NET ZERO CITIES
EU MISSION PLATFORM | CLIMATE NEUTRAL AND SMART CITIES

Climate City Contract

2030 Climate Neutrality Action Plan I.

2030 Climate Neutrality Action Plan of the City Pécs

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Abbreviations and acronyms

Abbreviations and acronyms	Definition
AP	Action Plan
IP	Investment Plan
KPI	Key Performance Indicator
MEL	Monitoring Evaluation & Learning
MRV	Monitoring Reporting Verification
WP	Work Package

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Executive Summary

The city of Pécs has been committed to climate policy for almost a decade. The ambitious targets set by the city, economic actors and society have been achieved through the implementation of the Sustainable Energy Action Plan (SEAP) of the city of Pécs, with a 20% reduction in emissions by 2020 compared to 2011. The city of Pécs joined the Covenant of Mayors in 2013 and thus joined the 2030 targets, which will reduce greenhouse gas emissions by a further 47.4% compared to 2019 by 2030 through measures in the areas of energy use, industrial emissions, transport and waste management, and the planting of forests and green spaces. Building on the targets set in the SECAP and the Climate Strategy of the City of Pécs, the City Council, in consultation with a wide range of professional, economic, institutional and public stakeholders, decided to submit a declaration of intent to the European Union Urban Mission initiative, building on the progress achieved so far, and to accelerate the process of reaching the 2030 climate neutrality target. In January 2022, the Municipality of Pécs submitted its application for the European Union's "100 Climate Neutral and Smart Cities Mission" programme as part of the European Green Deal, to be implemented under Horizon Europe. The City of Pécs has been selected by the European Commission along with 99 other cities to participate in the programme, under which the City of Pécs commits to achieving net zero carbon emissions by 2030.

It is a great opportunity for the City of Pécs to become a member of a European community of a hundred cities, and thus accelerate the complex process that is the key to its development, helping to implement a development policy based on the economic, social and environmental dimensions of sustainability. To this end, in line with the Urban Development Concept, the Integrated Urban Development Strategy and the Sustainable Urban Development Strategy of Pécs, the City of Pécs has prepared its Climate City Contract, Climate Neutral Action Plan and the Investment Plan underpinning its implementation, which will be submitted in September 2023 to the NetZero Consortium implementing the programme on behalf of the European Commission in the Climate City Contract process. The present Climate City Contract summarises the City's goals and ambitions, which have been designed and can only be implemented in a broad partnership with stakeholders. In addition to the Local Government, the city's main emitters are also making commitments under the Climate City Contract, as the net emission value can only be achieved through a joint effort.

The City of Pécs recognises its responsibility to strive for sustainability and achieve net zero emissions as it faces the challenges of climate change, pollution and resource depletion in its growth and development. In line with its Urban Agenda to improve the quality of life of its citizens, and in line with the objectives of "a city where it is good to live" and "a city where its citizens like to live", the city will pay particular attention to sustainability and climate change measures, which are an integral part of ensuring a high quality of life, both objectively and subjectively. A city that provides a high quality of life for its inhabitants will have a significant reduction in carbon emissions, a significant improvement in individual health, an increase in the proportion of climate-resilient green spaces, energy security and the availability of clean energy. Together with its residents, the city is shaping an environment that will provide a long-term attractive and dynamic environment for businesses, residents, people living and working there.

Its aim is to contribute to carbon neutrality by creating energy security, relying on indigenous resources, integrating decentralised energy sources and applying best practices. It will implement local and regional measures to optimise the use of green energy in buildings, facilities and transport used by the population, local government and its institutions, as well as by economic operators, by making rational use of locally available resources, while ensuring a sustainable living environment that contributes to a good quality of life and healthy living, adapting to the challenges of climate change.

The preparation of the Climate Neutral Action Plan and Investment Plan is based on modelling, using an urban climate transition economic model developed in collaboration with the University of Madrid under the NetZero Programme. The tool is scientifically based and provides the opportunity to develop a robust climate finance framework for the climate transition of Pécs, taking into account climate science, with emission values and associated costs broken down by target groups (city, population, institutions, university, business, transport, energy and other public services) to show the necessary investment costs and the savings over the time horizon up to 2030. The investment needs identified at the level of the investment measures (see key measures above) provide a continuous feedback loop to harmonise the top-down framework with the corresponding bottom-up projects, to ensure a precise implementation of the programme set out in the Action Plan and Investment Plan. For further reference on the economic model used, see the NetZero Portal group "Capability Building Programme: building a strong economic case" at the following link: https://netzerocities.app/group-capabilitybuildingprogrammebuildingastrongeconomiccase

By 2030, the City of Pécs has set a target of achieving net zero GHG emissions by 2030 compared to 2019 through actions in the areas of energy use, industrial emissions, transport and waste management, and the planting of forests and green spaces.

In order to achieve the net zero target, Pécs will achieve an overall 80% reduction in emissions by 2030 compared to 2021 levels, resulting in a saving of 325 ktCO2. Currently, transport emissions account for the largest share of emissions at 35%, followed by electricity emissions at 32% and the carbon impact of heating buildings at 25%.

A-2.3: Emission gap (kt Co2e)

	Base issue (BAU 2030)	Emissions residual compensation		Emission reduction target		Emission gap (amount needed to reach net zero)	
	(Absolute value)	**(Absolute value)**	**(% of BAU 2030)**	**(Absolute value)**	**(% of BAU 2030)**	**(Absolute value)**	**(% of BAU 2030)**
Transport	108	34	32%	73	68%	0	0%
Buildings and heating	103	11	10%	93	90%	0	0%
Electricity	164	25	15%	139	85%	0	0%
Waste	6	5	83%	1	17%	0	0%
Other	24	5	20%	19	80%	0	0%
Total	404	79	20%	325	80%	0	0%

As a result of the targets and interventions set out in the Action Plan, emissions from the transport sector will be neutralised by 68%, electricity emissions by 85% and the carbon value of heating in buildings by 90% as a result of investment and significant non-investment measures. The city aims to achieve a 17% reduction in the waste sector and an 80% reduction in other sectors (waste water, economy, agriculture).

The main objectives of the Climate Neutral Action Plan of the City of Pécs are:

- Access to renewable energy for 50% of households
- 85% decarbonisation of electricity consumption
- The share of renewable energy sources increases to 60%

- Emissions from buildings reduced by 50% by 2030
- Natural gas consumption for heating will be reduced by 50% by 2030 and natural gas for cooking will be phased out
- Energy savings of 40% of final energy consumption
- Public transport 100% emission reduction by purchasing electric buses
- 35% reduction in car use
- 50% of vans of less than 3.5 t and 40% of trucks of more than 3.5 t will be electrified

Achieving the net-zero target includes, in addition to the 80% emission reduction, the 20% residual emission offsetting, which the Municipality intends to achieve primarily through the development of the sink capacities of Pécs, in line with the strategy presented in the Action Plan. A total of 79 ktCO2 will be required to be emitted, 34 kt by transport actors, affecting both freight and cars, 25 kt by electricity producers and 11 kt to compensate for heating of buildings. The remainder will be compensated by th waste sector, industrial, commercial and agricultural entities. The contributions that form the basis for interventions to improve sink capacity are accumulated in the urban carbon fund.

The Municipality of Pécs plans to take a number of measures to achieve the objectives detailed in the Climate Neutral Action Plan, among which the main measures are:

- Building renovations
- New, energy-efficient buildings
- Efficient lighting and appliances
- Decarbonising heating production
- Decarbonising electricity generation
- Reduced demand for motorised passenger transport
- Switch to public transport and non-motorised transport
- Growing car poolin and car-sharing
- Electrification of passenger cars and motorcycles
- The electrification of buses
- Optimised logistics
- Electrification of lorries
- Increased waste recycling

One of the most serious challenges is the retrofitting of the building stock. The municipality has started a detailed survey and energy audit of the municipal building stock, which will be followed by a residential building stock audit with the Green Office, which will be a one-stop-shop window to help renovate the residential building stock and introduce a system of building renovation passports. Energy efficiency interventions will be supported by the promotion of smart meters, the development of a digital platform, real-time traceability of energy consumption, the creation of a city centre energy community with institutional actors and the organisation of university buildings into an energy community to test the model. A number of solutions need to be tested before scaling up, such as energy efficiency solutions using smart systems, piloting of local energy supply models - microgrid, energy storage as a pilot project.There are 870 five and ten storey prefabricated buildings in Pécs, with a number of solutions for renovation, e.g. decarbonisation of prefabricated buildings pilot project: installation of renewable energy capacity to replace cooling, lighting and cooking in a ten-storey prefabricated building, mechanical retrofitting of prefabricated buildings for individual heat use and efficiency increase, replacement of cooking gas.

For families on social assistance, a support programme for energy security to replace fossil fuels.

Street lighting will be reconstructed and the lighting systems of the building stock will be upgraded to provide energy-efficient lighting and equipment.

To decarbonise heating, the main interventions include the connection of institutional actors to district heating, the replacement of natural gas for heating with heat pump systems, and the piloting of ground source heat pump systems.

Decarbonisation of electricity is mainly achieved by building solar park capacity and urban energy storage capacity in cooperation with energy utilities. In connection with this, in order to use the electrical surplus of the valley periods, electrolysis capacity will be built in Tüskésrét as part of the development of a hydrogen ecosystem, which will perform energy storage and hydrogen fuel production tasks. An assessment of the hydrogen refuelling needs for public transport and freight transport was carried out by the University of Pécs in June 2023, during which 180 t/year were identified. The utility-scale solar power plant will be complemented by the construction of institutional solar capacity, industrial and commercial solar capacity, and small-scale solar capacity for domestic small-scale solar power plants.

In the field of transport, reducing the volume of private motorised transport is one of the important areas for intervention. To this end, a community planning programme to promote climate-friendly land use, the promotion of behavioural measures in the field of transport, both for cars and lorries, a contracting system with large employers to reduce car use, the testing of zero-emission zones where only electric, hydrogen and biogas cars can be used, and a rethinking of the parking system will be implemented.

An important objective is to increase the share of public transport and non-motorised transport, partly by supporting access from the agglomeration by public transport through targeted services and by increasing the ratio of car sharing.

The electrification of cars and motorcycles and the electrification of freight transport is an important challenge, which requires the availability of a support scheme in addition to education.

The decarbonisation of public transport is underway, with Tüke Busz Zrt.'s decarbonisation plan to convert its entire bus fleet to electric propulsion by 2027.

Significant emissions reductions can also be achieved through optimised logistics. Smart pylons, real-time data generation from IoT sensors, network remote control and automation systems: installation of sensors, diverting traffic from Route 6 by relieving congestion in the city centre and Garden City, and the construction of transfer stations at three locations are key interventions in the area.

In the waste and wastewater sector, the city has already achieved a number ofresults, which it will continue to take forward, such as the application of smart solutions in waste management and urban operations, the fermentation of high biodegradable fraction separated by mechanical treatment with biogas recovery, Pretreatment of high biodegradable fraction, selection of fractions for energy recovery, selection of inert components, Waste prevention centre, Increasing wastewater recovery capacity in Pécs by installing a solar dryer.

The systematic building of the foundations of a circular economy will be initiated in cooperation with urban enterprises, through the implementation of pilot circular construction, the construction of a circular building materials marketplace and the conversion of the Industrial Park to a renewable, zero-emission, circular economy.

** Note: negative numbers represent cash outflows (investment/cost), positive numbers represent cash inflows (savings/benefits).*

Summary budget - CAPEX (current prices, EUR million)							
Sector	**Subsector**	**Citizens and institutions**	**Enterprises (industry and commerce)**	**Eco-government**	**Transport service providers**	**Energy producers**	**TOTAL**
Transport	Reduced demand for motorised passenger transport	€ -	€ -	€ -	€ -	€ -	€ -
	Switch to public transport and non-motorised transport	€ (3)	€ -	€ (0)	€ (3)	€ -	€ (6)
	Enhanced car-pooling communities	€ -	€ -	€ -	€ -	€ -	€ -
	Electrification of passenger cars and motorcycles	€ (20)	€ (3)	€ (0)	€ -	€ -	€ (24)
	The electrification of buses	€ -	€ -	€ -	€ (8)	€ -	€ (8)
	Optimised logistics	€ -	€ -	€ -	€ -	€ -	€ -
	Electrification of lorries	€ -	€ (19)	€ (3)	€ (98)	€ -	€ (119)
Bulding and heating	Building renovations	€ (141)	€ (50)	€ (10)	€ -	€ -	€ (201)
	New, energy-efficient buildings	€ (1)	€ (2)	€ (0)	€ -	€ -	€ (4)
	Efficient lighting and appliances	€ (64)	€ (23)	€ (5)	€ -	€ -	€ (92)
	Decarbonising heating production	€ (20)	€ (7)	€ (51)	€ -	€ (197)	€ (275)
Electricity	Decarbonising electricity generation	€ (2)	€ (1)	€ (0)	€ -	€ (25)	€ (27)
Waste	Increased waste recycling	€ -	€ -	€ 0	€ -	€ -	€ 0
SUMMARY		**€ (251)**	**€ (105)**	**€ (69)**	**€ (109)**	**€ (222)**	**€ (756)**
% OF TOTAL		**33%**	**14%**	**9%**	**14%**	**29%**	**100%**
Euro per capita (2030 citizens)		**€ (1,844)**	**€ (771)**	**€ (507)**	**€ (797)**	**€ (1,625)**	**€ (5,545)**

1 Introduction

In January 2022, the Municipality of the City of Pécs submitted its application for the European Union's "100 Climate Neutral and Smart Cities Mission" programme, part of the European Green Deal, to be implemented within the framework of Horizon Europe. The City of Pécs has been selected by the European Commission along with 99 other cities to participate in the programme, under which the City of Pécs commits to achieving net zero carbon emissions by 2030. To this end, a Climate City Contract will be concluded with the European Commission. However, this goal can only be achieved in a broad partnership involving all stakeholders. In addition to theLocal Government, the main urban emitters will also make commitments under the Climate City Contract, as the net emission value can only be achieved through a joint effort.

Pécs is a large city with a central regional role, second in the hierarchy after the capital as a full-function regional centre. The majority of Pécs' regional functions cover the three counties of South Transdanubia, with education, health and cultural services being particularly strong. The development trend of Pécs has been interrupted by the loss of economic potential since the regime change period since the 1990s. The city has not been able to turn this loss into a renewal trend creating a new competitive economic structure. For many years, the development of Pécs was hampered by the lack of a motorway link to the capital, which was completed in 2010 and connects the city to the national network. The construction of the M6 motorway up to the national border is underway, which will contribute to the accessibility of the Belgrade-Zaragreb motorway (E70) and the increasingly developed Osijek-Zarajevo-Ploče route (E73).

The experience of the past three decades has clearly demonstrated that the collapse of the city's economy in the 1990s led not only to a quantitative but also to a qualitative decline. This change has led to a reduction in income, uncertainty, a lack of development resources, vulnerability to individual funding decisions and a significant outflow of the most sought-after segment of the population in terms of the labour market. Many local businesses have relocated to other areas.

The city of Pécs, in cooperation with Baranya County, has set itself the goal of becoming the hub of this metropolitan area as the centre of the Budapest-Belgrade-Zagreb triangle. As a county centre, Pécs is predestined to play the primary role of this south-west gateway. To this end, Pécs must coordinate its operations with the area's key towns and settlements in terms of logistics and accessibility, and establish a division of labour that will ensure complex development conditions.

Pécs is considered one of the most attractive cities in Hungary, thanks to the forested Mecsek, the city's Mediterranean climate and atmosphere. However, in personal decisions, the weighing up of practical advantages and disadvantages increasingly often ends in a negative outcome for the city.

The permanent population of Pécs in 2021 is 138,420, which has been decreasing over the last decade. This, together with the increase in the average age, shows signs of a strong ageing process. The social structure of Pécs has changed over the years, with a significant outflow of young people, including graduates. The proportion of the city's stable population is decreasing, which leads to labour market problems, as those moving to Budapest and foreign cities have higher skills than those migrating to Pécs. The average monthly earnings of employed persons in Pécs are only 84% of the national average.

The city's infrastructure system is designed to cope with a population of 150-200 thousand people, which in the event of a significant setback would lead to capacity under-utilisation, funding and supply tensions. The city's population decline cannot be followed by a proportional reduction in the amount of residential land to be maintained, nor in infrastructure, so only population density and capacity utilisation will decline.

Despite the demographic challenges, human capital remains the city's most important resource, with outstanding potential both regionally and nationally. The high quality of the natural and built environment supports the retention of a quality workforce, the relocation of people to Pécs and the choice of Pécs as a place for further education. The University of Pécs, with its student population of around 20,000 and its teaching community of 7,000, is a significant employment, educational, scientific-research and community resource in the city.

There is a growing awareness of environmental issues among the population, which is also increasing the demand for a more sustainable living environment. The natural environment, including the natural conditions embedded in the built environment (green spaces, parks, urban ecosystems, natural resource management, healthy air, water, noise, infrastructure for healthy living, etc.), is becoming an increasingly important factor in the choice of housing.

According to the Urban Development Concept of Pécs, the vision of the city:

"Pécs should be a city where it is good to live and its inhabitants like to live. The standard of living should be close to the European top. The city's population should form a community. The city should regain its historically established regional and metropolitan role and weight. Pécs should offer attractive employment conditions with a promising outlook on life, and at the same time the positive emotional attitude of the population towards the city, their satisfaction and their willingness to do something for the city should contribute to its capacity to survive and develop. The city should be attractive to both residents and newcomers, providing a high level of environmental, material and service conditions that meet the requirements of the times.

In the long term, a balanced development of the natural and built environment, the economy and society, harmoniously linked to the regional environment, is needed.

The imbalance works against sustainability. Sustainability and development are inseparable requirements, because without development, sustainability is called into question, and without sustainability requirements, development is constrained. The city needs to strengthen its historically established regional and metropolitan attractiveness, its integrative and development-promoting role, because the city and its surroundings are strongly interdependent in terms of resources, and Pécs, as the largest city in the region, has a responsibility to help and encourage regional development."

The city of Pécs has been committed to climate policy for almost a decade. The City of Pécs aims to contribute to carbon neutrality by creating energy security, relying on its own resources, integrating decentralised energy sources and applying best practices. It will implement local and regional measures to optimise the use of green energy in buildings, facilities and transport used by the population, the municipality and its institutions, as well as by economic operators, by making rational use of locally available resources, while ensuring a sustainable living environment that contributes to a good quality of life and healthy living, adapting to the challenges of climate change.

By 2030, the City of Pécs has set a target of achieving net zero GHG emissions compared to 2019 through actions in the areas of energy use, industrial emissions, transport and waste management. To achieve the net zero target, Pécs will achieve an overall 80% reduction in emissions by 2030 compared to 2021 levels, resulting in a saving of 325 ktCO2. In addition to the 80% emission reduction, the net zero target also includes addressing the 20% residual emissions, which the Municipality intends to achieve primarily by developing the sink capacities of Pécs primariliy through the development of green infrastructure in line with the strategy presented in the Action Plan. In total, 79 ktCO2 will need to be replaced.

2 Work Process

For more than a decade, the City of Pécs has been emphasising climate-neutral policies, which has laid the groundwork for the preparation of the current ClimateCity Contrct, Climate Neutrality Action Plan and Investment Plan. The SEAP, the SECAP and the Climate Strategy have provided the city with a solid foundation, so that the action planning process did not have to be built from scratch. The implementation of the Sustainable Energy Action Plan (SEAP) of the City of Pécs has resulted in a 20% reduction of emissions by 2020 compared to 2011 levels. By preparing the SECAP, the City of Pécs joined the Covenant of Mayors and thus the 2030 targets, which set a further 47.4% reduction in greenhouse gas emissions compared to 2019 through measures in the areas of energy use, industrial emissions, transport and waste management, and the planting/improvement of forests and green spaces.

This has been complemented by the process of preparing the Integrated Urban Development Strategy, which also provides the city with more than a decade of experience in partnership planning, forward planning and an integrated approach.

The Urban Development Concept of Pécs contains the vision and strategic objectives of the city, which lay the foundations for the development path of the next decade, and based on this, the Sustainable Urban Development Strategy was prepared, which contains the roadmap for the urban green and digital transition, which assesses the urban complex sustainability starting point based on the six objectives of the Taxonomy Regulation, and based on the Urban Development Concept, it unfolds the urban green vision and objectives, and sets priority areas for achieving the objectives.

As a first step in establishing the vision, the starting point provided by the above framework has been summarised, demonstrating the political commitment and systematic building process of the Municipality in the field of climate neutrality. In defining the vision, the city has recognised the need to build strong political commitment and consensus on the one hand, and on the other hand, it is important to coordinate and communicate this vision with the citizens, as steps towards climate neutrality can only be achieved in cooperation with the population, and as a result, a number of outputs will be achieved that will affect the entire urban population, thus improving quality of life, reducing energy costs, and reducing urban heat islands. As part of the vision, indirect impacts have also been considered, which are not directly mitigation-related measures, but represent a very significant co-benefit of the carbon reduction process. Reducing transport and phasing out fossil fuels will improve air quality, the livability of urban spaces, have a positive impact on the health of Pécs residents and create new jobs in a number of sectors, with the vocational training system and higher education providing the relevant training opportunities.

As a second step, the city established a governance structure to coordinate the planning and implementation of the climate neutral process in September 2022.

The task was managed on behalf of the Municipality by its 100% owned organisation, the Pécs City Development Company (PVF Zrt.), which, together with a team of experts, ensured the professional planning, the implementation of the partnership consultation and the operation of the Pécs Climate Neutrality Platform. The transition team is also placed within the PVF Zrt.

The Climate Neutrality Platform is composed of a Steering Committee and working groups, which includes Municipal departments, institutions, service providers, other public sector institutions, the University of Pécs, energy suppliers, commercial actors, industry and NGOs. The Climate Forum ensures continuous communication with the public and the channelling of their views into decision-making. NGOs working in the field of sustainability play a major role in engaging, communicating and raising awareness.

The Steering Committee is made up of organisations representing the most important emission sectors and emission reduction targets, which are also signatories to the Climate City Contract. The working groups ensure that expert consultation takes place on each sub-sector and its related issues. It will operate not only until the submission of the Climate City Contract on 15 September 2023, but also throughout its implementation thereafter, and will ensure broad partnership engagement, consultation, monitoring and feedback.

After the governance structure was established and the vision was set, the baseline carbon inventory was created. To this end, the City examined the methodological expectations of the Covenant of Mayors and NetZero Consortium guidelines and found that the methodology for the carbon inventory to be developed in the context of the Urban Mission has broader and deeper expectations than the version to be developed in the SECAP process. The Urban Carbon Inventory submitted to SECAP identified 2019 as the base year, building on which a carbon inventory was prepared using 2021 data to meet the Urban Mission guidelines for the emission values of electricity consumption/generation, heating/cooling of buildings, transport sector emissions, waste and waste water management, and industrial and commercial operator emissions. A national census was conducted in Hungary in 2022, which allowed detailed information on the building stock to be included in the action plan. The carbon inventory currently focuses on carbon dioxide emissions, with additional GHGs to be measured during implementation.

We have prepared a "no change" scenario, which includes the value of greenhouse gas emissions in 2030 if no additional measures are taken to achieve the net zero target. The comparison of the baseline inventory and the business-as-usual scenario proved useful to determine the level of emission reductions needed to achieve climate neutrality, while also taking into account population size and the economic environment.

Carbon reduction targets have been set, to reach the net zero target, the City of Pécs has committed to an 80% reduction target by 2030 in the energy sector, buildings, transport, waste, waste water, industry and agriculture, and to the offsetting of 20% residual emissions. The action plan also includes a strategy to compensate for the residual emissions, which will be achieved primarily through the development and expansion of sink capacities and urban green spaces, complemented by the purchase of carbon credits where necessary.

The legal environment, funding opportunities and local constraints were assessed and identified, and the obstacles that may currently hinder the implementation of certain carbon neutral ideas were taken into account when setting the objectives. The options for addressing each of these barriers and the impact pathways that would allow them to be implemented were also examined.

In defining the measures, consultations were held with all departments and stakeholders in all sectors. The related national objectives and policies that support the achievement of the carbon neutrality objectives in Pécs were also assessed. In defining the measures, a detailed analysis of their immediate short and long-term outputs, outcomes, longer-term impacts and indirect impacts in terms of e.g. energy savings, renewable energy produced, greenhouse gas emissions, energy consumption savings, cost savings, job creation was carried out. The financing needs and possible sources of financing for the implementation of the identified measures have been assessed. For each intervention, a project host has been assigned who is responsible for implementation and monitoring progress. The interdependence and interdependence of each project has also been assessed, so that synergies have been taken into account in the preparation of the timetable. In a first step, more emphasis will be put on enabling projects, preparatory interventions, the development of digital tools, platforms, surveys, awareness-raising, communication, on the basis of which a number of pilot projects will be implemented, allowing for better preparation and more efficient implementation of larger-scale interventions.

The preparation of the Action Plan and Investment Plan is the result of a year and a half of work, but it is only a milestone on the road to achieving climate neutrality. Following the submission of the Climate Action Plan, the implementation of the project portfolio will start, with continuous monitoring of resources, preparation of financing schemes, feasibility studies, technical studies and business plans to create "bankable" projects.

Ongoing monitoring and feedback of the project portfolio is implemented with partners, identifying funding sources, schemes and recording results.

The key to the implementation of the action plan and investment plan is continuous consultation and feedback, and ongoing communication of both results and potential difficulties.

The PVF Zrt., responsible for the implementation of the climate-neutral portfolio on behalf of the Municipality, will ensure the operation of the management structure, the monitoring and evaluation system, the monitoring of the indicators defined for each measure and the reporting of data from the project promoters. The City will ensure that the carbon inventory is updated every 2 years to monitor overall progress.

With the Steering Committee and working groups, at least every six months, the monitoring information will be interpreted in order to adapt and update the priorities for action which takes into account changes in the external environment, including technological developments, government policies, available resources and public preferences. A Climate Neutrality Platform will also be convened at least annually to ensure public communication, engagement and involvement in decision-making.

Figure 1: Pécs - Széchényi tér

3 Part A - Current State of Climate Action

3.1 Module A-1: Greenhouse Gas Emissions Baseline Inventory

A-1.1: Final energy use by source sectors				
Base year	**MWh/year**			
Unit	**Scope 1**	**Scope 2**	**Scope 3**	**TOTAL**
Buildings				
Natural gas	565 119			565 119
Electricity		399 887		399 887
District Heating		368 896		368 896
Transport				
Petrol (passenger car, lorry)	296 844			296 844
Diesel	389 978			389 978
Public bus transport	71 198	145		71 343
City operation diesel	6 535	260		6 795
City operation petrol	220	11 080		220
MÁV diesel	6 973			18 053
MÁV natural gas	2 600			2 600
Waste				
Waste generated in the city (t)			44 240	44 240
Residues disposed of in landfills (t)			6 127	6 127
Waste water				
Waste water treatment (t)	89 242			89 242
Water utility (Mwh)	5 801			5 801

Achieving climate neutrality requires Pécs to reduce the GHG emissions from all sectors and sources within the city's boundary to net zero by 2030, including:

- Emissions from combustion of fossil fuels in all buildings and facilities including residential, commercial and industrial buildings as well as municipal buildings and public lighting within the city boundary
- Emissions from combustion of fossil fuels for all vehicles and transport within the city boundary
- Emissions arising from the consumption of electricity and district heating/cooling within the city's boundary, from power plants located within the city boundary
- Emissions arising from waste generated within the city boundary, treated/managed/disposed outside the city boundary
- Emissions from changes in land use including agriculture, forestry and other land use within the city boundary
- Emissions from chemical processes in industry within the city boundary

A-1.2: Emission factors applied								
Base year	2021							
t or Mwh								
Methodology of the Intergovernmental Panel on Climate Change (IPCC) and the Covenant of Mayors on Climate and Energy.								
Sector	**Primary energy / energy source**	**Carbon Dioxide (CO)2**	**Methane (CH)4**	**Nitrous Oxide (N2O)**	**Hydrofluorocarbons and perfluorocarbons**	**Sulphur hexa-fluoride (SF)6**	**Nitrogen trifluoride (Nf3)**
Transport	Cars + motorcycles (g/km)	267					
	Buses (g/km)	249					
	Light trucks (<3.5 t) (g/km)	267					
	Heavy trucks (>3.5 t) (g/km)	249					
Bulding and heating	Heat production (district heating) (g/kWh)	17					
	Heat production (local heating) (g/kWh)	202					
Electricity	Electricity production (g/kWh)	364					

A-1.3: Activity by source sectors			
Base year		2021	
	Scope 1	Scope 2	Scope 3
Transport			
Transport demand - cars + motorcycles (M km/year)	541		
Transport demand - buses (M km/year)	9		
Transport demand - trains / metros (M km/year)	0		
Transport demand - light trucks (<3.5 t) (M km/year)	25		
Transport demand - heavy goods vehicles (>3.5 t) (M km/year)	4		
Buildings and heating			
Heating demand (space heating + domestic hot water) (GWh/year)	887		
Residential buildings	594		
Commercial buildings	103		
Institutional buildings	120		
Manufacturing and construction	46		
Energy industry	23		
Agricultural, forestry and fishing activities	0.870		
Fugitive emissions from coal mining, processing, storage and transport	0.046		
Fugitive emissions from oil and gas systems	0.458		

A-1.3: Activity by source sectors			
Base year		2021	
	Scope 1	Scope 2	Scope 3
Electricity			
Electricity demand within the city limits (GWh/year)		400	
Residential buildings		164	
Commercial buildings		111	
Institutional buildings		44	
Manufacturing and construction		65	
Energy industry		15	
Agricultural, forestry and fishing activities		0.530	
Fugitive emissions from coal mining, processing, storage and transport		0.129	
Fugitive emissions from oil and gas systems		0.443	
Waste			
Waste collected within the city limits (t)			44 277
Paper and cardboard			1,123
Metal			1,073
Plastics			2,458
Glass			711
Organic waste			5,272
Other waste (e.g. textiles, scrap, wood, etc.)			33,640

The **geographic boundary** of the baseline inventory is the administrative territory of the City of Pécs, that is 162.77 km2. The GHG emission inventory covers Scope 1 and 2 emission, and Scope 3 for waste sector.

A-1.4a: GHG emissions by source sectors					
Base year	2021				
Unit	t CO2 equivalent / year				
	Scope 1	Scope 2	Scope 3	Total	% of Total
Transport	166157			166157	35%
Buildings and heating	118439			118439	25%
Electricity		149583		149583	32%
Waste*			11150	11150	2%
Other	23505			23505	5%
Total	308100	149583	11150	468833	100%

** Includes Scope 3 (produced in the city but processed outside the city limits).*

A-1.4b: GHG emissions by source sectors					
Base year	BAU 2030 (Business as Usual 2030)				
Unit	t CO2 equivalent / year				
	Scope 1	Scope 2	Scope 3	Total	% of Total
Transport	107536			107536	27%
Buildings and heating	103343			103343	26%
Electricity		163546		163546	40%
Waste*			6161	6161	2%
Other	23505			23505	6%
Total	234383	163546	6161	404090	100%

** Includes Scope 3 (produced in the city but processed outside the city limits).*

A-2.3: Emission gap (kt Co2e)							
	Base issue (BAU 2030)	Emissions residual compensation[1]		Emission reduction target[2]		Emission gap (amount needed to reach net zero)	
	(Absolute value)	**(Absolute value)**	**(% of BAU 2030)**	**(Absolute value)**	**(% of BAU 2030)**	**(Absolute value)**	**(% of BAU 2030)**
Transport	108	34	32%	73	68%	0	0%
Buildings and heating	103	11	10%	93	90%	0	0%
Electricity	164	25	15%	139	85%	0	0%
Waste	6	5	83%	1	17%	0	0%
Other	24	5	20%	19	80%	0	0%
Total	404	79	20%	325	80%	0	0%

[1]Residual emissions include emissions that cannot be reduced by climate action and are offset. Residual emissions are limited to 20% according to the Mission Info Kit.

[2]The target reduction percentage for the "Other" sector is assumed to be the same as for the other 4 main sectors.its).

