG	2	CHP
3.3.2	Heating and cooling from renewable energy sources in the urban area			
	Ongoing planning for further biogas CHP units in local heating networks or individual properties	STAWAG	1	CHP, RE
3.3.3	Electricity from renewable energy sources in the urban area			
	Promoting the use of solar energy	FB 36, STAWAG	1	EE
	PV electricity storage pilot project	STAWAG	2	EE
	Planning of further PV systems on municipal and other buildings	STAWAG	3	EE

Table 19: eea measure proposals in area 3, supply/disposal

eea no.	Measure	Responsibility	Priority	HaSchP
4.1.2	Municipal vehicles			
	Reducing emissions from the bus fleet	ASEAG	1	EE
	Expansion of the share of municipal electric vehicles	E 18	3	EE
4.3.1	Footpath network, signposting			
	Premium paths for pedestrians	FB 61	2	Mob
4.3.2	Cycle path network, signposting			
	Priority cycle routes and regional cycle paths	FB 61	1	Mob
4.3.3	Parking facilities			
	Cycle parking facilities at transport hubs	FB 61	3	Mob
4.4.1	Quality of public transport services			
	Expansion of rail transport	FB 61, AVV	1	Mob
4.5.2	Exemplary mobility standards			
	Cycle lanes made in Aachen	FB 61	1	Mob

Table 20: eea measure proposals in area 4, mobility

eea no.	Measure	Responsibility	Priority	HaSchP
6.3.2	Professional investors and homeowners			
	Initiation of new approaches for the modernisation of buildings	FB 36	3	Where
6.5.1	Energy, mobility, ecology advice centre			
	Optimisation of the advisory service	FB 36, STAWAG	2	EE

Table 21: Proposed eea measures in area 6, communication/cooperation

5.3. Overview of the 2025 action plan

In addition to the existing planning of measures, the 2025 action programme developed and compiled measures that are particularly relevant to the 2030 climate protection strategy. The action programme is divided into the following fields of action

- Urban planning
- Municipal buildings
- Energy supply
- Mobility
- Building refurbishment
- Communication
- Economy

The following overviews contain the short titles of the measures in the respective fields of action. The measures are described in detail in Chapter 5.4 in the form of measure profiles.

5.3.1. Urban planning

Various measures and instruments for controlling climate-friendly and sustainable construction in the area of urban planning are suitable for having an impact on the climate. These range from the use of checklists in urban land-use planning to requirements for the sale of urban properties. In future, the creation of energy supply and mobility concepts is to be incorporated into urban development planning. In view of the adopted climate protection target, a climate-neutral model housing estate with a pioneering character for future urban development is to be developed in the near future. Possibilities for anchoring climate-relevant aspects more firmly in the committees that advise politicians and the administration are being examined.

The measures in the area of urban planning have a steering effect, particularly for the new construction sector, and cannot be quantified in terms of the amount of CO2 saved. Compared to the fields of renewable energies or mobility, they are of lesser importance for the CO2 reduction strategy. The steering instruments are not effective in the short term due to the duration of planning processes and are also limited by the legal framework. However, as they are gaining in importance with a view to achieving a climate-neutral city in the medium term, the legislator is called upon here. There is room for manoeuvre both through changes to the options for setting targets in planning and through incentives in the form of funding programmes.

No.	Measure
1.1	Activation of vacant lots / land management
1.2	Checklist for urban development designs and B plans
1.3	Climate-neutral new buildings as part of property purchase agreements and urban development contracts
1.4	Development of a strategy for dealing with existing buildings
1.5	Creation of energy supply concepts as part of development plans and larger construction projects
1.6	Creation of mobility concepts as part of development plans and larger construction projects
1.7	Climate-neutral model housing estate
1.8	Establishment of a climate council

Table 22: Measures in the urban development planning field of action

5.3.2. Municipal buildings

Even though the proportion of $CO_{2\ emissions}$ from the municipality's own buildings is less than 2% of the city's total emissions, the administration is acting as a role model on the way to becoming a climate-neutral city.
The introduction of an energy management system including online monitoring in all companies of the City Group can also open up potential savings, as can the reintroduction of an incentive system for the users of municipal buildings. Even if investment in building technology, particularly in the building envelope, is not as economically viable as the use of renewable energies, for example, the city still has a responsibility to make its own contribution to this core area of the climate change problem and to be a role model for other building owners, particularly with regard to large state and federal properties. The guidelines for new buildings, which are already ambitious in energy terms, are being optimised in terms of sustainability, resource conservation and life cycle considerations in order to serve as a model for the city's flats and other associated companies. The expansion of solar energy utilisation to cover the city's electricity requirements should be seen as an important contribution in the overall context of PV expansion in the city. As the climate protection strategy also focuses on improving the proportion of greenery, the city also wants to make its contribution here with its own buildings, whereby the focus here is less on $CO_{2\ reduction.}$ The green roofs of municipal buildings should also be seen as a measure against local heating and for local water retention in terms of climate impact adaptation. Workplace conversions in the IT sector and the centralisation of the data centre are also measures in municipal buildings.

No.	Measure
2.1	Energy management of buildings, extension to the entire city group
2.2	Incentive system for energy savings, introduction of bonuses
2.3	Energy-efficient refurbishment of municipal buildings, non-residential buildings
2.4	Energy-efficient refurbishment of municipal buildings, residential buildings
2.5	Energy-efficient refurbishment of gewoge residential buildings
2.6	Climate-neutral new buildings
2.7	PV systems on municipal buildings for own use of electricity
2.8	Climate protection & climate impact adaptation: greening the roofs of municipal buildings
2.9	Conversion from fat clients to VDI clients
2.10	Relocation of the data centre to the EURAIX site

Table 23: Measures in the municipal buildings field of action

5.3.3. Energy supply

The transformation of the supply of electricity and heat from renewable energy sources will be the challenge for the next 10 years. The expansion of PV and wind power plants are the key measures on the electricity side, while the transformation of the district heating supply begins with the switch from waste heat from lignite-fired power plants to heat from CHP plants.

Expanding the use of renewable energies is a central pillar of this climate protection concept. In order to achieve the climate protection target, the city can only make a small contribution in the area of solar energy utilisation with its municipal buildings. In order to realise the main potential, it must provide support: The potential on the roofs of private and commercial owners must be mobilised, particularly via PV systems, see section 4.3.2 and Table 13. Following the great success in the district of Düren with the 1000 Roofs Programme and based on the experience with the funding for private systems offered by STAWAG until the end of 2018, a new funding programme is to be launched. The proportion of electricity generated from wind energy is to be utilised to the extent permitted by law.

The municipal energy supplier STAWAG operates a district heating (DH) network based on heat extraction from the Weisweiler lignite-fired power plant. As this power plant will be decommissioned in 2028, solutions need to be generated to secure the future of the district heating network. In particular, ways must be found to increase the proportion of renewable energy.

No.	Measure
3.1	Expansion of solar energy use, establishment of a support programme
3.2	Ground-mounted PV systems
3.3	Secure and expand the share of renewables from wind energy
3.4	Decentralised heat supply, securing the district heating network and neighbourhood-specific individual solutions
3.5	Waste heat utilisation

Table 24: Measures in the field of action Energy supply, use of renewable energies

5.3.4. Mobility

The 22 measures of the "Mobility turnaround" scenario (see Chapter 4.3.3) in the three areas of urban transport, regional transport and reduction of vehicle emissions are included in the mobility field of action for the ICSK: The scenario relies on a strong expansion of eco-mobility, for which significant restrictions on moving and stationary car traffic are necessary for reasons of space and cost.
Key measures are

- the realisation of the plans for the premium trails
- a massive expansion of cycle paths (complete and consistent implementation of the cycling decision),
- a significant increase in the attractiveness of public transport services in line with ASEAG's Vision 2027 with 30% more services, a halving of public transport fares, a significant expansion of express bus services and the infrastructural implementation of bus lanes on "strong axes"
- a practical implementation of the relocation of on-street parking spaces to multimodal neighbourhood car parks that are also bicycle parking, car sharing and e-charging stations.
- the expansion of P+R/mobility hub facilities on the outskirts of the city
- the construction of the RegioTram (based on the feasibility study currently underway)
- Continuation and expansion of the measures of the #AachenMooVe! (in particular mobility management, city logistics and electromobility programme)
- Renewal of traffic light systems to optimise traffic control and communication options between traffic lights and vehicles
- Expertise for direct measures to reduce emissions from car traffic (e.g. congestion charge)

No.	Measure in the field of action Reduction of car traffic in urban transport
4.1.1	Expansion of cycle traffic according to cycle decision
4.1.2	Premium paths and squares, crossing aids
4.1.3	Creation of "strong axes" in bus transport
4.1.4	30 % additional output from ASEAG
4.1.5	Tariffs to be halved from 2025
4.1.6	Binding mobility concepts for construction projects and events
4.1.7	Relocation of residents' parking spaces to MobilityHubs: electrified neighbourhood car parks for cars, CarSha- ring and bicycles
4.1.8	Expansion of traffic area control
4.1.9	Scientific support for the mobility transition

Table 25: Measures in the mobility field of action, reduction of car traffic in urban areas

No.	Measure in the field of action Reduction of car traffic in regional transport
4.2.1	Strong expansion of express bus services
4.2.2	RegioTram
4.2.3	Campaign and funding programme for the mobility transition (2,000 switchers/a; around €300 per switcher)
4.2.4	Mobility management for visitors
4.2.5	Continuation of BMM programme from 2022
4.2.6	Parking concept for private transport (tariffs, car parks)
4.2.7	P+R / mobility hubs on all access roads
4.2.8	City tolls and financing models

Table 26: Measures in the mobility field of action, reduction of car traffic in regional transport

No.	Measures in the field of action Reduction of vehicle emissions
4.3.1	Support programme for 2,000 cargo bikes
4.3.2	Electromobility programme (procurement, promotion...)
4.3.3	Procurement support for e-buses at ASEAG
4.3.4	Reducing emissions from delivery traffic
4.3.5	Expansion of traffic management and digital foundations
4.3.6	Expansion of charging infrastructure

Table 27: Measures in the mobility field of action, reduction of vehicle emissions

5.3.5. Building refurbishment (private, commercial, non-municipal)

As explained in Chapter 4.3.2 (see also Table 13), the energy-efficient refurbishment of buildings harbours a very high CO_2 reduction potential. In order to reduce the heat demand in the building sector, private and commercial building owners must be motivated with incentives, as the renovation of the building envelope in particular is difficult to realise economically. Such an incentive is to be created with a funding programme for building refurbishment. As the city of Aachen was able to significantly increase the renovation rate locally with its advice at neighbourhood level, the approach in neighbourhoods is to be intensified and made even more targeted. Commercial buildings are also moving more into the focus of the consultation, as is the provision of heat using renewable energies and the use of sustainable materials.

No.	Measure
5.1	Re-introduction of a funding programme for the renovation of old buildings
5.2	Neighbourhood-specific refurbishment consulting - Permanent consulting services in changing neighbourhoods with a target group-specific approach
5.3	Advice on the use of renewable energy for heating buildings
5.4	Mobilisation of commercial property owners for energy efficiency measures
5.5	Resource-saving refurbishment of existing buildings

Table 28: Measures in the housing construction / refurbishment field of action

5.3.6. Communication

General awareness-raising campaigns are important components of the action plan. In addition, there are campaigns on key topics such as solar utilisation and building refurbishment. Finally, citizens are also to be involved in the development via round tables or competitions. The aim of all these activities: The city wants to increase the acceptance of climate protection measures and the motivation for climate-friendly behaviour, cf. chapter 6.1.

No.	Measure
6.1	Concerted action & "Öcher Solardach" campaign
6.2	Sustainability competition for schools/daycare centres
6.3	KlimaRegion - regional energy efficiency cooperative
6.4	Öcher trinken Öcher Wasser - Campaign for tap water
6.5	Linking the energy and mobility transition
6.6	Citizen information and involvement
6.7	Climate-neutral travelling
6.8	Green in the city funding programme and campaign
6.9	Municipality as a role model: bicycle infrastructure in comm. buildings

Table 29: Measures in the field of action Communication, cooperation, participation

5.3.7. Economy

In the economy field of action, various measures serve to support companies by providing information and advice or exchange, e.g. an exchange platform as an energy network including external expertise, energy efficiency advice and funding advice in companies as well as a series of events. The selection and development of an industrial park with a sustainable heat supply harbours great potential for reducing CO_2 emissions. There are also plans to participate in projects to make energy distribution grids more flexible and to develop hydrogen as an energy source. The development of an incentive system for PV systems, the establishment of a building monitoring system and the offer of a new eco-profit round round off the package of measures.

No.	Measure
7.1	Energy Network Aachen
7.2	On-site energy efficiency advice
7.3	Series of events "Energy-efficient Aachen companies"
7.4	Integrated industrial park development
7.5	Promoting renewable energy generation in urban areas
7.6	Digitalisation and flexibilisation of energy distribution grids
7.7	Hydrogen as an energy source
7.8	Improved database
7.9	Targeted subsidy advice on climate protection measures, in particular to increase energy efficiency
7.10	Ecoprofit

Table 30: Measures in the Economy field of action

5.4. Profile of measures

In the following fact sheets, the measures of the action programme that were identified as the most important measures in the participation process and listed in table form in the previous chapter are presented in more detail in the form of fact sheets.

In the evaluation of the measures, the higher the reduction or value added, the more "+" is given for $CO2_{reduction}$ and regional value added. The threshold values for GHG reduction are:

- + : less than 80 t/a or 0.1 % of the annual savings target of 76,900 tonnes of CO_2 per year
- ++: 80 to 770 t/a or up to 1 % of the annual savings target
- +++: more than 770 t/a or more than 1 % of the annual savings target

The lower the financial and personnel costs, the more "+" are given. The rating ranges from + to +++. Where quantification is not possible, estimates were made.

In some cases, costs per tonne of CO_2 saved are stated. These result solely from dividing the values for "total costs" by "$CO2_{savings}$". These are not actual CO2 avoidance costs, which could only have been determined at great expense. The informative value is limited insofar as savings effects are not included and, in particular, the economic viability of measures to utilise renewable energies (wind and solar energy) is not taken into account. Investments in wind power and PV systems in particular are highly cost-effective. Transport measures such as the expansion of cycle paths, on the other hand, will never generate direct income for the city. Investments in the building envelope also only pay off over the life cycle of buildings after decades, if at all, whereas investments in efficient technology such as heating pumps or lighting are generally economically viable.

The political framework conditions in particular play a role in the assessment of economic viability. In particular, the price of energy, which was recently discussed in the Federal Climate Protection Act in the context of $CO2_{pricing,}$ or the change in tax concessions for refurbishment costs are parameters over which the City of Aachen has no influence, but which will have a significant impact on the assessment of the cost-benefit ratio.