A-1.6: Description and assessment of GHG baseline inventory

The preparation of the Climate Neutral Action Plan and Investment Plan is based on modelling, using an urban climate transition economic model developed in collaboration with the University of Madrid under the NetZero Programme. The tool is scientifically based and provides the opportunity to develop a robust climate finance framework for the climate transition of Pécs, taking into account climate science, with emission values and associated costs broken down by target groups (city, population, institutions, university, business, transport, energy and other public services) to show the necessary investment costs and the savings over the time horizon up to 2030. The investment needs identified at the level of the investment measures (see key measures in the Projectportfolio section) provide a continuous feedback loop to harmonise the top-down framework with the corresponding bottom-up projects, to ensure a precise implementation of the programme set out in the Action Plan and Investment Plan. For further reference on the economic model used, see the NetZero Portal group "Capability Building Programme: building a strong economic case" at the following link:

https://netzerocities.app/group-capabilitybuildingprogrammebuildingastrongeconomiccase

In order to achieve climate neutrality, the City of Pécs has assessed the energy consumption, production and emissions from all urban systems within the administrative boundaries of the city:

- Emissions from the combustion of fossil fuels in all buildings and installations (so-called "stationary" emissions). This includes residential, commercial and industrial buildings, municipal buildings and street lighting within the city boundary: volume of natural gas consumption including all urban consumption 565 GWh (2021).

- Emissions from electricity consumption and district heating/cooling within the city boundary: district heating energy consumption 369 GWh and electricity consumption 400 GWh (2021).

- Emissions from the combustion of fossil fuels for all vehicles and means of transport in the city: consumption of petrol and diesel equivalent to 786 GWh (2021)

- Emissions from treated/disposed waste generated within the city: 44277 t of waste generated, 6127 t of residues disposed of in landfills. Within this, paper and cardboard 1,123 t, metal 1,073 t, plastic 2,458 t, glass 711 t, organic waste 5,272 t, other waste (e.g. textiles, scrap, wood, etc.) 33,640 t. Waste is treated in the Kökényi landfill, which is located outside the administrative boundary of Pécs. The amount of wastewater generated in 2021 was 89242 t, which is treated in the city.

- Emissions from land use change, including agriculture, forestry and other land uses (AFOLU) within the city boundary; emissions from industrial chemical processes (IPPU) within the city boundary.

The consultation with industry started in early 2023, but the estimation of the emission items will take longer, so an estimation of the magnitude could be made before the submission of the Climate City Contract, and the item estimation is ongoing. For this purpose, a questionnaire has been prepared by the City. Carbon emission measurements vary widely in terms of the size, sector and operational nature of the economic entities. In particular, data are available for large companies, which are already legally obliged to report their emissions (it should be noted that in many cases the data of the parent company are available, while the data of the Pécs site can only be pro-rated), or are subject to environmental regulations, The economic sector in Pécs, which is predominantly made up of micro and small enterprises, does not yet have the resources and capabilities to do this, so the Climate City Contract is also used to encourage this and to provide information. However, it is important that the emission values of the real estate and vehicle fleet of industrial actors are included under the relevant sectors, the survey focuses on the emission values of industrial processes and products.

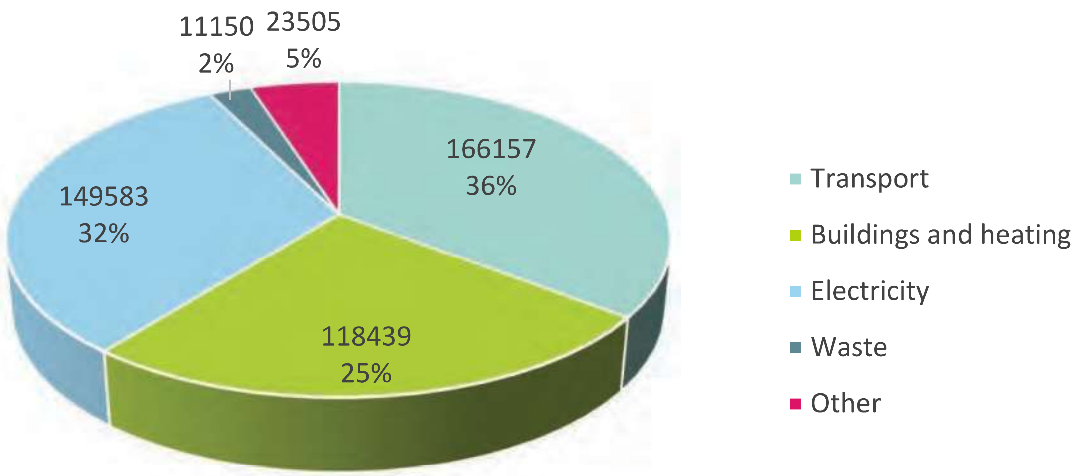


Figure 2: GHG emission by source sectors, 2021

Content of each emission item:

Transport:
- Transport demand - cars + motorcycles (M km/year)
- Transport demand - buses (M km/year)
- Transport demand - light trucks (<3.5 t) (M km/year)
- Transport demand - heavy goods vehicles (>3.5 t) (M km/year)

The transport emissions figure includes emissions from cars and engines, public transport and freight transport.

The emissions of cars and engines are calculated by taking into account the annual kilometres travelled and the utilisation of cars.

For buses, the passenger-kilometres travelled and the occupancy rate were also taken into account.

For freight traffic, the annual tonne-kilometres travelled and the capacity utilisation of lorries were examined in the divisions below and above 3.5 tonnes.

Buildings and heating: heating demand (space heating + domestic hot water) (GWh/year)

The emission value is calculated based on city-wide natural gas consumption data and district heating consumption data for the year 2021.

Electricity: electricity demand within the city limits (GWh/year)

The emission value is calculated based on the city-wide electricity consumption data for 2021. The share of renewable energy in EON's service mix is reflected in the emission factor.

Waste: waste collected within the city limits (tonnes)

Within the total amount of municipal waste (t, 2021), the distribution of paper, metal, plastic, glass, organic waste, other waste and the processing rate of these categories (landfilled, incinerated - also for energy recovery, recycled) is taken into account.

Other:
- Waste water generated in the city
- Emissions from industrial processes and products
- Agricultural output value

This covers wastewater treatment, industrial and agricultural emissions. Here, the model calculates a flat rate and the assessment with industrial and agricultural actors is ongoing. Although we have specific data for wastewater, by adopting the model we are not adopting the specific value but the flat rate calculation.

GHGs monitored in all cases: CO2, NOx, PM2.5, Pm10

The building stock is the largest emitting sector at (32% + 25%) 57%, which, with district heating being almost entirely carbon neutral, represents a relatively small share compared to the national average. Decarbonisation of the building stock can be achieved by decarbonising the electricity consumption volume based on solar energy and by phasing out/reducing natural gas consumption by at least 50%.

The second largest emitting sector is transport with 35%, where the major challenge is to reduce the amount of private transport and increase the electric share of the passenger car fleet. In the truck fleet, the main challenge is to electrify vans and increase capacity utilisation.

Waste and waste water management can be managed with the continuation of current processes to ensure sufficient results, with waste prevention and the development of a circular economy offering opportunities for reduction.

Based on the baseline inventory and the unchanged scenario, it can be seen that a 12% reduction would occur even if the city had not committed to a net zero target by 2030 as a member of the Mission Cities.

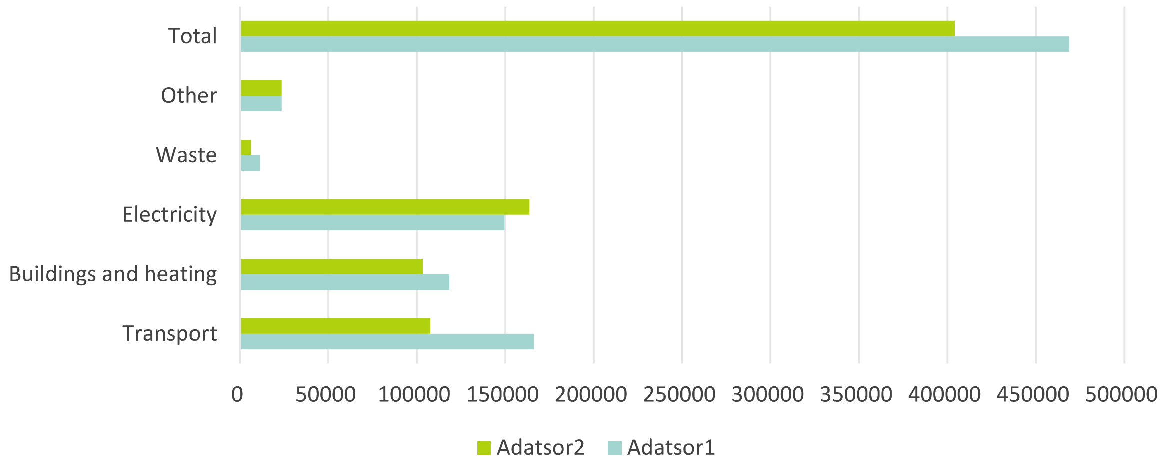


Figure 3: GHG emission by source sectors, 2021, 2030 (tCO2e/year)

Series 1: 2021 data
Series 2: unchanged scenario, 2030

GHG emissions are on a downward trend due to a number of factors, even if the city does not target net zero by 2030, the reduction would be around 12%. The natural decline in natural gas consumption will lead to an increase in electricity consumption due to the natural penetration of heat pump solutions. In the transport sector, decarbonisation of urban bus transport will be achieved and further emission reductions will be achieved through waste and waste water management measures.

The survey with industrial and agricultural stakeholders is ongoing, so the emission value is assumed to remain unchanged in the model, but will be refined during the reviews.

The two largest emitting sectors are buildings and transport, including private transport. In Pécs, the energy transition can be based on the decentralised use of solar energy and biogas, and the construction of small power plants.

In the last year, three solar parks were built, each with a capacity of 0.5 MW, giving a combined annual capacity of 2100 MWH/year. The combined value of the residential and public feed-in was 23.7 GWh in 2021. Thanks to previous EU funding, the energy efficiency of public buildings is being upgraded by installing solar panels, and the number of small residential plants is steadily increasing.

The district heating system uses predominantly renewable sources to meet heat demand, which is already 95% carbon neutral. Pannon-Hő Kft. produces 35-40% of the total electricity generated by the Pécs power plant and about 60% of the total district heating demand of the city. It sells 190-200 GWh of electricity and 900-1000 TJ of heat per year. Pannon-Hő Kft. was founded in 2005 with the aim of constructing and operating a 35 MW electrical power unit using baled herbaceous agricultural by-products, a renewable energy source. Today, the company is responsible for the combined production of electricity and heat with a second biomass boiler, which came on stream in 2013.

Regional waste management centres were set up in 2015. In two centres (Kökény 150,000 t/year, Marcali 30,000 t/year), further sorting of mixed waste by mechanical-biological treatment was carried out, and transfer stations with an annual capacity of 53,000 tonnes were set up.

The wastewater treatment plant has also been upgraded, and biogas from sewage sludge is used to produce green energy.

At the University of Pécs, research is carried out by the Research Centre for Secondary Raw Materials, the Hydrogen Technology Research and Development Centre, the Centre for the Development, Validation and Research of Intelligent Health Technologies, which can significantly contribute to the realisation of urban carbon neutralisation goals by adapting its research results.

Pécs has already put 18 electric solo buses into service in 2020 and 2022, and the entire fleet will be replaced by 2027. The development of e-charging stations is also ongoing to meet capacity needs.

The electric community bike rental scheme will contribute to the availability of alternative modes of transport by installing 107 docking stations and 70 electric rental bikes.

The HungAIRy-LIFE project currently under implementation includes as pilot project elements the development of a smart parking system, a green space survey and green register, and the measurement of energy consumption in public buildings. The smart parking system will reduce CO2 emissions from cars by at least 5%.

Building on these foundations, the city has set its net zero targets for 2030: Pécs will achieve an overall net zero target of 80% emission reduction by 2030 compared to 2021, resulting in a net reduction of 325 ktCO2. The largest share of this is currently accounted for by transport emissions at 35%, followed by electricity emissions at 32% and the carbon impact of heating buildings at 25%.

As a result of the targets and interventions set out in the Action Plan, emissions from the transport sector will be neutralised by 68%, electricity emissions by 85% and the carbon value of heating in buildings by 90% as a result of investment and significant non-investment measures. The waste sector will achieve a 17% reduction, while economic operators and waste water management will achieve a combined reduction of 80%.

In order to achieve the above carbon reduction targets, the city identifies the following main sub-sectors as the main intervention directions, which form the framework of the project portfolio to be implemented and for which a sub-sector specific carbon reduction target is set:

- Reduced demand for motorised passenger transport
- Switch to public transport and non-motorised transport
- Growing car pools
- Electrification of passenger cars and motorcycles
- The electrification of buses
- Optimised logistics
- Electrification of lorries
- Building renovations
- New, energy-efficient buildings
- Efficient lighting and appliances
- Decarbonising heating production
- Decarbonising electricity generation
- Increased waste recycling

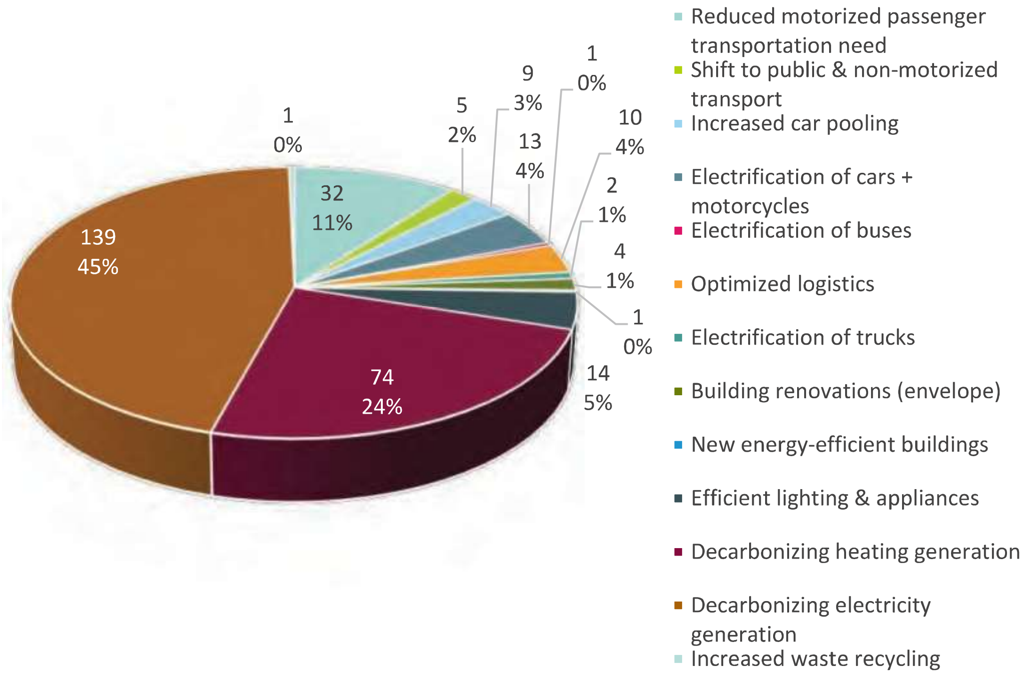


Figure 4: CO2e reduction (kton) by subsector

The main objectives of the Climate Neutral Action Plan of the City of Pécs are:

- Access to renewable energy for 50% of households
- 85% decarbonisation of electricity consumption
- The share of renewable energy sources increases to 60%
- Emissions from buildings reduced by 50% by 2030
- Natural gas consumption for heating will be reduced by 50% by 2030 and natural gas for cooking will be phased out
- Energy savings of 40% of final energy consumption
- Electric buses, public transport 100% emission reduction
- 35% reduction in car use
- 50% of vans of less than 3.5 t and 40% of trucks of more than 3.5 t will be electrified

A-1.5: Residual emissions and compensation strategy

Between direct emission reductions and offsetting the remaining emissions, Pécs aims to achieve a net zero emissions balance by 2030, which will ensure that the amount of greenhouse gases emitted from the city's territory is completely neutralised.

Pécs intends to manage the remaining emissions in two ways to achieve net zero emissions:

- The development of carbon sinks, i.e. removal through natural and technological solutions within the city boundaries.
- It is intended to be secured by using official credits/certificates from outside the city limits, subject to certain rules and restrictions.

The focus is on developing sink capacity, the green infrastructue system, with the purchase of carbon credits used only as a complementary measure, if necessary.

A detailed carbon offset strategy will be prepared by the City of Pécs by the end of 2024, based on the following starting points:

In addition to the 80% emission reduction, the achievement of the net-zero target also includes the management of 20% residual emissions, which the Municipality intends to achieve primarily through the development of the absorption capacities of Pécs, in line with the strategy presented in the Action Plan. A total of 79 ktCO2 will be required to be emitted, 34 ktCO2 by transport actors, affecting both freight and cars, 25 ktCO2 by electricity producers and 11 ktCO2 to compensate for heating of buildings. Waste management and the waste water management, IPPU and AFOLU sectors will achieve savings of 5-5 ktonnes. The contributions that form the basis for interventions to improve absorption capacity will be accumulated in the urban carbon fund.

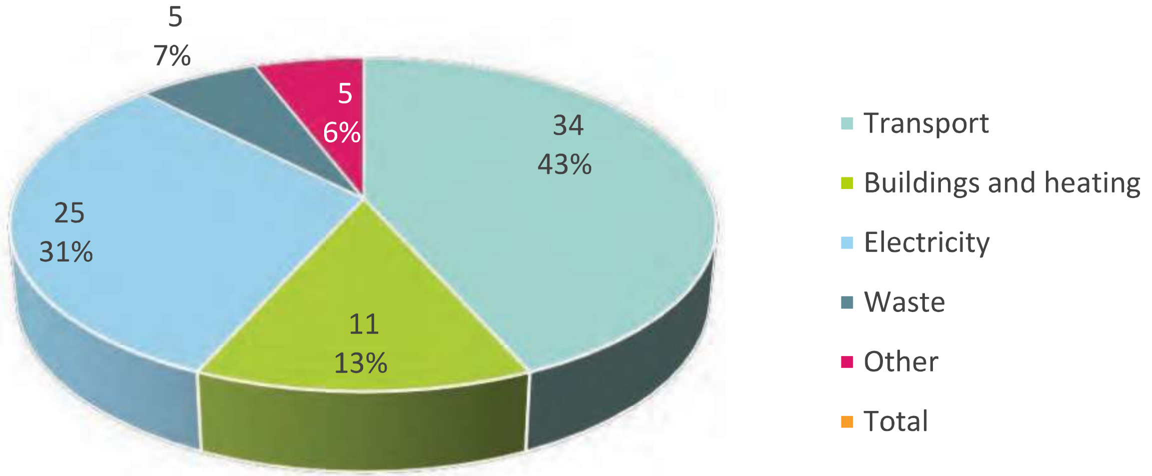


Figure 5: Residual emissions (ktCO2/year)

At present, the urban spatial structure is characterised by fragmentation of the urban body, with many missing or inadequate connections, partial functional coverage of urban sub-centres, and a lack of networking of green and blue space infrastructure. These aspects are crucial for development through climate neutrality, reducing average travel times, thus reducing the specific transport demand and the environmental impact of motorised transport. Under-used and under-utilised areas provide a key location for the necessary investments, whether in increasing solar energy capacity or in developing green space.

Orderliness, accessibility and equal coverage increase social equality. Land use becomes more balanced, and the ongoing rehabilitation of under-used or poorly used land strengthens the cohesion of urban areas, so that the built-up area of the city does not grow without reason.

Modern greenspace standards, the development of green and blue infrastructure, improvements in the energy performance of buildings, rational transport links that integrate the urban area and modern public transport are effective in reducing energy use, noise and carbon emissions, reducing other pollutants in the air and improving air quality.

The development of the Mecsek site becomes a qualitative rather than a quantitative issue, and its expansion is severely limited by local building regulations, both in terms of the amount of development and the height of buildings, taking into account the available infrastructure.

Along the lines of the above argumentation, the City of Pécs intends to achieve the residual emission value primarily through the elements of the green space network and by increasing its resilience, in which the building and real estate owners and transport operators, i.e. the population and economic operators, have the biggest role.

Pécs is a part of the Mecsek Hills, and forest covers 38.8% of the total area of 162.77 km2, that is 63.09 km2. This forest area has a sink capacity of 57 ktCO2e/year, which already today contributes to compensating the emissions in the administrative area of the city of Pécs. Out of the total forest area, 938 ha of forest and green areas registered as public land owned by the city as park forest and urban green area and are the focus of green infrastructure development for climate resilient and adaptive development.

The volume of underutilised land is also available and is described below. In preparing the carbon offsetting strategy, the city will consider how its short, medium and long-term land use plans will allow for temporary or permanent green space development, thus contributing to the value of carbon offsetting.

In another approximation, on the afforestation side, the total 79 ktonnes of residual emissions can be offset by an average of about 1.1 million trees of average size of 8-12 years, equivalent to about 2 million trees of average canopy size of 4-5 years, or 3 million tree seedlings.

Biokom NKft. runs the Municipal Tree Nursery, where maples, ash, plane trees and hornbeams are grown. The company regularly distributes seedlings to the population, thus contributing to the growth of green areas and climate adaptation. Increasing urban green spaces is not only achieved by planting trees in public spaces, but also by planting trees in private plots and gardens. Increasing the area of the Municipal Tree Nursery and creating new ones in underused areas are also part of the carbon offset strategy.

The HungAIRy-LIFE project is currently being implemented as a pilot project to develop a green space inventory and a green register, which will also form the basis for the implementation of the carbon offset strategy. In the framework of the project, a survey and inventory of trees and shrubs in public areas of Pécs will be carried out in four phases:

I.) Three urban districts (Uranváros, Makár, Rácváros), covering a total area of 80.23 ha, were surveyed

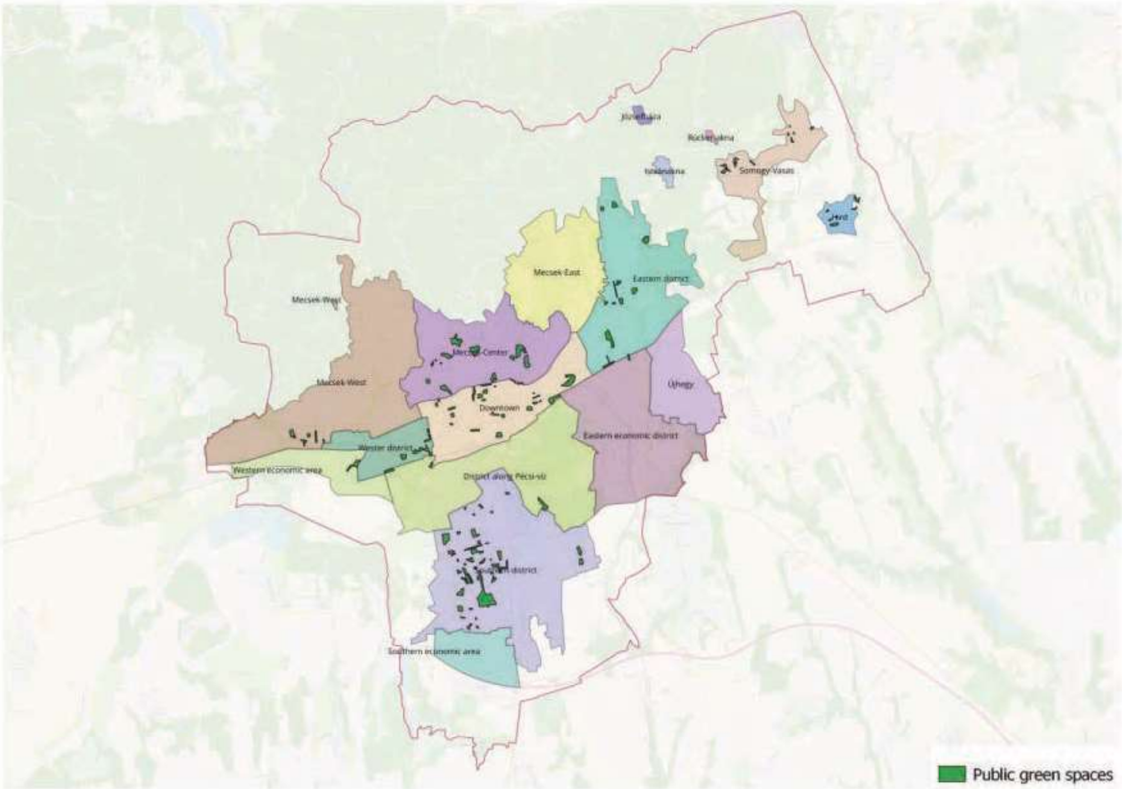
II.) 242.09 ha of land will be surveyed in five neighbourhoods in the southern part of the city

III.) 148.08 ha will be surveyed in seven districts, including the city centre and the Mecsek side

IV.) An additional 242.91 ha will be surveyed in the Eastern districts.

The database created through the surveys will be displayed on a geo-spatial interface, which will enable urban management, urban planning, official tasks and utility planning. The new geo-spatial functions developed in the framework of the project will all serve the purpose of ensuring that the existing trees and shrubs can provide a long-lasting ecological service to the city's population. The new functions are based on the calculation of a subsurface root coverage using the current measured parameters of the trees, which is displayed on the map. The system will be able to filter out public areas where there are still tree sites that can be planted due to the presence of pipelines and their protection distances.

Figure 6: Major public green spaces
Source: own editing



Underutilised, abandoned and brownfield sites in Pécs, as defined in the Local Building Code:

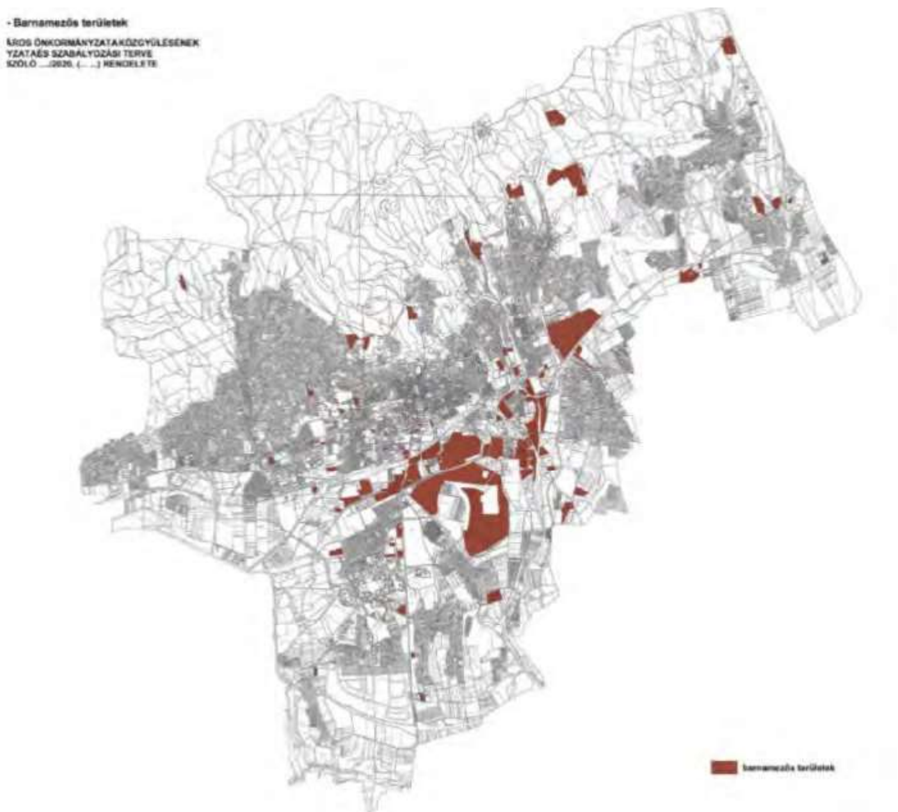


Figure 7: Underutilised, abandoned and brownfield sites in Pécs
Source: Annex 7 to the Local Building Code

Pécs brownfield, underutilised and abandoned areas as shown in the figure above:

- **Closed coal mines:** the György mine, Petőfi mine, Vasasi mine, Rücker mine, István mine, István III. mine, Széchenyi mine, Karolina mine

- **Economically underutilised areas:** the area around the Pécs thermal power plant - former coal sorting and power plant in Pécsújhegy (the buildings have been demolished), Gyárváros, the area of the Zsolnay factory - part of the Zsolnay quarter, Balokány, the area of the leather factory and Nordmegyer, the area of the horticultural area of the MÁV ÉHK, Tüskésrét, the area of the former amusement park

- **Military brownfield site:** ÁPER barracks

- **Technical-infrastructural:** buildings along the former railway line No. 64 Pécs-Pécsvárad, Siklósi út Pannon Volán site, Erkel F. u. former DÉDÁSZ site

- **Residential buildings:** the former hemp weaving mill building of Pécs-Hird, the Petőfi House on the corner of Surányi M - Székely B. u., the Pécsbányai segregate, the Szabolcs segregate (Hősök tere), the Gyárvárosi northern segregate (former House Factory area), the Gyárvárosi southern segregate (Mohácsi út - Csaba u.), Vágóhídi segregate (Fűzfa u. - Pipacs u. - Gyöngy u.), István akna segregate, Somogy mining colony, Rücker-akna mining colony, Vasas mining colony, Balokány (area west of Zsolnay district)

- **Human infrastructure:** the building of the former hospital in Pécsbányatelep, the building of the former dermatological clinic on Kodály Z. u., the former clinic on Munkácsy u., the former clinic on Apáca u. former Csorba Győző County Library building, Bóbita puppet theatre building, former rehearsal hall of the Pannon Philharmonic Orchestra, former Anikó Street Primary School building, Lakits barracks, former MDF headquarters on Apáca u., Pécsbányatelep fire brigade station building, Tüdőszanatórium building

- **Brownfield sites of a recreational nature:** Tüzér Street PAC track, Balokány Spa

The city is also exploring the possibility of installing green roofs and green walls. Estimated sink capacity of green roofs: 1 m2 of green roof can absorb 5 kg of CO2 per year (photosynthesis). Reducing energy use will reduce carbon dioxide emissions by a further 3.2 kg per year (electricity, gas), for a total reduction of 8.2 kg/m2/year.

(Source: Hungarian Chamber of Architects http://www.fejermek.hu/attachments/article/915/2017-06.pdf)
For a 400 sqm roof-level prefabricated building/staircase, this means 2.6 tCO2 savings per year. Covering a building with a green wall with a wall area of 500 sqm can result in a 1.15 tCO2 sequestration per year.

The municipality can provide about 50% of the residual emissions compensation with its own resources. The remaining 50% needs to be provided by residential, industrial and commercial actors through the use of green space solutions.

The carbon offsetting strategy will be linked to a sectoral and actor-specific commitment, which will be continuously monitored.

Carbon capture projects planned in Pécs are presented in the project portfolio section.

3.2. Situation assessment

3.2.1 Electricity production and consumption

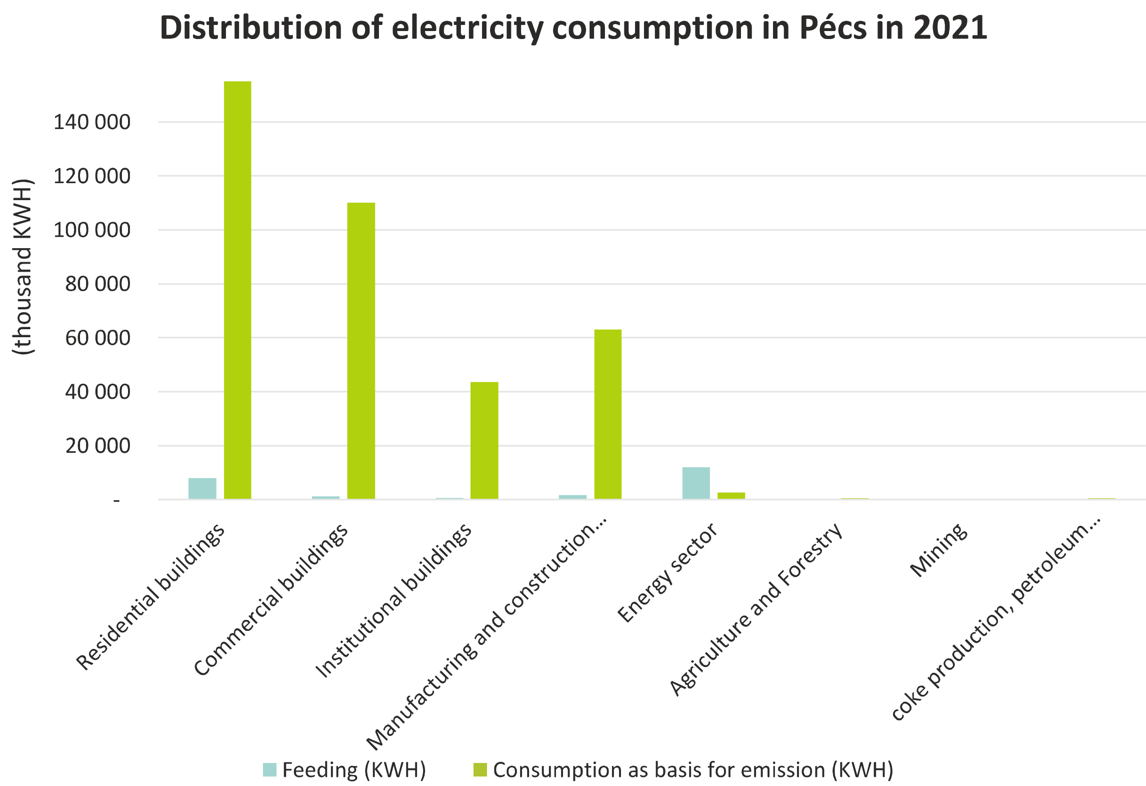


Figure 7: Distribution of electricity consumption in Pécs in 2021 (thousand kWh)
Source: data provided by EoN Zrt.

The diagram below shows the amounts of electricity consumed and supplied (in kWh) by the different sectors of Pécs. Examining the data, it can be stated that the main sectors in this area are residential buildings, commercial buildings, institutions, and the manufacturing and construction industries. In terms of electricity consumption, the other sectors are relatively small: Agriculture and forestry (530 329 kWh); Mining and quarrying (129 474 kWh); Coke production (443 064 kWh).

In 2021, the following feed-in rates for total consumption in the different emission sectors were reported: residential buildings: 4.85%, commercial buildings: 1.15%, institutional buildings: 1.26%, manufacturing and construction: 2.61%, energy: 81.95%, agriculture and forestry: 30.45%, mining and quarrying: 0%, coke and refined petroleum products: 0%. The missing consumption percentages are all energy consumption based on actual output. The data show an outstanding feed-in performance of almost 82% for the energy industry, with total consumption of 14 693 703 kWh, while energy feed-in from renewable energy sources reached 12 042 057 kWh for the year.

The aggregation of the data suggests that only 6% of the total consumption is energy input, so the remaining 94% is actual baseline consumption. Achieving carbon neutrality will require a significant increase in the share of electricity supplied per sector by 2030, based on improving energy efficiency and increasing the share of renewables in the energy mix.

The specific CO2 emissions of E.ON Energiamegoldások Kft. are 0.202 tonnes/MWh, which corresponds to 0.056 tonnes/GJ.

Percentage share of gross electricity consumption not covered by guarantees of origin by energy source:

- Renewable energy sources 16,38%
- Nuclear 39,60%
- Fossil energy sources 44,02%

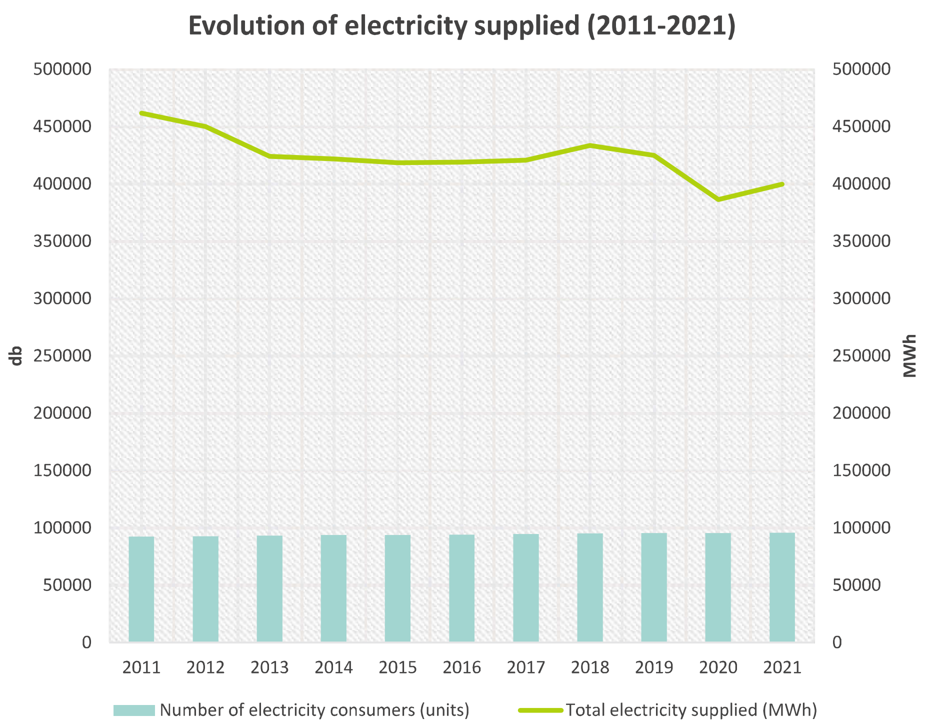


Figure 8: Evolution of electricity supplied in Pécs 2011-2021
Source: KSH database

An analysis of the data from 2011 to 2021 shows that the total electricity supplied, including the import intensity of electricity supplied to households, has also decreased by more than 13% over the period. Compared to 2019, the consumption data for 2020 show a significant decrease, largely due to the effects of the pandemic that peaked in 2020. In 2021, energy consumption started to increase again, a trend that is expected to continue in the coming period. For the sector concerned, this reduction is very significant.

Despite the general decrease in the amount of electricity supplied, the same cannot be said for consumers. The number of electricity consumers has increased from 9,217 to 9,589,891 during the period under review, representing an increase of 3.6%.

Renewable capacity

Pécs' energy supply will be based on solar energy, and the aim is to fully green the current electricity generation.

EON aims to increase the share of renewables in its own balance sheet as much as possible and to serve nearly 30% of total customer consumption by 2025 and nearly 44% by 2030 with electricity of origin guarantees or physical green transport.

The total energy consumption of Pécs in 2021 was 399887 MWh, which requires 266.6 MW of capacity to supply the full solar capacity. Currently, 15.8 MW of capacity is available at city level, of which 8 MW of capacity is in the form of a solar power plant/solar park. This implies the construction of an additional 250 MW of capacity. 1 MW of solar capacity produces on average 1500 MWh of energy per year.

However, capacity building should be considered on a sector-by-sector basis, and all sectors, especially industrial, commercial and agricultural actors, should be encouraged to build their own capacity, which can be complemented by urban capacity. This is currently being assessed. An assessment of the energy self-sufficiency of enterprises in the D energy sector is also under way.

In the sectors of construction, manufacturing, energy, agriculture, forestry and fisheries, fugitive emissions from coal mining, processing, storage and transport, and fugitive emissions from oil and gas systems, the switch to renewable energy is mainly an industry-specific task, requiring the construction of a total of 50 MW of additional capacity (individual assessments).

In the following, the renewable energy conversion capacity of the residential, institutional and commercial sectors is examined, which represents 80% of total urban electricity consumption and requires the deployment of 200 MW of capacity.

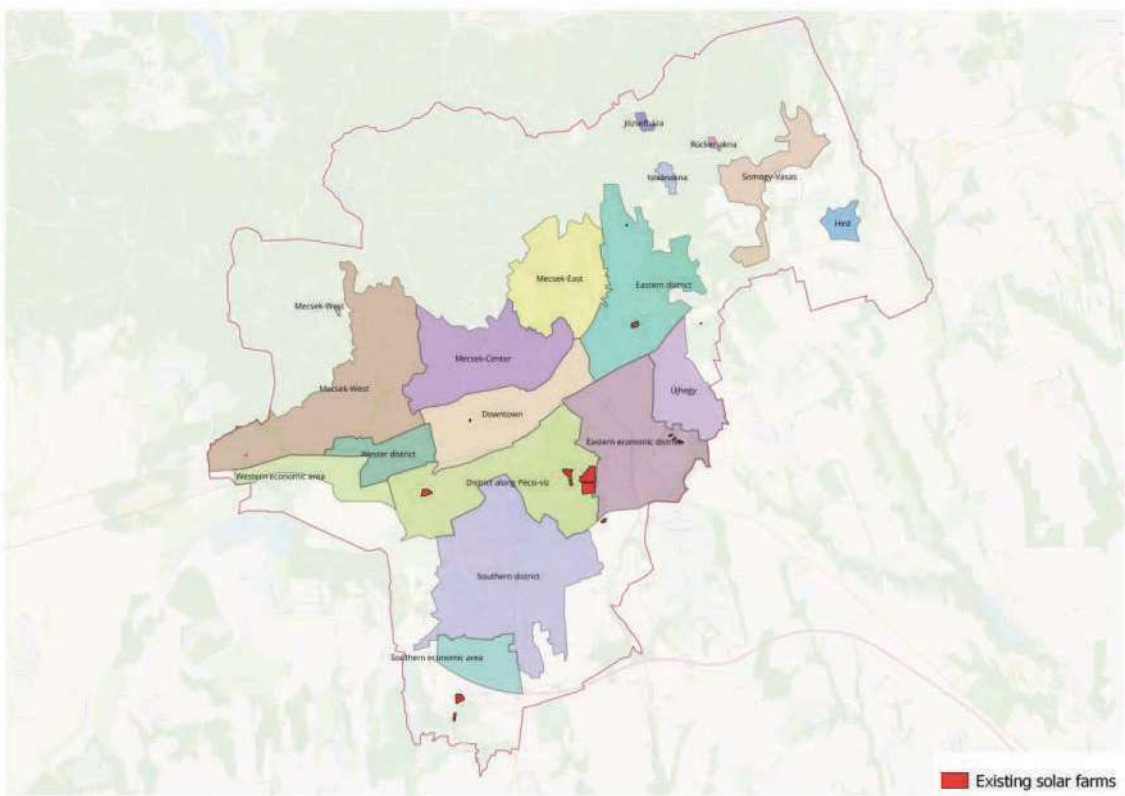


Figure 9: Current utility-scale solar capacity in Pécs
Source: own editing

Residential buildings

Residential buildings account for 41% of total urban electricity consumption. This includes not only lighting but also heating electricity for properties already equipped with heat pumps. Current heat pump capacity: 1239 units (census data)

The current residential demand can be met with 110 MW of capacity, of which 5.3 MW is currently available, which is roof-mounted solar capacity, so an additional 105 MW needs to be provided.

At present, Pécs has a minimal wind energy capacity (having a wind turbine on a block of flats), which should be further expanded. It is also possible to install individual wind turbines on the roof instead of solar panels, and the feasibility of this should be investigated. A wind channels survey has already been conducted.

In the following, the energy supply of residential buildings will be considered: the construction of solar parks at city level, capacity built by individual households, the development of energy communities.

EON Dél-Dunántúli Áramhálózati Zrt. developments

Distribution networks are becoming smarter through the installation of sensors and automation, providing a more detailed and constantly updated picture of energy flows, which not only means better quality data, but also avoids further network expansion by allowing remote intervention. Smart grids are the basis for a number of innovative technological solutions that also help to achieve the clean energy transition needed to achieve carbon neutrality. They also play a role in helping us to manage even instantaneous changes in energy demand much more quickly and efficiently, and in the development and deployment of Virtual Power Plants (VPPs) and energy storage solutions. They also have a major role to play in decentralising and making the energy distribution network more flexible. The growing demand for electrification, together with smart solutions, requires network development, so the total length of overhead lines and cables is increasing year on year.

EON Dél-Dunántúli Áramhálózati Zrt. has launched a high/medium voltage transformer replacement programme, which aims to reduce technological grid losses and thus also our indirect carbon emissions. In response to the new challenges of the energy sector, EON is taking an active role in the development of the Hungarian energy community regulatory system and is also involved in the preparation of several joint pilot projects.

One of the solutions to these challenges is the use of new technologies. Taking advantage of the opportunities provided by the regulatory environment, it operates 540 kVA and 250 kVA energy storage units at two pilot sites in the country, continuously analysing the experience gained to support the transformation of both the technical development directions and the regulatory environment.

In areas of extreme poverty, it works with local authorities and social service providers to ensure secure electricity supply and reception: by rebuilding its distribution networks and installing prepayment meters, it is making supply more secure and increasing energy awareness among consumers.

In addition to ongoing cooperation, in 2020 it launched a sustainable energy support programme in Tiszabő, unique in Hungary, to help families in social need. The aim of the model programme is to ensure that every family with children under 3 has at least one room that is heated safely and technically safe for their health during the cold winter months. Adaptation options are assessed.

In Hungary, E.ON Hungária serves its electric car customers with more than 350 public charging points operated by members of the E.ON Hungária Group. From 2021, the e-charging network will be powered by green energy, so the energy used for charging will also serve long-term sustainability goals, whether it is an alternating current (AC) or direct current (DC) charger. In the future, it plans to expand its national charging network with high capacity (150/300 kW) chargers.

For dedicated e-car drivers, the home charging solution offers the opportunity to balance leisure and mobility. Its comfort package covers 1 MWh of energy used per month from renewable or high-efficiency energy sources, with a Green Future origin guarantee.

Smart meters work in a similar way to a normal electricity meter, but they can communicate with the energy supplier via a two-way data link, and thus extract more data. Users can monitor on the smart meter display how much energy has been used or fed back into the distribution network when operating a small household-scale power plant (SMPP).

EON aims to increase the share of renewables in its own balance sheet as much as possible and to serve nearly 30% of total customer consumption by 2025 and nearly 44% by 2030 with electricity of origin guarantees or physical green transport.

Figure 10: Solar park in front of Pannon Power Plant

3.2.2 Natural gas supply and consumption

In the sectors of construction, manufacturing, energy, agriculture, forestry and fisheries, fugitive emissions from coal mining, processing, storage and transport, and fugitive emissions from oil and gas systems, the transition to renewable energy is primarily an industry-specific task, which requires dialogue with the actors in the sector. The annual consumption volume is 64 GWh, for which biomass and biogas solutions are available in addition to solar energy.

The renewable energy conversion capacity of the residential, institutional and commercial sectors is examined, accounting for 88% of total urban natural gas consumption, 71% for the residential sector, 13% for commercial institutions and 4% for institutions.

One of the solutions to replace natural gas is to replace heating demand with electricity, which will be 50% by 2030, supplying 250 GWh of annual consumption with electricity, mainly using heat pumps.

Part of the remaining 250 GWh of annual consumption of natural gas is cooking gas in industrialised residential buildings, the amount of which is for households.

Alternatives to be explored: procurement of LNG - its introduction for domestic consumption is only possible in cooperation with national energy suppliers.

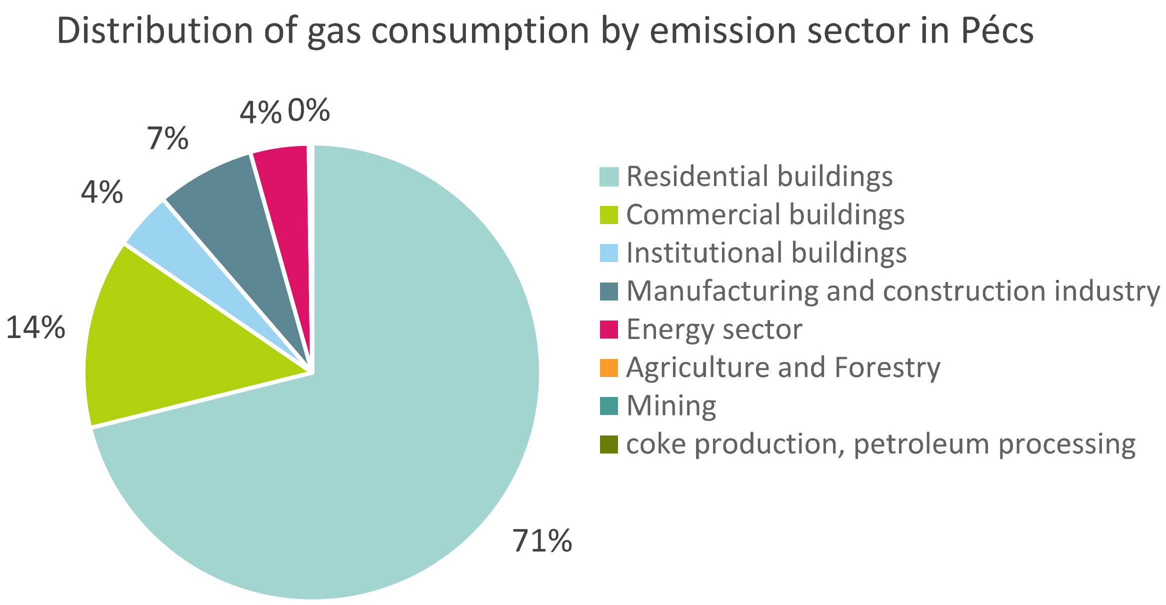


Figure 11: Distribution of gas consumption in Pécs by emission sector 2021 (%)

Examination of the 2021 gas consumption data shows that the distribution between sectors is rather uneven. More than 71% of the annual gas consumption is in the residential heating sector, which implies that energy efficiency measures to reduce/reduce gas consumption should focus on this sector. As the residential sector's gas consumption in 2021 (401 776 MWh) exceeds the annual electricity consumption of all sectors (399 887 MWh), this is where the most significant savings can be achieved.

Compared to residential buildings, commercial units are a small percentage but significant consumers (14%) compared to other sectors. Gas consumption related to agricultural activities, coal mining activities, coke production and petroleum refining is negligible.

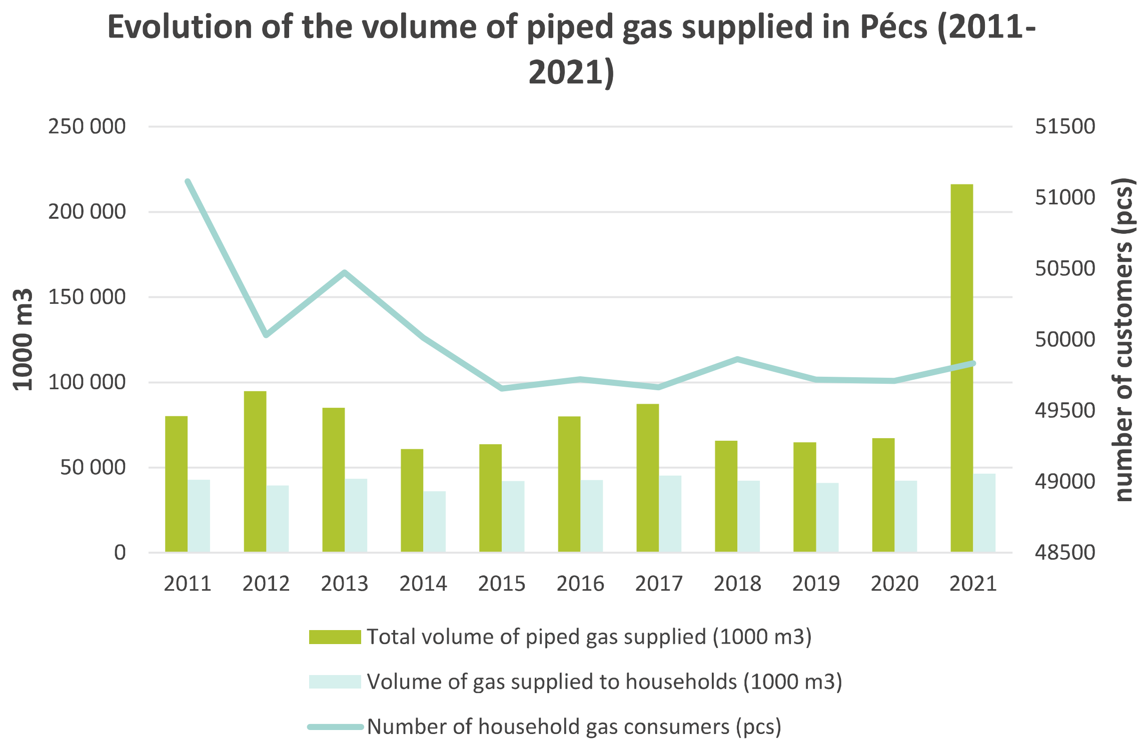


Figure 12: Evolution of the volume of piped gas supplied in Pécs (2011-2021)
Source: KSH database

The only significant change over the period under review is in the total volume of pipeline gas supplied. The total number of gas consumers and hence the number of household gas consumers in 2021 will remain approximately the same as in the base year (2011), with a slight decrease from 51114 to 49834 household gas consumers.

The volume of gas supplied to households (excluding small fluctuations) was finally 8.4% higher in 2021 than ten years earlier. The graph also shows that in 2021 there was a sharp increase in the total volume of gas supplied through pipelines: the volume of gas supplied more than tripled compared to the previous year, exceeding 200 million m^3.

3.2.3 District heating

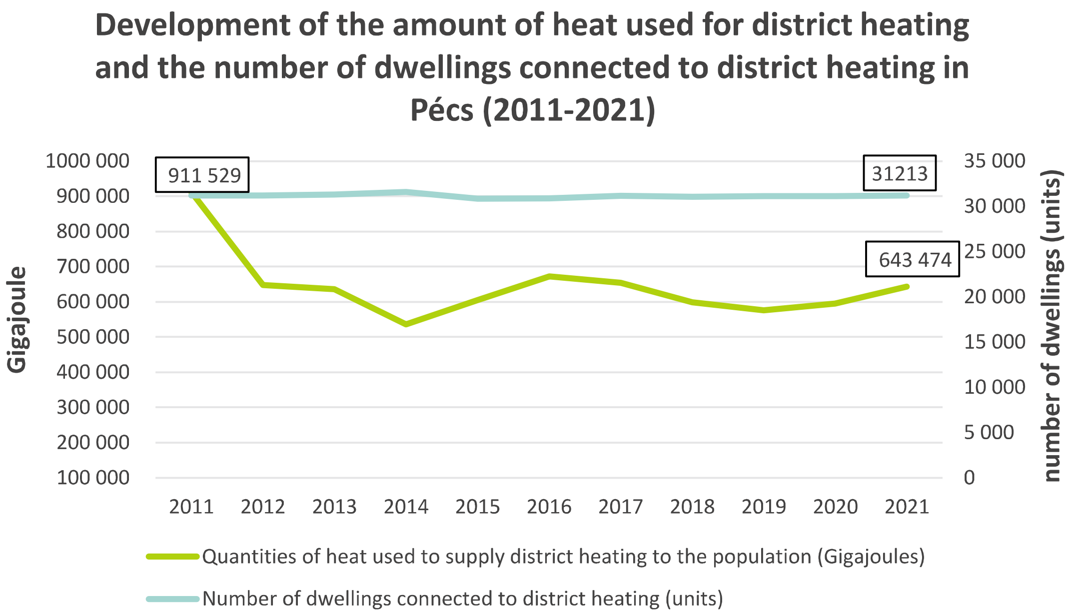


Figure 13: Evolution of the amount of heat used for district heating in Pécs (2011-2021)

Source: data provided by PETÁV Ltd.

Looking at the district heating service, the amount of district heating consumed between 2011 and 2012 for the population decreased significantly from 911 529 GJ in 2011 to 648 103 GJ in 2012. Thereafter, no longer-term trend can be established for the period under review, with the curve showing fluctuating values.

The evolution of the number of dwellings connected to district heating has been relatively stable over the period, with the number of dwellings concerned hovering around 31 thousand over the whole period. In Pécs, the number of dwellings is around 74 thousand, so the analysis of the data obtained suggests that the population of Pécs relies heavily on district heating.

In terms of the number of dwellings connected to the hot water network and the volume of hot water supplied to the population, there were no significant changes in the indicators concerned during the period under review. The number of dwellings connected to the hot water network in 2021, which fluctuated minimally over the years, was the same as in 2011, i.e. 29513 in both years. The volume of hot water supplied to the population fluctuated between 777 000 m3 and 859 000 m3 in the years concerned.

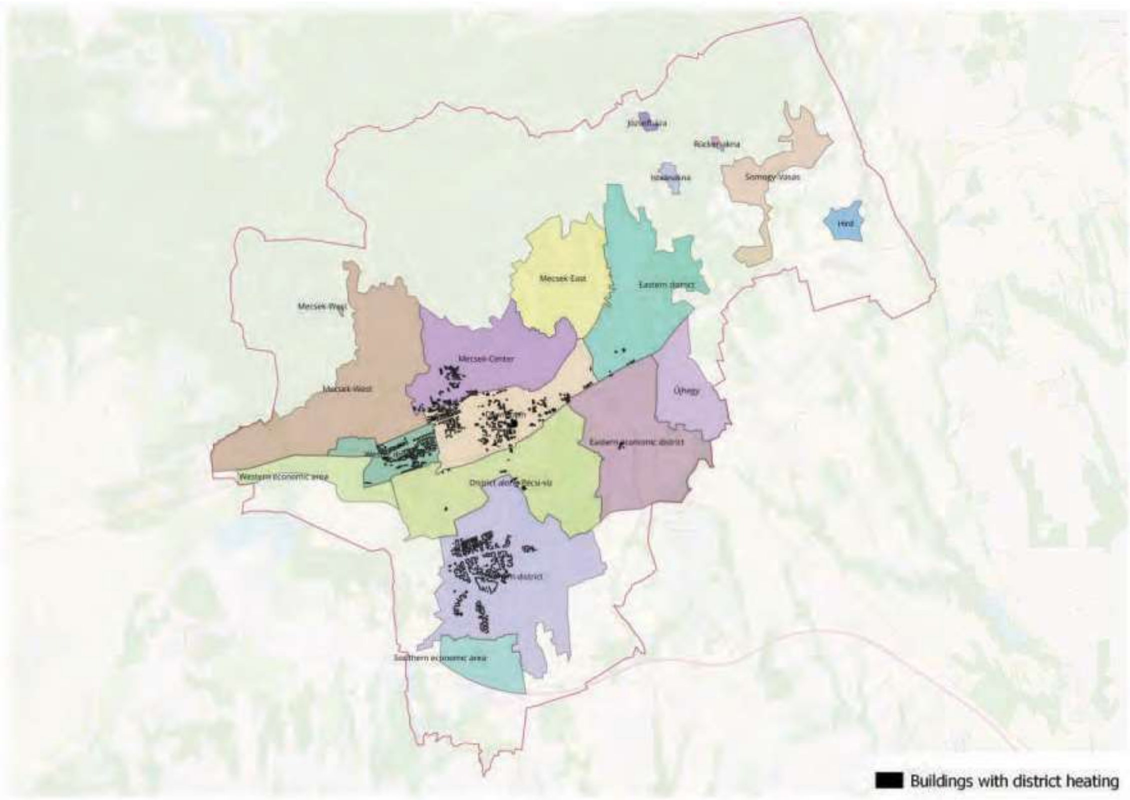


Figure 14: District heating in Pécs
Source: own editing

	Number of dwellings connected to district heating (units)	Number of buildings connected to district heating (number)
Heat used for district heating for the population - industrial buildings	28562	870
Quantities of heat used to supply district heating to the population - conventionally built buildings	3061	132
Quantities of heat used for district heating for institutional customers (without PTE)	178	
Quantities of heat used for district heating for commercial customers	232	
Quantities of heat used for district heating for PTE	59	
Quantities of heat used for district heating for industrial consumers	12	22558.82

Table 9: Number of consumers connected to district heating

	Number of properties connected to district heating (number)	2021 data heating	Number of properties connected to the HMV service (pcs)	2021 data HMV	SUM GJ	SUM kWh
Heat used for district heating for the population - industrial buildings	28562	567100.27	27962	204582.45	771682.72	214356482.6
Quantities of heat used to supply district heating to the population - conventionally built buildings	3061	75565.43	1981	14493.88	90059.31	25016495.01
Quantities of heat used for district heating for institutional customers	178	180970.51	178	1210.64	182181.15	50605915.48
Heat used for district heating for PTE	59	164606.17		0	164606.17	45723972.69
Quantities of heat used for district heating for commercial customers	232	95718.29	232	1218.19	96936.48	26926821.54
Quantities of heat used for district heating for industrial consumers	12	22558.82		0	22558.82	6266343.902
						368896031.2

Table 10: District heating 2021

Pannon Thermal Power Plant Ltd. is responsible for the operation and maintenance of the units of the Pécs power plant. As a result of the fuel switchover between 2004 and 2013, this currently involves the operation of two biomass-fired units: the 49.9 MW wood chip-fired boilers and the 35 MW baled herbaceous agricultural by-products boilers. In addition, Pannon Thermal Power Plant Zrt. will also ensure that the gas boilers, which have been in reserve since 2013, are kept in working order.

Pannon Thermal Power Plant Zrt. supplies district heating to about 31.5 thousand district-heated apartments and 460 other consumers (e.g. hospitals, schools, shopping centres, etc.).

PANNONGREEN Ltd. operates the largest biomass-fired power plant in Central Europe. The 49.9 MWe fluidised bed boiler is heated esentially with wood chips, wood and agricultural by-products, contributing to sustainable energy management and making the city of Pécs more liveable. PANNONGREEN Ltd. sells annually 325-330 GWh of electricity and 350-400 TJ of thermal energy.

Pannon-Hő Kft. was founded by the group in 2005 with the aim of managing the construction and operation of a 35 MW unit for the utilisation of baled agricultural by-products, a renewable energy source, as an independent project company. Today, the company is responsible for cogeneration of electricity and heat with a second biomass boiler, which came on stream in 2013.

Pannon-Hő Kft. produces 35-40% of the total electricity generated by the Pécs power plant and about 60% of the total district heating demand of the city. It sells 190-200 GWh of electricity and 900-1000 TJ of heat per year.

3.2.4 Urban structure and buildings of Pécs

Urban districts and structure of Pécs

A general principle in relation to urban structure is that a balanced use of land should be achieved through the continuous and planned rehabilitation of under-used or under-utilised areas, and by strengthening the cohesion of urban cores.

There is no justification for designating a new mixed town centre, but existing town centres almost all need to be reviewed. The historic city centre and center of Uránváros are in a relatively good position. The spatial elements and functions of the centres of Megyer and Meszes need to be reviewed. The retention and redevelopment of a reasonable number of public, retail and service functions will reduce the need for mobility, create jobs and strengthen the local community. There is a complete lack of Újhegy centre and attention should also be given to revitalising and then maintaining the viability of sub-centres and institutional elements that provide independence for small and distinct neighbourhoods.

There are central mixed and special institutional areas to be developed south of the railway (on both sides of Siklósi út, currently used for industrial and service purposes, and the former leather factory area without any function). Along Pécsi-víz, part of the former commercial - service zone includes functioning facilities (Verseny utca, Móra F. utca), while the other part (Füzes dűlő) is undeveloped and still mostly used for agricultural purposes. The structure plan includes additional cca. In addition, the structural plan has designated a further 100 ha of special institutional areas in the areas of Balokány, Tüskésrét and Basamalom, which need to be fully reassessed in the light of geotechnical (disturbed areas) and settlement structure conditions.

The transformation of the function of this structurally important area, which is at the centre of Pécs, has not yet started, which is complicated by the complex ownership situation. The development direction for the entire area along the Pécs waterfront is to propose a land use that offers demanding operating conditions for the SME sector, innovative and creative industries in the built-up parts, but also with residential and institutional functions linked to the inner city areas, i.e. with "24-hour" occupancy. The area should be characterised by a continuous system of green spaces from the Willow Fields to the Basamalom economic zone.

(Source: Pécs Urban Development Concept)

Building sector analysis

There are currently more than 3.7 million dwellings in Hungary, with a total floor area of approximately 274 million m2 .

Most of the public buildings are owned by the Hungarian State and the municipalities, managed by the Hungarian National Asset Management Ltd., and are owned by churches and private owners. The number of public buildings larger than 250 m2 is about 24 000, totalling cca. 50 million m2 of heated floor area.

For residential buildings, the national average renovation rate is around 1% per year. The final energy consumption of residential buildings averages between 205 and 225 kWh/m2 /year, while that of public buildings is around 214 kWh/m2 /year. Within this, there are very large variations based on the year of construction and the renovations carried out since then.

Types of apartments in Pécs:

Types of housing	Pécs (2021) KSH
Number of dwellings (including holiday homes) (units)	74055
Number of dwellings (units)	24626
Number of single-family houses (number)	18832
Number of ground-floor dwellings with more apartments(units)	2023
Number of apartment buildings (number)	3771
Of which 10 storey panel	
Of which 4-5 storey panel	
Number of dwellings in 2-3 apartment buildings (units)	4937
Number of dwellings in buildings with 4 or more apartments (number)	48308

Table 11: Types of apartments in Pécs

Energy certification of residential buildings

Of the 24626 residential buildings 6248, and of the remaining 49429 dwellings 16613 have an energy certificate, which represents 30.78% of the housing stock in Pécs. Based on this, we have pro-rated for the city as a whole, showing that currently 2.27% of the dwellings are at least BB, i.e. near net energy use. 42.59% of the housing stock can be classified as modern and 55.14% as below modern, which is the focus of the Action Plan.