Ultimately, the consideration of economic efficiency as a decision criterion for climate protection measures is only suitable to a limited extent, as cost-intensive measures or measures that cannot be assessed in terms of emissions are also necessary to achieve the climate protection targets. These include, for example, the refurbishment of municipal buildings, as the city has a role model function, or communication measures, as information work is required to motivate the population.

5.4.1. Urban planning

Field of action: Urban development planning / No. 1.1

Activation of vacant lots / land management

Brief description:

Activate private and urban inner-city development potential on the basis of the building gap register, the urban potential analysis and the settlement area monitoring (SFM). In terms of redensification, the aim is on the one hand to examine the areas for sensible and sustainable development opportunities, and on the other hand to increase the willingness of owners to make these areas available and sell them. This topic area is supplemented by information on loft conversions and extension options in order to create additional living space in a space-saving manner.

Incentive systems are to be developed for private property owners.

First steps for action:

Preparation of a resolution, development of a concept for the activation of redensification and extension potential.

Target group:

Private owners, city as owner

Those responsible and those involved:

FB 61 (private areas), **FB 23** (municipal areas)

Criteria:

CO_2 reduction

Evaluation:

Every new building causes an increase in CO_2 emissions due to the production costs of the materials required. The integration of resource efficiency in contractual terms and conditions through to consultation (mandatory) is intended to counteract this, cf. measure no. 1.3. By activating the potential for inner development, the outer area is protected.

Financial expenditure	5,000 € per year
Time expenditure (personnel)	1 MÄ
Regional added value	+

Explanation of the valuation:

Costs are incurred e.g. for flyers, information events.

Implementation period: 2020 (decision), 2022 (concept) - 2023

Field of action: Urban development planning / No. 1.2

Checklist for urban development designs and B plans

Brief description:

Application of criteria for climate- and resource-friendly construction and adaptation to climate change: compact construction methods, orientation of building structures, e.g. for the use of solar energy, consideration of grey energy, preservation/planning/optimisation of green spaces, preservation of fresh air corridors, limitation of surface sealing, shading elements, measures to prevent heavy rainfall; energy supply see measure no. 1.5; mobility aspects see measure no. 1.6

First steps for action:

Development of the list and coordination in the departments, preparation of a resolution on the application of the list in the PLA and, if applicable, the AEC

Target group:

Investors, city as owner

Responsible and involved parties:

FB 61, FB 36

Criteria:

Rating:

$CO_{2\ reduction}$	+
Financial outlay	
Time expenditure (personnel)	
Regional added value	

Implementation period: Decision June 2020

Field of action: Urban development planning / No. 1.3

Climate-neutral new buildings as part of property purchase agreements and urban development contracts

Brief description:

Development of a standard with energy and sustainability parameters from construction to demolition: definition as the "Aachen Standard" (partly based on the planning guidelines of the municipal building management). Building Management).

As a result, the previously climate-friendly requirements are supplemented by the aspect of resource-conserving construction. As a result, the energy-related expenses for the production, maintenance and end of life of the building materials are taken into account. The use of non-renewable energies and the climate impact in the form of equivalent $CO_{2\ emissions}$ are included in the assessment.

The allocation of urban properties should be based on concept quality, taking into account climate-relevant and social aspects, among other things.

First steps for action:

With immediate effect, the purchase contract for municipal properties should stipulate that an energy consultation (including sustainability aspects) is mandatory. The energy advice centres of the consumer advice centre and altbau plus e.V. can provide this advice.
Development of a guideline for awarding concepts (from 2020)
Development of new specifications as the "Aachen Standard". Introduction planned for 2021

Target group:

Building owners, investors

Those responsible and those involved:

FB 23, FB 61, B 03, altbau plus

Criteria:

$CO_{2\ reduction}$

Financial expenditure Time

expenditure (personnel)

Regional added value

Evaluation:

+

Implementation period: Decision 2020

Field of action: Urban development planning / No. 1.4

Development of a strategy for dealing with existing buildings

Brief description:

Further development of the strategic integration of the refurbishment of existing buildings into urban development neighbourhood concepts (experience from the courtyard and façade programme and the Socially Integrative City of Aachen North project should be incorporated): Dealing with existing buildings with regard to climate protection and climate adaptation issues, energy supply structure, green roofs, façade greening, etc.

Development and implementation of a strategy for selected case studies.

First steps for action:

Development of an overall urban development strategy within the framework of neighbourhood concepts, in addition to measure no. 5.2.

Target group:	**Those responsible and those involved:**
Owner	FB 61, altbau plus, STAWAG

Criteria:		**Evaluation:**
$CO2_{reduction}$	+	
Financial expenditure		
Time expenditure (personnel)		1 MÄ
Regional added value	+	

Explanation of the evaluation criteria:

External costs may be incurred.

Implementation period: from 2021

Field of action: Urban development planning / No. 1.5

Creation of energy supply concepts as part of development plans and larger construction projects

Brief description:

Examination of suitable energy supply options for the purpose of transformation to climate-neutral supply (district/local heating, solar thermal energy, photovoltaics, heat pump, etc.), the necessity and scope of an energy concept are determined at an early stage on the basis of an initial rough estimate based on the results of the checklist (see measure no. 1.2).

First steps for action:

Examination of where the creation of energy concepts for current development plans and projects makes sense in terms of resource conservation.

Preparation of a decision in principle.

Target group:

Investors, city as owner

Those responsible and those involved:

STAWAG, FB 61

Criteria:

Criteria:	Evaluation:
$CO2_{\text{reduction}}$	++
Financial expenditure	Not yet foreseeable
Time expenditure (personnel)	
Regional added value	+

Explanation of the evaluation criteria:

External costs may be incurred.

Implementation period: Decision 4th quarter 2020 / 1st quarter 2021

Field of action: Urban development planning / No. 1.6

Creation of mobility concepts as part of development plans and larger construction projects

Brief description:

Examination of suitable mobility options (public transport, car sharing, e-mobility, pedestrian and cycle path connections, etc.) as part of development plans and larger construction projects based on the results of the checklist (see measure no. 1.2.). Application of the experience gained with the Burggrafenstraße neighbourhood development.

First steps for action:

Examination of where it makes sense to create mobility concepts for ongoing development plans and projects.

Preparation of a decision in principle.

Target group:

Investors, city as owner

Responsible and involved parties:

FB 61, FB 63, mobility providers

Criteria:	Rating:
$CO_{2\ \text{reduction}}$	++
Financial outlay	not yet foreseeable
Time expenditure (personnel)	
Regional added value	+

Explanation of the evaluation criteria:

External costs may be incurred.

Implementation period: Decision 4th quarter 2020 / 1st quarter 2021

Field of action: Urban development planning / No. 1.7

Climate-neutral model housing estate

Brief description:

Development of a model neighbourhood on the way to climate neutrality with an integrated approach. Consideration of elements of the NRW climate protection housing estate and the Factor X housing estate. Commissioning a specialist office to develop criteria and specifications for climate-friendly construction.

First steps for action:

Commissioning of external expertise, examination and, if necessary, utilisation of funding opportunities

Target group:

Investors, city as owner

Responsible and involved parties:

FB 61, FB 36, FB 23, specialised office

Criteria:	Rating:
$CO_{2\ \text{reduction}}$	+
Financial outlay	50.000 €
Time expenditure (personnel)	
Regional added value	+

Implementation period: 2021

Field of action: Urban development planning / No. 1.8

Establishment of a climate council

Brief description:

The establishment of a climate council as an advisory body for politicians and the administration should be examined in order to take climate- and resource-friendly construction and adaptation to climate change into account at an early stage and in an appropriate manner in major construction projects. The city of Aachen currently has two committees where external expertise in the above-mentioned sense is obtained. The Energy Advisory Board has been in existence since the beginning of the 1990s, where the expertise of the universities in particular is incorporated and which advises the administration and politicians on energy supply issues. For the past five years, the remit has been redefined to include all climate-relevant areas. In addition, strategically significant and important building projects pass through the Design Advisory Board (formerly the Architects' Advisory Board) of the City of Aachen. Here, aspects of climate protection and adaptation to climate change have so far played a rather subordinate role. The aim is to examine how climate-relevant aspects can be given a higher priority in external expertise in the context of building projects, and whether an expansion of the existing Energy Advisory Board or an addition to the content of the Design Advisory Board would be expedient.

First steps for action:

Examination of tasks, composition and organisation

Target group:

Investors

Those responsible and those involved:

FB 36, FB 61

Criteria:

$CO_{2\ \text{reduction}}$	+
Financial expenditure Time	
expenditure (personnel)	
Regional added value	

Evaluation:

Implementation period: 2021

5.4.2. Municipal buildings

Field of action: Municipal buildings / No. 2.1

Energy management of buildings, extension to the entire city centre

Brief description:

Expansion of energy management to all buildings in which the City Group holds a majority stake: monitoring and visualisation of consumption data. The prerequisite for the energy-saving management of buildings is that an overview of the energy consumption points is first created and the consumption occurring there is analysed. Over the last 15 years, the Municipal Building Management Department has established a differentiated analysis of the consumption of heat, electricity and water by installing intermediate meters and analysing the data by developing its own software. The software enables quarter-hourly readings to be taken via Internet access. The caretakers in the buildings, e.g. in the schools, have been trained to use the system.
Automated monitoring of characteristic values also makes it possible to set up alarm messages in the event of overruns. User behaviour can also be optimised - as a two-year project with the city's schools impressively demonstrated - using such a system, which is publicly accessible to everyone.

The introduction of analogue energy and water management systems in the buildings of the city's associated companies offers both high savings potential and a good role model for imitation in other companies.

First steps for action:

Introduction of a monitoring system analogue to e2watch in headquarters buildings of STAWAG, ASEAG, regioIT, gewoge, Kur- u. Badegesellschaft. Installation of meters, purchase of hardware and software.

Target group:

Public buildings in the city as a whole

Those responsible and those involved:

E 26, städt. operations

Criteria: / **Evaluation:**

$CO_{2\ reduction}$	++	180 t/a
Financial expenditure		Costs city: Costs verb. Companies: €5,000 per year (€5,000 per year for software and €5,000 one-off for hardware)
Time expenditure (personnel)		
Regional added value	+	

Explanation of the evaluation criteria:

At least 2 % savings are expected in the areas of heat and electricity. The city's consumption of 74 million kWh of heat & 19 million kWh of electricity per year serves as a guide. consumption of 74 million kWh heat & 19 million kWh electricity /a → around 90 million kWh in total, with 2 % savings → 900 t/a, assuming 20 % of municipal consumption → 180 t/a. consumption → 180 t/a.

Implementation period: 2021 - 2025

Field of action: Municipal buildings / No. 2.2

Incentive system for energy saving

Brief description:

Energy savings in all buildings in the City Group through an incentive/bonus system for all users, especially in schools/daycare centres.

From the mid-1990s to 2006, the city of Aachen offered a bonus system for schools and kindergartens, which is to be reintroduced. At that time, the savings achieved were valued in monetary terms and the bonuses were distributed to the facilities for free use, for the realisation of savings activities and to the caretakers. Schools and nurseries are seen as the primary target group, as they account for around half of the city's energy requirements. However, the system is also to be extended to other administrative areas.

The mode of the bonus system is to be optimised based on experience with the previous system. The experience gained with the "ACtiv fürs Klima - Aachener Schulen und Kitas machen mit" project will also be incorporated into the development.

First steps for action:

Re-introduction of bonuses for measures on a voluntary basis, initially for schools and daycare centres (the city has around 120 facilities in total). In addition to energy (electricity, heat), the system will also take waste and mobility into account. The introduction of bonuses will be accompanied by information, counselling and training for the facilities.

Target group:

Pupils, children, educational staff, caretakers

Those responsible and those involved:

E26, E18 (FB 61, FB 45)

Criteria / Evaluation:

Criteria:		Evaluation:
$CO2_{reduction}$	++	350 t/a
Financial expenditure		Costs of assoc. Unter. (possibly foundation): 25,000 € per year
Time expenditure (personnel)		0.5 MÄ
Regional added value		none

Explanation of the evaluation criteria:

At the time, the bonus system had only saved 8% energy and waste through changes in user behaviour (312 t + 432 t, in 2 years). Assumption therefore 350 t/a. Consultancy services are to be provided by external consultants and can be financed with foundation funds.

Implementation period: 2021 - 2025

Field of action: Municipal buildings / No. 2.3

Energy-efficient refurbishment of municipal buildings, non-residential buildings

Brief description:

Refurbishment planning for schools, daycare centres and sports buildings is based on an annual key performance indicator report. In addition, the effects of climate change are taken into account and corresponding adaptation measures such as roof greening/sealing and the selection of materials/technology are included in the planning.
The refurbishment rate over the last 10 years has averaged 1% per year (one major refurbishment per year plus partial refurbishments, ventilation/lighting refurbishment). Monitoring is mandatory according to performance phase 10 PHPP. The aim is to at least double the annual refurbishment rate to 2%.
Energy-efficient refurbishment (refurbishment rate of 2%) is also to be introduced for other buildings in the City Group. The city's role model function, particularly in relation to the state properties (university buildings), is important here.

First steps for action:

Development of a prioritised list based on potential/needs:

- Schools: from 100 kWh/m², 13 properties, € 82 million
- Daycare centres from 100 kWh/m², 26 properties, € 35 million
- Administration building € 10 million
- Fire brigades € 5 million
- Indoor swimming pools € 20 million
- Other buildings € 10 million
- Total approx. €162 million by 2050, i.e. €5.5 million per annum over 30 years

According to the priority list, identification of the first property and further specification of the measures in the property including cost calculation, planning costs for this in 2020 around 300,000 euros.

Target group:

Public buildings

Those responsible and those involved:

E 26

Criteria:

		Evaluation:
$CO2_{reduction}$	++	928 t/a
Financial expenditure		City costs: €5,500,000 per year
Time expenditure (personnel)		3 MÄ
Regional added value	++	

Explanation of the evaluation criteria:

Orientation values according to refurbishment of various daycare centres/schools, heat savings between 62-80 %. 370 municipal. properties consume 74 million kWh of heat → around 200,000 kWh/year, savings at schools 477 t/a, daycare centres 226 t/a

Implementation period: 2021 - 2050

Field of action: Municipal buildings / No. 2.4

Energy-efficient refurbishment of municipal buildings, residential buildings

Brief description:

The city of Aachen has its own portfolio of around 2,700 flats, which are to be successively upgraded in terms of energy efficiency. This includes measures to optimise the building services and energy supply structure as well as insulating the building envelope. The use of renewable heat (versus district heating connection) and renewable electricity (installation of PV systems) will also be examined. Where possible, the roofs should be greened in future as part of the building refurbishment.

The city of Aachen can build on the positive experiences with the EU project EU-GUGLE (Joseph-von-Görres-Strasse and Rehmviertel, 254 flats) and the refurbishment of the Burggrafenstrasse properties. Final energy savings of between 60 and 75 % were achieved as part of EU-GUGLE, which also benefit the tenants.

The aim is to modernise the energy efficiency of around 160 flats per year.

First steps for action:

Analysing the condition of the buildings in order to draw up a list of priorities. Planning of the first conversions.