EPC certification	Residential property	Other real estate	City scale (number, %)	
AA++	24	0	78	0.10%
AA+	17	39	181	0.24%
AA	7	0	23	0.03%
BB	328	105	1403	1.89%
CC	992	8,754	31571	42.59%
DD	589	1,995	8371	11.29%
EE	710	1,700	7807	10.53%
FF	736	1,372	6829	9.21%
GG	729	1,086	5879	7.93%
HH	910	894	5844	7.88%
II	674	434	3589	4.84%
JJ	556	234	2559	3.45%
	6248	**16,613**	**74133**	**100.00%**

Table 12: Energy certification of the urban building stock

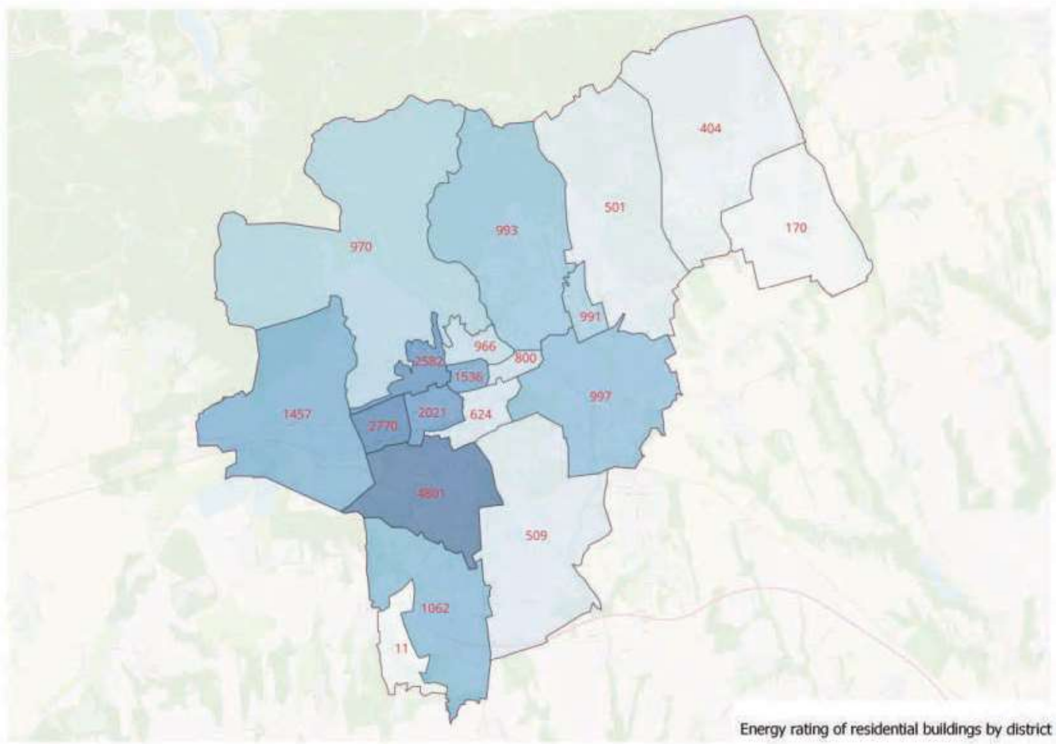


Figure 15: Energy certification of residential buildings by district
Source: own editing

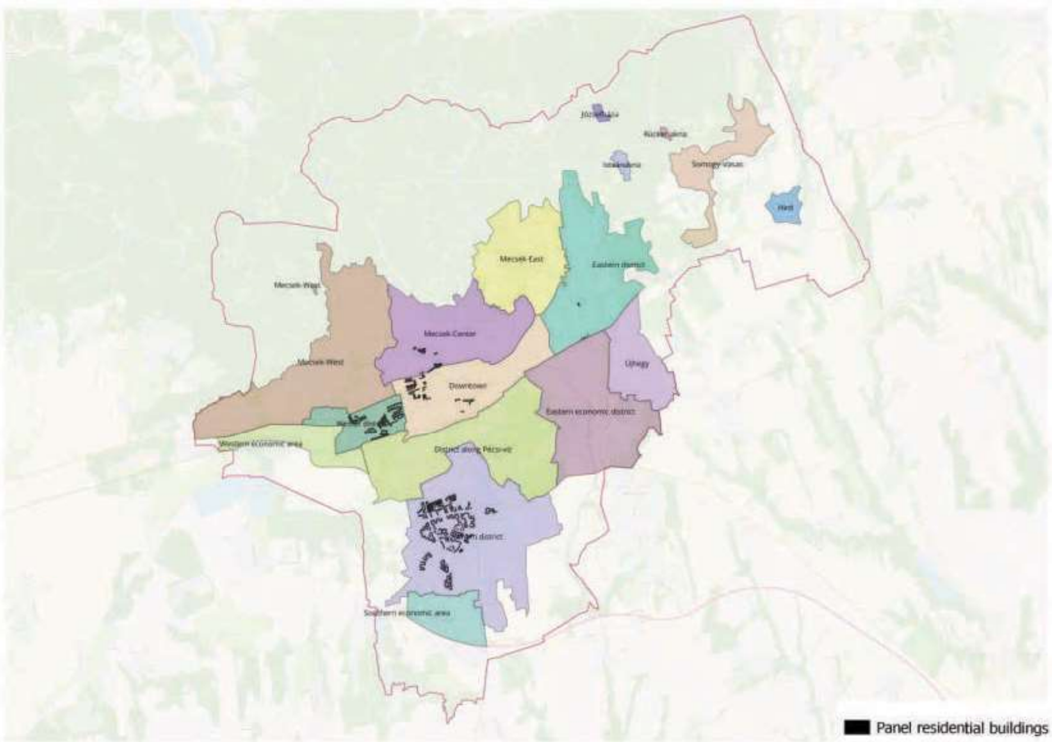


Figure 16: Location of panel apartments in Pécs (28562 apartments, 870 buildings)
Source: own editing

Number of dwellings in prefabricated and conventional construction

Neighbourhoods	Panel	Traditional residential building
Inner Districts	85	4032
Mecsek-Central	53	3724
Western Districts	132	1059
Mecsek-Nyugat	0	2290
Eastern Districts	8	2426
Mecsek-East	0	1059
Eastern Economic Area	0	523
Pécs-watershed	0	95
Southern Districts	503	2957
New Hill	0	1219
Somogy-Vasas		1180
Hird		477
Southern Economic Area	0	0
Western Economic Area		16
Total	**870**	**21041**

Table 13: Number of dwellings in prefabricated and conventional construction

Further analysis of the housing stock will be carried out by analysing the data of the housing questionnaire of the 2022 census, which will provide a comprehensive picture of the housing stock in Pécs and will provide the basis for the development of renovation packages and the elaboration of a system of building renovation passports.

Table 14a: Distribution in terms of the masonry of the dwellings occupied	
Total	64,265
Brick, stone, manual masonry	38,198
Panel masonry	22,155
Concrete, medium or large block masonry	2,212
Earthen, mud masonry	812
Other masonry	888

Table 14b: Distribution by size of dwellings occupied	
Total	64,265
Less than 30 m²	1,337
30-39 m²	5,649
40-49 m²	8,817
50-59 m²	17,341
60-79 m²	13,471
80-99 m²	6,927
100-119 m²	3,985
120 m² or larger	6,738

Table 14c: Distribution of dwellings by heating	
Total	74,055
Central heating	60,972
Central heating of one or more dwellings, with a central heating boiler, circulating hot water boiler or other means	30,023
Heating a dwelling with a central heating boiler, boiler or other means	26,526
Heating several apartments in a building by boiler or other means	3,497
District heating (district heating from a heat centre)	30,949
By room with convector, stove or other means	13,083

Table 14d: Distribution of dwellings by fuel type	
Total	74,055
With one type of fuel	35,187
Mains (piped) gas	29,320
With electric current	1,892
With wood	3,674
With other fuels	301
With multiple fuels	7,919
Mains (piped) gas and electricity	2,775
Mains (piped) gas and wood	4,051
Other fuels	1,093
District heating (district heating from a heat centre)	30,949

Table 14e: Houses with heat pump heater	
Total	1,239
Built before 1919	73
Built between 1919 and 1945	70
Built between 1946 and 1960	102
Built between 1961 and 1980	221
Built between 1981-2000	244
Built between 2001-2010	145
Built after 2010	384

Out of 74055 dwellings, 30949 dwellings have district heating and the remaining 43106 dwellings will have a heat pump penetration of 2.9% in 2022, with 40 heat pumped dwellings per 1000 dwellings.

Table 14f: Number of dwellings with air conditioning	
Total	23,595
Built before 1919	819
Built between 1919 and 1945	1,178
Built between 1946 and 1960	1,830
Built between 1961 and 1980	8,085
Built between 1981-2000	6,276
Built between 2001-2010	3,384
Built after 2010	2,023

Solar PV coverage:

Total urban supply from households: 7960081 kWh (2021)

Number of household solar panels per district (average household solar panel capacity: 2-4 kWp)	Pécs, 2021	Rate
Inner districts	187	5%
Mecsek-Central	285	8%
Western districts	55	5%
Mecsek-Nyugat	394	17%
Eastern districts	154	6%
Mecsek-East	93	9%
Eastern economic area	28	5%
Pécs-watershed	4	4%
Southern districts	296	10%
New Hill	184	15%
Somogy-Vasas	24	2%
Hird	24	5%
Southern Economic Area	0	
Western Economic Area	0	
Total	**1728**	**8%**

Table 15: Total urban supply from households: 7960081 kWh (2021)

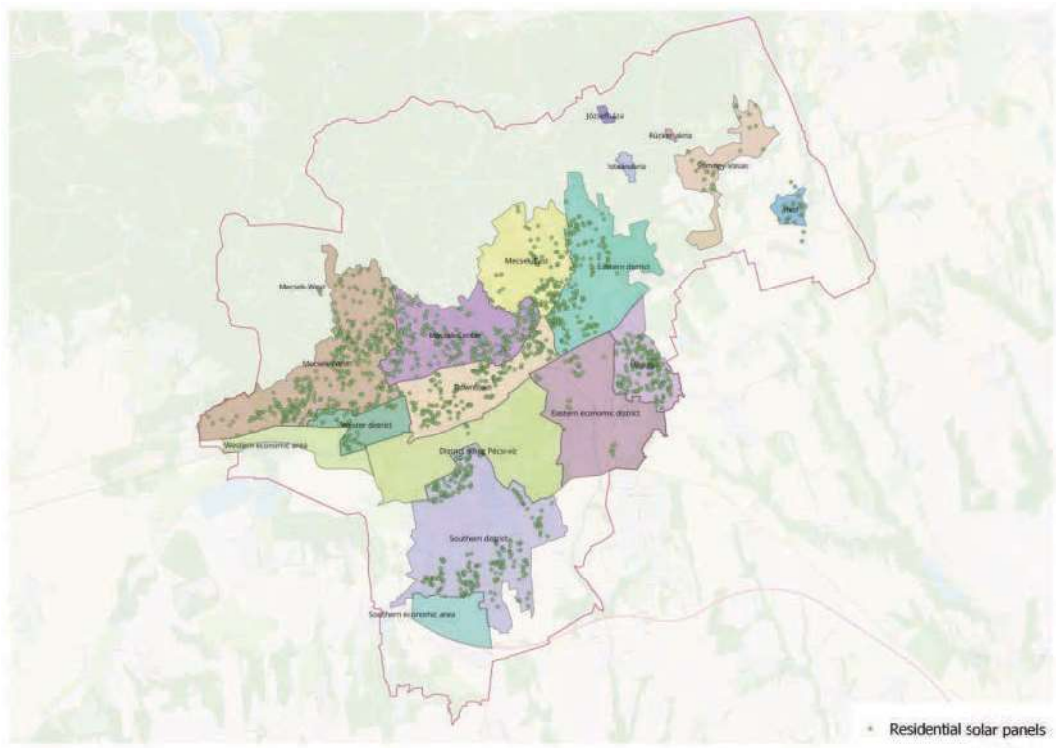


Figure 17: Current household solar PV capacity in Pécs
Source: own editing

Table 16a: Dwellings by year of construction	
Total	3,291
Built before 1919	116
Built between 1919 and 1945	127
Built between 1946 and 1960	227
Built between 1961 and 1980	720
Built between 1981-2000	923
Built between 2001-2010	674
Built after 2010	504

Table 16b: Dwellings by masonry	
Total	3,291
Brick, stone, manual masonry	2,826
Panel masonry	254
Concrete, medium or large block masonry	97
Earthen, mud masonry	33
Other masonry	81

Solar panels are being installed in larger proportions by owners, mainly on residential buildings built after 1960, but substantial capacity is also appearing on older properties. Solar panels are primarily found on residential buildings of brick construction, but it can be seen that 254 of the 22,155 panel dwellings also have solar panels, which represents the solar panel coverage of 10-12 panel buildings built between 1961 and 2000. A total of 601 dwellings have solar panels installed.

In terms of the spatial location of solar panels, Mecsek Central and Mecsek West have higher capacities, where the houses are typically newer, built after 2000. A larger number of houses with solar panels built between 1960 and 2000 are located in the southern and eastern parts of the city.

Thermal insulation rates for each type of dwelling type nationally based on the National Energy and Climate Plan:

- Family houses 33%
- Panel 44%
- Large apartment buildings 26%
- Small apartment buildings 16%

The number of occupied properties in prefabricated buildings is likely to remain stable until 2030; - Buildings built after 1990 are also assumed to remain stable in occupancy; - New housing built until 2030 is assumed to reduce the occupancy rate of residential properties built before 1990, mainly in less sought-after areas. The primary energy consumption of residential buildings is estimated to be on average 215 kWh/m2 /year, while that of public buildings is estimated to be around 214kWh/m2 /year. The average m2 consumption in the service sector is above 200 kWh/m2 /year. The 93 buildings of the 51 institutions of the municipality are 80% classified in the corresponding A-D class instead of the previous E-H energy class. The municipality of the city of Pécs operates about 270 administrative, educational, health, public cultural, etc. institutions.

Typical renovation elements that can cost-effectively reduce energy use in buildings in Hungary:

Improving the heat transfer parameters of building envelope structures based on the Long Term Retrofit Strategy:

Modernisation of heating systems

- Upgrading existing heating systems, from improving controllability to replacing the entire system:
- Creating and improving the possibility of regulation:
  - In the case of central and district heating, the installation of local home control units and meters (including smart meters) for each dwelling, and the possibility of individual control,
  - In the case of central heating per dwelling, the installation of weather-tracking control and the possibility of temperature control per room
  - For individual heating, it is possible to install a thermostat. If there are individual heat generating heat emitters (e.g. electric convectors), it is also possible to connect the heat emitters to a system with smart controllers, thus providing more precise heat control.
- Upgrading of heating system elements: upgrading of various elements of the systems that do not produce or dissipate heat, e.g. circulating pumps, network controls
- Upgrading heat exchangers: modern heat exchangers ensure adequate thermal comfort even with lower temperature heating mediums, and provide the possibility to control the amount of heat.
- Modernisation or replacement of heat generators: installation of modern heat generators: boilers, heat pumps, convectors
- Building a new, more efficient system:

Modernisation of cooling and ventilation systems

The design of the ventilation system shall take into account the provisions of the TNM Regulation 7/2006 (24.V.2006) and the European Union (EU) Directives 1253/201414 and 1254/201415 on energy efficient ventilation systems. State-of-the-art ventilation systems are equipped with user-specific controls
The solution may be to install heat recovery ventilation systems in the home.

Heat pump systems can provide cooling, heating, domestic hot water and thermal energy for ventilation systems.

Passive thermal protection: the simplest solution is to install external shading structures. Automatic, sensor-based smart control of shading systems improves efficiency and can be retrofitted to existing shading systems.

Lighting modernisation

Replacing light sources and luminaires with modern LED-based elements will result in tangible energy savings at a relatively low investment. In public buildings, the energy demand for lighting is significant, and can account for 25-40% of total energy demand. On this basis, replacing lighting fixtures - bulbs can save up to 20-35% of total electricity consumption. It is important to stress, however, that in many cases lighting modernisation has to be combined with the renovation of the electrical network, which is a high investment renovation in itself, but does not result in significant energy savings. The use of presence-sensing lighting control and smart systems can further reduce energy consumption.

Modernisation of domestic hot water supply system

In apartment blocks, a control centre per apartment can be a more economical way of heating and hot water production. This unit contains the heat consumption meter, the heating controller and produces hot water for domestic use locally.

Installation of an electricity generation system

Intelligent building management, "smart building" The use of different smart building management solutions, which can cover all building services and household electronics, can lead to significant energy savings thanks to precise control.

Building types used as a basis for modelling the renovation of the housing stock:

Housing types:

- Family houses
- Prefabricated buildings
- Apartment building built at the turn of the 19th-20th c.
- Condominium built before 1950s
- 20th no. 2nd half of building condominium
- Flat-roofed brick condominium

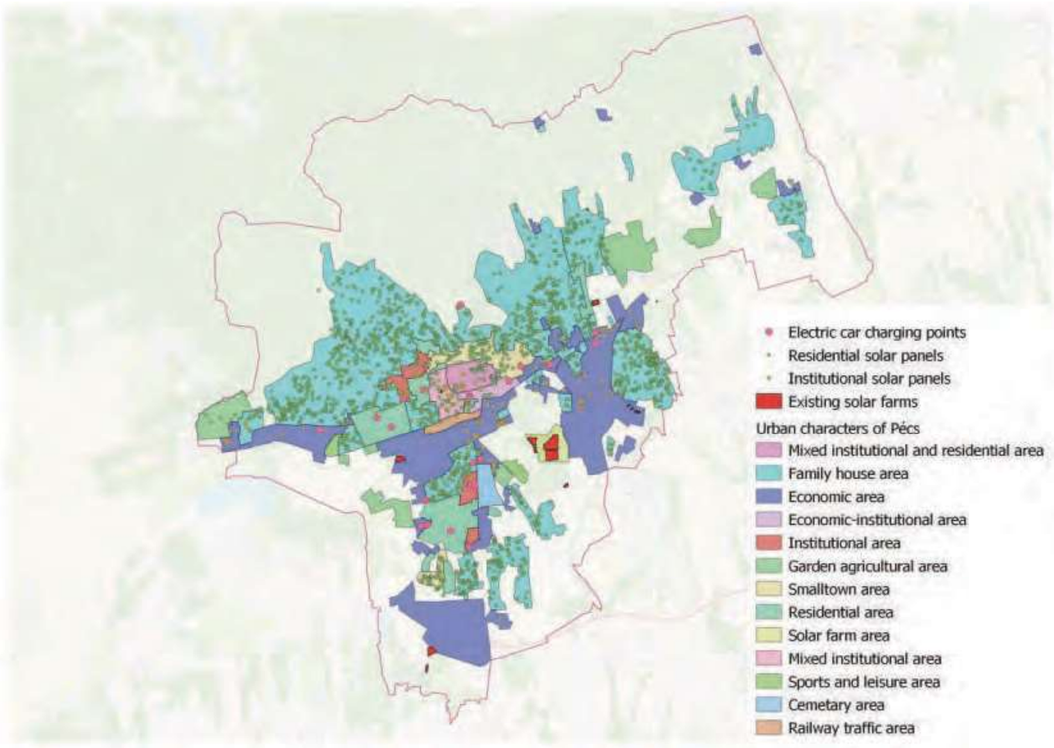


Figure 18: Energy map of Pécs
Source: own editing

3.2.5 Transport sector

Transport is a major emitting sector, the share of car transport is quite high, and its replacement is the most significant barrier to decarbonising the sector.

The city's road network is defined by the route of Highway 6, which brings significant transit traffic into the city and limits north-south access. The two main elements of another dominant north-south road axis, Highways 66 and 58, are also connected via a section of Highway 6 through the city. These two road axes, east-west and north-south, are characterised by dense built-up areas and significant traffic congestion through residential areas. In addition to through traffic on the road network, there is also a significant volume of private vehicle traffic associated with commuting, which the Action Plan focuses on reducing.

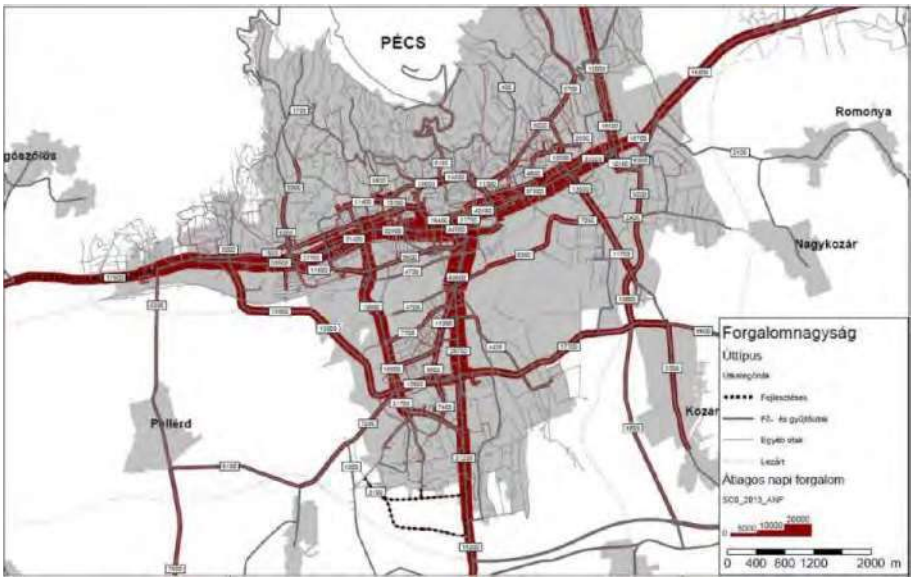


Figure 19: Main traffic routes
Source: SUMP Annex 7

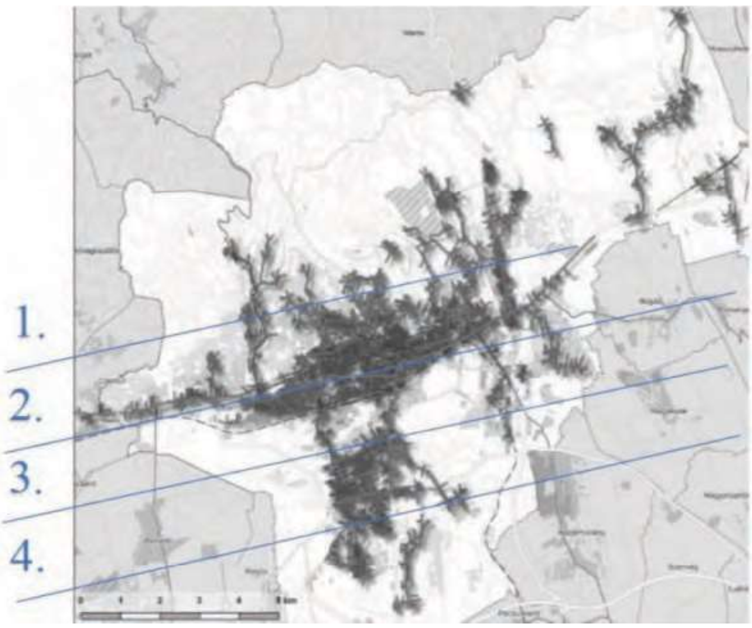


Figure 20: Traffic load
Source: Tüke Busz Zrt. decarbonisation plan

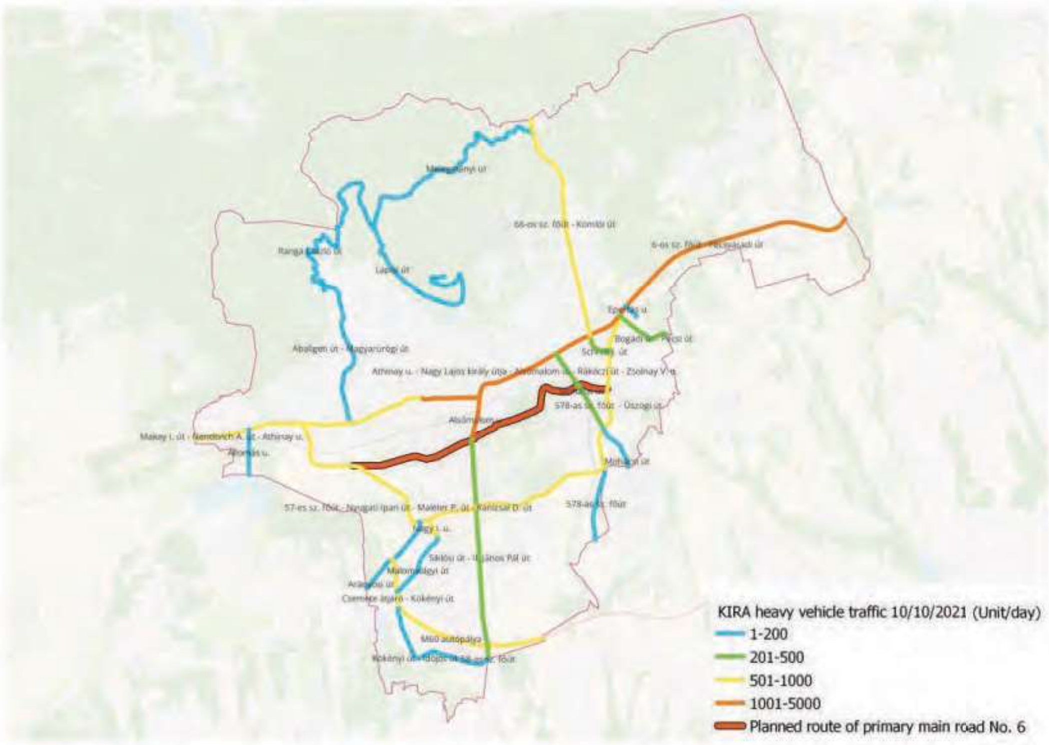


Figure 21: Heavy goods vehicle traffic load, 2021
Source: KIRA

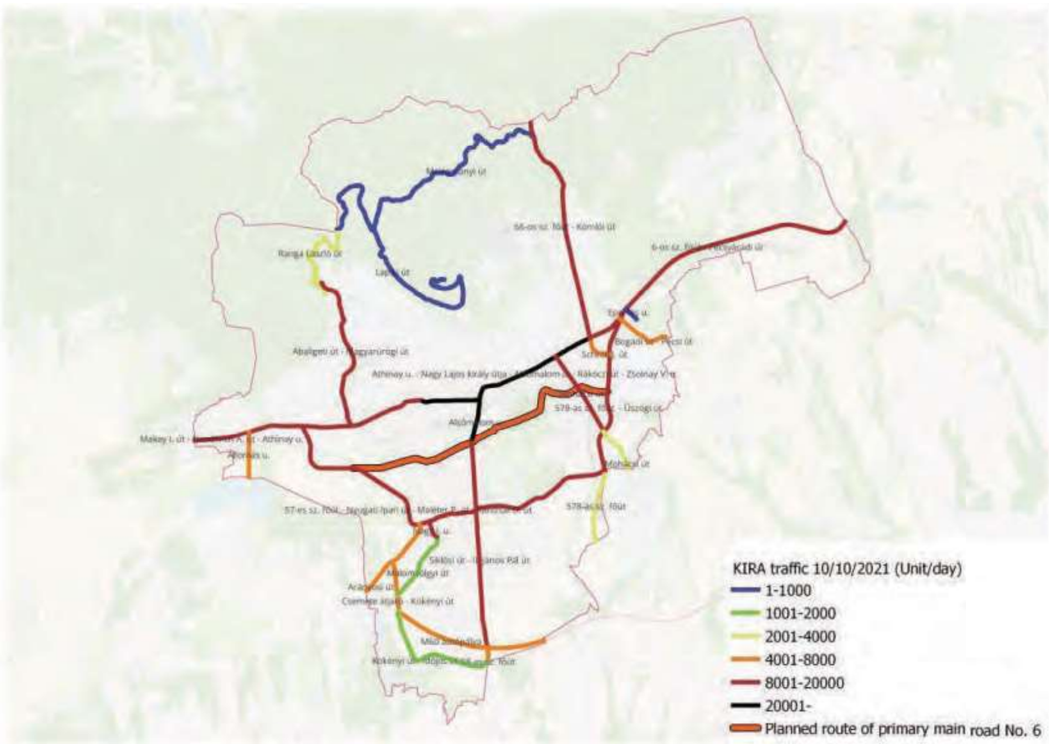


Figure 22: Traffic load, 2021
Source: KIRA

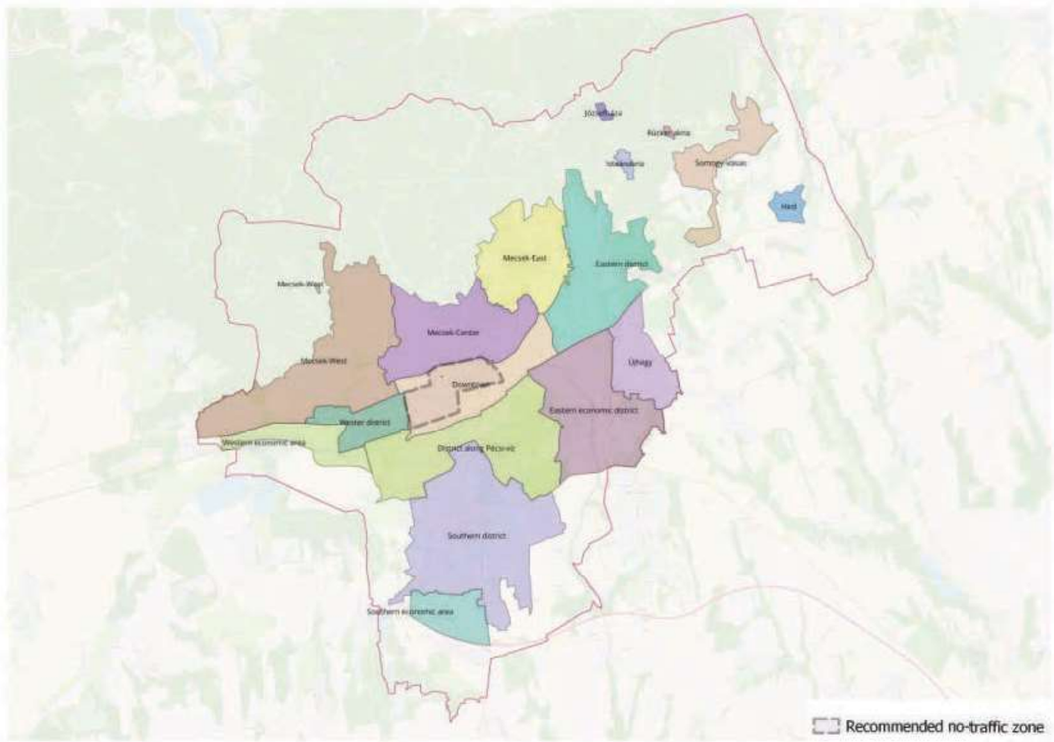


Figure 23: Potential Zero Emission Zone
Source: own editing

Pécs is a rather centralised city, its eastern, southern and western sub-centres are not sufficiently developed, and their functional capacity to take over the burden of the city centre is limited, which is often reflected in the pattern of travel demand. The spatial extent of the urban body is characterised by its location within a 5 km radius of the city centre, which is central to the spatial structure and land use and therefore to travel demand, and therefore in principle professional cycling could be a competitive alternative to car use for the vast majority of travel demand. The topography of Pécs indicates the main directions of use, as the city is well suited for cycling in the east-west and south direction, while the 3-400m difference in level of the Mecsek is a major obstacle.

The share of walking and car transport is 28-28%, while urban public transport (bus) is 40%. The survey was carried out in 2014 and needs to be updated and continuously monitored. The share of cycling is estimated at 3% of daily trips, mainly due to topography.

The competitiveness of public transport compared to private transport is ensured by its high territorial and stop coverage. The proportion of the population living within 300 metres of an hourly (or more frequent) public transport service in Pécs is 80.03%.

The share of all trips shorter than 5 km made by private car (as driver or passenger) in Pécs is 53%. This is an average rate, but implies unjustified car use, the reduction of which is the focus of measures.

(Source: Sustainable Urban Mobility Action Plan, SUMP)

The public transport service provider is Tüke Busz Zrt., the tasks related to public transport planning, timetable, customer relations, sales and control are performed by the Mobility Centre, a division of BIOKOM NKft. as the transport organiser. Thus all transport management, whether it concerns walking, cycling, parking, road infrastructure or public transport, is coordinated by a single company.

The local bus transport is provided by Tüke Busz Zrt. as an internal service provider, the national and regional bus transport by DDKK Zrt., while the railway service is provided by MÁV-Start Zrt. Due to the lack of integration of the three separate systems, the harmonisation and integration of networks, timetables, services and fares is below the expected level and typically offers ad hoc connections instead of systemic solutions.

The train station and the bus station are separated, and can only be reached by a long walk or a local bus from one station to the other. There is a possibility to change between local, national and regional buses, and between rail and local buses at the railway station.

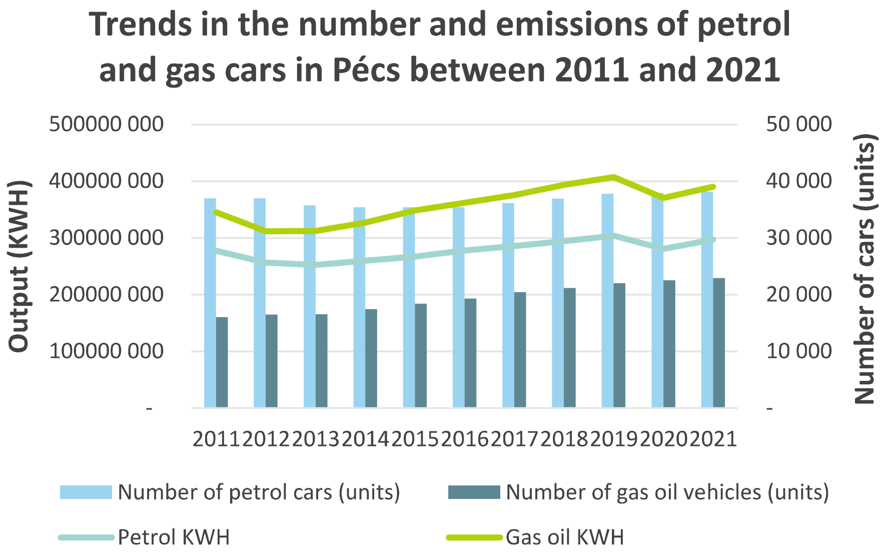


Figure 24: Trends in the number and emissions of petrol and gas cars in Pécs between 2011 and 2021
Source: municipal data

The bar charts in the figure above show the evolution of the number of petrol and gas cars. The number of petrol cars showed a downward trend in the first half of the 2010s, but has increased year on year since 2017. By contrast, the number of diesel cars has increased steadily over the years. The growing popularity of diesel cars is illustrated by the fact that, while the number of petrol cars increased by only 1 150 units during the period shown above, the number of diesel cars increased by 6 877 units. Despite the increase in the number of diesel cars, petrol cars continue to outnumber diesel cars in the city, although their share has decreased by about 8% over this period. Despite the fact that petrol cars account for the majority of cars in the city, the emissions of these cars were on average nearly 81 thousand KWH lower than those of diesel cars per year.

Given the lower consumption figures for petrol cars, it can be concluded that emissions will continue to rise as diesel cars take over in cities. The largest decrease in car emissions in recent years occurred in 2020, which is likely to be related to the measures introduced in response to the COVID-19 epidemic.

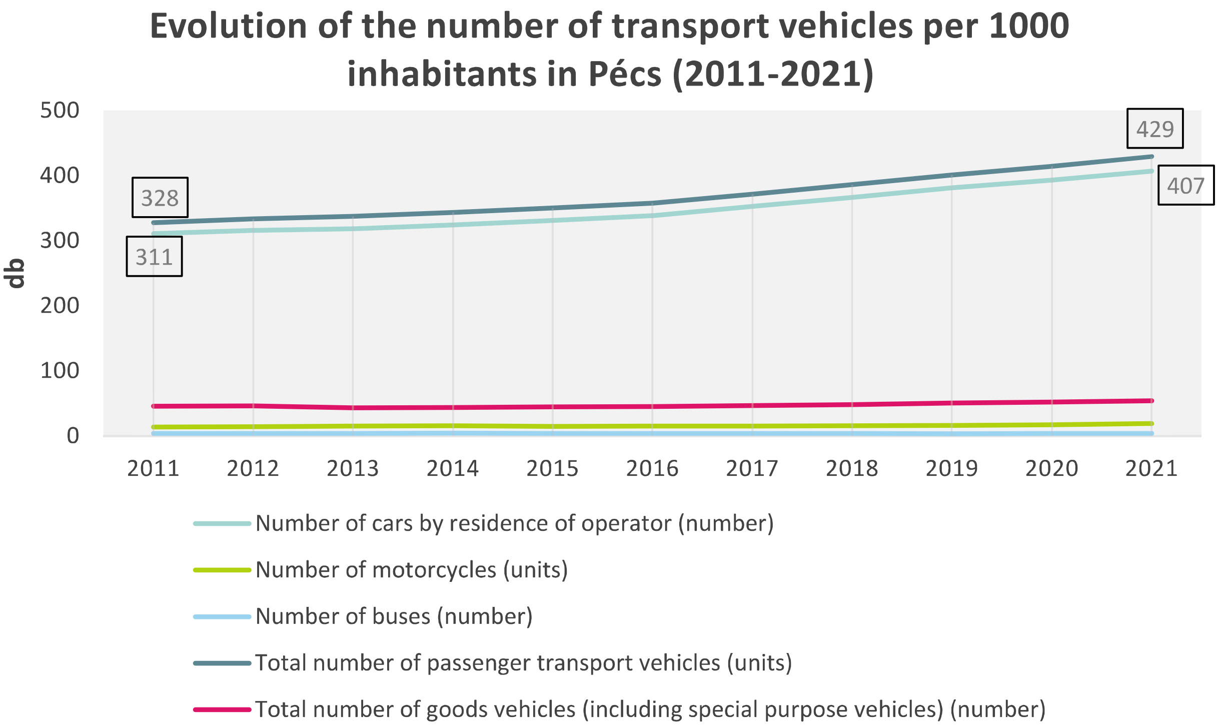


Figure 25: Evolution of the number of transport vehicles per 1000 inhabitants in Pécs (2011-2021)
Source: data provided by KSH

In general, despite an 8% decrease in the population by 2021, the number of vehicles tested is increasing. This increase does not reflect the negative impact of the COVID-19 epidemic. Taking also the population into account, the number of transport vehicles per 1000 inhabitants has increased for all types of vehicles compared to 2011.

The most significant change is for passenger cars and passenger transport vehicles. For the former, the number of passenger cars per 1,000 people rose to 429, almost 31% more than in the base year of the period. In addition to passenger cars, there was a sharp increase in the number of passenger transport vehicles per 1000 inhabitants, which also increased by around 30%. Examination of the data suggests that more and more people can afford to drive their own vehicle.

There has also been an increasing trend in the number of goods vehicles and in the number of slow vehicles over the period.

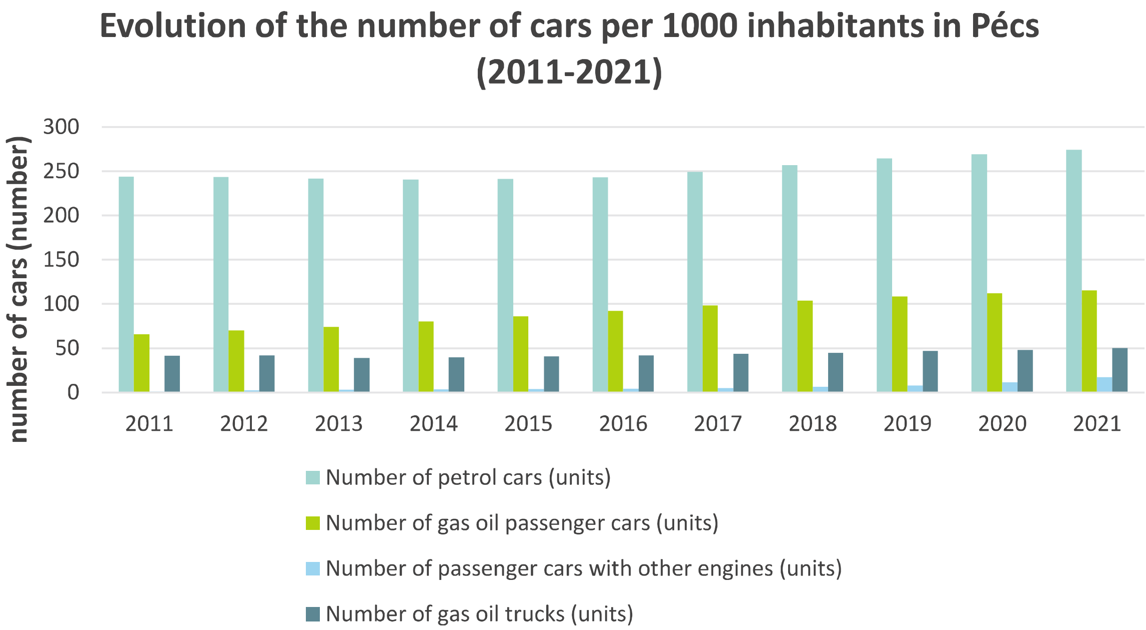


Figure 26: Evolution of the number of cars per 1000 inhabitants in Pécs (2011-2021)
Source: KSH

The graph shows a similar trend as the distribution of the number of cars for different types of vehicles. Since the second half of the 2010s, the number of petrol cars has gradually increased, and hence their share per 1000 inhabitants. There is a strong upward trend in the number of diesel cars, which has increased from 66 to 116 per 1000 inhabitants, with a 76% increase by 2021. The analysis of the data shows that, in general, despite a shrinking population, the number of cars has increased, with the population of Pécs preferring diesel cars to conventional vehicles.

In relation to trucks, the number of petrol vehicles halved over the period, while the number of diesel vehicles started to increase steadily from the second half of the period.

The trend in the number of passenger cars with other fuels has been positive in terms of reducing carbon emissions, with the number of electric cars per 1000 people increasing from 1 initially to 17 in 2021, which translates into an increase from 164 to 2417. Thanks to various technological innovations and incentives, the share of electric cars is likely to increase significantly in the coming years, reducing the contribution of transport to air pollution.

Parking

Due to the central nature of the city, the main traffic attracting institutions are located in the Downtown, so the parking demand for professional and administrative parking is concentrated in time and space. BIOKOM Nonprofit Ltd. currently operates a paid public parking system in the city centre, divided into three zones with around 4,200 parking spaces, which encompasses the highly protected access zone along the University City - Railway Station - Búza Square - Aradi Vértanúk útja. At the border of the parking zone, next to the former DOMUS building and next to the Post Office building, there are two additional P+R parking lots, which primarily serve the needs of professional traffic, with a small amount of transfer traffic to public transport. In addition, in the immediate vicinity of the city centre, there are a total of 1 333 pay parking spaces in the underground car parks of Kossuth Square, Nádor Hotel, King's House and Arkád, and smaller pay parking spaces in the city centre.

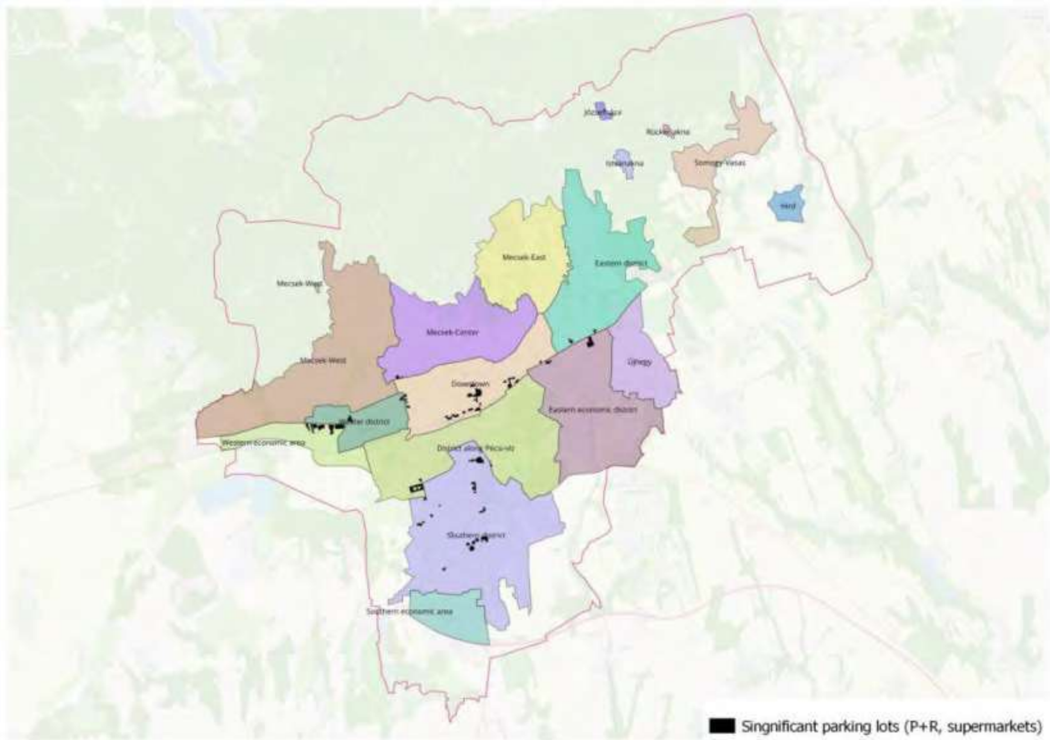


Figure 27: Significant parking spaces
Source: own editing

Suburban parking needs

With the increase in the number of stores, the size of the service car parks built is proving to be excessive, their average occupancy rate is low and in some places there are no examples of maximum capacity being reached. The institutional share of parking demand in the suburbs is generally less than 15%, which is now served by the residential parking lots due to the extra time (arrivals in place of departures) parking demand. However, with the emergence of parking problems in the city centre, the number of people commuting to work by car from residential areas is gradually decreasing, and the parking situation in the suburbs, which is based on the time-share principle, is expected to deteriorate.

Figure 28: Bike sharing dock

3.2.6 Waste, waste water and drinking water management

BIOKOM Nonprofit Ltd. is the largest waste collection and treatment company in the South Transdanubian region, which is also recognized at the national level.The area covered by its services covers the city of Pécs and 300 surrounding settlements, which together serve nearly 450 thousand residents and 4 thousand businesses.

Pécs has a complex, modern and cost-effective collection system with landfills, sorting complexes, yards, transfer stations and the necessary machinery and collection vehicles to serve the population. Full selective collection and processing of residual waste for energy recovery. This has reduced the amount of waste landfilled to less than 30%.

The Kft. also performs the city management tasks of the Municipality of Pécs within the framework of a public service contract.

Tasks include water damage prevention, maintenance of surface water courses and three lakes, and maintenance of closed storm drains. The company places a strong emphasis on prevention in this area, as the extreme weather conditions of recent years can lead to unexpected events.

Its activities include the maintenance of the active elements of street lighting and the supply of electricity for the operation of the city (traffic lights, event lighting, decorative lighting, fountains).

BIOKOM operates the Mobility Centre, which continuously monitors the continuity of urban transport, organises and coordinates local public transport in Pécs. It is also responsible for passenger information; timetable and bus network planning; parking operation, access permits; public space utilisation; traffic control and traffic engineering tasks.

Biokom takes care of the organisation of urban green space management, maintenance of the tree nursery garden, urban forest management. In the latter activity, it primarily manages recreational forests using specifically nature-friendly (Pro Silva) methods.

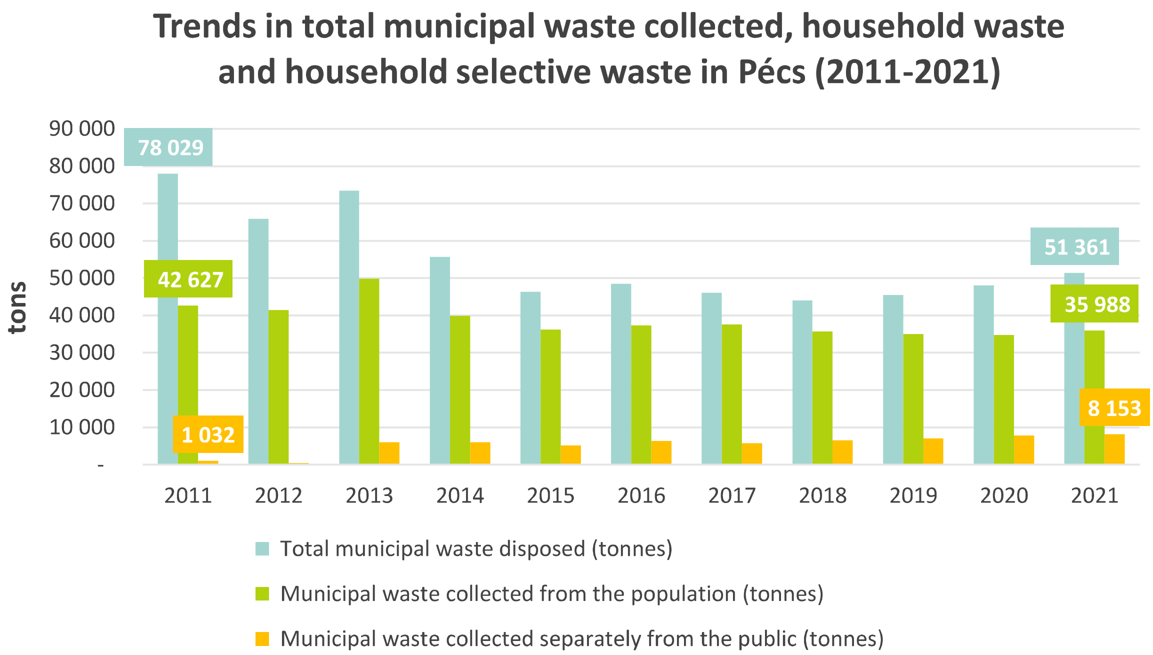


Figure 29: Evolution of total municipal waste, household waste and household selective waste in Pécs (2011-2021)
Source: KSH Database

In terms of waste management, Pécs has seen positive changes in the period under review.After 2013, the total amount of municipal waste collected decreased significantly (by more than 34%), including the amount of municipal waste collected from the population. From an initial 55% of total municipal waste disposed of, by the end of the period 2011-2021, the amount of municipal waste disposed of from the public had increased to more than 70%.

During the period under review, the share of municipal waste collected separately from the population in the total amount of municipal waste collected increased significantly, from an initial 1% to 16% by 2021. Compared to the amount of separate waste collected initially, this figure increased more than 8-fold by the end of the period, thanks to, among other things, the development of the separate waste collection system.

Solid waste generated in the city	44277875 kg
Of which municipal waste	29 986 310 kg
Of which refuse from waste	3 654 420 kg
Of which mixed selective waste (paper, plastic, metal)	4 654 040 kg
Of which glass	711 230 kg
Amount of biological waste generated in the city	5 271 875 kg
Of which green waste	5 271 875 kg
Amount of waste to be recovered for energy recovery	
Mechanical-biological pre-treatment for municipal and municipal solid waste	9 836 550 kg
Energy recovery: RDF, combustible fuel	11 437 850 kg
Metals separated for recycling	672 810 kg
Residues disposed of in landfills	20 857 250 kg
Total mechanical-biological pre-treatment	32967910
Sorting plant selective waste treatment	
Selected secondary raw materials to be recycled (paper, tetrapack, plastic, metals, glass)	3 312 510 kg
Sorting residue	2 006 220 kg
Sorted hazardous waste	5 119 kg
Selected electronic waste	14 430 kg

Table 17: Municipal waste volume

Waste-water management

Tettye Forrásház Zrt. is the leading knowledge base and market player in the field of water supply and wastewater treatment in the South Transdanubian region. Its main task is to provide the inhabitants of Pécs and 14 surrounding settlements with healthy, safe drinking water: it supplies high-quality, mostly underground (Tortyogó, Pellédi, Tettyei) water from the aquifer of Class I and Class II stratified and Class I karst water to homes and institutions, supplemented by drinking water from wells with coastal filtration, which it takes over from its partner suppliers. The Company has a drinking water production capacity of 29,500 m3 per day and pays particular attention to its water resources and the development of water resources.

On the other hand, the Company takes care of the drainage and treatment of 25,000 cubic metres of wastewater generated daily in households, industry and 12 settlements around Pécs, as well as the collection and disposal of liquid waste from Pécs. Operating one of the most modern and largest wastewater treatment plants in the region, Tettye Forrásház Zrt. is committed to sustainable, environmentally friendly wastewater treatment: it produces biogas from the sludge generated during the treatment process and then produces green energy.

In total, I monitor and maintain 1,540 kilometres of water and wastewater networks every day. It operates three vulnerable water bases (two of which are crossed by the city's watercourse, Pécsi Víz).

The main elements of the utility network are in place, with no known significant land requirements. The piped water supply is fully developed and available to all dwellings in the city. Sewerage coverage in the city is excellent and fully developed, which is also good by national standards. The entire length of the sewerage network is separated, allowing separate collection and treatment of wastewater and stormwater. Also of particular importance from an environmental point of view is the fact that the wastewater generated in the city is fully treated (including biological treatment in line with EU standards).

Energy use in 2021				
Energy	Annual weight loss	Unit of measurement	Energy consumption (kWh)	Percentage distribution
Electricity	11 247 480,11	kWh	11 247 480,11	84
Natural gas	116 638	m3	1 230 530,90	9
PB gas	48	kg	624,00	0.005
Petrol	4 724,57	l	46 206,29	0.35
Gas oil	81 816,22	l	800 162,63	6
Total			13 325 003,94	100

Table 18: Wastewater consumption Tettye Forrásház Zrt.

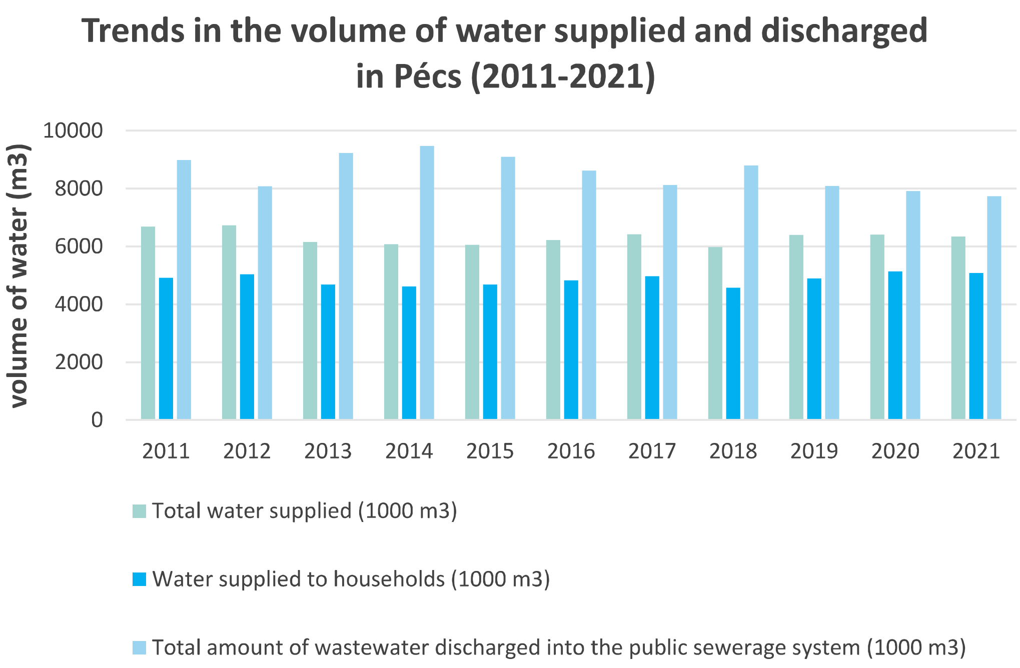


Figure 30: Trends in the volume of water supplied and discharged in Pécs (2011-2021)
Source: KSH Database

During the period concerned, the total amount of wastewater discharged into the public sewerage network (public sewer) exceeded the total amount of water supplied in each year. The values for all indicators show a small but fluctuating trend, with the most significant change between 2011 and 2021 being in the total amount of wastewater discharged to public sewers, which is approximately 14% less in 2021 than 10 years before. This decrease is explained by the gradual decline in the population of Pécs.

There is a steadily increasing trend in the percentage of water supplied to households by the end of the period: by 2021, it accounted for 80% of total water supplied, 7% more than at the beginning of the period.

3.2.7 Green and blue infrastructure

The urban fabric is uneven in the distribution of green space, and the distribution of both conditioning surfaces and green spaces serving human activity needs to be improved.

In the inner districts, especially in the historic city centre, the number and intensity of conditioning surfaces is insufficient, with a built-up to paved area ratio of more than 80%. The microclimate is most unfavourable in summer, with frequent heat island phenomena; at the same time, the lack of space limits the possibilities for planting. This is why, like the stepping stones of the ecological network, this part of the city needs to be planted with point green spaces.

Excessive building on the Mecsek slope and the eastern part of the Mecseknyugat has caused permanent damage, mainly to ventilation, but the ratio of building and paving together has a negative impact on the microclimate and air purity of the lower parts. It would be important to stop further building in these areas. The situation could be improved by reducing the proportion of paving, planting woody plants, vertical green spaces, roof and balcony gardens.

The older settlements (Uranváros, the northern part of the new Garden City, the Sziget district, part of Meszes) are embedded in greenery, their green areas are mostly established and of favourable intensity. In the southern parts of Garden City, in the upper parts of the Megyerváros and in parts of the Málom district, overuse is common due to high population density, but there are also many underused green areas of low intensity. In the latter, large public parks with intensive vegetation cover (>1 ha) could be created, but also a few hectares of woodland could be planted.

In Pécs, there are several well-defined suburban developments (Ispitalja, old Kertváros, Kovácstelep, Gyárváros) where there are small and large gardens and green areas on individual plots, but the built-up to paved area ratio is above 50-80%. In the courtyards, there is an excess of paving and a small number and low intensity of vegetation. In these areas, it is desirable to reduce the proportion of paving, and at the same time to plant more woody plants, arbours and vertical green spaces.

The urban section of the Pécs waterfront is sparsely covered with green space and is currently underutilised. A new, urban-level sports and recreation area can be created along the entire length of the watercourse by means of riverbank management and the complex development of the riparian strips (Tüskésrét- Balokány-Füzes):

"There could be opportunities for recreational and sporting activities, as well as for the expansion or transformation of green spaces along the Pécs waterway. In some of these areas there are already reservoirs (e.g. Tüskésréti pond), but further utilisation and use is a given. A small lake system could be created along the Pécsi watercourse (by modifying the current protection of the watercourse) by flooding low-lying areas. In the event of heavy rainfall, these could also serve as reservoirs for rainwater, and a specific flora and fauna could be created. The parks could also be opened to the public and other useful or specific functions could be added (e.g. birdwatching, pond tours, nature trails, etc.).

Well-chosen water surfaces and green spaces would also have a positive impact on climate and water quality, while optimising maintenance costs."

Forests are the most effective elements of the green space system, having a positive impact on their environment, especially in mitigating the effects of climate change, and therefore the planting of forest patches in fields near and around the city is justified. The installation of street trees connecting the elements of the green space system throughout the city and the continuous replacement of existing trees is necessary. Along watercourses, where feasible, the installation of a multi-storey vegetated riparian strip is recommended. Particular attention should be paid to the creation of community gardens, which are important for community education and awareness-raising.

In the area of green space for human activity, it would help to open up the yards and ball and sports fields of educational establishments (nurseries, schools, universities) to public use at weekends and during the holidays, particularly in inner city areas and in slum areas. This would allow youth leisure activities to take place under guarded and supervised conditions.

Elements of conditioning water surfaces (blue network) are present in the city in small numbers. In each of the districts, there is a need to create more water surfaces (splash, fountain, pool, pond), both large and small.

(Source: Pécs Urban Development Concept)

Figure 31: Balokány liget

3.1 Module A-2 Current Policies and Strategies Assessment

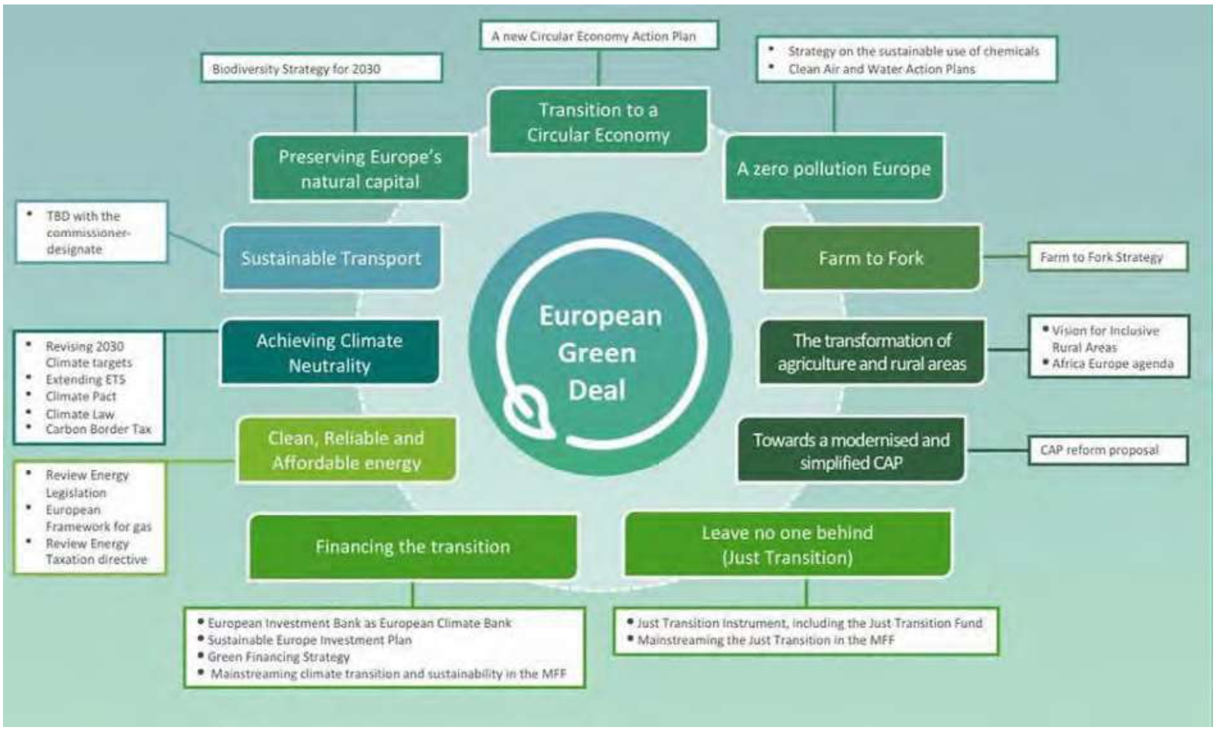


Figure 32: Strategies under the Green Deal

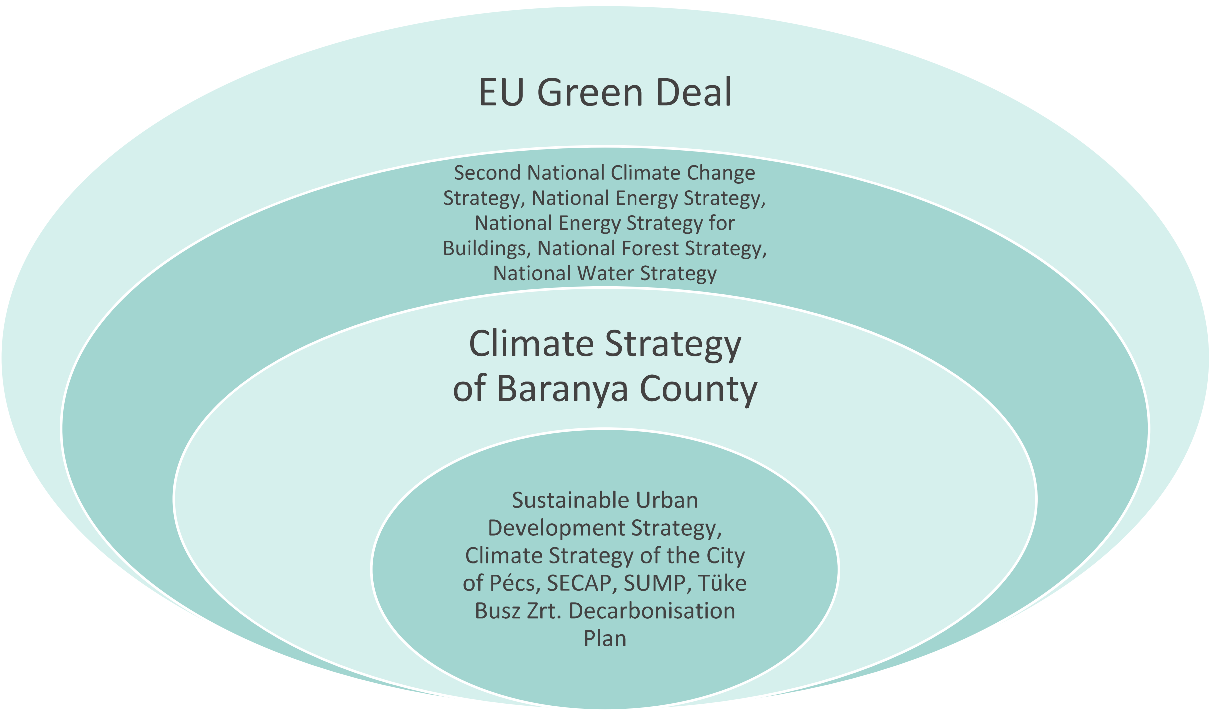


Figure 33: National, regional and local strategies underlying the Action Plan

A-2.19: List of relevant policies, strategies & regulations					
Type	**Level**	**Name & Title**	**Description**	**Relevance**	**Need for action**
Framework strategy	EU	Green Deal	Climate neutrality framework strategy for 2050 net zero goals	All sectors	Implemention of strategies and goals
Strategy	National	Second National Climate Change Strategy (NÉS 2)	National climate change strategy	All sectors	Implementation, feedback and review in 2030
Strategy	National	National Energy Strategy	National energy targets	Energy sector	Implementation, feedback and review in 2030
Strategy	National	National Energy Strategy for Buildings - NES	National energy performance targets for buildings	Building sector	Implementation, feedback and review in 2030
Action Plan	National	Energy and Climate Awareness Action Plan (ECAP)	National targets for awareness-raising	Awareness raising	Implementation, feedback and review in 2030
Strategy	National	National Forest Strategy	National Forest Strategy	Forests, green areas	Implementation, feedback and review in 2030
Strategy	National	National Hydrogen Strategy	Designing the national hydrogen strategy	Energy systems, transport, hydrogen	Implementation, feedback and review in 2030
Strategy	National	Jenő Kvassay Plan-National Water Strategy (NWSS)	National strategy for water management	Water management	Implementation, feedback and review in 2030
Action Plan	National	National Energy Efficiency Action Plan 2020 (NEHCsT)	National energy efficiency frameworks	Building sector	Framework strategy
Legislation	National	Waste Management Code	National legal framework for waste management	Waste management	Implementation
Strategy	National	National Green Public Procurement Strategy	National framework for green public procurement and specific actions	All sectors	Implementation
Strategy	Regional	Baranya County Climate Strategy	County-wide climate strategy	All sectors	Feedback from CAP, review by 2023
Strategy	Local	Sustainable Urban Development Strategy	Urban coverage, green transition roadmap included	All sectors	Green Financing Framework based on Green Transition Roadmap to be developed
Strategy	Local	Climate Strategy of the City of Pécs	A city-wide climate strategy	All sectors	Feedback from CAP, review by 2023
Action Plan	Local	SECAP	Carbon reduction action plan	All sectors mitigation and adaptation	2-yearly review
Action Plan	Local	SUMP	Action Plan for the Sustainable Development of Transport	Transport	2-yearly review
Action Plan	Local	Tüke Busz Zrt. Decarbonisation Plan	Decarbonisation plan for public transport	Transport	Implementation and monitoring

The **European Union**, including Hungary as an EU Member State, acts on the basis of EU-level Community legislation and policy frameworks in the field of climate policy. In October 2014, the European Council adopted the 2021-2030 climate and energy policy framework, on the basis of which the adoption of sectoral legislation, which is the primary source of legislation defining the EU's climate and energy policy for 2021-2030, was completed by 2019. In December 2019, the EU committed to achieving zero greenhouse gas emissions by 2050, and in December 2020 it was decided to increase the 40% emission reduction target to 55% (compared to 1990 levels) by 2030. Achieving this will require a comprehensive reform of EU climate policy and significant investment and support to ensure the transition to a carbon neutral economy. All 27 EU Member States committed to turning the EU into the first climate neutral continent by 2050. To get there, they pledged to reduce emissions by at least 55% by 2030, compared to 1990 levels. This will create new opportunities for innovation and investment and jobs, as well as reduce emissions, create jobs and growth, address energy poverty, reduce external energy dependency, improve our health and wellbeing. At the same time, it will ensure there are opportunities for everyone, supporting vulnerable citizens by tackling inequality and energy poverty, and strengthening the competitiveness of European companies.