Target group:

Public housing stock

Responsible and involved parties:

FB 23

Criteria:		Rating:
CO_2 reduction	++	800 tonnes CO2/a
Financial outlay		City costs: € 4,000,000 per year
Time expenditure (personnel)		
Regional added value	+	

Implementation period: from 2021

Field of action: Municipal buildings / No. 2.5

Energy-efficient refurbishment of gewoge residential buildings

Brief description:

The housing company gewoge AG has its own portfolio of around 4,700 flats, which are to be successively upgraded in terms of energy efficiency. This includes measures to optimise the building services and energy supply structure as well as to insulate the building envelope. The use of renewable heat (versus district heating connection) and renewable electricity (installation of PV systems) will also be examined. Where possible, the roofs are to be greened in future as part of the building refurbishment.

Among other things, gewoge can build on its positive experience with the EU project EU-GUGLE. The refurbishment of the 4 blocks of flats in Wiesental (123 flats) resulted in savings of 54% in heating energy, 62% in final energy and 71% in CO_2 emissions.

The aim is to refurbish at least 80 flats per year, corresponding to 1.7% of gewoge AG's own portfolio.

First steps for action:

Analysing the condition of the building and drawing up a renovation roadmap, planning and preparing initial implementation measures.

Examination of the option of financing by waiving parts of the profit transfer to the City of Aachen.

Target group:

gewoge flats

Responsible and involved parties:

gewoge, FB 23

Criteria:

		Rating:
CO_2 reduction	++	400 tonnes CO2/a
Financial outlay		Costs verb. Companies: € 2,000,000 per year
Time expenditure (personnel)		
Regional added value	+	

Implementation period: from 2021

Field of action: Municipal buildings / No. 2.6

Climate-neutral new buildings

Brief description:

Since 2014, administrative buildings and schools have been constructed almost entirely as passive houses.

With immediate effect, the corresponding planning guidelines will be expanded to include criteria for sustainability, resource efficiency and life cycle assessment. The use of sustainability certifications is being introduced.

In future, these requirements for new buildings are to be applied to all buildings of the City Group (majority shareholding), including municipal flats (see measure no. 2.4).

First steps for action:

All future buildings will be calculated in terms of $CO_{2\ emissions}$ and optimised in this respect. Currently, an immediate application is being made for the extension of the Lagerhausstrasse administration building. The $CO_{2\ emissions}$ from the operation of the building must be offset over 50 years. (Construction materials are taken into account via C2C). A system for offsetting within the company's own building portfolio is to be examined and introduced if possible: If CO_2 neutrality is not possible (e.g. too little PV area), CO_2 certificates should be purchased.

Target group:

Public residential & non-residential buildings

Those responsible and those involved:

E 26, all companies in the City Group

Criteria:

		Evaluation:
$CO_{2\ reduction}$	+	Calculation of CO2 emissions over the lifetime of each new building
Financial outlay		property-specific
Time expenditure (personnel)		
Regional added value	+	

Explanation of the evaluation criteria:

Calculation of $CO_{2\ emissions}$ over the lifetime of each new building. Less PV electricity generated = number of $CO_{2\ certificates}$ required. $CO_{2\ certificates}$ cause "operating" costs that cannot yet be estimated

Implementation period: 2020 - 2025

Field of action: Municipal buildings / No. 2.7

PV systems on municipal buildings for own use of electricity

Brief description:

PV systems are to be installed with immediate effect in all new municipal buildings and major renovations (especially roof refurbishments). The summer electricity load will be used as the basis for determining own requirements.

A fundamental investigation is being carried out with the aim of 100% PV on municipal buildings in order to cover the entire municipal electricity demand of 20 GWh. To this end, a model for the local grid feed-in of renewable energies from municipal systems (distribution via regional direct marketing) will be developed in the short term with the grid operator Regionetz and STAWAG. Energy consumption is to be offset across all buildings.
PV systems with an area of 138,000 m² and an output of 20,000 kWp are required to cover the city's electricity needs (costs €1,300/kWp + €200/kWp ancillary costs = €30 million), spread over 10 years, i.e. 10,000 kWp in 5 years.

First steps for action:

PV systems as part of a refurbishment on the buildings: Einhard-Gymnasium (2019 f), Hander Weg (2020), Inda-Gymnasium (2021 ff)

New buildings 2020-2022: Reimser Strasse and Kaiserstrasse primary schools, Kollenbruch and Stettiner Strasse daycare centres Installation of a 9.9 kWp system in 2020 (costs EUR 17,000)

Target group:	**Those responsible and those involved:**
City AC	E 26

Criteria:		**Evaluation:**
CO_2 reduction	++	982 t/a
Financial outlay		City costs: € 3,000,000 per year (PV systems are economical)
Time expenditure (personnel)		2 MÄ
Regional added value	++	

Explanation of the evaluation criteria:

The emission factor is currently 554 g/kWh. If the emission factor of PV electricity is deducted, the emission factor of municipal electricity procurement is 491 g/kWh.

With electricity generation of 900 kWh/kWp, → 20,000 kWp are required to cover the city's entire electricity demand. The generation of 20 GWh of PV electricity saves a total of 9.82 million kg of CO_2. Spread over 10 years, this means savings of just under 4,910 tonnes and 982 tonnes per year by 2025.

Implementation period: 2020 - 2025

Field of action: Municipal buildings / No. 2.8

Climate protection & climate impact adaptation: greening the roofs of municipal buildings

Brief description:

Greening of suitable roof surfaces (integrating green roofs and PV systems), especially in the Aachen basin (synergies due to evaporation effects). Other effects include quality of stay, water retention, pollutant binding, summer heat insulation, noise protection and habitats for small creatures.

Buildings are only air-conditioned if they are covered by renewable electricity.

First steps for action:

Systematic inspection of roof surfaces for the possibility of using green roofs (structural analysis). Annual realisation of up to 10 green roofs, target value 2000 ^{m2} per year.

Target group:		Responsible and involved parties:
public buildings		E 26
Criteria:		**Rating:**
$CO2_{reduction}$	+	1.8 t/a
Financial expenditure		City costs: €100,000 per year
Time expenditure (personnel)		
Regional added value	+	

Explanation of the evaluation criteria:

Ext. greening 0.9 kg $_{CO2}$ / m^2 : 1.8 t/a (for 2000 m^2 /a) [at 50 €/m^2 and 10 roofs per 200 m^2 : 100,000 € per year]

Implementation period: 2020 - 2025

Field of action: Municipal buildings / No. 2.9

Conversion from fat clients to VDI clients

Brief description:

Use of thin clients at the workplace and utilisation of efficient central infrastructure. The measure is implemented together with the Windows 10 roll-out to simplify the workplace infrastructure.

First steps for action:

The project was launched in 2018 and will run until the end of 2020. There are no additional costs or personnel requirements.
The reorganisation of the workplaces serves as a model for other companies.

Target group:

City administration

Responsible and involved parties:

regio IT, FB 11

Criteria:

$CO_{2\ reduction}$ Financial outlay

Time expenditure (personnel)

Regional added value

Rating:

++ 123 t/a

Explanation of the assessment criteria: Flexibility of working (home office)

Implementation period: 01.01.2019 - 31.01.2021

Field of action: Municipal buildings / No. 2.10

Relocation of the data centre to the EURAIX site

Brief description:

Savings in server capacity by merging with the central EURAIX site. Savings can be generated through more efficient operation.

First steps for action:

Consolidation of mailboxes has already been moved to a centralised infrastructure

Target group:

City administration

Responsible and involved parties:

FB 11, regio IT

Criteria:

Criteria:		Rating:
$CO_{2\ reduction}$	+	20 t/a
Financial expenditure		Costs and personnel expenses have not yet been analysed
Time expenditure (personnel)		Costs and personnel expenses have not yet been analysed
Regional added value		

Explanation of the evaluation criteria: IT operation according to the state of the art

Implementation period: not yet defined

5.4.3. Energy supply

Field of action: Energy supply, renewable energies / No. 3.1

Expansion of private solar energy use, launch of a subsidy programme

Brief description:

The expansion of the use of solar energy is a central pillar of this climate protection concept. As early as 2011, the city of Aachen created a solar roof register and identified enormous potential for solar installations. The cadastre was published and the topic was promoted by writing to owners of large suitable roof areas, among others. However, the framework conditions of the EEG have led to a slump in the construction of systems.

In order to achieve the climate protection target, suitable existing roof areas must be mobilised for energy generation, either via PV or solar thermal systems. Following the great success of the 1000 Roofs Programme in the district of Düren and based on the experience with the funding for private systems offered by STAWAG until the end of 2018, a new funding programme is the central component of this measure.

First steps for action:

1. Concept for the further utilisation of PV systems that are no longer eligible for EEG remuneration.
2. Subsidy programme, promotion of PV systems, approx. 10% subsidy rate, review of Model 1000 roofs in the district of Düren and relief for balcony systems.
3. Continuation of the STAWAG subsidy for solar thermal energy and applications to tap this potential (discontinued on 1 April 2020)
4. Campaign, stakeholder network and cooperation see HF Communication

Target group:

Private and commercial rooftop owners

Those responsible and those involved:

City, STAWAG, altbau plus

Criteria:

		Evaluation:
$CO_{2\ reduction}$	+++	6,540 t/a
Financial expenditure		City material costs: € 1,900,000 per year
Time expenditure (personnel)		1 MÄ
Regional added value	++	19 million in investments are made annually solves

Explanation of the evaluation criteria:

Reduction potential to be tapped by 2030: 60,700 tonnes of CO_2 and 123.6 GWh of PV electricity. Per year 6070 t/a (municipal costs only 10 % subsidy share)

Through continuation and more advertising for solar thermal promotion (cf. HF communication) 470 t/a

Implementation period: 2020 - 2025

Field of action: Energy supply, renewable energies / No. 3.2

Ground-mounted PV systems

Brief description:

Utilisation of buildable areas by STAWAG or other system builders. According to Energis (project render), the theoretical potential for PV yields on 166.2 ha of motorway areas is 72.88 GWh, on 97.4 ha of railway areas 38.18 GWh

First steps for action:

Examination of the potentials according to the render project with regard to their legal realisation possibilities. If necessary, discussions with the federal motorway and railway, clarification of the plant manufacturer (whether STAWAG or others)

Target group:

PV system builder

Responsible and involved parties:

FB 36, FB 61

Criteria:		Rating:
$CO2_{reduction}$ Financial	++	500 t/a
outlay		External costs (STAWAG, private)
Time expenditure (personnel)		
Regional added value	+	

Explanation of the evaluation criteria:

Of the theoretical potential, at best just under a third is realistically considered to be tappable by 2030: 21 and 11 GWh/a, corresponding to 10.3 plus 5.4 million kg CO_2, 1570 tonnes/a as theoretical potential. External costs may be incurred

Implementation period: 2021 - 2023

Field of action: Energy supply, renewable energies / No. 3.3

Securing and expanding renewable shares from wind energy

Brief description:

The expansion of wind power utilisation in the city area does not require any financial support from the city thanks to its high economic efficiency and is one of the most efficient measures on the way to achieving the city's climate protection goals. On the other hand, wind power utilisation is limited by legal framework conditions. As the latter are currently under discussion at state and federal level, it is currently difficult to analyse the exact status quo. This 5-year plan is therefore based on a conservative estimate of expansion potential of 5 wind turbines per 3 MW by 2025. In addition, the re-powering of old turbines needs to be clarified. STAWAG has already initiated a research project with hydrogen as a wind energy storage system.

First steps for action:

1. Examination of further possible locations (priority areas) and expansion options.
2. Workshops to find solutions with regard to re-powering, possibly with external moderation. Clarify how to deal with wind turbines after the EEG feed-in tariff expires: due to the complex ownership structure in the Vetschau wind farm, a moderated solution process makes sense.

Target group:

Wind turbine operators

Responsible and involved parties:

FB 36, FB 61

Criteria:

Criteria	Rating	Rating:
$CO2_{reduction}$	+++	4431 t/a
Financial expenditure		STAWAG or private; revenue for the city e.g. through land leasing and taxes
Time expenditure (personnel)		
Regional added value	++	

Explanation of the evaluation criteria:

5 systems of 3 MW each save 22,100 tonnes of CO_2 at 2750 full-load hours (this corresponds to 4431 tonnes per year and s y s t e m). At 2500 full load hours, 20,400 tonnes are saved.

Implementation period: 2019 - 2025

Field of action: Energy supply, renewable energies / No. 3.4

Secure decentralised heat supply, district heating network and implement neighbourhood-specific individual solutions

Brief description:

The municipal energy supplier STAWAG operates a district heating (DH) network based on heat cogeneration from the Weisweiler lignite-fired power plant. As this power plant will be decommissioned in spring 2029, solutions need to be generated to safeguard the district heating network, in particular ways to increase the proportion of renewable energy (improve the primary energy factor). A concept for renewable district heating and cooling is to be drawn up.

In order to improve the utilisation of the FW network, a compulsory FW connection in redeveloped districts is being examined.

A feasibility study for a solar storage facility in an old quarry in Walheim will show the potential for minimising local supply in this area.

First steps for action:

1. Construction of a 20 MW CHP plant in the Schwarzer Weg area for feeding into the FW grid
2. Concept for transformation towards renewable district heating

Target group:

Potential customers for district heating

Responsible and involved parties:

STAWAG

Criteria:

$CO2_{reduction}$	+++	8200 t CO2/a through CHP Schwarzer Weg
Financial expenditure Time expenditure (personnel)		Costs at STAWAG
Regional added value	+	

Explanation of the evaluation criteria:

The savings from the Schwarzer Weg CHP plant and the associated connection of three industrial companies to the district heating network were analysed. The effects on the emissions of the FW from Weisweiler, which are taken into account in the $CO2_{balance,}$ have not yet been determined here. Costs at STAWAG

Implementation period: 2021 - 2025

Field of action: Energy supply, renewable energies / No. 3.5

Waste heat utilisation

Brief description:

Testing the suitability of utilising waste heat as part of the development of new building projects. For example, the use of waste heat from the new computer centre to be built on the West Campus is planned.

First steps for action:

Concretisation in the course of planning progress

Target group:

Heat supplier

Responsible and involved parties:

STAWAG

Criteria:

$CO_{2\ reduction}$	++	500 t/a
Financial outlay		Costs at STAWAG
Time expenditure (personnel)		
Regional added value		

Explanation of the evaluation criteria:

The construction of the data centre is accompanied by an expansion of IT applications that increase CO2 emissions. The use of waste heat contributes to the energy efficiency of the data centre. Overall, the CO2 reduction depends on the potential and extent of waste heat utilisation and therefore quantification is only possible with caution.
Costs at STAWAG

Implementation period: 2023

5.4.4. Mobility

The package of measures in the area of mobility consists of 22 measures in 3 fields of action of the scenario "Mobility turnaround" together. It aims to achieve a total local CO_2 reduction of 20% or 83 tonnes by 2030 compared to 1990. The programme is designed to complement the federal climate protection plan, which aims to reduce CO_2 emissions in transport by 40% by 2030.