Making transport sustainable for all

- 55% reduction of emissions from cars by 2030
- 50% reduction of emissions from vans by 2030
- 0 emissions from new cars by 2035

Leading the third industrial revolution

- By 2030 35 million buildings could be renovated
- 160,000 additional green jobs could be created in the construction sector

Cleaning our energy system

- 40% new renewable energy target for 2030
- 36-39% new 2030 energy efficiency targets for final and primary energy consumption

Renovating buildings for greener lifestyles

- Require Member States to renovate at least 3% of the total floor area of all public buildings annually
- Set a benchmark of 49% of renewables in buildings by 2030
- Require Member States to increase the use of renewable energy in heating and cooling by +1.1 percentage points each year, until 2030

Working with nature to protect our planet and health

- New targets for natural carbon removals:
- 225 Mt old target
- 268 Mt current carbon removals
- 310 Mt new target

In the case of Hungary, the most significant national document in line with the EU 2030 climate and energy policy goals and orientations is the National Energy and Climate Plan, the new National Energy Strategy (NES) prepared in parallel with it, and the second National Climate Change Strategy (NCS 2.) The second National Climate Change Strategy (NES), adopted by the Parliament with the OGY Decision 23/2018 (31.X.), for the period 2018-2030, including the period up to 2050, foresees a gross GHG emission reduction of 52-85% by 2050 compared to 1990. In addition to the National Decarbonisation Roadmap, this strategy also includes the National Adaptation Strategy (NAS) and the Partnership for Climate Awareness Plan. To implement the targets of the second National Climate Change Strategy, Climate Change Action Plans will be prepared for three-year periods.

In our country, greenhouse gas emissions must be reduced by at least 40% by 2030 compared to 1990, i.e. gross emissions in 2030 must not exceed 56.28 million t CO2e gross. The Effort Sharing Regulation sets national emission reduction targets for Member States in the non-ETS sectors for the period 2021-2030 compared to 2005 as a base year. Under the Regulation, Hungary's reduction target for the period 2021-2030, the ESR period, is 7%. Hungary is targeting a 20% share of renewable energy by 2030.

In Act XLIV of 2020 on Climate Protection, Hungary set the goal of achieving full climate neutrality by 2050. The path to achieving climate neutrality is set out in the National Clean Development Strategy. To achieve climate neutrality, Hungary plans to reduce its gross greenhouse gas emissions by at least 50% by 2030 compared to 1990. This means that emissions should not exceed 47.5 million t CO2eq gross in 2030, i.e. a reduction of 16.7 million t CO2eq in 2021 (NEKT review)

National Energy Strategy 2030, looking ahead to 2040:

The National Energy Strategy 2030, adopted in 2020, sets out the long-term energy security of Hungary. The document details the following key principles:

- Energy efficiency measures throughout the supply and consumption chain
- Increase the share of low CO2 intensity electricity generation - mainly based on renewable energy sources;
- Expanding renewable and alternative heat production;
- Increasing the share of low CO2 emission transport modes.

In terms of climate change, the climate-friendly transformation of the energy sector is of particular importance, but there is also an emphasis on focusing on the individual consumer, taking into account the reducing the share of natural gas imports to around 70% by 2030 (below 70% by 2040),

- Reduce the use of natural gas for district heating to below 50%,
- Domestic installed photovoltaic capacity to exceed 6,000 MW by 2030 and approach 12,000 MW by 2040 (reducing the electricity import ratio to below 20%),
- By 2035, at least 200,000 households should have an average of 4 kW of roof-mounted solar panels
- The number of residential heat pumps and their installed capacity should reach 410-420 MW (about 100 000 units)
- 1 million smart meters installed,
- The share of carbon-neutral domestic electricity generation increases to 90% by 2030,
- Final energy consumption must not exceed 2005 levels (while maintaining economic growth), and if final energy consumption increases after 2030, it can only come from carbon neutral energy sources,
- The share of renewable energy in final energy consumption increases to at least 21%,
- GHG emissions will be reduced by at least 40% compared to 1990 (93.7 million tCO2e). This means that (gross) emissions excluding land use, land use change and forestry will not exceed 56.19 million tCO2e in 2030.
- There is also significant potential for energy savings in the energy efficiency improvement of the building stock of some 12-15 thousand public institutions (about 960 thousand public buildings) in Hungary. Based on experience from abroad, energy savings of around 15-30% can be achieved in public buildings within 5 years

The currently adopted, valid adaptation policy in Hungary is the National Adaptation Strategy (NAS) module of the second **National Climate Change Strategy** (NÉS-2) for the period 2018-2030, which provides a vision for adaptation and sets out broad and specific (strategic) objectives for climate adaptation in Hungary. In addition, it sets out sectoral short-, medium- and long-term action directions in the fields of human health, water management, disaster management, agriculture, forestry, nature conservation, energy infrastructure, urban development and tourism.A mid-term evaluation of the implementation of the Strategy is due in 2023, based on the second National Climate Change Strategy, as set out in the OGY Decision 23/2018 (X. 31.) on the second National Climate Change Strategy. In 2024-2025, depending on the evaluation report, it will be necessary to update the NES-2 and the NAS, which may also affect the adaptation objectives.

Based on the **National Climate and Energy Plan**, Hungary will increase the share of renewable energy to at least 29% of gross final energy consumption by 2030. The focus of renewable electricity generation is to increase solar power capacity from the current 4,800 MW to nearly 12,000 MW by 2030. A similar, almost three-fold increase is expected for wind power, although the installed capacity is lower (from around 330 MW to an expected 1,000 MW). In cooling and heating, the share of renewable energy will be increased by 1 percentage point between 2021 and 2025 and by at least 1.3 percentage points per year between 2026 and 2030, in line with the revised draft Renewable Energy Directive. Hungary will also increase the share of renewable energy and waste heat and waste cooling in district heating by 2.2 percentage points per year. Hungary sees great potential in using ambient heat through heat pumps. Hungary has significant geothermal potential, which is increasingly being exploited. Given our country's specificities, the aim is to exploit geothermal thermal energy more intensively and for a wider range of uses. Under the draft Renewable Energy Directive, Hungary must ensure that by 2030 renewable energy accounts for at least 29% of total energy consumption in the transport sector. The share of advanced biofuels and renewable non-biological fuels will be increased to 1% by 2025 and 5.5% by 2030. In the energy sector, greenhouse gas reductions will be achieved primarily through improvements in energy efficiency and the use of renewable and nuclear energy. For energy-intensive industries, we will increase the use of CO2 capture technologies through targeted regulatory and financial instruments. In industry, systemic energy efficiency investments and technology change can bring about substantial reductions in GHG emissions. Switching to electricity is a primary means of achieving the latter.

Our energy efficiency target is for the country's final energy consumption to be no more than 750 PJ in 2030. This implies a small reduction in final energy consumption, which can be achieved by increasing the rate of GDP growth above the rate of growth in energy use. The final energy intensity of GDP will continue to improve, falling below 0.429 toe/million PJP by 2030.

In 2021, the Government adopted the **Long-Term Renewal Strategy** (HTFS), which lays the foundations for achieving a sustainable, energy and cost-efficient domestic building stock by 2050. The strategy aims to achieve a 20% saving in the energy use of the domestic residential building stock by 2030, a 60% reduction in CO2 emissions related to the energy use of buildings by 2040 compared to the 2018-2020 average, and a near-zero energy demand building stock of 90% by 2050. The renovation rate for the total residential building stock should reach 3% per year by 2030, and for the public building stock a renovation rate of 5% per year. This will help to reduce the total energy consumption of public buildings and CO2 emissions by 18%. The long-term achievement of these targets for the existing building stock can only be achieved through deep renovation.

In addition to the deep renovation, the preparation for the introduction of the Smart Building Indicator (SRI) system is also an important objective. The development and piloting of SRI is foreseen in Article 8(10) and (11) of the Directive and Annex 1. The introduction of the SRI system is a Community pilot policy action directly managed by the Commission.

The Building Renovation Monitoring System (EBMOR) will be able to be linked to the State Public Building Register, the electronic applications of the National Building Register - in particular the e-certification system - and, for public buildings, to the Municipal Property Register and the Central Public Investment Control System (CACS). As a result of the complex data collection, the Building Renovation Monitoring System will be able to measure and record five main indicators: number of buildings renovated per building type (number/type); floor area of public buildings renovated (m2 /type); energy savings and CO2 emissions savings (kWh; tco2); financial resources spent on building renovations (Ft; Ft/kWh); which policy measure is being implemented with what result (Ft/kWh). The Hungarian Energy and Public Utilities Regulatory Office (MEKH) is responsible for the creation and updating of the Public Buildings Register.

The reduction of GHG emissions from agriculture will be achieved through the adoption of good agricultural practices, including the promotion of adaptation to a changing climate, and through various support instruments, including increasing the share of renewable energy production in agricultural energy use. In line with the **National Forestry Strategy**, we will significantly increase the proportion of land covered by forests and other wooded land to increase CO2 absorption capacity. To maintain the carbon sequestration capacity of forests, we will improve their resilience to environmental factors.

The **National Hydrogen Strategy** identifies the industrial use of hydrogen as one of the priority areas for intervention. In order to promote green hydrogen production, the Strategy foresees the installation of at least 240 MW of electrolysis capacity by 2030. The value is not in the production of green hydrogen per se, but in the cost-effective use of green hydrogen. This will require appropriate regulatory and predictable support measures, while facilitating basic infrastructure investments commensurate with the location and scale of the planned use. Hydrogen will need to be used in industries that are difficult to electrify and typically energy-intensive, in particular chemicals, steel, cement, glass and ceramics. The National Hydrogen Strategy also sets the objective of promoting hydrogen propulsion in transport sectors where it is technically and financially competitive, in order to facilitate the transition to cleaner modes of transport. By 2030, this means heavy-duty vehicle traffic, primarily medium and heavy goods vehicles (e.g. trucks, waste collection vehicles), buses and certain target vehicle categories (e.g. forklifts, tractors). The Strategy sets a target of 4,800 hydrogen vehicles by 2030. At the same time, hydrogen refuelling infrastructure should be deployed in parallel, with a territorial focus on two objectives: the location of hydrogen refuelling for transport purposes (e.g. buses) and along major European transport corridors.

The July 2019 amendment to the **Road Transport Act** aims to encourage the uptake of this GHG-free mobility mode by regulating electromobility services. Fully electric, partially electric and zero-emission cars will be exempt from vehicle tax, company car tax and registration tax. In addition, the vehicle tax rate for buses, lorries and trucks will depend on the environmental classification of the vehicle. Lorries are granted an additional tax reduction when using combined transport. The rate of company car tax and registration tax is also determined by the environmental classification of the vehicle. We will continue to promote the uptake of electric vehicles and the development of the necessary infrastructure through regulatory, fiscal and financial support instruments, as set out in the Y2K Plan 2.0. A further means of keeping energy use in transport within limits is to develop public transport, increase its utilisation and make rail freight transport more competitive. Under the Green Bus Programme, it is expected that around 1 100 environmentally friendly local buses could be in operation by 2029. Measures for the development of alternative fuel infrastructure are set out in Hungary's Alternative Fuel Infrastructure Development Policy Framework.

Based on current trends in the world's economically developed countries, it is predicted that by 2030 the share of electric vehicles in the car market is expected to be 20-30%, making it crucial to build charging infrastructure of sufficient quality and quantity.The **Jedlik Ányos Plan 2.0 - National Electromobility Strategy** was published in 2019. In this strategy document, a number of objectives have been formulated to promote the deployment and increase the density of charging points. Based on the Jedlik Ányos Action Plan, e-mobility in the built environment was ensured by amending Government Decree 10/2016 (II. 9.) - Government Decree 253/1997 (XII. 20.) on the national settlement planning and building requirements (OTÉK) - to ensure that aspects promoting the spread of electric mobility in the built environment must be taken into account. A new requirement will also be introduced in the framework of the amendment to TNM Decree 7/2006 (24 May 2006) on the definition of energy performance of buildings. The requirement will apply to new buildings and non-residential buildings undergoing major renovation with more than 10 parking spaces.

Introduction of the obligation to provide a filling point in residential car parks for residential buildings with at least 20 parking spaces of their own between 2025 -2030. Hungary will amend the necessary legal framework to make it compulsory for residential buildings to install 1 electric charging station for every 20 parking spaces in existing parking lots and for every 20 parking spaces in new parking lots.

Extending the possibilities for the replacement of mandatory parking spaces provided by municipalities. Persons required to provide new parking spaces in the course of new buildings or extensions in 2025 – 2030. A legal framework will be examined to allow for the possibility of replacing the obligation to provide parking spaces under the Urban Development Plan by the construction of an electric charging point in public spaces or by contributing to the financing of its construction.

GHG reduction measures that can be applied to waste management will be set out in the new waste strategy. However, we also intend to increase the share of reused or recycled waste through the introduction of waste concessions, thereby reducing the amount of waste going to landfill. Law II of 2021 amending certain laws on energy and waste management (**Waste Management Code**) contains provisions on waste prevention, the elimination of illegal dumping (waste abandonment), strict sanctions for waste abandoners, a compulsory return fee system, waste concessions, public management of waste and the creation of the legal basis for the transition to a circular economy. It makes it mandatory to reduce the proportion of municipal waste going to landfills to 10% or less of the total municipal waste generated by 2035. The amount of municipal waste prepared for re-use and recycled in relation to the amount of municipal waste generated nationally in the year under review must be increased to at least 55% by weight by 2025, 66% by weight by 2030 and at least 60% by weight by 31 December 2035. The amount of municipal waste prepared for re-use and recycled shall be increased to at least 50 % by weight in 2025, 55 % by weight in 2030 and 60 % by weight by 31 December 2035, compared to the amount of municipal waste generated at national level.

Climate Strategy of the County of Baranya - Climate-smart Baranya - Where everyone has a role to play!

Comprehensive climate strategy targets and actions:

- Reducing emissions, increasing prosperity - emission reduction targets and actions
- Adapting to the inevitable - climate adaptation targets and actions
- You are part of it! - Awareness-raising objectives and actions

The primary responsibility for achieving the objectives and implementing the actions set out in the Climate Strategy lies with the Baranya County Municipality. However, the public, institutions and businesses also have a major role to play in implementation. This cooperation and the development of the highest possible level of cooperation are necessary because no sector alone can fully achieve the objectives. This calls for a partnership between local government, public institutions, NGOs and farmers. Monitoring of the measures and activities set out in the county's climate strategy is also important to ensure that any difficulties or shortcomings encountered during the implementation period can be remedied in good time. The monitoring of the strategy will be based on the objectives set and the measures taken to achieve them. In both cases, indicators have been defined. These indicators will help to identify the directions and pace of progress set out in the document and to prepare the reviews.

By 2030, Baranya will become a self-governing region that is prepared, fully aware of its competence and legitimacy, able to significantly improve its own and its environment's climatic conditions as a result of the work of its sustainable and cooperative society, with sustainable economy in the background, able to manage external risks, to adapt flexibly to changes, preserving and exploiting its rich natural and built heritage. The above vision will be achieved if, in 2030, the county has 50% fewer deaths from climate change-related causes than in 2017 and its GHG emissions are reduced by at least 20% (excluding emissions from ETS-affiliated entities, which are under national government responsibility).

Reducing emissions, increasing prosperity - Baranya County's overall emission reduction and adaptation targets Baranya County's overall emission reduction target is to reduce its GHG emissions by 20% as compared to 2016. To achieve this, the county municipality is implementing three comprehensive programmes, namely

- Renewable Baranya,
- Sustainable Mobility in Baranya and
- Baranya Circular Economy.

The development framework strategy of Pécs is the **Integrated Urban Development Strategy**, complemented by the Basic Study and the **Urban Development Concept**. As an umbrella strategy, the Integrated Urban Development Strategy summarises the development path of the city in a comprehensive and holistic approach. Accordingly, the vision and overall strategic goal of the City of Pécs is:

Pécs should be a city where it is good to live and its inhabitants like to live. The quality of life should be close to the European top. Let the people of the city form a community. The city should regain its historically established regional and metropolitan role and weight. Pécs should offer attractive employment conditions with a promising outlook on life, and at the same time the positive emotional attitude of the population towards the city, their satisfaction and their willingness to do something for the city should contribute to the city's ability to survive and develop. The city should be attractive to both residents and newcomers, providing a high level of environmental, material and service conditions that meet the requirements of the times.

Pécs is a regional centre of attraction capable of sustainable development, and in the long term it needs a balanced development of the natural and built environment, the economy and society, harmoniously linked to the regional environment. Sustainability and development are inseparable requirements, since in the absence of development, sustainability is called into question, and if sustainability requirements are ignored, development is hampered. The city needs to strengthen its historically established regional attractiveness, its integrative and development-promoting role, because the city and its surroundings are strongly interdependent in terms of resources, and Pécs, as the largest city in the region, has a responsibility to help and encourage regional development.

The strategic objectives include the goal of a healthy, carbon-neutral city, which Pécs MJV intends to implement along three sub-objectives: adaptation to the effects of climate change through the retention of precipitation, complex utilisation of collected rainwater and waste water, improvement of the city's ventilation, landscape architecture, architecture, urban design, development and application of a set of guidelines for climate adaptation capacity, and raising and promoting climate awareness.

In order to create a coherent system of green and blue spaces, the intensity of conditioning green spaces is increased, conditioning water surfaces are increased, green space functions serving public purposes and human activity are provided, the quality and accessibility of public green space provision is improved, the ecological and visual landscape potential of natural, semi-natural and cultural landscape areas and landscape character are preserved, possibly enhanced and protected.

An important sub-objective is to reduce environmental damage through measures to improve air quality, ensure clean urban surface water, protect the groundwater aquifer, reduce noise pollution, further increase the share of separate waste collection, use clean tech technologies in line with the principles of the circular economy and reduce light pollution.

Energy security from clean, sustainable energy sources is part of the Compact City objective, which is implemented through measures to reduce energy dependency, develop and implement a new, carbon-neutral, integrated, planned urban energy and secondary raw materials management system and promote the use of renewable energy by businesses and residents.

As a condition for receiving integrated urban development funds for the 2021-27 EU development cycle, the cities concerned, including the city of Pécs, have prepared a **Sustainable Urban Development Strategy** according to the methodological guidelines of the Ministry of Finance. Within this framework, the cities have prepared a detailed green transition roadmap, the objectives of which are set out below for the city of Pécs:

The City of Pécs aims to contribute to carbon neutrality by creating energy security, relying on its own resources, integrating decentralised energy sources and applying best practices. It will implement local and regional measures for optimisation and greening. It will implement local and regional measures to optimise the use of green energy in buildings, facilities and transport used by the population, local government and its institutions and economic operators, through the rational use of locally available resources, while ensuring a sustainable living environment that contributes to a good quality of life and healthy living, adapting to the challenges of climate change.

By 2030, the City of Pécs aims to further reduce its greenhouse gas (GHG) emissions by 100% compared to 2019, through actions in energy use, industrial emissions, transport and waste management, and the planting of forests and green spaces.

In the timeframe for the first years of the current EU funding cycle (2021-2024), the city will focus on preparing for carbon emission reductions, including

- Establishing major GHG reduction targets and adaptation capacities
- Identifying more complex system improvements to help achieve the long-term goals
- Green projects and awareness-raising actions with a motivating effect, with smaller sub-targets
- An information system to support local climate adaptation measures will be developed, including environmental information service, forecasting, spatial information based spatial management and operational systems.

There are two ways to reduce CO2 emissions:

1. by increasing the efficiency of energy use for heat production and reducing losses during heat generation and transfer,

2. by replacing CO2 emitting energy sources with CO2 neutral renewable energy sources.

There are several ways to encourage and regulate emission reductions:

- By working with businesses in the industry and services sector
- Developing comprehensive measurement and monitoring systems
- Pilot programmes, projects and testing platforms to test new low emission solutions
- Adapting modern soil management and landscape irrigation and water storage methods
- Through traffic planning, promoting the concept of a slow city, creating conditions for cycling and walking
- Managing the construction works
- By encouraging public transport
- By promoting low emission vehicles
- Through purchases and investments.

Identifying areas of intervention for green development

Priority areas identified for the strategic objectives:

- Energy security from clean, sustainable energy sources
- Strengthening climate adaptation and resilience in urban infrastructure - by strengthening the resilience of urban buildings, facilities and infrastructure
- Creating a coherent system of green and blue surfaces
- Healthy urban environment, healthy people: contributing to the health of city dwellers through emission and pollution reduction, climate adaptation and awareness-raising measures
- Strengthening a climate-resilient green economy: working with the business sector, industry and services to reduce emissions from the corporate sector, exploit the potential of the circular economy and encourage the establishment of green economy businesses

In its Resolution 196/2013 (20.06.2013), the Municipal Council of the City of Pécs expressed its intention to join the Covenant of Mayors, with which the municipality has committed itself to climate protection and rational energy management in the long term. The ambitious targets set by the city administration, economic operators and society have been achieved through the implementation of the Sustainable Energy Action Plan (SEAP) of the city of Pécs, with a 20% reduction in emissions by 2020 compared to 2011. By preparing the SECAP, the City of Pécs joined the 2030 targets set by the Covenant of Mayors, which will reduce greenhouse gas emissions by a further 47.4% compared to 2019 through measures in the areas of energy use, industrial emissions, transport and waste management, and the planting of forests and green spaces.

In line with the national-level strategic documents, supporting their objectives, the county climate strategies were prepared in the second half of 2010, including the climate strategy of Baranya county. The strategy at the municipal level has several objectives, on the one hand to support and contribute to the achievement of the EU, national and county climate and energy targets, on the other hand to articulate the goals of the local community and to create a framework for effective local action. Building on the latter, Pécs MJV has prepared **the Climate Strategy of the City of Pécs,** which provides a framework document for mitigation and adaptation measures.

Pécs - as a borderless city, as a city of culture, Mediterranean atmosphere, as a gateway to the Balkans - by preserving the natural environment and cultural values, the city is developing a system of urban development and operation, a complex water management system supporting sustainability, enhancing green spaces and nature reserves, while at the same time municipal institutions, residents and businesses are significantly reducing the city's GHG emissions through energy efficiency and the development of local renewable energies.

In the short term, it is necessary to focus on objectives that require less investment, but which are identifiable and mobilising for a large part of the population and target groups. Another important consideration when setting objectives is to ensure that, as far as possible, their implementation also supports the overall economic and social development of the municipality. The following should therefore be taken into account when formulating the objectives:

- Quick implementation of green projects and awareness-raising actions with a motivating effect, achieving smaller sub-objectives
- Establishing major GHG reduction targets and adaptation capacities with available resources
- Identifying more complex system improvements to help achieve the long-term goals

Already in the short term, these can make a significant contribution to visible climate

Effectiveness: awareness-raising actions in schools and institutions, local authorities

Energy development, development of an action plan against heat waves, complex protection against inland water and droughts in the context of sustainable water management, increase and development of urban green spaces.

By 2030, an information system is in place to support local climate adaptation measures, including environmental information services, forecasting, spatial information-based land management and operational systems. The proportion of urban green spaces and water surfaces increases, a system of sustainable water management based on water conservation is developed, a significant proportion of municipal public buildings undergo complex energy renovation, and the use of renewable energy in public buildings reaches a share of over 20%. The age group is growing up and playing a meaningful role in the socio-economic life of the city, which, thanks largely to local climate protection improvements, is imagining its future locally and sustainability is a fundamental factor in shaping its behaviour and attitudes. As a result, a large part of the population will be aware of the basic climate change processes, their local impacts, the importance of climate action, the main strategic climate objectives, which will also help to implement larger-scale projects at institutional, corporate and household level, including investment and renewable energy.

By 2030, the City of Pécs has set a target to reduce by a further 47.4% compared to 2019

Greenhouse Gas (GHG) emissions through action on energy use, industrial emitters, transport and waste management, and the establishment of forests and green spaces.

A significant part of the public transport system of the City of Pécs will be fossil fuel neutral, with renewed green shelters and passenger information systems. Individual modes of transport (e.g. bicycles) will dominate, and motorised modes will play a decreasing role in local transport. The use of alternative energies will continue to increase. A significant proportion of municipal buildings have been renewed. The green spaces of the municipality are being renewed and support the recreational and leisure activities of the population, but also ensure a better adaptability of natural communities and enhance biodiversity, with a positive impact on the microclimate of the municipality. A well-functioning sustainable urban management and development system, as well as an inland water management system that promotes water conservation, will help climate adaptation. A significant proportion of residential properties, around 10%, meet passive house requirements, with widespread use of local, natural building materials and climate-friendly solutions (rainwater permeable pavements, passive shading, community gardens, etc.). The population is not only aware of the practical protection skills needed to build resilience (e.g. storm damage, heat waves, inland waterways) but also routinely applies them, and climate change action is an important area of community life and civic self-organisation. By 2050, the City of Pécs has set a target of reducing its greenhouse gas (GHG) emissions by an additional 61.5% compared to 2019 through actions in the areas of energy use, industrial emissions, transport and waste management, and the planting of forests and green spaces.

The commitment of the Municipality of the City of Pécs to sustainability and sustainable mobility is demonstrated by its participation in a number of related initiatives. In the last 5 years, the city has developed an environmental programme, the **Eco-City-Ecoregion Programme**, a long-term strategy for making Pécs a sustainable city, an energy strategy and, in the second half of last year, the **Green Infrastructure Network Development and Maintenance Action Plan** (ZIFFA). The Hungarian Environmental Technology Manufacturing and Development Cluster was established.

When the **Urban Development Concept and the Integrated Spatial Development Strategy** were prepared **in** 2014, the basic principles of future planning were clearly organised around sustainable development. In 2014, the City of Pécs won a special prize for "100% renewable district heating" in the fifth edition of the Renewable Energy Sources Championship. In 2016, the city applied for the European Green Capital Award for the second time for the year 2019. The SMART City Pécs programme is under preparation.

Building on its commitment to sustainability and its strategic planning practice, Pécs decided to prepare a **Sustainable Urban Mobility Plan (SUMP)** in 2016. The Sustainable Urban Mobility Plan aims to improve the management of existing transport infrastructure and services and to identify cost-effective mobility measures. The SUMP is on the one hand a strategy summarising the long-term development vision of the City of Pécs (mainly transport infrastructure and services) and on the other hand a short-term action plan based on the specificities of the existing and future transport system.

In its decarbonisation plan, Tüke Busz Zrt. committed itself many years ago to improving the quality of public transport, reducing its environmental impact and, in the longer term, to electric buses. Between 2013-15, the Company implemented a comprehensive fleet development programme that resulted in a share of EEV-powered vehicles in urban public transport of over 70%, making Pécs one of the cities with the cleanest bus fleet in Hungary. This was followed by the first, but significant step towards an even cleaner, zero-emission vehicle transition, as a result of which the Municipality acquired 10 buses with exclusively electric propulsion in 2019, using the grant from the IKOP, which were connected to the public transport service provided by Tüke Busz Zrt. in autumn 2020.

During the 2013-15 urban bus fleet upgrades, second-hand buses - typically 6-8 years old - were purchased that can only be operated efficiently for a limited period of time, so it is desirable to replace the entire bus fleet within the next 5 years. In line with the direction set out in the Green Strategy and confirmed by the Municipality, Tüke Busz Zrt. intends to replace its entire fleet with electric buses by 2027. The first step in this process will be the purchase of the BYD solo buses put into service in 2020, the second step will be the purchase of 8 additional solo electric buses in 2022 with the support of the Green Bus Programme, followed by the purchase of additional solo and articulated vehicles until 2026. This will enable the City of Pécs to become carbon neutral by 2027, ahead of the EU 2050 deadline.