It has not yet been possible to quantify the CO_2 contributions of the individual measures. However, it should be noted that a CO_2 reduction of 10 thousand tonnes per year or 2.6% of the 387 thousand tonnes of CO_2 emissions generated locally in Aachen was estimated for the €15 million implementation package #AachenMooVe! by 2022.

The measures are a sensible combination of measures to achieve the objective. Individual measures can also be replaced by others or possibly even omitted. However, it should be noted that without emission targets and/or restrictions and price increases for car and freight transport, it is unlikely that the target can be achieved.

5.4.4.1. Field of action 4.1: Reduction of car traffic in urban areas

Field of action: Reduction of car traffic in urban areas / No. 4.1.1

Expansion of cycle traffic according to cycle decision

Brief description:

The citizens' petition for a different design of cycling facilities in Aachen was signed by 37,000 Aachen residents in 2019 and adopted by the city council in November 2019. The most important points are as follows:

- Creation of at least 5 km of structurally separated cycle paths with a width of at least 2.30 m on main roads per year
- Creation of at least 10 km of main cycle routes per year
- Conversion of three major junctions per year according to the Dutch design principle
- Design new cycle paths in red
- 15,000 new bicycle parking spaces in 8 years
- Transparent notification and reporting system

Additional resources would have to be made available for measures that go beyond this.

First steps for action:

1. Discussions with the initiators regarding consideration of the new principles in measures that have already been decided,
2. Recruitment of 7 additional transport planners
3. Construction of the priority cycle routes Eilendorf, Campus Melaten, Brand, Vaals, Berensberg
4. Expansion of bicycle parking facilities at the main station administration building,
5. Expert opinion on bicycle parking and digital reporting platform for new bicycle racks
6. Construction of approx. 20 lockable and covered bicycle car parks on the street as part of the "AachenMooVe!" project

Target group:

Residents, especially children, senior citizens, cyclists in need of safety

Those responsible and those involved:

FB 61/300, FB 61/400, FB 61/700

Criteria:

CO_2 reduction	Part of the mobility transition scenario
Financial expenditure	Approx. € 10 million p.a. (planned in the budget)
Time expenditure (personnel)	7
positions Regional added value	

Implementation period: 2020 - 2027

Field of action: Reduction of car traffic in urban areas / No. 4.1.2

Realisation of premium routes

Brief description:

Implement concept with 10 premium paths for pedestrians from the city centre into the countryside: Upgrading squares, recreational areas and crossing points.

First steps for action:

Premium path to Frankenberger Park with redesign of the town square in Lothringer Straße

Target group:

Inhabitants

Those responsible and those involved:

FB 61/500, FB 61/300, FB 36

Criteria:

	Evaluation:
$CO_{2\ \text{reduction}}$	
Financial expenditure	approx. 1 million €/a
Time expenditure (personnel)	1 new position (already included in fin. expenditure)
Regional added value	

Durchführungszeitraum: 2020-2030

Field of action: Reduction of car traffic in urban areas / No. 4.1.3

Creation of "strong axes" in bus transport

Brief description:

Strengthening the most important bus routes with separate bus lanes

First steps for action:

Target group:

Inner-city bus users and commuters

Those responsible and those involved:

FB 61/300

Criteria:

$CO_{2\ \text{reduction}}$

Financial expenditure

Time expenditure (personnel)

Regional added value

Evaluation:

2.5 million € / a

1 new position (already included in fin. expenditure)

Durchführungszeitraum: 2021-2026

Field of action: Reduction of car traffic in urban areas / No. 4.1.4

Expansion of bus transport by 30 %

Brief description:

The expansion of bus services by around 30 % is part of ASEAG's Vision 2027.

A concept will be drawn up for this purpose, the financial resources will be made available and the range will be successively expanded.

An expert report for the AVV is currently analysing which service changes are advisable for Aachen.

In the medium term, reactivation of the rail link from Baesweiler, Würselen via Merzbrück airfield to the bus station on Grabenring in Aachen "regiotram".

First steps for action:

1. densification line 51

Concept development, adaptation of local transport plan
Clarification of the extension of the public service contract awarded to ASEAG until 2027

Target group:

Residents

Those responsible and those involved:

FB 61/300, ASEAG

Criteria:

CO_2 reduction

Financial expenditure

Time expenditure (personnel)

- Regional added value

Evaluation:

20 million €/a (successive expansion to 40 million/a from 2026)

Implementation period: 2020 - 2026

Field of action: Reduction of car traffic in urban areas / No. 4.1.5

Halving of public transport fares in Aachen from 2025

Brief description:

In recent years, public transport fares have been regularly increased in order to cover the costs not covered by direct users. As a result, fares have risen considerably, especially in comparison to car parking charges. The ratio of public transport fares to the cost of an hour's parking on the roadside has been defined in the transport development planning indicators. A medium improvement was decided for a ratio of 0.5 - 0.75 and a strong improvement for a ratio of less than 0.5. An expert opinion for the AVV is currently analysing which other pricing models are recommendable for Aachen.

First steps for action:

Financing of ASEAG's additional financial requirements from the budget; freezing of Aachen-specific ticket prices on the AVV public transport network

Target group:

Public transport users

Those responsible and those involved:

FB 20, FB 61/300, AVV

Criteria:

$CO2_{\text{reduction}}$

Financial expenditure

Time expenditure (personnel)

Regional added value

Evaluation:

6,667,000 € Costs involved Company

Implementation period: 2019 - 2021

Field of action: Reduction of car traffic in urban areas / No. 4.1.6

Binding mobility concepts for construction projects and events

Brief description:

Mobility concepts for construction projects and events can have a high level of acceptance and therefore a great impact if they are designed specifically for the location. They can be realised for the benefit of builders and users and adapted to changing needs. Mobility impacts on the surrounding area can be avoided, benefits created for the neighbourhood and emissions reduced.

The effect results from a reduction in the number of cars required, the number of kilometres driven and the establishment of electromobility.

As part of the "#AachenMooVe!" project in the ongoing "Burggrafenstraße" residential construction project, a business model for the operation of mobile stations - Mobility Stations" project, a business model is being developed for the operation of mobility stations in conjunction with location-based mobility concepts.

However, in order to achieve the best possible conditions for the reduction of transport-related emissions over the lifetime of construction projects, such emission-reducing mobility concepts would have to be introduced on a mandatory basis and planned from the outset. (see also measure no. 1.6). The city administration offers consulting expertise for suitable measures and functioning solutions for building owners and event organisers.

For major events in the city of Aachen, emission-saving mobility concepts will be introduced on a mandatory basis.

First steps for action:

Burggrafenstrasse mobile station business model

Establishing the visibility of mobile stations at 25 stations as part of #AachenMooVe!

Target group:

Public transport users

Those responsible and those involved:

FB 20, FB 61

Criteria:

CO_2 reduction

Financial expenditure

Time expenditure (personnel)

Regional added value

Evaluation:

just under € 200 thousand p.a. from 2021

1 new position (already included in fin. expenditure)

Implementation period: 2019 - 2021

Field of action: Reduction of car traffic in urban areas / No. 4.1.7

Neighbourhood car parks as mobile stations

Brief description:

The expansion of bus lanes and cycle paths requires space on public roads. Many roadside parking spaces will probably have to be removed, particularly on main roads and in cycle lanes. In the short and medium term, it is unlikely that the number of cars needed by people who live, work or shop in these areas will fall by the same amount.

Therefore, in areas where parking spaces are lost, replacement solutions should be created in existing multi-storey car parks, but also through the construction of new multi-storey car parks, ideally in conjunction with new construction projects. This will primarily affect areas where resident parking exists, so that there is a high demand for spaces in the multi-storey car parks.

These neighbourhood car parks should then not only be areas for parking private cars, but also offer the prospect of reliable parking and charging of electric vehicles, enable large-scale secure parking for bicycles and vehicle sharing (organised and private car sharing, cargo bikes, pedelecs). This would create neighbourhood mobile stations that can be modified in terms of demand and use.

At least the costs for the land acquisition will probably have to be borne by the public sector. In order to make the costs of the measure acceptable, the parking spaces should be rented out to cover costs and the mobility services provided by APAG. The business models from measure no. 4.1.6 will be utilised.

First steps for action:

Elaboration of the business model from measure no. 4.1.6 with external and internal experts

Target group:

Residents, commuters

Those responsible and those involved:

FB 61,

Criteria:

$CO_{2\ \text{reduction}}$

Financial expenditure

Time expenditure (personnel)

Regional added value

Evaluation:

1.5 million €/a

3 new positions (already included in fin. expenditure)

Implementation period: 2020 - 2025

Field of action: Reduction of car traffic in urban areas / No. 4.1.8

Expansion of traffic area control

Brief description:

In order to be able to use the new cycling facilities and bus lanes safely and comfortably without disruption, the monitoring of the observance of stopping and parking bans in bus lanes and cycling facilities, particularly in the city centre, will be stepped up. Personnel capacities will be expanded for this purpose.

First steps for action:

Creation of 10 additional positions for monitoring staff, including clarification of the means of transport to be used for monitoring

Target group:

Parking offenders

Those responsible and those involved:

FB 32

Criteria:

$CO2_{\text{reduction}}$

Financial expenditure

Time expenditure (personnel)

Regional added value

Evaluation:

600 thousand €/a

10 new jobs (included in fin. expenditure)

Implementation period: 2020 - 2025

Field of action: Reduction of car traffic in urban areas / No. 4.1.9

Scientific support for the mobility transition

Brief description:

The package of measures for the mobility transition for the IKSK was developed within the administration in spring 2020. The costs and effects of the mobility transition measures have been roughly estimated. It has not yet been possible to conduct a dialogue with the transport development planning committees and the public.

The next steps for a successfully organised mobility transition should be discussed with experts from RWTH and FH Aachen. The efficiency of the range of measures should also be re-examined. Scientific support for forecasting effects and recording the effects in a monitoring programme is required.

First steps for action:

Coordination of the type and scope of scientific monitoring

Target group:

Decision makers

Those responsible and those involved:

FB 61, ASEAG, RWTH and FH Aachen

Criteria:

CO_2 reduction

Financial expenditure

thousand €/a Time expenditure (personnel)

Regional added value

Evaluation:

25

Implementation period: 2019 - 2021

5.4.4.2. Field of action 4.2: Reduction of car traffic in regional transport

Field of action: Reduction of car traffic in regional transport / No. 4.2.1

Expansion of express bus services

Brief description:

The new NRW state funding guideline is to be used to create 8 attractive, regional express bus routes of a quality comparable to rail transport.

First steps for action:

One express bus route to Jülich and one to the south of Aachen

Target group:

Commuters from the Aachen region

Those responsible and those involved:

FB 61/300, ASEAG, FB 20

Criteria:

CO_2 reduction

Financial expenditure

1,700,000 / a Time expenditure (personnel)

Regional added value

Evaluation:

Approx.

Explanation of the evaluation criteria: approx. €300 thousand per year per express bus line

Implementation period: 2021 - 2025

Field of action: Reduction of car traffic in regional transport / No. 4.2.2

RegioTram

Brief description:

A feasibility study is currently being carried out for the expansion of the Euregio railway between Baesweiler, Würselen, Merzbrück airfield and the bus station in Aachen under the name "RegioTram".

In the medium term, reactivation of the rail link from Baesweiler, Würselen via Merzbrück airfield to the bus station on Grabenring in Aachen "regiotram".

First steps for action:

Continuation of planning based on the results of the feasibility study

Target group:

Residents

Those responsible and those involved:

FB 61/300

Criteria:

$CO_{2\ \text{reduction}}$ Financial

outlay

Time expenditure (personnel)

- Regional added value

Evaluation:

Explanation of the evaluation criteria: Successive expansion with financial expenditure of 40 million/a from 2026

Implementation period: 2020 - 2026

Field of action: Reduction of car traffic in regional transport / No. 4.2.3

Campaign and funding programme for the mobility transition

Brief description:

The #AachenMooVe!3 mobility management project is establishing structures for systematic mobility management in Aachen. Many instruments such as analysis tools, intensification of the public relations work "Aachen clever mobil" and personnel are financed until 2022.

It was not possible to fund direct incentive measures for switchers that were deemed necessary, such as taster tickets or mobility credits for testing existing offers, discounts for taking out subscriptions, rewards for providing places in carpooling systems and subsidies for the purchase of pedelecs. This can motivate people who are willing to make the switch to actually test alternatives and make the switch.

The programme is to be worth an average of €300 per person making the switch; 2,000 people per year are to be motivated in this way. The programme requires additional mobility management staff.

First steps for action:

Setting up taster quotas for private individuals and employees of companies in the movA system

Target group:

Car users who are prepared to switch to another mode of transport or to form car pools

Those responsible and those involved:

FB 61/300, ASEAG, Velocity, cambio

Criteria:

CO_2 reduction

Financial expenditure

Time expenditure (personnel)

expenditure) Regional added value

Evaluation:

800 thousand €/a

3 new positions (included in fin.

Implementation period: 2020 - 2025

Field of action: Reduction of car traffic in regional transport / No. 4.2.4

Mobility management for visitors

Brief description:

The measure is intended to support visitors to Aachen's city centre by public transport and P+R. To this end, information and incentives are to be created via the information channels of the facilities that visitors wish to visit.

The measure is to be designed and implemented as part of the city of Aachen's mobility management strategy.

First steps for action:

Establishment of taster quotas for private individuals and employees of companies in the movA system

Target group:

Visitors to the city centre

Those responsible and those involved:

FB 61/300

Criteria:

CO_2 reduction

Financial expenditure

Time expenditure (personnel)

expenditure) Regional added value

Evaluation:

200 thousand €/a

0.5 new position (included in fin.

Implementation period: 2021 - 2025

Field of action: Reduction of car traffic in regional transport / No. 4.2.5

Company mobility management (BMM) for employers

Brief description:

The #AachenMooVe!3 mobility management project is establishing structures for systematic mobility management in Aachen. Many instruments such as analysis tools, intensification of the public relations work "Aachen clever mobil" and personnel are financed until 2022.

After that, a solution must be found to finance the continuation of the programme.

First steps for action:

Discussions with the initial partners IHK Aachen, AVV and Städteregion Aachen about a joint continuation from 2022

Target group:

Employees of large employers

Those responsible and those involved:

FB 61/300, FB 02

Criteria:

$CO2_{\text{reduction}}$

Financial expenditure

Time expenditure (personnel)

Regional added value

Evaluation:

300 thousand €/a from 2022

and 3 new jobs

Implementation period: 2022 - 2025

Field of action: Reduction of car traffic in regional transport / No. 4.2.6

Car parking concept

Brief description:

The parking concept should clarify which strategy should be pursued in order to control the entry to Aachen and the parking of cars by commuters and visitors: What potential does the P+R approach offer? What potential do neighbourhood car parks offer for employee traffic?

First steps for action:

Assignment of an expert opinion

Target group:

Commuters and visitors to the city centre

Those responsible and those involved:

FB 61/300, FB 02

Criteria:

CO_2 reduction

Financial expense

Time expenditure (personnel)

Regional added value

Evaluation:

33.333 €

Explanation of the evaluation criteria: €100 thousand, one-off in 2021

Implementation period: 2020 - 2021

Field of action: Reduction of car traffic in regional transport / No. 4.2.7

P+R / mobility hubs on access roads

Brief description:

In order to achieve a reduction in car journeys in the Aachen city area, more P+R spaces ("mobility hubs") are also needed on the main access routes, possibly also outside the Aachen city area.

In order for these places to be accepted, it is necessary that there is an attractive connection from there to the city centre (see measures no. 4.1.4 and 4.1.5). It is also necessary to make it significantly more expensive to drive on (or park in the city centre) (see measure no. 4.2.8).

It is assumed that a car park with 500 P+R spaces will cost around EUR 10 million.

First steps for action:

Identification of possible locations

Target group:

Employees of large employers

Those responsible and those involved:

FB 61/300, FB 02

Criteria:

CO_2 reduction	
Financial expenditure	3.25 million €/a
Time expenditure (personnel)	1 new position
(plus) Regional added value	

Evaluation:

Explanation of the evaluation criteria: €20 million for 2 locations with 500 places each

Implementation period: 2021 - 2025

Field of action: Reduction of car traffic in regional transport / No. 4.2.8

Financing models for the mobility transition

Brief description:

In order for the mobility turnaround to succeed, considerable financial resources are required that go far beyond the current level. At the same time, a massive reduction in emissions requires prices for the use of motorised private and freight transport to be set in such a way that motorised journeys are reduced to the desired extent.

While the federal government must develop suitable nationwide instruments to make transport more expensive in order to achieve its goals (see the Federal Environment Agency's proposals in Chapter 4.2.1), the City of Aachen must clarify which urban financing instruments it can use. To this end, an expert report should provide the basis for a decision. Politicians and the administration must be suitably involved in the preparation of the report.

First steps for action:

Formulation of a bill of quantities for the expert opinion

Target group:

Politics and administration

Those responsible and those involved:

FB 61/300, FB 20, FB 14

Criteria:

CO_2 reduction

Financial expense

Time expenditure (personnel)

position Regional added value

Evaluation:

€ 270 thousand for the expert opinion

1

Implementation period: 2021

5.4.4.3. Field of action 4.3: Reduction of vehicle emissions

Field of action: Reduction of vehicle emissions / No. 4.3.1

Cargo bikes funding programme

Brief description:

Following the expiry of the funding programme for cargo bikes for businesses, a new funding programme will be launched for cargo bikes for families; with a volume of 500 thousand euros per year, it is expected that 333 cargo bikes per year can be funded.

First steps for action:

Decision on the programme in the Mobility Committee, prompt start of funding

Target group:	**Those responsible and those involved:**
Families	FB 61/300, B03

Criteria:	**Evaluation:**
$CO2_{reduction}$	
Financial expenditure	340.000 €/a
Time expenditure (personnel)	2 new jobs (plus)
Regional added value	

Explanations of the evaluation criteria: €150 thousand in 2020; €500 thousand p.a. from 2021

Durchführungszeitraum: 2020-2025

Field of action: Reduction of vehicle emissions / No. 4.3.2

Electromobility programme

Brief description:

In the #AachenMooVe!5 - Electromobility Programme project, hydrogen-powered waste collection vehicles are being procured for the first time in addition to the existing battery-electric vehicles at Aachen's municipal services.

A budget of 2 million euros per year is proposed for such vehicle tests and to enable the city authorities to submit funding applications for converting the fleet to emission-free drives.

A separate office is needed to apply for the funding measures as part of the city's strategy for an emission-free city fleet.

First steps for action:

Procurement of 2 hydrogen-powered waste collection vehicles

Target group:

City fleet

Those responsible and those involved:

E18, B03

Criteria:

$CO2_{\text{reduction}}$

Financial expenditure

Time expenditure (personnel)

Regional added value

Evaluation:

2 million from 2021

1 new position (included in fin. expenditure)

Durchführungszeitraum: 2021-2025

Field of action: Reduction of vehicle emissions / No. 4.3.3

Procurement support for e-buses at ASEAG

Brief description:

With the procurement of 14 electric buses at ASEAG, we have set the course for an emission-free ASEAG fleet.

As part of the "mobility turnaround" scenario, 60 ASEAG buses will be replaced with emission-free buses by 2030. Additional costs of €2 million per year for 6 e-buses are estimated for this.

At the same time, it must be clarified what requirements and costs are necessary to charge the vehicles.

First steps for action:

Purchase of a further 6 e-buses

Target group:

Logistician

Those responsible and those involved:

FB 61/300

Criteria:

$CO_{2\ reduction}$

Financial expenditure

(ASEAG) Time expenditure (personnel)

Regional added value

Evaluation:

110 t/a per bus, i.e. 6.6 thousand t/a in 2030 with 60 buses

2 million €/a from 2021

Explanation of the evaluation criteria:

Durchführungszeitraum: 2021-2025

Field of action: Reduction of vehicle emissions / No. 4.3.4

Reducing emissions in delivery traffic

Brief description:

The foundations for viable solutions for emission-free delivery transport in Aachen are being laid in the #AachenMooVe! project. Deliveries in the immediate city centre area are to be made using electric cargo bikes and electric vans. Intensive cooperation between CEP service providers through to bundled deliveries and interim storage facilities close to the city centre (micro-depots) and new approaches to delivery in neighbourhoods, which are intended to avoid unsuccessful multiple deliveries, are intended to slow down the growth of delivery journeys.

First steps for action:

Target group:

Logistician

Those responsible and those involved:

FB 61/300

Criteria:

CO_2 reduction

Financial expense

Time expenditure (personnel)

Regional added value

Evaluation:

250 thousand € from 2022

1 new position (included in fin. expenditure)

Durchführungszeitraum: 2022-2025

Field of action: Reduction of vehicle emissions / No. 4.3.5

Expansion of traffic management and digital foundations

Brief description:

Updating the control devices to enable communication between traffic lights and vehicles

First steps for action:

Target group:

Road users

Those responsible and those involved:

FB 61

Criteria:

$CO_{2\ \text{reduction}}$

Financial expenditure

€/a Time expenditure (personnel)

Regional added value

Evaluation:

1.25 million

Implementation period: 2020 - 2025

Field of action: Reduction of vehicle emissions / No. 4.3.6

Expansion of the charging infrastructure

Brief description:

The charging infrastructure in Aachen is being significantly expanded in the pilot project "ALigN - Expansion of charging infrastructure through targeted network support", which is 100% funded by the federal government and coordinated by the city and STAWAG. In particular, publicly usable car parks on private property are to be made accessible for smart parking and charging processes. These include company and supermarket car parks, but also multi-storey car parks.

Based on the findings in ALigN, further expansion is to take place on a private-sector basis.

First steps for action:

Construction of around 900 charging points by 2021

Target group:

Those responsible and those involved:

FB 61/300, STAWAG

Criteria:

$CO_{2\ reduction}$ Financial outlay

Time expenditure (personnel)

Regional added value

Evaluation:

Explanation of the evaluation criteria: After completion of ALigN finances not in the municipal budget

Implementation period: 2020 - 2025

5.4.5. Building refurbishment

Field of action: Buildings - refurbishment in the private and commercial sector / No. 5.1

Re-introduction of a funding programme for the renovation of old buildings

Brief description:

In order to reduce heat demand in the building sector, private and commercial building owners must be incentivised to renovate their buildings to make them more energy efficient, as the measures are difficult to implement economically. There is good experience with subsidy programmes at municipal level, for example in the cities of Cologne and Düsseldorf. Until the expiry of the energy efficiency concept (EEK, 2006-2010), STAWAG also subsidised the energy-efficient refurbishment of buildings. During the evaluation of the EEK, this subsidisation was identified as one of the most effective measures for reducing CO_2. A municipal funding programme should therefore be launched to initiate a refurbishment push. As outlined in chapter 4.3.2, a CO_2 reduction potential of 8840 tonnes per year must be tapped. A funding programme can make a major contribution to this by initiating the refurbishment of 450 buildings per year (1.5% of the housing stock in need of refurbishment) with an average investment volume of €80,000 per building. With a subsidy rate of 10%, an average (purely mathematical) subsidy of €8,000 per refurbishment would be paid out. This would trigger investments totalling €36 million per year.

First steps for action:

1. Development of funding criteria, i.e. concrete design of the funding conditions such as maximum amount and funding quotas for individual funding objects depending on the component/technology.
2. Orientation towards well-running programmes in other cities.
3. Integration of sustainable materials (conservation of resources, life cycle).
4. Application of the funding programme.

Target group:

Building owner

Those responsible and those involved:

altbau plus, FB 36

Criteria:		**Evaluation:**
CO_2 reduction	+++	7,200 t/a
Financial outlay		3.6 million € per year
Time expenditure (personnel)		2 MÄ
Regional added value	+++	

Explanation of the evaluation criteria:

36 million euros of investment in refurbishments are required per year to generate the savings potential. The funding programme is based on a funding rate of 10%. For every euro invested, 0.2 kg of CO_2 savings are recognised. Investments in energy-efficient refurbishments and the replacement of heat generators are estimated to generate regional added value effects totalling EUR 7.6 million per year through entrepreneurial profits, employee income and municipal tax revenue (https://owr-eg.difu.de/rechner/).

Implementation period: from 2020

Field of action: Buildings - refurbishment in the private and commercial sector / No. 5.2

Neighbourhood-specific refurbishment consulting - Permanent consulting service in changing neighbourhoods with a target group-specific approach

Brief description:

Neighbourhood-based advice on energy-efficient building refurbishment is to be expanded. The positive experiences with increased refurbishment rates due to neighbourhood work in AC-Nord and AC-Haar are to be rolled out while simultaneously implementing a target group-optimised approach. To this end, an advice centre will be present in the neighbourhood for 2-3 years, after which it will be continued in the next neighbourhood.

An important component is the neighbourhood-specific analysis of the target group and the development of specific approach strategies and support services. An analysis (external commission) of the housing stock is being carried out with regard to
• Building types with high savings potential,
• Ownership structure,
• financial and socio-cultural characteristics of the owners,
• buildings of significance to the cityscape.

Building on this, spatially focused, specific approach strategies and accompanying support services are being developed for selected target groups (including housing associations) within the building owners in one neighbourhood per year (external commission).

First steps for action:

1. Recruitment of neighbourhood manager, office search (can also be in the district office), office costs and overheads €13,000, €13,000 for public relations work in the neighbourhood.
2. Application of a target group-specific approach strategy: Selection of a suitable neighbourhood for a starter project.
3. Development of the strategy and implementation of the approach in the neighbourhood.
4. Costs are neighbourhood analysis, development of the approach strategy, implementation; per neighbourhood 25.000 €

Target group:

Private homeowners

Those responsible and those involved:

altbau plus e.V., FB 36

Criteria:		Evaluation:
$CO_{2\ reduction}$	++	90 t/a Financial
outlay		51,000 € per year
Time expenditure (personnel)		1 MÄ
Regional added value	++	

Explanation of the evaluation criteria:

If around 50 refurbishments are achieved, around 90 tonnes of CO2eq/a can be saved

Implementation period: 2020 ff

Field of action: Buildings - refurbishment in the private and commercial sector / No. 5.3

Advice on the use of renewable energy to heat buildings

Brief description:

The main share of energy demand in households lies in the provision of heat. However, in addition to the use of energy-efficient technologies, increased promotion of the use of renewable energies in the heating sector is necessary. In the interests of decarbonising heat generation, more information on renewable heat must be included in the advice provided.

First steps for action:

Proactively integrate the use of renewable energy heating systems into ongoing advisory work.
Invite external speakers, obtain expertise for techniques that are not yet standardised. Obtain expertise for techniques that are not yet standardised, if necessary create information and argumentation material.

Target group:

Private homeowners

Those responsible and those involved:

altbau plus e.V., FB 36

Criteria:		Evaluation:
$CO_{2\ \text{reduction}}$	++	386 t/a
Financial outlay		10,000 € per year
Time expenditure (personnel)		
Regional added value	++	

Explanation of the evaluation criteria:

Replacing 100 heating systems with RE in the single-family home sector can save 386 tonnes per year.

Implementation period: from 2020

Field of action: Buildings - refurbishment in the private and commercial sector / No. 5.4

Mobilisation of commercial property owners to take energy efficiency measures:

Brief description:

Inform and sensitise owners of commercial properties. Commercial properties are often in a poor energy condition, as the buildings are not used by the owners themselves but are rented out. Institutions and networks that have access to the owners of commercial properties should be used for this measure to sensitise owners in addition to directly addressing them. Topics include the building envelope, building technology, PV systems, renewable heat, property protection due to climate adaptation.

One good reason to approach property owners is to inform them about their own property protection measures based on the heavy rain hazard map, which will be available in 2021.

First steps for action:

1. Coordination by the city. Economic development
2. Creation of information material to address business owners Specialist monitoring/support by altbau plus

Target group:

Owners of commercial property

Those responsible and those involved:

City of Aachen (36, 02), altbau plus, IHK, VUV

Criteria:

		Evaluation:
$CO_{2\ \text{reduction}}$	+++	400 t/a
Financial outlay		15,000 € per year
Time required (personnel)		1 employee, as there has been no activity in this direction to date
Regional added value	++	

Explanation of the evaluation criteria:

Reaching around 50 companies could save around 400 tonnes of CO_2/a. 1 employee, as there has been no activity in this direction to date. 15,000 € for external expertise.

Implementation period: from 2021

Field of action: Buildings - refurbishment in the private and commercial sector / No. 5.5

Resource-saving refurbishment of existing buildings

Brief description:

In future, the topic of "grey energy" should be given greater consideration when advising on energy-efficient refurbishment, as every construction activity has a negative impact on the climate. The expertise for this must be built up among the consultants.

The aim is to inform those wishing to build that, wherever possible, only materials characterised by economical use of materials and resources will be used in future.

First steps for action:

1. Further training for employees;
2. Creation of a material and technology catalogue;
3. Creation of a counselling guideline

Target group:

private homeowners

Those responsible and those involved:

old building plus

Criteria:

		Evaluation:
$CO2_{reduction}$	+	18 t/a Financial
outlay		47,000 € per year
Time expenditure (personnel)		0.5 MÄ
Regional added value	+	

Explanation of the evaluation criteria:

Additional savings of approx. 20 % $_{CO2}$ for each refurbishment. With 10 % of the targeted refurbishments, this is 20 % of 90 tonnes.