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

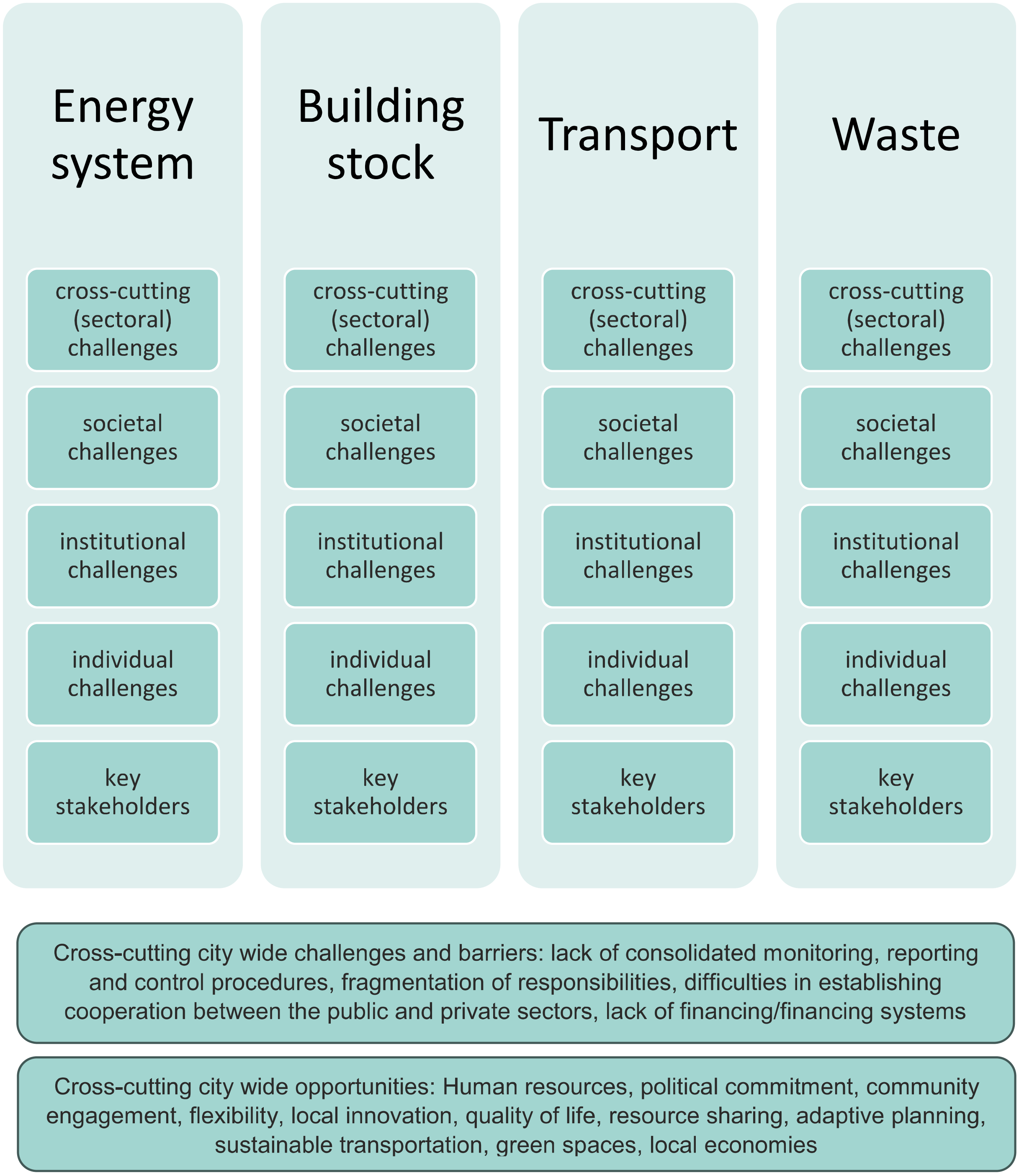


Figure 34: Systemic barriers and opportunities

Climate adaptation of the urban **building stock** represents a shift towards more sustainable and energy-efficient building practices. However, this transition faces different challenges at the societal, organisational and individual levels. Measures mainly involve political incentives, awareness campaigns, education, training and promoting a culture of sustainability.

Social challenges:

- Awareness and education: a challenge is the lack of public awareness and understanding of the importance of energy efficient buildings and their role in reducing carbon emissions, with the effect off limited support for sustainable building practices and slow adoption of energy efficient technologies.

- Equity and affordability: the challenge is to balance the need for energy efficient buildings with the need to provide affordable housing for all, especially in low-income communities. Excluding low income groups would reinforce social inequalities.

- Behaviour change: challenging individuals to adopt energy-efficient behaviours, such as reducing energy consumption, maintaining systems properly and using appliances carefully. Resistance to changing habits and practices can be an obstacle to the effectiveness of energy saving measures.

- Policy and regulation: implementing and enforcing building codes, regulations and incentives that promote sustainable building practices is complex and challenging due to political, economic and administrative factors.

- Urban planning and spatial planning: the challenge is to integrate sustainable building practices into urban planning and spatial planning codes to ensure that new developments are in line with climate objectives. Inappropriate planning can lead to inefficient land use, increased commuting distances and higher energy demand.

Organisational challenges:

- Industry resistance to change: the traditional construction and real estate industry may be resistant to adopting new technologies and practices that are energy efficient but require upfront investment, which may lead to slow uptake of energy efficient building methods and technologies.

- Skills and workforce development: training a workforce with the skills needed to design, build and maintain energy efficient buildings takes time and resources. A lack of trained professionals can limit the adoption of sustainable building practices.

- Financial barriers: high upfront costs associated with energy-efficient technologies and building retrofits can deter developers and homeowners from investing in sustainable options. Financial barriers can slow adoption, despite long-term savings.

- Supply chain challenges: the challenge of ensuring a reliable supply chain of sustainable building materials and technologies, including availability, quality and affordability. Limited access to necessary components can delay projects and increase costs.

- Data and information sharing: the lack of standardised data collection and sharing practices can hinder the assessment of building performance and the identification of energy saving opportunities, making it difficult to measure progress and make informed decisions.

Individual challenges:

- Perceived inconvenience: individuals may find energy-efficient practices such as using public transport or adjusting the thermostat uncomfortable or inconvenient, and may be reluctant to adopt sustainable behaviours because of perceived disadvantages.

- Lack of motivation: individuals may not see immediate benefits for themselves from adopting energy-efficient behaviours if the effect is not immediate. The effect may be reduced motivation to change behaviour, which can lead to continued energy wastage.

- Information overload: individuals may feel overloaded with information on sustainable practices, making it difficult to prioritise and implement changes. This creates difficulties in making informed decisions and taking action.

- Cultural and social norms: cultural norms and social pressures can influence energy consumption behaviour, making it challenging to deviate from established patterns. Resistance to change due to social and cultural factors can be a challenge.

- Lack of access to resources: limited access to information, technology and financial resources can prevent individuals from adopting energy-efficient practices, resulting in an uneven distribution of the benefits of sustainable behaviour.

Sectoral barriers:

- Lack of a legal framework for independent power producers

- High initial capital costs

- Long-term energy savings instead of ad hoc campaign-like actions

- Solving the individual measurement

- The installation of solar panels on detached houses and institutions is common practice, but the use of a shared solar system in a condominium faces accounting constraints.

- The energy storage solution is challenging, the installation of batteries is required by law, as the Hungarian electricity grid is under-utilised, the feed-in tariff system and the METÁR system are currently not operational.

- The legal and financing structure of energy communities is not resolved.

- The focus of the energy transition, based on preliminary studies, is the replacement of gas heating in the identified building types. Government strategy to reduce the use of natural gas in the energy mix, increase the share of alternative energy sources. Geothermal energy is available, hydrothermal (based on thermal energy from thermal water extracted from thermal wells) and geothermal heat pump systems can be installed. There are concrete examples, but it is not known to what extent this can be applied to condominiums and thus directly ensure emissions neutrality.

- Lack of data is an important limiting factor in the energy transition. The modelling of the building sector transition requires the development of a real-time, large-scale database for the action area.

Addressing these challenges requires cooperation between many actors:

The Municipality and Pécs Urban Development Zrt. on behalf of the Municipality provide the comprehensive project planning and implementation, while the University of Pécs plays a significant role in the modelling of the building stock. The Municipality is responsible for ensuring policy and regulatory challenges and information transfer. The Municipality Department of Urban Management, the Municipality Department of Urban Architecture and Biokom coordinate the urban planning and spatial planning areas. E.ON Pécs and Pétáv Pécsi Távfűtő Kft. are involved in the modelling of different solutions and in offering concrete solutions, in cooperation with Pannon Hőerőmű Zrt.

The University of Pécs and the Baranya County Vocational Training Centre contribute to the availability of a qualified workforce in the related fields by adapting the training offer.

The Pécs Tankerület, Pécs Vagyonhasznosító Zrt., Zsolnay Örökségkezelő NKft. and the PMJV Unified Health Institutions play a significant role in the renovation of institutional buildings, while the Pécs housing cooperatives - LAKTÁSZ can coordinate the deep renovation of prefabricated residential buildings.

The Municipality Economic Development Department, the Pécs-Baranya Chamber of Commerce and Industry and the National Chamber of Agriculture - Baranya County are contributing with industrial, commercial and farming organisations. These actors have an important role to play in industrial adaptation and in ensuring a smooth supply chain.

The Villány-Siklós Wine Route Association, Mecsekerdő Zrt., Duna-Dráva National Park Directorate, "FutaPécs" Sports Association, Baranya Natural Values Foundation, Baranya County Naturefriends Association, Run for the Trees Sports and Environment Foundation, Pécs City Naturefriends Association, Balokány-ligetért Association, Misina Nature and Animal Protection Association, Ökováros-Ökorégió Foundation, Baranya County Group of the Hungarian Ornithological and Nature Conservation Association, Pro Natura Karst and Cave Research Association, Pécs Student Council, Europe Direct and the House of Educators Association can play a role in raising awareness, education and promoting behaviour change.

Climate adaptation of **energy systems** means a shift to cleaner and more sustainable energy sources, more efficient consumption and more resilient infrastructure. Successful urban climate adaptation of energy systems requires policy innovation, technological development, education, public engagement and a focus on equity to create a sustainable and resilient energy future.

This transition is accompanied by various challenges at social, organisational and individual levels.

Social challenges:

- Equity and access: the challenge is to ensure that all communities, including low-income populations, have access to clean and affordable energy sources and benefit from the transition. If this is not specifically addressed, energy poverty can occur and the benefits from the introduction of renewable energy sources will be unevenly distributed.
- Public awareness and involvement: a challenge to raise public awareness of the importance of clean energy, climate change and the need to move to sustainable energy sources. If this is not successful, support for policies and investments to facilitate the transition will be limited.
- Behaviour change: challenging individuals to adopt energy efficient behaviours, such as reducing consumption, optimising energy use at home and at work. Resistance to changing established energy consumption habits.
- Policy and regulation: effective policies and regulations need to be developed and implemented to encourage the uptake of renewable energy, promote energy efficiency and ensure grid stability. There may be uncertainty for investors and a lack of alignment with climate objectives.

Organisational challenges:

- Energy market transition: A challenge to transform energy markets to accommodate the integration of renewable energy, storage technologies and distributed generation. Impacts may include disruption of traditional energy business models and potential market instability.
- Technological innovation: the challenge is to develop and deploy new technologies for renewable energy production, energy storage, smart grids and demand-side management. Transition may be slow due to technological and infrastructure constraints.
- Energy infrastructure investments: financing and upgrading ageing energy infrastructure is needed to support renewables, grid resilience and demand fluctuations. Delays in infrastructure upgrades and reliability concerns can be a problem.
- Data and interoperability: the challenge is to establish data standards and interoperability between different energy systems and technologies to enable seamless integration. Enabling interoperability and interoperability across systems and technologies to facilitate interoperability.
- Workforce transition: training and retraining of the workforce is needed to adapt to the new tasks and skills required in the renewable energy sector. Otherwise, there will be labour shortages and a lack of skills to implement clean energy technologies.

Individual challenges:

- Energy awareness and behaviour: challenge to raise individuals' awareness of their energy consumption patterns and how their choices affect overall energy demand. Lack of motivation to reduce energy consumption occurs when there is a lack of awareness of personal contribution.

- Lifestyle changes: challenge to encourage individuals to make lifestyle changes that reduce energy consumption, such as using public transport or energy efficient appliances. Resistance to changing habits and practices.

- Perceived costs and benefits: the challenge is to overcome the perception that renewable energy technologies are expensive and that the benefits may not be immediately apparent. Impacts may include limited adoption of clean energy solutions due to perceived economic barriers.

- Technology adoption: the challenge is to convince individuals to adopt new technologies such as rooftop solar panels or home energy management systems. The impact is slow uptake of innovative solutions despite the potential benefits.

- Access to information:

- The challenge is to ensure that individuals have access to accurate information on energy efficiency, renewable energy options and financial incentives. In its absence, there are difficulties in making informed energy choices.

Sectoral challenges:

- Until the end of 2016, the growth of grid electricity generation in Hungary was mainly driven by the so-called mandatory feed-in tariff (FIT) system.From 2017, this was replaced by the Renewable Energy Support Scheme (METÁR), which provides operational support similar to the FIT, while at the same time facilitating the market integration of renewable energy generation. In addition to the construction of new units, the METÁR scheme also supports the maintenance of renewable energy generation (so-called brown premium). To ensure a cost-effective level of support, METÁR support is only available through technology-neutral renewable capacity tenders.

- In periods without weather-dependent renewable generation, will there be sufficient capacity on the supply side of the electricity system to fully meet demand during these periods through the activation of domestic generation capacity and trading across borders? Can the development of the domestic electricity grid keep pace with the rapid penetration of weather-dependent generation? Will sufficient flexible response capacity be available to deal with the electricity system problems caused by the rapid penetration of weather-dependent generation?

- Energy communities may be able to alleviate congestion in the electricity grid, make renewable energy generation more accessible to a wider range of consumers, and the explicit aim is to fine-tune the legislation that supports the creation and operation of energy communities and to enable the creation of energy communities that generate heat. Their expansion has been and will be encouraged through financial support.

- The very dynamic increase in the installation of small-scale household-scale solar power plants in recent years also confirms that the target of at least 200,000 households with an average of 4 kW of roof-mounted solar panels will be significantly exceeded by 2030. In order to maintain this trend, a complex regulatory and financial solution needs to be put in place that is sustainable in the longer term, both for the owners of small-scale plants and for the electricity grid as a whole. The main intervention in the field of individual heating, in addition to reducing the heat demand of buildings, is the deployment of heat pumps. Before the rapid uptake phase, outdoor heat pump units should be considered in terms of their urban landscape and noise impact, so that they can be seen as a positive solution once they are massively installed.

- There is also untapped potential in the use of biogas from wastewater treatment, landfill gas and biogas from agriculture. Although geographically limited (biogas plants need to be located close to the source), it has the significant advantage of being sustainable and can be exploited at relatively low investment costs. Biogas plants can not only meet local heat demand, but also feed purified biomethane into the natural gas network, although this entails higher investment costs.

- The buildings and technologies used by businesses are considered to be the most energy-efficient, as energy price developments and market competition have forced them to carry out energy renovations, which has been facilitated by several support schemes. Both EU-funded and nationally funded grants were available for SMEs, while the Factory Savings Scheme provides support for energy efficiency and energy production investments for energy-intensive large companies.

- The energy consumption of public buildings accounts for nearly 10% of the energy use of the domestic building stock. Fit for 55 calls for annual savings of 1.9% compared to two years ago, and an annual energy retrofit of 3% of the floor area of public buildings. To achieve this renovation target, we plan to make use of ESCO financing in the first instance and the obligation scheme to the extent of the co-financing, with additional investment support for public institutions involved in the renovation.

Regulatory environment:

- Decree No 7/2006 (V. 24.) TNM on the definition of the energy performance of buildings

- Easier solar panel installation: no unanimous vote is now required for the installation of solar panels and solar collectors in condominiums. During the emergency, Decree 293/2022 (VIII. 9.) No. 2 of the Government Decree 293/2022 (VIII. 9.) on certain provisions of Act CXXXIII of 2003 on condominiums. § (1) The installation and operation of solar collectors and solar systems (hereinafter collectively referred to as "systems") on a part of a building under common ownership, to be installed and operated in order to reduce the common costs of the condominium community, may be prohibited by the general meeting or by a repeated general meeting by a vote of more than half of the owners present.

- Energy Community: the main rules on the Energy Community have been transposed into the VET (Act LXXXVI of 2007 on Electricity) and the VET VHR (Government Decree 273/2007 (X. 19.) on the implementation of certain provisions of Act LXXXVI of 2007 on Electricity) as of 1 January 2021.

- Act XL of 2008 on the Supply of Natural Gas

- Government Decree No 19/2009 (I. 30.) on the implementation of the provisions of Act XL of 2008 on the Supply of Natural Gas

- In view of the energy crisis, one of the most important goals for gas consumption is to minimise gas consumption and increase energy efficiency. In connection with this reduction, Government Decree 353/2022 (IX.19.) on the emergency operation of certain institutions entered into force on 1 October, which regulates that the air temperature provided by heating in public institutions may not exceed 18 degrees Celsius.

Addressing these challenges requires cooperation between many actors:

The Municipality of Pécs and the Pécs Urban Development Zrt. on its behalf will ensure the overall project design and implementation. The Municipality is responsible for policy and regulatory challenges, for coordinating and making data available and for information transfer. The Municipality Department of Urban Management, the Municipality Department of Urban Architecture and Biokom coordinate urban planning and spatial planning, provide the necessary areas for energy systems, including integration into the urban landscape. Energy suppliers are primarily responsible for the carbon decarbonisation of energy systems, in close cooperation with E.ON Pécs, Pétáv Pécsi Távfűtő Kft. in cooperation with Pannon Hőerőmű Zrt. The University of Pécs and Kontakt-Elektro Kft. play a key role in the establishment of the hydrogen economy, and the University is also implementing the cleantech programme in cooperation with Mecsekérc Zrt. and

Logframe Consulting Kft. The University of Pécs and the Baranya County Vocational Training Centre play a role in the transfer of labour and the provision of training courses that meet the expectations of the workforce. In the prevention of energy poverty, the Municipality cooperates with the KRTK Institute for Regional Research and the RKI.

Important partners in the development of institutional renewable energy capacity are the Pécs School District, Pécs Vagyonhasznosító ZRt., Tettye Forrásház Zrt., Zsolnay Örökségkezelő NKft., PMJV Unified Health Institutions, Pécs housing cooperatives - LAKTÁSZ, Biokom NKft, Mecsekerdő Zrt., Duna-Dráva National Park Directorate and the National Chamber of Agriculture - Baranya county.

The Municipality Economic Development Department, the Pécs-Baranya Chamber of Commerce and Industry and the Baranya County Chamber of Engineering have a significant promotional and information activity in order to implement energy infrastructure investments.

The Balokány-ligetért Association, Ökováros-Ökorégió Foundation, Pécs Green Circle Association and the Green Bridge Regional Energy Efficiency and Environment Foundation can play a role in raising awareness, education and promoting behaviour change.

Urban climate adaptation in the **transport sector means** a shift towards more sustainable and low-carbon mobility solutions to reduce greenhouse gas emissions. Meeting these challenges will require policy innovation, infrastructure investment, education and efforts to shift societal norms towards more sustainable transport practices. However, this shift will bring with it a number of challenges at the societal, organisational and individual levels.

Social challenges:

- Equity and access: the challenge is to ensure that all segments of society have access to sustainable transport options and that the benefits of the transition are shared equitably, avoiding the exclusion of the less advantaged from the benefits of clean transport.

- Behaviour change: the challenge is to encourage individuals to adopt sustainable transport behaviours such as public transport, carpooling, cycling or walking. There is resistance to changing well-established travel habits and personal preferences.

- Infrastructure investment: a challenge to allocate resources for the development of sustainable transport infrastructure, including public transport, cycle paths and charging stations for electric vehicles. Limited infrastructure can discourage the use of clean transport modes.

- Improving public transport: the challenge is to expand and improve public transport systems to make them a more attractive alternative to the private car. Inadequate public transport options can lead to congestion and air pollution.

- Urban planning and land use: the challenge is to integrate sustainable transport considerations into urban planning, promote mixed land use and reduce urban sprawl. Poorly designed urban areas can lead to longer commutes and increased car dependency.

Organisational challenges:

- Transforming the transport sector - Challenge to encourage traditional transport industries and transport service providers to shift to low-carbon technologies and services. Resistance to change in established business models and practices.

- Infrastructure development: the challenge is to develop a network of electric vehicle charging stations and other alternative fuel infrastructure. Limited charging infrastructure may hinder the uptake of electric vehicles.

- Regulatory framework: There is a need to develop and implement regulations that promote sustainable transport practices while taking into account emerging technologies. Ineffective regulation can hinder the adoption of clean transport options.

- Data integration and sharing: data sharing standards are needed to enable efficient transport planning, access to real-time information and multimodal travel options. Limited data interoperability can lead to inefficient transport systems.

Individual challenges:

- Perceived inconvenience: it is a challenge to convince individuals that sustainable transport options such as public transport or cycling are convenient and practical. Reluctance to use alternative modes of transport due to perceived inconvenience is reported as an effect.

- Lack of awareness: a challenge to educate individuals about the environmental impacts of transport choices and the benefits of low-carbon alternatives. Impacts may include lack of motivation to change behaviour due to limited understanding of the issue.

- Cost considerations: it is a challenge to address the perception that sustainable transport options are more expensive than private car ownership. This can act as a financial barrier to the introduction of clean transport options.

- Vehicle choice: Consumers need to be encouraged to choose low or zero emission vehicles, such as electric cars, instead of conventional internal combustion engine vehicles.

- Cultural norms: the challenge is to address cultural norms and preferences that prioritise car ownership and individual mobility over shared and sustainable transport options. Resistance to changing entrenched transport habits.

Sectoral barriers:

- Action areas and areas adjacent to city centres are characterised by high traffic congestion. Alternative mobility systems, traffic flow reduction and optimisation are key challenges. Systemic improvements are needed, as the city centre is a protected pedestrian zone in Pécs, with high traffic and parking problems around it. The aim is to create a mixed zone between the city centre and the suburbs, limiting vehicular traffic through traffic engineering and architectural solutions, and making it more pedestrian-friendly.

- The lack of intermodal ticketing and payment systems (to encourage modal shift).

- Time and economic constraints for people to use public transport.

- Insufficient flexibility to change urban forms and functions (to reduce travel times).

- Infrastructure and planning barriers to active transport (lack of pavements, cycle lanes, etc.)

Addressing these challenges requires cooperation between many actors:

The Municipality of Pécs and the Pécs Urban Development Zrt. on its behalf will ensure the overall project design and implementation. The Municipality is responsible for policy and regulatory challenges, for coordinating and making data available and for information transfer. The Department of Urban Management, the Department of Urban Architecture and Biokom NKft. are responsible for integrating sustainable transport considerations into urban planning, promoting mixed land use and reducing urban sprawl.

The Tüke Busz Zrt., the MÁV Zrt Pécs Regional Directorate and the Volánbusz Közlekedési Zrt. (VOLÁNBUSZ Zrt. Forgalmi és Kereskedelmi Directorate) Baranya Megyei Forgalmi Üzem) are responsible as transport service providers for infrastructure development, data integration and sharing, and the transformation of the transport sector. The University of Pécs and Kontakt-Elektro Ltd. play a key role in the establishment of the hydrogen economy, with a portfolio of projects for the deployment of hydrogen cell vehicles.

Logframe Consulting Kft. The University of Pécs and the Baranya County Vocational Training Centre play a role in the transfer of labour and the provision of training courses that meet the expectations of the workforce. In the prevention of energy poverty, the Municipality cooperates with the KRTK Institute for Regional Research and the RKI.

Important partners in the development of institutional renewable energy capacity are the Pécs School District, Pécs Vagyonhasznosító ZRt., Tettye Forrásház Zrt., Zsolnay Örökségkezelő NKft., PMJV Unified Health Institutions, Pécs housing cooperatives - LAKTÁSZ, Biokom NKft, Mecsekerdő Zrt., Duna-Dráva National Park Directorate and the National Chamber of Agriculture - Baranya county.

The Municipality Economic Development Department, the Pécs-Baranya Chamber of Commerce and Industry and the Baranya County Chamber of Engineering have a significant promotional and information activity in order to implement energy infrastructure investments.

The Balokány-ligetért Association, Ökováros-Ökorégió Foundation, Pécs Green Circle Association and the Green Bridge Regional Energy Efficiency and Environment Foundation can play a role in raising awareness, education and promoting behaviour change.

Urban climate adaptation in the transport sector means a shift towards more sustainable and low-carbon mobility solutions to reduce greenhouse gas emissions. Meeting these challenges will require policy innovation, infrastructure investment, education and efforts to shift societal norms towards more sustainable transport practices. However, this shift will bring with it a number of challenges at the societal, organisational and individual levels.

Social challenges:

- Equity and access: the challenge is to ensure that all segments of society have access to sustainable transport options and that the benefits of the transition are shared equitably, avoiding the exclusion of the less advantaged from the benefits of clean transport.

- Behaviour change: the challenge is to encourage individuals to adopt sustainable transport behaviours such as public transport, carpooling, cycling or walking. There is resistance to changing well-established travel habits and personal preferences.

- Infrastructure investment: a challenge to allocate resources for the development of sustainable transport infrastructure, including public transport, cycle paths and charging stations for electric vehicles. Limited infrastructure can discourage the use of clean transport modes.

- Improving public transport: the challenge is to expand and improve public transport systems to make them a more attractive alternative to the private car. Inadequate public transport options can lead to congestion and air pollution.

- Urban planning and land use: the challenge is to integrate sustainable transport considerations into urban planning, promote mixed land use and reduce urban sprawl. Poorly designed urban areas can lead to longer commutes and increased car dependency.

Organisational challenges:

- Transforming the transport sector - Challenge to encourage traditional transport industries and transport service providers to shift to low-carbon technologies and services. Resistance to change in established business models and practices.

- Infrastructure development: the challenge is to develop a network of electric vehicle charging stations and other alternative fuel infrastructure. Limited charging infrastructure may hinder the uptake of electric vehicles.

To ensure equity and access, the municipality works in cooperation with the Institute for Regional Research of the KRTK. The local Hungarian Cycling Club - Green Youth Association's Green Bike Group, Pécs Touring Cycling and Environment Club Association, Fittbike SE, Run for Trees Sports and Environment Foundation, Balokány-ligetért Association can play a role in raising awareness, education and promoting behaviour change.

Climate action in the **waste sector** includes reducing waste generation, promoting recycling and reuse, and implementing sustainable waste management practices to minimise environmental impacts. A successful transition in the waste sector requires policy innovation, investment in waste infrastructure, consumer education and efforts to promote a circular economy and sustainable consumption patterns. This transition is accompanied by various challenges at societal, organisational and individual levels.

Social challenges:

- Behavioural change: challenge to encourage individuals to adopt waste reduction, recycling and proper disposal behaviours. Resistance to change in established waste management habits and consumer practices.

- Waste minimisation: a challenge to promote a shift from a throwaway culture to one that emphasises waste reduction, repair and product longevity. Failure to do so will result in continued high levels of waste generation and landfill.

- Education and awareness: there is a need to raise public awareness of the environmental and climate impacts of inappropriate landfilling and the benefits of sustainable waste management practices. Impacts may include limited support for waste reduction initiatives and inadequate sorting of waste at source.

- Equity and access: the challenge is to ensure that waste reduction and recycling initiatives benefit all communities, including marginalised populations.

- Cultural and societal norms: addressing cultural norms that encourage over-consumption and disposability is a challenge, making it difficult to move towards more sustainable waste management practices. Resistance may arise to adopting waste-reducing behaviours and promoting reuse.

Organisational challenges:

- Waste management infrastructure: the challenge is to develop and maintain efficient waste management infrastructure, including recycling facilities, composting plants and waste-to-energy plants.

- Supply chain considerations:Challenge to encourage businesses to adopt sustainable packaging and production practices that reduce waste production.

- The shift to a circular economy: the challenge is to shift from a linear economy to a circular economy that promotes reuse, recycling and resource efficiency. Slow adoption of circular economy principles and increased pressure on natural resources may result.

- Government policies and incentives: effective policies, regulations and incentives are needed to promote waste reduction, recycling and sustainable waste management practices. Inadequate regulatory frameworks can hinder progress.

- Waste-to-energy: the challenge is to balance the promotion of waste-to-energy solutions with ensuring that they do not hold back waste reduction and recycling efforts. Over-reliance on waste-to energy technologies can hinder waste reduction targets.

Individual challenges:

- Consumer behaviour: encouraging individuals to make informed purchasing decisions, choose products with less packaging and participate in recycling schemes. The continued demand for single use products and packaging needs to be balanced.

- Waste separation and sorting: the challenge is to ensure that individuals properly separate recyclable, compostable and non-recyclable waste, both at home and in public places. There is a risk of contamination of recycling processes and increased processing costs.

- Convenience versus sustainability: the challenge is to balance the convenience of disposable products and packaging with the environmental benefits of waste reduction and recycling. Reluctance to introduce reusable alternatives due to perceived inconvenience.

- Lack of access to recycling: ensuring that individuals have convenient access to recycling facilities and collection services. Otherwise, recycling rates are limited in areas without adequate infrastructure.

- Lifestyle choices: encouraging a shift in consumer preferences towards longer-lasting and less environmentally damaging products. This can be hindered by fast fashion, disposable products and the continued demand for short-life electronics.

Sectoral barriers:

- From 1 January 2023, waste management will become a state responsibility, and the powers of local authorities will be reduced.

- Inefficient recycling processes

- Insufficient data collection

- Limited community involvement and support

- Lack of infrastructure for circular economy measures

Addressing these challenges requires cooperation between many actors:

The Municipality of Pécs and the Pécs Urban Development Kft. on its behalf will ensure the overall project design and implementation. Municipality of Pécs Department of City Operations, Tettye Forrásház Zrt., Biokom Nonprofit Kft., Dél-Kom Nonprofit Kft., MOHU MOL Hulladékgazdálkodási Zrt. Involved in the transition of the waste management sector. Kontakt-Elektro Kft.Ltd. In cooperation with the University of Pécs, Kontakt-Elektroelektro will play a role in the conversion of urban waste transport vehicles to hydrogen cell mode.

Municipality Economic Development Department, the Pécs-Baranya Chamber of Commerce and Industry, Ipark Pécs Kft., National Chamber of Agriculture - Baranya County plays an important role in the establishment of circular economy models and the organisation of the ecosystem related to the circular economy.

Körber Hungária Kft., BAT Pécsi Dohánygyár Kft., Holcim Cement Mo. Kft., Innovation Cluster/IT Hub, Harman Professional Kft., Hanon Systems Hungary Kft., Honsa Kft., Matro Kft., Somapak Kft., Terrán Tetőcserép Gyártó Kft., Dél-Dunántúli Gépipari Klaszter, Geochem Kft. Contributes to the implementation of circular business models.

Pécs City Naturefriends Association, Eco-City-Ecoregion Foundation, Green Bridge Regional Energy Efficiency and Environment Foundation, KRTK Institute for Regional Research contribute to education, attitude formation and changing consumer behaviour.

Climate Transition Opportunities:

As Pécs has already a decade history in climate transition, several foudations and related opportunities are stake in order to support the acceleration of the emission reduction process.

Human Resources: Being a University city with 20,000 students, educated and skilled human resources are available to dedicate to climate initiatives, to implement comprehensive sustainability programs.

Political and Public Will: The local government is committed politically to climate transition, and has demonstrated it through adoption of SEAP, later SECAP and now Urban Mission goals. Political will and public support is necessary to prioritize and fund climate transition projects.

Expertise: Expertise is avialble in the City that is needed to develop robust climate action plans and measure progress effectively.

Community Engagement: Pécs has a long tradition in community engagement, as a mid-size city has closer-knit communities, which can facilitate engagement and collaboration among residents, businesses, and local government in climate action initiatives.

Flexibility: Pécs as a mid-size city can be more nimble in decision-making and implementation, allowing for quicker adoption of sustainable practices and technologies.

Local Innovation: Due to the University of Pécs, the City can become hubs of innovation, experimenting with new technologies and sustainable practices, particularly in fields like hydrogen reasearch, applicability f geothermal energy, research on secondary material adaptation.

Quality of Life: The scale of Pécs can lead to a higher quality of life, which can attract eco-conscious residents and businesses. Attracting the youngsters to make a choice for Pécs having as residence and offering them jobs among thers in sustainability related industries is the key goal of Pécs.

Adaptive Planning: Pécs adopted a climate adaptation strategies that are tailored to its unique vulnerabilities, such as planning for extreme weather events, like extreme heat.

Sustainable Transportation: Pécs has prioritized sustainable transportation options like efficient public transport, cycling infrastructure, and pedestrian-friendly urban design.

Green Spaces: Pécs can enhance its environmental resilience by creating and preserving green spaces, urban forests, and other green infrastructure, like green roofs and walls.