Implementation period: from 2021

5.4.6. Communication

Field of action: Communication, cooperation, participation / No. 6.1

Concerted action & "Öcher Solardach" campaign

Brief description:

The aim of the measure is to increase the utilisation of suitable existing roof surfaces for PV or solar thermal systems by private and commercial customers. The development of a funding programme is listed in the energy supply field of action. With the support of the various local stakeholders and experts, this programme can be developed in line with demand and communicated widely. To this end, the city is forming and coordinating a network of stakeholders. Advice and information on the funding programme should also be organised and advertised as part of a funding campaign.

First steps for action:

1. Alliance "Sun for Aachen" as a network of local stakeholders with specialist expertise for the purpose of developing support formats
2. Campaign to mobilise private and commercial homeowners, parallel to the start of the funding programme (cf. measure no. 3.1), budget of 35,000 already planned for this under general climate protection
3. Write to or contact owners of large roof areas, e.g. the Building and Real Estate Agency of the State of North Rhine-Westphalia (BLB) or the Federal Agency for Real Estate Management (BIMA)
4. Continuation of the STAWAG subsidy for solar thermal energy and applications, goal: tap potential, 470 t/a (expected to be discontinued on 1 April 2020)

Target group:

House owners (private and commercial)

Those responsible and those involved:

FB 36, FB 13, STAWAG

Criteria:

		Evaluation:
$CO_{2\ reduction}$	+	High reduction potential on the basis of the targeted plant expansion, see 3.1
Financial expenditure		Around € 35,000 one-off (financial estimate available)
Time expenditure (personnel)		
Regional added value	+	

Explanation of the valuation:

High reduction potential on the basis of the targeted plant expansion, cf. measure no. 3.1

Implementation period: from 2020

Field of action: Communication, cooperation, participation / No. 6.2

Sustainability competition for schools and daycare centres

Brief description:

Development and organisation of a competition that creates incentives and rewards activities or projects in climate protection and sustainability. Activities in the areas of mobility, waste, energy saving, solar energy, consumption/purchasing, nutrition, green/trees, climate adaptation, integration/living together, One World are all conceivable. Good ideas and activities are honoured, e.g. financially or materially. Personnel support is also conceivable.

First steps for action:

1. Concept for preparatory information work at schools, organisation of workshops and other offers (external contract, € 20,000 from foundation funds are available)
2. Preparation of a competition
3. Realisation / evaluation (ext. order)

Target group:

Schools, daycare centres

Those responsible and those involved:

FB 36, E 26, FB 45

Criteria:

$CO2_{reduction}$	+	cf. measure no. 2.2
Financial expenditure		20,000 € (see below)
Time expenditure (personnel)		
Regional added value		

Explanation of the valuation:

cf. measure no. 2.2, reintroduction of a bonus system, possibly financed by foundation funds

Implementation period: from 2020

Field of action: Communication, cooperation, participation / No. 6.3

KlimaRegion - regional energy efficiency cooperative

Brief description:

Together with the city region, the city will set up a platform for civic engagement and support for climate protection projects, in particular energy efficiency projects, under the name "KlimaRegion". The platform is based on the REEG (Regional Energy Efficiency Cooperative) project, which is subsidised by the federal government and supported by the state of North Rhine-Westphalia. Following the creation of a concept, the first steps towards implementation are in preparation.

First steps for action:

Support of the City of Aachen for the "KlimaRegion", e.g. in the promotion of the platform and the dissemination of the "KlimaRegion" offer, and participation in the "Regional Energy Efficiency Cooperative"

Target group:

General public

Responsible and involved parties:

FB 36

Criteria:	Rating:
$CO_{2\ \text{reduction}}$	+
Financial outlay	500 € decided for membership fee
Time expenditure (personnel)	
Regional added value	++

Implementation period: 2020 - 2025

Field of action: Communication, cooperation, participation / No. 6.4

Öcher trinken Öcher Wasser - Campaign for tap water

Brief description:

The city wants to promote the use of more tap water. The aim is to avoid the journeys involved in transporting mineral water. The city of Wiesbaden and ProKlima Wiesbaden advertise that an average of 158 g of CO_2 is saved per three-quarter litre if bottling in factories and transport to the consumer are eliminated. In Wiesbaden, glass bottles labelled "158" were distributed by the city's environmental shop and a refill system was set up for self-filling.

First steps for action:

Development of a concept and a brand for a campaign in the city of Aachen. Purchase of bottles for the administration as an introductory phase. Search for ways to spread the idea further, e.g. via the Eurogress. The project will be accompanied by a corresponding campaign to promote imitation throughout the city (planned in the general climate protection budget, approx. €35,000).

Target group:

General public

Responsible and involved parties:

FB 36, FB 13, water supplier STAWAG

Criteria:

$CO_{2\ reduction}$	+
Financial outlay	
Time expenditure (personnel)	
Regional added value	

Rating:

Implementation period: 2022

Field of action: Communication, cooperation, participation / No. 6.5

Linking the energy and mobility transition

Brief description:

Prospective buyers of PV systems should be given more information about electric vehicles as part of subsidy information and consultations. The primary aim here is to make prospective buyers aware of the need to take the cables and charging points into account. Conversely, buyers of electric cars should be sensitised to the need to generate the required electricity themselves if possible, otherwise to purchase green electricity. Appropriate communication channels should be established or expanded and information about PV systems should be intensified for the target group of electric vehicle owners.

First steps for action:

1. Bundle and coordinate information providers to strengthen joint action, e.g. e-store, altbau plus and consumer advice centre
2. Create information (possibly guidelines) for car dealerships, expand advertising of existing subsidy programmes. One-off budget of €10,000 earmarked for general climate protection.

Target group:

Car dealerships, car owners

Responsible and involved parties:

FB 36, FB 61, STAWAG, advice centres

Criteria:

Criteria	Rating:
$CO_{2\ \text{reduction}}$	+
Financial outlay	
Time expenditure (personnel)	
Regional added value	+

Implementation period: 2021 - 2025

Field of action: Communication, cooperation, participation / No. 6.6

Citizen information and involvement

Brief description:

The city of Aachen will increasingly develop communication measures and offers to increase the acceptance of climate protection measures. To this end, the city is working closely with the Climate Emergency Round Table, among others. To intensify citizen participation and citizen information, methods are being tested for specific suitability and targeted communication strategies are being developed for specific events.

First steps for action:

1. Climate protection round table, continue regular meetings with this and other initiatives
2. Organise event formats on climate protection, regularly, e.g. quarterly, also together with other institutions, e.g. with the VHS (adult education centre)

Target group:

General public

Responsible and involved parties:

FB 36

Criteria:

Rating:

$CO_{2\ \text{reduction}}$	+
Financial outlay	
Time expenditure (personnel)	
Regional added value	

Implementation period: from 2020

Field of action: Communication, cooperation, participation / No. 6.7

Climate-neutral travelling

Brief description:

1. Concept and measures for climate-neutral events.
   Events such as conferences or seminars affect the environment in different ways. This starts with the mobility of event visitors, includes electricity and water consumption, the production of brochures and flyers and many other aspects. In future, events organised by the City of Aachen and its associated companies are to be made climate-neutral. The initial aim is to provide information on how emissions can be avoided. Events should be organised as energy-efficiently as possible. The departments that regularly organise events will be informed and trained. A system for offsetting residual emissions is also to be developed.
2. Tourism and leisure activities
3. A concept is to be developed that shows how tourism and leisure can be organised in a climate-neutral way. The possible offers are to be developed together with the Aachen Tourist Service.

First steps for action:

1. Research in other municipalities, with service providers, etc.
2. Review of the NRW Energy Agency guidelines
3. Development of an implementation proposal for the city of Aachen

Target group:

Event organisers, internal and external, Aachen Tourist Service, ASEAG-Reisen etc.

Those responsible and those involved:

FB 36

Criteria:

$CO_{2\ \text{reduction}}$ +

Financial expenditure Time

expenditure (personnel)

Regional added value

Evaluation:

Implementation period: 2022 - 2025

Field of action: Communication, cooperation, participation / No. 6.8

Green in the city funding programme and campaign

Brief description:

In order to generate more greenery as a CO_2 sink, a municipal funding programme is being launched for existing buildings and new constructions. The aim is to encourage citizens and businesses to build more green roofs, green facades and backyards and unseal front gardens and terraces. All of these measures make sense in order to adapt to changes in the climate (heat prevention, water retention).

First steps for action:

1. Establishment of a support programme, examination of the use of the guidelines for Aachen-Nord or "Green to the power of 3" in Cologne, continuation of funding allocation to 4-140101-944-2 after expiry in Aachen-Nord
2. Accompanying campaign (funds have already been budgeted for this, € 25,000)

Target group:

House owners (private and commercial)

Those responsible and those involved:

FB 36, FB 13, altbau plus

Criteria:		Evaluation:
CO_2 reduction	+	
Financial expenditure		100,000 € per year
Time expenditure (personnel)		1 MÄ
Regional added value	+	

Implementation period: from 2021

Field of action: Communication, cooperation, participation / No. 6.9

Municipality as a role model: bicycle infrastructure in comm. buildings

Brief description:

In the Mozartstraße administration building, rooms are being set up as shower and changing facilities for employees who cycle. This measure can serve as a model for companies and be communicated accordingly.

First steps for action:

Press work, social media, possibly information flyers for imitation in other companies (funds are provided in the budget for general climate protection)

Target group:

Employees Administration, Operations

Those responsible and those involved:

E 26, FB 36

Criteria:

$CO_{2\ \text{reduction}}$

Financial expenditure Time

expenditure (personnel)

Regional added value

Evaluation:

+

Implementation period: 2021

5.4.7. Economy

Field of action: Economy / No. 7.1

Energy Network Aachen

Brief description:

Due to the possible increase in energy costs and the decrease in security of supply when switching to alternative energy generation, there is a great deal of uncertainty in the corporate landscape. For these reasons, an exchange platform similar to an energy regulars' table is to be set up, offering companies the opportunity to network with each other as well as with renowned institutes such as the Fraunhofer Centre for Digital Energy or the E.ON Energy Research Center at RWTH Aachen University. Both established companies and start-ups are addressed here. In addition to linking the players, the focus here will also be on tracking developments in the context of structural change in the Rhineland mining region.

First steps for action:

Target group:

Company, university, research

Responsible and involved parties:

FB 02

Criteria:	Rating:
CO_2 reduction Financial	+
outlay	10,000 € per year
Time expenditure (personnel) Regional	0.25 MÄ
added value	+

Implementation period: from 2020

Field of action: Economy / No. 7.2

On-site energy efficiency advice

Brief description:

According to the EnergyAgency.NRW, companies have the potential to save between 5 and 20 % energy. The aim is to demonstrate this potential to companies through in-depth on-site advice and thus sensitise companies to the issue of energy efficiency. In addition to appealing to corporate social responsibility, companies are also given concrete support in setting up energy and environmental management in the company and advice on topics such as:

- Energy-efficient technologies, e.g. compressed air and pump systems
- Innovative air, refrigeration and conveyor technology
- CHP
- Improvement of external image, e.g. through certification in accordance with DIN EN ISO 5001

First steps for action:

Target group:	**Responsible and involved parties:**
Company, university, research	FB 02

Criteria:		**Rating:**
$CO_{2\ reduction}$ Financial	++	200 t/a
outlay		15,000 € per year
Time expenditure (personnel)		0.5 MÄ
Regional added value	+	

Explanation of the evaluation criteria: conservative estimate based on empirical values

Implementation period: from 2020

Field of action: Economy / No. 7.3

Series of events "Energy-efficient Aachen companies"

Brief description:

In co-operation with

- Guilds and chambers
- Local energy suppliers
- Consumer centres
- EnergyAgency.NRW
- etc.

a series of events for companies will be initiated to provide information on current trends and developments, set thematic priorities and thus sensitise companies to their responsibility.

First steps for action:

Topics are prepared:

- Energy modernisation
- Efficient energy utilisation
- Environmentally friendly mobility
- Energy contracting
- Eco-sponsoring
- Technical measures to save energy in buildings
- Development of new business models

Target group:

Company, university, research

Responsible and involved parties:

FB 02

Criteria:		Rating:
$CO_{2\ \text{reduction}}$ Financial	+	
outlay		15,000 € per year
Time expenditure (personnel) Regional		0.25 MÄ
added value	+	

Implementation period: from 2020

Field of action: Economy / No. 7.4

Integrated industrial park development

Brief description:

High savings rates can be achieved by networking the industrial companies in an industrial park, e.g. by coupling the use of waste heat for process heat or a decentralised gas supply at the level of industrial areas, e.g. combined heat and power plants. The measure provides for the concept development, management and development measures for such an integrated industrial park.

First steps for action:

Analysis for the purpose of selecting a commercial area as an industrial park

Target group:

all companies located in the business park

Those responsible and those involved:

FB 02

Criteria:

Criteria:		Evaluation:
$CO2_{reduction}$	+++	400 t/a
Financial outlay		One-off costs € 40,000
Time expenditure (personnel)		0.5 MÄ
Regional added value	+	

Explanations on the evaluation: conservatively estimated $CO2_{reduction}$ based on empirical values; higher emission reductions are certainly possible here.

One-off costs of €40,000.

Implementation period: 2020 - 2025

Field of action: Economy / No. 7.5

Promoting renewable energy generation in urban areas

Brief description:

More and more production is currently taking place in urban areas. Unused potential can be utilised through rooftop processes in industry, in particular by linking PV systems with direct consumption. To this end, an incentive system is to be created to provide financial support for the installation of PV systems in the industrial sector.

First steps for action:

Target group:

Industrial companies

Responsible and involved parties:

FB 02

Criteria:		Rating:
$CO2_{reduction}$	++	200 t/a
Financial expenditure		100,000 € per year
Time expenditure (personnel)		
Regional added value	+	

Explanation of the evaluation criteria: conservatively estimated $CO2_{reduction}$ based on empirical values

Implementation period: from 2020

Field of action: Economy / No. 7.6

Digitalisation and flexibilisation of energy distribution grids

Brief description:

- Supporting the development of measures to ensure the stability of distribution grids even in critical grid conditions through knowledge transfer in the field of cooperative detection between university institutions and companies.
- Cooperation with STAWAG, TRIANEL, Fraunhofer Centre for Digital Energy
- Restructuring of the energy system requires numerous new interfaces with opportunities for industry and infrastructure

First steps for action:

Target group:

Public utilities, companies, science

Those responsible and those involved:

FB 02

Criteria:

Evaluation:

CO_2 reduction	
Financial expenditure	32,000 € per year
Time expenditure (personnel)	0.25 MÄ
Regional added value	+

Implementation period: from 2020

Field of action: Economy / No. 7. 7

Hydrogen as an energy source

Brief description:

Hydrogen is seen as a good sustainable alternative to conventional energy sources. Numerous players are currently planning research projects in this area. The local players (e.g. Siemens, Prof. Kampker) are to be supported in their plans to establish the use of hydrogen as an energy source in the economy via real-world labs along the entire value chain. This also involves the formation of networks, e.g. between the Siemens hydrogen pilot plant at the Melaten Campus and potential customers of the hydrogen produced. The task of FB02 in this area will be to involve citizens to increase acceptance of the new energy source.

First steps for action:

Target group:

Company, university, research

Responsible and involved parties:

FB 02

Criteria:		Rating:
$CO2_{reduction}$	++	200 t/a
Financial expenditure		18,000 € per year
Time expenditure (personnel)		0.25 MÄ
Regional added value	++	

Explanation of the evaluation criteria: conservatively estimated emission reduction based on empirical values

Implementation period: from 2020

Field of action: Economy / No. 7.8

Improved database

Brief description:

Establishment of nationwide non-residential/residential building monitoring including review of efficiency measures

First steps for action:

Target group:

Responsible and involved parties:

FB 02

Criteria:

Criteria:	Rating:	
CO_2 reduction	+	
Financial expenditure		4000 € software acquisition costs in the first year, then € 800 annually
Time expenditure (personnel)		0.25 MÄ
Regional added value	+	

Explanation of the valuation:

4000 € software acquisition costs in the first year, then € 800 annually

Implementation period: from 2020

Field of action: Economy / No. 7.9

Targeted subsidy advice on climate protection measures, in particular to increase energy efficiency

Brief description:

A new thematic focus is to be added to the range of tasks of FB 02's subsidy advisory services. In future, the focus will be on funding instruments in the area of climate protection and energy efficiency (incl. CHP). A constantly updated overview of the relevant subsidies, particularly from the federal and state governments, will be provided. On this basis, companies that are eligible for relevant funding can be approached proactively and specifically and companies looking for suitable funding instruments can be given expert advice.

First steps for action:

Target group:

The company

Responsible and involved parties:

FB 02

Criteria:		Rating:
CO_2 reduction	+	
Financial expenditure		
Time expenditure (personnel)		0.25 MÄ
Regional added value	+	

Implementation period: from 2020

Field of action: Economy / No. 7.10

Ecoprofit

Brief description:

A total of nine ÖKOPROFIT projects have been carried out in the Aachen region since 2001 as part of a co-operation between the city and city region of Aachen. A total of 97 companies, small and large, manufacturing companies and service providers, craft businesses and social institutions have successfully participated in the ÖKOPROFIT environmental management programme and achieved considerable savings:

- 12,436 tonnes of CO_2
- 52 million kWh of energy
- 211,000 cubic metres of water
- 6200 tonnes less waste

The tenth ÖKOPROFIT project in the Aachen region is due to start in 2020. There is close cooperation with FB 36, the cooperation partners and the city region to recruit companies. Targeted advertising at companies, support measures such as workshops, public relations, etc. are being organised.

First steps for action:

Target group:

The company

Responsible and involved parties:

FB 02

Criteria:	Rating:	
$CO_{2\ reduction}$	+++	1200 t/a (planned in the budget)
Financial expenditure		
Time expenditure (personnel)		
Regional added value	+	

Explanation of the evaluation criteria: The $CO_{2\ reduction\ is}$ based on the evaluation of implemented Ökoprofit projects (since 2001)

Implementation period: 2020 - 2022

6. Communication and participation

6.1. Communication

A concept for public relations and marketing in the field of energy and climate protection has been in place since 2011. As part of its communications work, the City of Aachen wants to set a good example, i.e. **provide information** on the measures it is taking to protect the climate and also highlight examples worthy of emulation. This includes, for example, the energy management of municipal buildings. On the other hand, citizens should be made aware of their own possibilities and feasibility and be motivated to take **action themselves,** i.e. climate awareness can be increased through continuous information work. Broadly publicising the topic also helps to improve the **motivation and participation of** other stakeholders and helps to find allies and supporters.

A wide range of different target groups can be reached with the diverse topics of climate protection. Here, a distinction is not made according to the usual classifications such as age or occupational groups, but rather according to the interest groups that are of particular relevance to local climate protection.

- Consumers
- Homeowner
- Tenant
- Road users (commuters, cyclists)
- Educational institutions (schools, kindergartens)
- Organisations, associations, institutions
- Trade, industry, commerce
- Politics
- Media (newspapers, specialised press, radio)
- Supra-regional addressees (municipalities, institutions/multipliers)

A mix of media, materials and measures is used to convey messages and topics. The most suitable instruments are selected depending on the target group and topic. The following list serves as a checklist:

- Press relations: press conference, press interview (press release, folder, photos), editorial visit, interview
- Internet homepage or own domain, social networks (Twitter, Facebook)
- City pages newsletter/e-mail, city pages supplement
- Presentation at trade fairs, campaign days, exhibitions, banners, posters
- Events: Congress, lecture, workshop, discussion round, open day
- Print media: brochure, flyer, poster, CL poster, postcard, information packs
- Campaigns (Participation in external campaigns must be decided on a project-by-project basis).
- Surveys, forums, participations, partnerships

The level of information and interest among the general public varies greatly. While those who are particularly committed, such as participants in Fridays4Future or the Climate Emergency Round Table, are very well informed about the facts and correlations, the general public must be approached in a differentiated manner depending on their knowledge and interests. This begins with creating an understanding of the climate change that is taking place and its global effects and ends with practical information such as opportunities to take advantage of funding. In this sense, the communication strategy is essentially characterised by the following elements:

- Campaigns/information on key strategic topics
    - Renovation of old buildings (funding opportunities, advisory services), see section 5.3.5
    - Solar energy utilisation (funding opportunities, etc.), see Chap. 5.3.3
    - Mobility turnaround, campaign (funding opportunities, etc.), see section 5.3.4
    - Importance of greenery in the city, see section 5.3.6
- Regular reporting, professional appearances
    - Internet, social media, press
- General sensitisation to the importance of climate change
    - Low-threshold information, action days
    - Consumer events
    - Specialised events

6.2. Participation

The integrated climate protection concept was developed over the course of a year-long process involving many participants. The development of the 2030 strategy and the 2025 action plan in the key areas of action with the highest reduction potential was carried out by a large number of stakeholders.

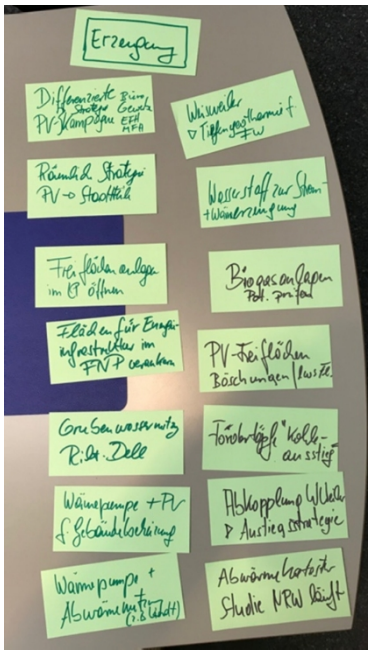
The core process of updating the Climate Protection Strategy 2030 was accompanied by the City of Aachen's energy and climate team, which has been working together continuously for many years, including in the European Energy Award management system.

The strategic focus with the corresponding fields of action was discussed at length in a workshop at the level of the department and division heads of 15 different administrative departments and participating companies that regularly deal with climate protection issues or have frequent points of contact (4 November 2019). As a result, the structural organisation of the fields of action was supplemented by the area of urban planning and the strategic level of consideration was expanded to include sustainability criteria, e.g. in the building sector, in addition to energy-related aspects. Some of the topics were given a new emphasis, e.g. in the area of communication, as it is very important to involve society in the transformation process and to promote acceptance of the measures among the population. A stronger interlinking of topics, for example the mobility and energy transition, was also emphasised, as was a greater focus on the neighbourhood level. In addition to the administrative action itself, there was also a discussion on how to create more incentives for activities in the private sector and in companies. Funding programmes emerged as a key pillar for this, e.g. for renovating old buildings and expanding PV systems. However, restrictions, for example in contracts, were also seen as necessary.

The entire management level of the City of Aachen, Lord Mayor, aldermen and department heads were informed and involved on 22 November 2019. After a detailed input on the importance of the topic

and the strategic approach developed, the decision-making level discussed the options for accelerated GHG reduction as part of a Word Café. A large number of technical suggestions were compiled in the respective fields of action, which were subsequently incorporated into the concept by those responsible in the climate team, e.g. in the form of a consultation obligation for property sales. The contributions emphasised the importance of inner-city green spaces, sustainable urban development and the city's role model function, whether in terms of switching to sustainable energy types and storage systems or its own building stock. With regard to the building stock, the focus was also explicitly placed on the housing stock and state and federal properties were identified as the target group. In the area of mobility, the suggestions ranged from higher parking fees and a car-free city centre to a free market liner. The level of awareness of support programmes such as altbau plus and funding opportunities must be increased, as must the importance of greenery, whether on the roof or in the backyard. When promoting the use of solar energy, the framework conditions for balcony systems should be optimised. The participants also made suggestions for financing the climate protection programme, ranging from participation models such as cooperatives and the establishment of a fund to property tax-based structures.
The City of Aachen's Energy Advisory Board discussed the integrated climate protection concept on 5 December 2019. In line with the tasks and membership structure of the advisory board (energy suppliers, various RWTH and FH institutes, etc.), there was a strong focus on the area of energy supply and generation. Particular attention was paid to the development of a strategy for the continuation of the district heating supply after the shutdown of the Weisweiler power plant and the transformation to a renewable district heating supply, e.g. by means of deep geothermal energy. When mobilising the potential for PV systems, a differentiated view of residential and commercial buildings as well as individual districts was suggested. The construction of ground-mounted systems should be taken into account in the development of the new landscape plan. The integration of heat pumps as well as waste heat and mine water utilisation should be examined. The lack of designation of areas for energy supply and generation in the draft of the new land use plan was criticised.

With regard to the requirements for new buildings, the members of the advisory board favoured the Factor X approach and suggested higher penalties for non-compliance with requirements in development plans as well as consistent application of the principle of density in urban development planning. In the interests of sustainability, timber construction should become more of a focus for municipal buildings. The building stock in the commercial sector offers great potential both for refurbishment and for PV systems. In general, according to the Energy Advisory Board, the building regulations/building services could take on a stronger advisory role. Car-free zones and free public transport were named on the way to climate-friendly mobility.



Handlungsfeld Energieversorgung, Nutzung erneuerbarer Energien

Kurztitel	CO2 Min-derungs-potenzial	Beschreibung
Konzertierte Aktion / Kampagne "Öcher Solardach" zur Nutzung geeigneter Dachflächen	++	Geeignete Bestandsdachflächen sollten zur Energiegewinnung genutzt werden, entweder über PV- oder solarthermische Anlagen. Prüfung planungsrechtlicher und vertraglicher Instrumente; Kooperation mit Handwerk u. Beratungs-/Dienstleistungsangeboten; Konzept zur Weiterverwendung von PV-Anlagen, die aus der EEG-Vergütung fallen. Kampagne (Kosten)
Verknüpfung von Energie - und Mobilitätswende	+	e-Auto nur mit PV, PV-Anlagenbauer ans e-Auto denken (Leitungen); Einbindung in Energieberatung, e-Store, Kooperation mit Autohäusern, Sanierungsberatung etc. Kostenansatz Kommunikation Modellprojekt Integration von Speichertechnologie
Abwärmenutzung	+	Potenzialstudie Abwärmenutzungsmöglichkeiten, Erstellung eines Abwärmekatasters, Anwendungsfall in einem Quartier prüfen
Dezentrale Wärmeversorgung, Fernwärmenetz sichern und quartiersspezifische Einzellösungen	++	Errichtung eines 20 MW BHKW im Bereich Schwarzer Weg ist in Vorbereitung, in Folge aber weitere Lösungen zur Bestandssicherung des Fernwärme(FW)-Netzes generieren, insbesondere den erneuerbare Anteil steigern (Primärenergiefaktor verbessern); Prüfung FW Anschlusszwang in Sanierungsquartieren; Konzept Nahwärme und -kälte; Machbarkeitsstudie Solarspeicher in altem Steinbruch, Walheim
Erneuerbare Anteil aus Windenergie sichern und ausbauen	++	Umgang mit Windkraft-Anlagen nach Auslaufen der EEG-Vergütung: wegen komplexer Eigentümerstruktur in Windpark Vetschau, moderierter Lösungsprozess erforderlich, externe Moderation (Kosten). Forschungsprojekt Wasserstoff als Windenergiespeicher. Überprüfung weiterer Standortmöglichkeiten

Figure 26 Participation of the Energy Advisory Council, contributions to the energy supply field of action

Targeted invitation of climate-relevant specialist groups, institutions and organisations

In the course of the Fridays4Future movement and the council resolution on the climate emergency, various initiatives, associations and clubs founded the Aachen Climate Emergency Round Table together with committed individuals. Well-known initiatives in the field of climate protection are represented there. The members drew up a position paper entitled "Demands on the city to contain the climate crisis", which they presented to the Lord Mayor on 10 July 2019. Structured into the relevant areas of action, the paper describes strategies and concrete proposals for action. At various meetings (4 Dec. 2019 round table, 13 Jan. 2020 energy group, 23 Jan. building/housing group, 26 Feb. transport group), the topics were discussed in the individual areas.

worked through. A lively exchange and intensive discussions took place between the representatives of the Climate Emergency Round Table and the relevant administrative staff. On the one hand, the Round Table's proposals were explained in detail and discussed in greater depth, while on the other, the administration provided information on the background, obstacles, status quo and procedures already planned. Overall, there was a very constructive discussion atmosphere, from which the administration was able to take a number of suggestions into the further development of the integrated climate protection concept. These include, for example, the model of the 1000 Roofs Programme of the district of Düren, the examination of the requirements for open-space and balcony PV systems, the promotion of roof extensions as a component of the promotion of building renovation and an extension of the specifications regarding energy standards for buildings to include resource conservation and life cycle considerations. It was agreed to meet in follow-up discussions on the progress of the implementation of measures and to discuss further aspects such as agriculture and nutrition.

In parallel to the internal and external participations, intergroup workshops were held on 28 November 2019 and 18 February 2020 with representatives from all political groups for the areas of environment/climate protection, urban development and transport in order to involve politicians in the development of the 2030 Strategy and the corresponding measures at an early stage.

7. Stabilisation and controlling

Due to its participation in the European Energy Award (eea), the City of Aachen has had practical experience in process controlling since 2009. The catalogue of measures recorded in the eea is reviewed and updated on an annual basis. The implementation status is scrutinised, obstacles are identified and possibilities for readjustment are discussed and, if possible, initiated. In accordance with the practice established here, the analysis of progress in the implementation of the 2025 action plan is integrated into the eea cycle.

However, an annual analysis alone is considered to be optimisable controlling due to the high requirements, the great pressure of expectations and the tight time budget available for implementing measures. Therefore, continuous involvement of the decision-making level in the implementation process is considered expedient. The installation of a committee above and beyond the eea team enables more direct progress monitoring and more direct (counter)steering by the responsible management level. The management level is to be informed by the eea team every two months in order to position the topics in accordance with the importance of climate protection as decided by the council. The joint meetings of the management level are also important in order to shorten coordination between the departments. Similar to the positive experience with the construction and environmental conference, in which important construction projects are discussed across departments and departments, a cross-departmental and cross-departmental steering group is recommended to accompany the most important measures for GHG reduction. This allows any difficulties that arise to be addressed, conflicts to be resolved and coordination to be accelerated.

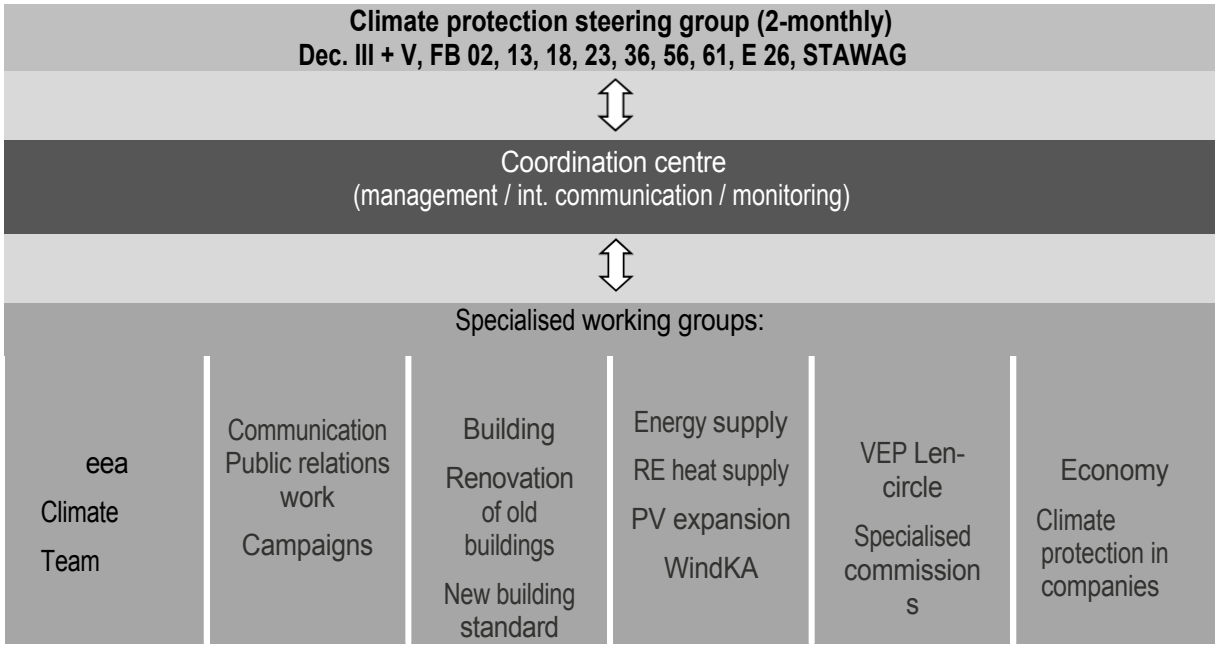


Figure 27: Optimisation of the management structure for the climate protection process

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9. Appendix

Overall summary of the IKSK action plan 2025 - City of Aachen

No.	Measure	Material costs city [€/a]	Personnel costs [€/a]	Total costs [€/a]	Costs comm. Participating companies	CO2 savings [t/a]	Euro/t CO2*	Share of the required emissions reduction 76.9 thousand tonnes [%]
	Field of action Urban planning							
1.1	Activation of vacant lots, land management	5.000	80.000	85.000	0	0	not quantifiable	not quantifiable
1.2	Checklist for urban development designs, B plans	0	0	0	0	not quantifiable	not quantifiable	not quantifiable
1.3	Climate-neutral new buildings as part of property purchase agreements, urban development contracts	0	0	0	0	not quantifiable	not quantifiable	not quantifiable
1.4	Strategy for dealing with existing buildings		80.000	80.000	0	not quantifiable	not quantifiable	not quantifiable
1.5	Energy concepts for larger construction projects, B plans	not quantifiable	not quantifiable	not quantifiable	0	not quantifiable	not quantifiable	not quantifiable
1.6	Mobility concepts for larger construction projects, development plans	not quantifiable	not quantifiable	not quantifiable	0	not quantifiable	not quantifiable	not quantifiable
1.7	Climate-neutral model housing estate	50.000	0	50.000	0	not quantifiable	not quantifiable	not quantifiable
1.8	Establishment of a climate council	0	0	0	0	not quantifiable	not quantifiable	not quantifiable
	TOTAL Urban development planning	**55.000**	**160.000**	**215.000**	0	not quantifiable	not quantifiable	not quantifiable

	Field of action Municipal buildings							
2.1	Extend energy management to the entire city group	0	0	0	5.000	180	28	**0,2**
2.2	Incentive: reintroduction of bonuses at schools	0	40.000	40.000	25.000	350	71	**0,5**
2.3	**Refurbishment of municip. non-residential buildings**	**5.500.000**	240.000	**5.740.000**	0	**928**	6.185	**1,2**
2.4	**Energ. Refurbishment of municipal residential buildings**	**4.000.000**		**4.000.000**	0	**800**	5.000	**1,0**
2.5	**Energet. Refurbishment of GEWOGE building**	0	0	0	**2.000.000**	400	5.000	**0,5**
2.6	Climate-neutral new buildings			case-by-case / not quantifiable	0	0	not quantifiable	not quantifiable
2.7	**PV systems on municipal buildings (E 26)**	**3.000.000**	160.000	**3.160.000**	0	**982**	3.218*	**1,3**
2.8	Greening of municipal buildings	100.000	0	100.000	0	1,8	not quantifiable	not quantifiable
2.9	Conversion of fat clients to VDI clients			in the current Process	0	123	not quantifiable	not quantifiable
2.10	Relocation of data centre to EURAIX			in the current Process	0	20	not quantifiable	not quantifiable
	TOTAL municipal buildings	**12.600.000**	400.000	**13.040.000**	**2.030.000**	**3.785**	not useful	**4,0**

	Field of action Energy supply, RE							
3.1	**Subsidy programme for solar systems**	**1.900.000**	80.000	**1.980.000**	0	**6.540**	**303**	**8,5**
3.2	Examination of the expansion of photovoltaics in the urban area (ground-mounted systems), STAWAG etc.			0	external, not quantifiable	500	not quantifiable	0,7
3.3	Safeguarding / expansion of wind energy (private /STAWAG)			0	not specified	4.431	not quantifiable	**5,8**
3.4	Decentralised heat supply, district heating network, individual solutions			0	not specified	**8.200**	not quantifiable	10,7
3.5	Waste heat utilisation (in the Campus West area)			0	not specified	500	not quantifiable	0,7
	TOTAL Energy supply, RE	**1.900.000**	**80.000**	**1.980.000**		**20.171**	not useful	**26,2**
	Mobility field of action							
4.1.1	**Expansion of cycle traffic in accordance with the cycling decision**	***9.440.000***	***560.000***	***10.000.000***	0	not quantifiable	not quantifiable	not quantifiable
4.1.2	**Premium trails and squares**	**920.000**	80.000	**1.000.000**	0	not quantifiable	not quantifiable	not quantifiable
4.1.3	**Strong public transport axes (bus lanes, H)**	**2.420.000**	80.000	**2.500.000**	0	not quantifiable	not quantifiable	not quantifiable
4.1.4	**30 % additional output from ASEAG**			0	**20.000.000**	not quantifiable	not quantifiable	not quantifiable
4.1.5	**Tariffs to be halved from 2025**			0	**6.667.000**	not quantifiable	not quantifiable	not quantifiable
4.1.6	Binding mobility concepts for construction projects and events	86.667	80.000	166.667	0	not quantifiable	not quantifiable	not quantifiable
4.1.7	**Relocation of residents' parking spaces to mobility hubs: electrified neighbourhood car parks**	**1.260.000**	240.000	**1.500.000**	0	not quantifiable	not quantifiable	not quantifiable

4.1.8	Expansion of traffic area control	0	600.000	600.000	0	not quantifiable	not quantifiable	not quantifiable
4.1.9	Scientific support for the mobility transition	25.000		25.000	0	not quantifiable	not quantifiable	not quantifiable
4.2.1	**Strong expansion of express bus services**			0	**1.667.000**	not quantifiable	not quantifiable	not quantifiable
4.2.2	RegioTram				not quantifiable			
4.2.3	Campaign and funding programme for the mobility transition (2,000 switchers/a; around €300 per switcher)	560.000	240.000	800.000	0	not quantifiable	not quantifiable	not quantifiable
4.2.4	Mobility management for visitors	160.000	40.000	200.000	0	not quantifiable	not quantifiable	not quantifiable
4.2.5	Continuation of BMM programme from 2022	293.333	240.000	533.333	0	not quantifiable	not quantifiable	not quantifiable
4.2.6	Parking concept for private transport (tariffs, car parks)	33.333		33.333	0	not quantifiable	not quantifiable	not quantifiable
4.2.7	**P+R / mobility hubs on all access roads**	**3.253.000**	80.000	**3.333.000**	0	not quantifiable	not quantifiable	not quantifiable
4.2.8	City tolls and financing models	270.000	80.000	350.000	0	not quantifiable	not quantifiable	not quantifiable
4.3.1	2000 cargo bikes funding programme	340.000	160.000	500.000	0	not quantifiable	not quantifiable	not quantifiable
4.3.2	**Electromobility programme**	**1.920.000**	80.000	**2.000.000**	0	not quantifiable	not quantifiable	not quantifiable
4.3.3	**Procurement support for e-buses at ASEAG**				**2.000.000**	not quantifiable	not quantifiable	not quantifiable
4.3.4	Reducing emissions from delivery traffic	170.000	80.000	250.000	0	not quantifiable	not quantifiable	not quantifiable
4.3.5	**Expansion of traffic management and digital foundations**	**1.250.000**	0	**1.250.000**	0	not quantifiable	not quantifiable	not quantifiable
4.3.6	Expansion of charging infrastructure			0	not quantifiable cash	not quantifiable	not quantifiable	not quantifiable
	TOTAL Mobility	**12.961.333**	**2.080.000**	**15.041.333**	**30.334.000**	**2.080**	not quantifiable	**2,7**

	Field of action: refurbishment							
5.1	**Funding programme for the renovation of old buildings**	**3.600.000**	160.000	**3.760.000**	0	**7.200**	**522**	**9,4**
5.2	Neighbourhood-specific refurbishment advice	51.000	80.000	131.000	0	90	1456	0,1
5.3	Advice on renewable heat/heating	10.000		10.000	0	**386**	26	0,5
5.4	Mobilisation of commercial properties	15.000	80.000	95.000	0	**400**	238	0,5
5.5	Resource-saving refurbishment of existing buildings	47.000	40.000	87.000	0	18	4833	0,0
	Total building refurbishment (private)	**3.723.000**	**360.000**	**4.083.000**	0	**8.094**	not useful	10,5
	Field of action Communication							
6.1	"Öcher Solardach" alliance & campaign			already in the house stop	0	not quantifiable	not quantifiable	not quantifiable
6.2	Schools sustainability competition			in the household	0	not quantifiable	not quantifiable	not quantifiable
6.3	ClimateRegion			in the household	0	not quantifiable	not quantifiable	not quantifiable
6.4	Öcher drink Öcher water			in the household	0	not quantifiable	not quantifiable	not quantifiable
6.5	Linking the energy and mobility transition			in the household	0	not quantifiable	not quantifiable	not quantifiable
6.6	Citizen information & involvement			in the household	0	not quantifiable	not quantifiable	not quantifiable
6.7	Climate-neutral travelling			in the household	0	not quantifiable	not quantifiable	not quantifiable
6.8	Green" funding programme & campaign	100.000	80.000	180.000	0	not quantifiable	not quantifiable	not quantifiable
6.9	Municipality as a role model: cycling infrastructure			in the household	0	not quantifiable	not quantifiable	not quantifiable
	TOTAL Communication	**100.000**	**80.000**	**180.000**	0	not quantifiable	not quantifiable	not quantifiable

	Field of action Economy							
7.1	Energy Network Aachen	10.000	20.000	30.000	0	not quantifiable	not quantifiable	not quantifiable
7.2	Energy efficiency consulting	15.000	40.000	55.000	0	200	not quantifiable	not quantifiable
7.3	Event series "Energy-efficient companies"	15.000	20.000	35.000	0	not quantifiable	not quantifiable	not quantifiable
7.4	Integrated industrial park development		40.000	40.000	0	400	not quantifiable	not quantifiable
7.5	Forcing RE generation	100.000	0	100.000	0	200	not quantifiable	not quantifiable
7.6	Digitalisg. Flexibilisation of energy distribution grids	32.000	20.000	52.000	0	not quantifiable	not quantifiable	not quantifiable
7.7	Hydrogen as an energy source	18.000	20.000	38.000	0	200	not quantifiable	not quantifiable
7.8	Improved data, non-residential building monitoring	800	20.000	20.800	0	not quantifiable	not quantifiable	not quantifiable
7.9	Funding advice	0	20.000	20.000	0	not quantifiable	not quantifiable	not quantifiable
7.10	Ecoprofit			already in the house stop	0	1.200	not quantifiable	not quantifiable
	TOTAL Economy (plus one-off € 44,000)	**190.800**	**200.000**	**390.800**	0	2.200	not quantifiable	2,9
	TOTAL	**31.530.133**	**3.360.000**	**34.930.133**	**32.364.000**	**36.330**		**46**
	Measure	**Material costs city [€/a]**	**Personnel costs [€/a]**	**Total costs [€/a]**	**Costs comm. Participating companies**	**CO2 savings [t/a]**	**Euro/t CO2***	**Share of the required emissions reduction 76.9 thousand tonnes [%]**

***Note to column "Euro per tonne of $_{CO2}$"**

The figures for costs per tonne of $_{CO2}$ saved result solely from dividing the values for "total costs" by "$_{CO2\ savings}$". These are not $_{CO2\ avoidance\ costs}$, which could only have been determined at great expense. The informative value is limited insofar as savings effects are not included and, in particular, the economic viability of measures to utilise renewable energies (wind and solar p o w e r) is not taken into account. These investments in wind power and PV systems are highly economical. Traffic measures such as the expansion of cycle paths, on the other hand, will never generate direct income for the city. Investments in the building envelope also only pay off over the life cycle of buildings after decades, if at all, whereas investments in efficient technology such as heating pumps or lighting are generally economically viable.

However, the political framework conditions in particular play a role in the assessment of economic viability. In particular, the price of energy, which was recently discussed in the Federal Climate Protection Act (e.g. CO2 price), or the change in tax concessions for refurbishment costs are parameters over which the City of Aachen has no influence, but which will have a significant impact on the assessment of the cost-benefit ratio.

Ultimately, the consideration of economic efficiency as a decision criterion for climate protection measures is only suitable to a limited extent, as cost-intensive measures or measures that cannot be assessed in terms of emissions are also necessary to achieve the climate protection targets. These include, for example, the refurbishment of municipal buildings, as the city has a role model function, or communication measures, as information work is required to motivate the population.