Local Economies: Pécs can foster the growth of local, sustainable businesses, thereby reducing dependence on carbon-intensive industries.

Education and Awareness: Pécs in collaboration with NGOs can effectively educate its residents about climate change, sustainability, and the actions they can take to mitigate it.

In summary, while cities with around 150,000 inhabitants may face challenges related to limited resources and infrastructure constraints, they also have the advantage of being more agile, fostering strong community engagement, and serving as incubators for innovative climate solutions. Leveraging these opportunities can help them make meaningful progress in their climate transition efforts.

A-3.1: Systems and stakeholder mapping				
System description	**Stakeholders involved**	**Network**	**Influence**	**Interest**
	Municipality Economic Development Department	Network	Businesses in Pécs	Interest
	Municipality Urban Management Department	Local government system	City management	Decarbonising the industrial sector Building a circular economy
	Municipal Chief Architect	Local government system	Urban planning, urban management	Transport, land use
	Pécs City Development Zrt.	Local government system	Urban development	Transport, land use, urban landscape
	University of Pécs	University	Research and development, students and teachers	All sectors
	Pétáv Pécsi Távfűtő Kft.	Local government system	Population, institutions	Hydrogen economy, building sector, university degree and courses
	Pannon Thermal Power Plant Kft.	Heat energy services	Citizens, institutions, economic operators	Expansion of district heating services
	E.ON Dél-Dunántúli Áramhálózati Zrt.	Energy services	Citizens, institutions, economic operators	Biomass-based energy supply
Energy sector	Baranya County Vocational Training Centre	Education	Secondary school age	Electricity and energy services
	Pécs School District Authority	Education	Participants in public education	Vocational training
	Pécsi Vagyon-hasznosító Zrt.	Local government system	Institutions, businesses	Bottom sector, economic sector
	Pécs-Baranya Chamber of Commerce and Industry	Enterprises, economic operators	Entrepreneurial ecosystem	Decarbonisation of industrial actors, circular economy
	Tettye Forrásház Zrt.	Local government system	Population	Wastewater management
	Zsolnay Heritage Management Kft.	Local government system	Population	Building sector
	Municipality Unified Health Care Institutions	Local government system	Institutions	Health
	Housing cooperatives in Pécs - LAKTÁSZ	Housing cooperative	Homeowners	Building sector
	Ex-Ante Consultancy Kft.	Consultant	Urban development	Climate-neutral switchover

A-3.1: Systems and stakeholder mapping				
System description	**Stakeholders involved**	**Network**	**Influence**	**Interest**
Energy sector	BIOKOM Nkft.	Local government system	Population	Waste management
	Mecsekerdő Zrt.	AFOLU	Population, economic operators	Absorption capacity, green space management, forest management
	Danube-Drava National Park Directorate	AFOLU	Population, economic operators	Absorption capacity, green space management, forest management
	National Chamber of Agriculture - Baranya megye	AFOLU	Economic operators	Circular economy, agriculture
	Balokány-ligetért Association	Civil organisation	Population	Education, public actions
	Ecocity-Ecoregion Foundation	Civil organisation	Population	Education, public actions
	Pécs Green Circle Association	Civil organisation	Population	Education, public actions
	Green Bridge Regional Energy Efficiency and Environment Foundation	Civil organisation	Population	Education, public actions
	MECSEKÉRC Zrt.	University, Local government	Cleantech, Earth sciences	Energy systems
	Baranya County Chamber of Engineers	Entrepreneurial ecosystem	Entrepreneurial ecosystem	Circular economy
	Logframe Consultancy Kft.	University	Cleantech, Earth sciences	Energy systems
	KRTK Institute for Regional Studies	University	Population	Energy poverty
	Kontakt-Elektro Kft.	University of Pécs	Hydrogen economy	Transport, energy sector
Building energy	Municipality Economic Development Department	Local government system	Businesses in Pécs	Decarbonising the industrial sector Building a circular economy
	Municipality Urban Management Department	Local government system	City management	Transport, land use
	Municipal Chief Architect	Local government system	Urban planning, urban management	Transport, land use, urban landscape
	Pécs City Development Zrt.	Local government system	Urban development	All sectors

A-3.1: Systems and stakeholder mapping				
System description	**Stakeholders involved**	**Network**	**Influence**	**Interest**
Building energy	University of Pécs	University	Research and development, students and teachers	Hydrogen economy, building sector, university degree and courses
	Pétáv Pécsi Távfűtő Kft.	Local government system	Population, institutions	Expansion of district heating services
	Pannon Thermal Power Plant Kft.	Heat energy services	Citizens, institutions, economic operators	Expansion of district heating services
	E.ON Dél-Dunántúli Áramhálózati Zrt.	Energy services	Citizens, institutions, economic operators	Biomass-based energy supply
	Baranya County Vocational Training Centre	Education	Secondary school age	Vocational training
	Pécs School District Authority	Education	Participants in public education	Embedding sustainability in school education
	Pécsi Vagyon-hasznosító Zrt.	Local government system	Institutions, businesses	Bottom sector, economic sector
	Pécs-Baranya Chamber of Commerce and Industry	Enterprises, economic operators	Entrepreneurial ecosystem	Decarbonisation of industrial actors, circular economy
	Villány-Siklós Wine Route Association	Civil organisation	Wine businesses	Sustainable agriculture
	Zsolnay Heritage Management Kft.	Local government system	Population	Building stock
	Municipality Unified Health Care Institutions	Local government system	Population	Health
	Housing cooperatives in Pécs - LAKTÁSZ	Housing association	Homeowners	Building Energy
	Ex-Ante Consultancy Kft.	Consultant	Urban development	Climate change
	BIOKOM Nkft.	Local government system	Population	Waste management
	Mecsekerdő Zrt.	AFOLU	Population, economic operators	Absorption capacity, green space management, forest management
	Danube-Drava National Park Directorate	AFOLU	Population, economic operators	Absorption capacity, green space management, forest management
	National Chamber of Agriculture - Baranya megye	AFOLU	Economic operators	Circular economy, agriculture

A-3.1: Systems and stakeholder mapping				
System description	**Stakeholders involved**	**Network**	**Influence**	**Interest**
Building energy	"FutaPécs" Sports Association	Civil organisation	Population	Education, public actions
	Foundation for the Natural Values of Baranya	Civil organisation	Population	Education, public actions
	Baranya County Naturefriends Association	Civil organisation	Population	Education, public actions
	Run for the Trees Sports and Environment Foundation	Civil organisation	Population	Education, public actions
	Pécs Municipal Naturefriends Association	Civil organisation	Population	Education, public actions
	Balokány-ligetért Association	Civil organisation	Population	Education, public actions
	Misina Nature and Animal Protection Association	Civil organisation	Population	Education, public actions
	Hungarian Ornithological and Nature Conservation Society Baranya County Group	Civil organisation	Population	Education, public actions
	Pro Natura Karst and Cave Research Association	Civil organisation	Population	Education, public actions
	Pécs Student Council	Civil organisation	Population	Education, public actions
	Europe Direct	Civil organisation	Population	Education, public actions
	House of Educators Association	Local government system	Young people, population	Education, awareness-raising
Transport	Municipality Urban Management Department	Local government system	City management	Transport
	Pécs City Development Zrt.	Local government system	Urban development	Transport
	Eco-Cortex Kft.	Consultant	Urban development	Climate transition, circular economy
	Tüke Busz Zrt.	Local government system	Population	Absorption capacity, green space management, forest management
	University of Pécs	University	Research and development	Hydrogen in transport

A-3.1: Systems and stakeholder mapping				
System description	**Stakeholders involved**	**Network**	**Influence**	**Interest**
Transport	Ex-Ante Consultancy Kft.	Consultant	Urban development	Sustainable transport
	Centre for Economic and Regional Research Institute for Regional Studies	University	Research and development	Sustainable transport
	Hungarian Cycling Club local organisation - Green Youth Association Green Bike Group	Civil organisation	Population	Public transport actions
	Biokom NKft. (transport management, electric bicycles and scooters)	Local government system	City management	Transport organisation
	Pécs Hiking and Environmental Protection Club Association	Civil organisation	Population	Education, public actions
	MÁV Zrt Regional Directorate Pécs	Transport service provider	Population	Transport
	Volánbusz Közlekedési Zrt. Traffic and Commercial Directorate Baranya County Traffic Plant)	Transport service provider	Population	Transport
	Fittbike SE	Civil organisation	Population	Education, public actions
	Run for the Trees Sports and Environment Foundation	Civil organisation	Population	Education, public actions
	Balokány-ligetért Association	Civil organisation	Population	Education, public actions
	Kontakt-Elektro Kft.	Entrepreneurial ecosystem	Hydrogen economy	Transport
Waste management and circular economy	Pécs City Development Zrt.	Local government system	Urban development	Circular farming
	Tettye Forrásház Zrt.	Local government system	Population	Waste water and drinking water management
	Municipality Economic Development Department	Local government system	Entrepreneurial ecosystem	Decarbonisation of industrial processes
	Municipality Urban Management Department	Local government system	City management	Waste management
	Eco-Cortex Kft.	Consultant	Urban development	Climate transition, circular economy
	Biokom Nonprofit Ltd.	Local government system	City management	Waste prevention, waste management

A-3.1: Systems and stakeholder mapping				
System description	**Stakeholders involved**	**Network**	**Influence**	**Interest**
Waste management and circular economy	MOHU MOL Waste Management Ltd.	Utility	National waste management	Waste management
	Dél-Kom Nkft.	Local government system	City management	Waste management
	Holcim Cement Magyarország Zrt.	Entrepreneurial ecosystem	Decarbonising the industrial sector	Circular economy
	Ex-Ante Consultancy Kft.	Consultant	Urban development	Climate transition, circular economy
	Kontakt-Elektro Kft.	Entrepreneurial ecosystem	Hydrogen economy	Hydrogen in waste sector
	Körber Hungária Kft.	Entrepreneurial ecosystem	Decarbonising the industrial sector	Circular economy
	BAT Pécsi Dohánygyár Kft.	Entrepreneurial ecosystem	Decarbonising the industrial sector	Circular economy
	University of Pécs	University	Research and development	Circular economy
	Ipark Pécs Kft.	Entrepreneurial ecosystem	Decarbonising the industrial sector	Circular economy
	Innovation Cluster/IT Hub	Entrepreneurial ecosystem	Decarbonising the industrial sector	Circular economy
	Harman Professional Kft.	Entrepreneurial ecosystem	Decarbonising the industrial sector	Circular economy
	Hanon Systems Hungary Kft.	Entrepreneurial ecosystem	Decarbonising the industrial sector	Circular economy
	Honsa Kft.	Entrepreneurial ecosystem	Decarbonising the industrial sector	Circular economy
	Matro Kft.	Entrepreneurial ecosystem	Decarbonising the industrial sector	Circular economy
	Somapak Kft.	Entrepreneurial ecosystem	Decarbonising the industrial sector	Circular economy
	Pécs-Baranya Chamber of Commerce and Industry	Entrepreneurial ecosystem	Decarbonising the industrial sector	Circular economy
	Terrán Roof Tile Manufacturing Kft.	Entrepreneurial ecosystem	Decarbonising the industrial sector	Circular economy

A-3.1: Systems and stakeholder mapping				
System description	**Stakeholders involved**	**Network**	**Influence**	**Interest**
Waste management and circular economy	South Transdanubian Mechanical Engineering Cluster	Entrepreneurial ecosystem	Decarbonising the industrial sector	Circular economy
	Geochem Kft.	Entrepreneurial ecosystem	Decarbonising the industrial sector	Circular economy
	National Chamber of Agriculture - Baranya megye	AFOLU	Economic operators	Circular economy, agriculture
	Pécs Municipal Naturefriends Association	Civil organisation	Population	Education, public actions
	Ecocity-Ecoregion Foundation	Civil organisation	Population	Education, public actions
	Green Bridge Regional Energy Efficiency and Environment Foundation	Civil organisation	Population	Education, public actions
	KRTK Institute for Regional Studies	University	Population	Energy poverty

A-3.3: Description or visualisation of participatory model for the city climate neutrality – textual and visual elements

Participatory model for the city climate neutrality

Applied model: Mission Groups

Mission Group is a collaborative governance structure based around a specific mission, like climate transition challenge: reaching climate neutrality by 2030. It involves the city government, industry, academia, other actors. Members of the Mission Group commit some time and are supported by a core Mission Team on behalf of the city government. Transition team is set up in the Pécs Urban Development Company, being in 100% ownership to the local government.

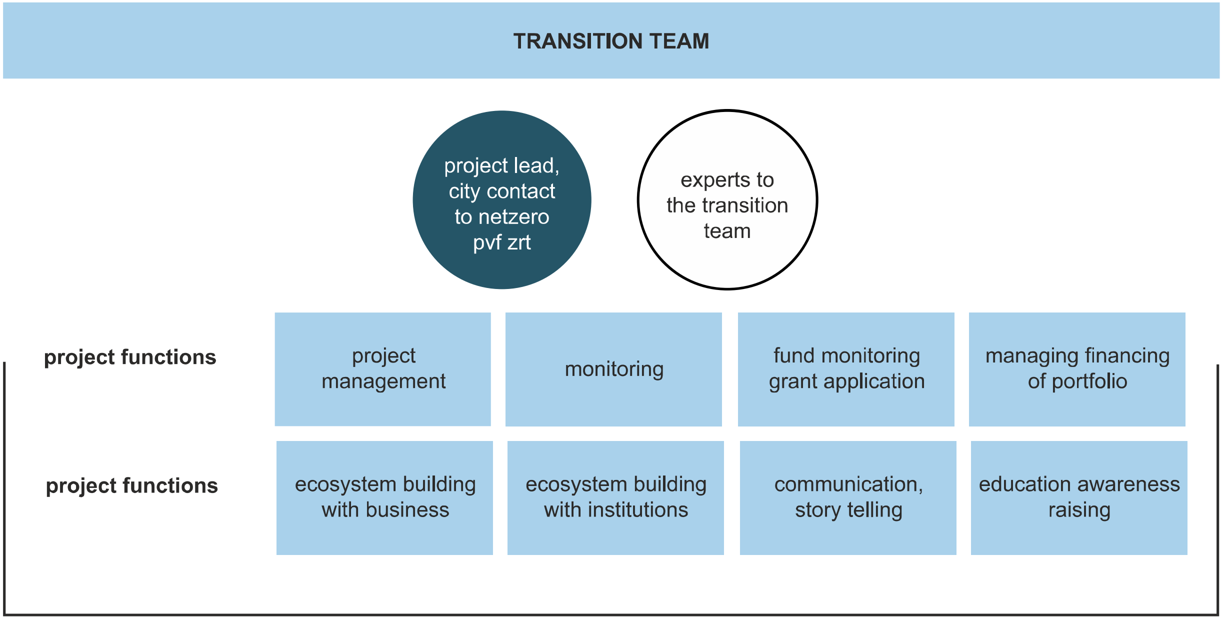


Figure 35: Transition team

Funcitons within the transition team:

- City Contact to NetZero Consortium
- Projectmanagers
- Experts to transition team
- Monitoring
- Communication and Story Telling
- Education and Awareness raising
- Fund monitoring and grant management
- Finance management
- Eco-system development with businesses
- Eco-system development with institutions

City Contact to NetZero Consortium:
Task: This role involves serving as the city's primary point of contact and liaison with external organizations, networks, and initiatives focused on achieving net-zero emissions. It involves collaboration, knowledge sharing, and alignment of the city's climate goals with broader sustainability initiatives.

Project Managers:
Task: Project managers are responsible for planning, executing, and overseeing specific climate transition projects and initiatives within the city. Their tasks include project planning, budget management, timeline tracking, and coordination of project teams.

Experts in the Transition Team:
Task: Experts in the transition team bring specialized knowledge in various fields, such as energy, transportation, urban planning, and environmental science. They provide technical expertise and guidance to inform climate policies and projects.

Monitoring:
Task: The monitoring function involves regularly collecting and analyzing data related to climate indicators, emissions, energy consumption, and the progress of climate initiatives. It plays a critical role in assessing the impact of climate actions and making data-driven decisions.

Communication and Storytelling:
Task: Communication and storytelling professionals are responsible for crafting and disseminating compelling narratives about the city's climate transition efforts. They engage with the public, stakeholders, and the media to raise awareness, build support, and highlight successes.

Education and Awareness Raising:
Task: This function focuses on designing and implementing educational programs, workshops, and awareness campaigns to inform residents, businesses, and local institutions about climate change, sustainability, and actions they can take to support the transition.

Fund Monitoring and Grant Management:
Task: Managing funding sources and grants is crucial for financing climate initiatives. This function involves tracking grant opportunities, securing funding, complying with grant requirements, and ensuring funds are used efficiently and transparently.

Financing Team:
Task: Finance managers focus on bankable projects, prepare business plans and project proposals for getting market funding. Overseeing innovating financing tools, negotiating with market actors, financial institutions, asset managers are the key tasks. The budgeting, accounting, and financial management of climate transition projects and the city's sustainability initiatives also lies with the team. They ensure financial sustainability and accountability.

Ecosystem Development with Businesses:
Task: This function focuses on building partnerships and collaborations with local businesses and industries to promote sustainable practices, green innovation, and support for city climate goals. It may involve incentives, certifications, and joint initiatives.

Ecosystem Development with Institutions:
Task: Building relationships with academic institutions, research organizations, and governmental bodies is essential. This function facilitates knowledge exchange, research collaboration, and policy alignment to advance climate transition.
Each of these functions plays a critical role in advancing urban climate transition efforts. Effective coordination among these roles and functions is essential for achieving sustainability, resilience, and the reduction of greenhouse gas emissions in urban areas.

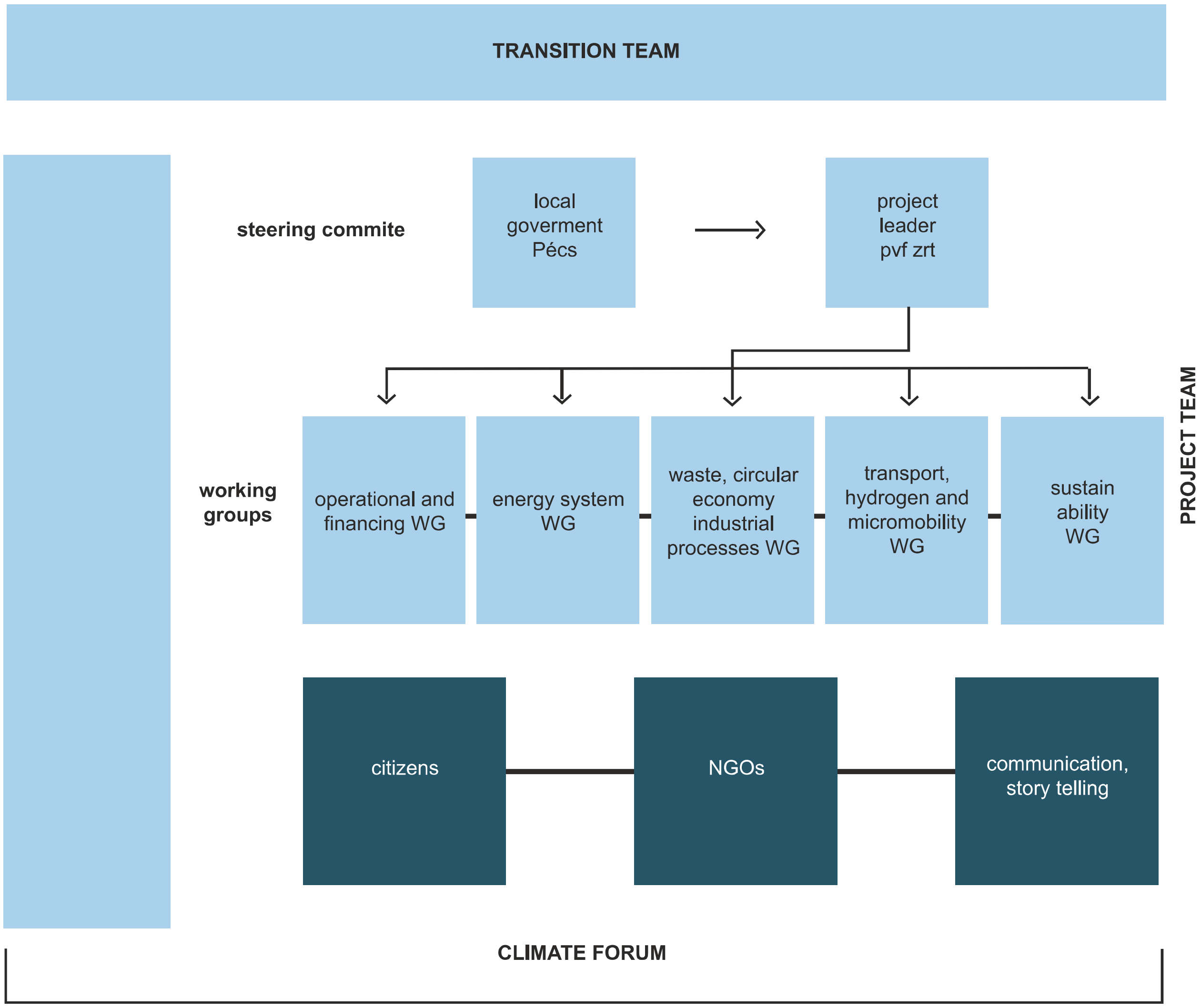


Figure 36: Pécs Climate Neutrality Platform

Steering Committee oversees the whole process, including the organisations/institutions that

- Responsible for the largest emissions in the city
- Providing a research and development background, innovation support
- They provide support at different levels of government decision-making, including legislative, regulatory and funding issues
- Ensure cross-disciplinary synergies for implementation

The working groups:

- Financing, smart city and operational
- Energy
- Liveable city
- Transport and Mobility
- Waste management and circular economy

The working groups are responsible for providing input to the launch of the Climate Neutral Action Plan and Investment Plan, according to the competence of their institution or organisation:

- Provide input data to develop a detailed carbon inventory
- Identifying available and applicable technologies
- Participation in the development of a project portfolio: identification of specific projects to reduce the CO2e value of the given organisation or emission sector, quantifying the carbon reduction potential
- Identifying alternative impact pathways, technological options
- Identification of the residual emission value by sector that cannot be provided by available technologies
- Definition of measures to trigger the residual value
- Identifying opportunities for cooperation between ecosystem actors, defining circular economic models
- Examination of the feasibility of the elements of the proposed project portfolio, analysis of the necessary legal framework
- Proposing a funding model for the proposed project portfolio elements, identifying business solutions beyond the funding sources
- Ensuring synergies between sectors

Cooperation between the Municipality of Pécs and the University of Pécs:
City undertakes

- It generates joint development objectives and cooperation frameworks with the University, as well as concrete projects.
- Provides urban resources for, participates in and contributes to the implementation of climate adaptation, carbon neutrality and energy resilience programmes and tenders initiated by the University.
- In relation to its remit, it provides support on relevant issues and projects being developed.

Participates in all planning, preparation and implementation processes required by the University.

University undertakes

- Contributing to the achievement of Pécs' carbon neutrality goals: participating in the development of the content of the Climate City Contract (CCC) initiated by the City for the "100 Climate Neutral Cities" programme and its periodic review, participating in the working groups and steering committee of the • Climate Neutrality Platform established by the City, and signing the non-binding CCC (Climate City Contract).
- To offer and secure the University's existing competences, awarded and ongoing tenders and skills to the City in relation to the urban green transition process, to provide the R&D background.
- Providing information on the development of available technologies in terms of technological pathways
- Developing and implementing joint projects with the City
- Outline solutions to reduce university emissions

Climate forum

Citizen involvement is crucial for the success of urban climate transition initiatives. Engaging residents in the planning, implementation, and monitoring of climate actions not only fosters a sense of ownership but also brings diverse perspectives and innovative ideas to the table. By actively involving citizens in urban climate transition efforts, cities can harness local knowledge, build community resilience, and ensure that climate actions align with the needs and aspirations of their residents, ultimately leading to more successful and sustainable outcomes.

Citizen involvement in Pécs during the planning phase:
As of June 2022, we have involved the population in the following events, around 1700 people:

- City Children’s Day
- City Centre Kindergarten “Together as One” integrated talent showcase closing conference
- Landscapes, Ages, Museums
- “We go to the house!” Foosball tournament
- Opening of the new Pécs Market Hall
- Szamárfül Festival
- Pécs Zoo Adoption Day
- Pécs Zoo Halloween
- Kindergarten of the Eastern City District Vasasi
- Learning Festival in the framework of the Unesco Learning City title

Socialisation of the Pécs Climate City Contract, awareness raising, sensitisation and education, involvement of the public

Achieving climate neutrality requires promoting and supporting public awareness. The population and society need to develop new approaches, mindsets and behaviours in order for the City of Pécs to reach its climate target. The role of mind-shifting is to develop and implement activities, programmes and initiatives that help people to recognise the challenges of climate change and their responsibilities, and to encourage them to take the necessary actions to achieve climate neutrality.

The main areas to focus on in this process are:

- **Raising awareness:** it is important that people understand the causes and consequences of climate change and the importance of climate neutrality. Awareness needs to be raised about the importance of reducing emissions and developing sustainable lifestyles.
- **Education and information:** educational institutions and the media need programmes and content to help people learn how to become climate neutral. Easy access to information and a variety of educational materials will help more people to access and understand the steps to achieve climate neutrality.
- **Encouragement and motivation:** people should be encouraged to change their lifestyles and choose more sustainable alternatives in their daily lives as well in the progress towards climate neutrality.
- **Leading by example:** it is important that community leaders, businesses and institutions also lead by example with climate-neutral measures. Demonstrating good practices and supporting innovation can inspire others and help achieve climate neutrality.

- Social dialogue and cooperation: social dialogue and cooperation need to be strengthened to achieve climate neutrality. Building partnerships between different interest groups, institutions and organisations can help to cooperate and increase the effectiveness of action.

It is important to take into account the local, regional and national environmental, social and economic context when designing and implementing activities. Policy programmes and initiatives should have detailed objectives, effective communication and evaluation mechanisms in order to contribute effectively to achieving climate neutrality.

The target group of socialisation:

- the population of Pécs; the educational institutions of Pécs
- the young age group of the city (kindergarten, primary and secondary school pupils, students);
- the city institutions - health and social institutions

The main thematic areas of socialisation:
Energy theme: Energy is key to achieving climate neutrality and sustainability. Energy production, use and efficiency have a major impact on greenhouse gas emissions and climate change.

The most important areas in the field of energy:

- Renewable energy sources (such as solar, wind, hydro and geothermal energy play a prominent role in climate-neutral energy production);
- energy efficiency (e.g. making buildings, transport and industrial processes more efficient reduces energy use and emissions).
- Energy efficiency measures can include better insulation, the use of energy-saving equipment and the introduction of smart energy systems);
- energy storage (Energy storage allows a balance between energy demand and energy supply, thus improving the flexibility and efficiency of energy production processes);
- energy saving (by using energy consciously, we can create a more sustainable future for ourselves and future generations. Energy saving measures improve the quality of life and comfort of the population. Energy-saving appliances and solutions are generally more efficient and environmentally friendly, helping to keep homes cooler or warmer and properly lit. This increases comfort and reduces consumer dissatisfaction.)

Transport theme:
The transport sector is a major contributor to greenhouse gas emissions and climate change. A number of measures are therefore needed in the transport sector to achieve climate neutrality. People need to be informed about the benefits of sustainable transport, alternative options and measures. In addition, transport policy and regulation should include incentives to promote sustainable transport and achieve climate neutrality.
Key areas for transport:

- electromobility;
- public transport;
- cycling and walking;
- efficient transport planning;
- fuel efficiency;
- distance reduction and teleworking.

Waste management:
Waste management and waste reduction are key to achieving climate neutrality and sustainability. Proper waste management, recycling and the development of a circular economy allow for the efficient use of raw materials and the reduction of greenhouse gas emissions. People should be informed about good waste management, the benefits of recycling and environmental measures. Waste planning and regulation are also key to promoting sustainable waste management.
The most important areas on waste:

- waste reduction;
- separate waste collection;
- composting;
- waste recycling;
- waste-to-energy recovery.

Citizen Advisory Groups: Forming citizen advisory groups or committees focused on climate and sustainability. Including representatives from various demographic groups to ensure diverse perspectives are considered in decision-making.

Ways to reach the population:

- Training and information workshops on “energy”, “transport” and “waste management”,
- Operation of an information stand and promotion of the spirit and content of the Pécs Climate Agreement within the framework of the annual Pécs Learning City Festival among the youth and the general public.
- Holding of citizens’ forums by neighbourhood
- Professional round table discussions
- Organising community actions for citizens on energy, transport and waste management
- Knowledge and skills workshops for children and youth

Further tool to be applied during the next phase:
Community Workshops and Meetings: Organizing community workshops, town hall meetings, and public consultations to gather input and feedback on climate policies and projects. Using these platforms to educate residents about climate issues and share information about the city’s sustainability goals.
Citizen Advisory Groups: Forming citizen advisory groups or committees focused on climate and sustainability. Including representatives from various demographic groups to ensure diverse perspectives are considered in decision-making.

Educational Campaigns: Launching educational campaigns to raise awareness about climate change, sustainable behaviors, and the role residents can play in reducing emissions. Offering workshops and training on energy conservation, waste reduction, and sustainable transportation.
Citizen Science Programs: Engaging residents in citizen science programs to collect environmental data, such as air quality measurements or biodiversity surveys. Using this data to inform climate policies and enhance environmental monitoring.

Community-Based Projects: encouraging and supporting community-led climate projects, such as tree planting, community gardens, or local clean energy initiatives. Providing resources and guidance to help residents implement these projects effectively.

Youth Engagement: Fostering youth engagement by involving schools and youth organizations in climate education and action. Creating opportunities for young people to voice their concerns and ideas for a sustainable future.

Feedback Mechanisms: establishing feedback mechanisms, such as hotlines, websites, or mobile apps, where residents can report environmental issues or suggest improvements related to climate and sustainability.

The City of Pécs understands, integrating marginalized groups into urban climate transition initiatives is essential to ensure that climate actions are inclusive and equitable. Marginalized communities often face disproportionate environmental and climate-related challenges, and their perspectives and needs must be prioritized in climate planning. Integrating marginalized groups in urban climate transition requires a commitment to social justice, equity, and inclusivity. By actively involving these communities and addressing their unique needs, Pécs creates climate policies and projects that promote resilience, reduce disparities, and contribute to a more equitable and sustainable urban future.

Further tool to be applied during the next phase
Community Engagement and Representation: establishing mechanisms for meaningful participation of marginalized communities in decision-making processes related to climate policies and projects.

Equitable Access to Resources: allocating resources, funding, and support to projects that directly benefit marginalized communities, such as energy efficiency upgrades for low-income housing or green infrastructure in underserved neighborhoods. Ensuring that funding mechanisms and grants are accessible to community-based organizations serving marginalized populations.

Co-Design and Co-Implementation: engaging marginalized communities in co-designing and co-implementing climate projects that directly affect their neighborhoods. Collaborating with community leaders, organizations, and residents to identify priorities and develop tailored solutions.

4 Part B – Pathways towards Climate Neutrality by 2030

4.1 Module B-1: Climate Neutrality Scenarios and Impact Pathways

B-1.1: Impact pathways

Sector	Subsector	Systemic drivers	Early changes (1-2 years)	Late results (3-4 years)	Direct impacts (emission reductions - kt CO2e)	Indirect effects (co-benefits)
Transport	Reduced demand for motorised passenger transport	Regulation, governance	Incentive schemes, testing of zero-emission zones, modification of parking schemes, understanding spatial patterns of car use	Behavioural change, adoption as a result of community planning,	32	improved air quality, reduced noise pollution, positive health effects, economic benefits
		Education, social innovation	Dialogue with car owners	Reduction in public parking spaces		
	Switch to public transport and non-motorised transport	Infrastructure	P+R, B+R parking spaces at the bus terminus	The spread of alternative transport modes	5	improved air quality, positive health effects, urban liveability Reduced Traffic Congestion, Social Interaction, Reduced Stress
		Education, social innovation	Dialogue with car owners	Commuters use public transport in large proportions		
	Enhanced car-pooling communities	Governance, regulation	Large employer partnerships	The spread of alternative transport modes		
		Education, social innovation	Progress in the adoption of car-sharing solutions	Private car use rate decreases		

Buildings and heating	Electrification of passenger cars and motorcycles	Technology	Decarbonising car transport, building charging capacity	Decarbonising car transport, building charging capacity	13	Noise Reduction, Lower
		Education, attitude shaping	Getting to know electric car use Learning about charging options, optimisation	Getting to know electric car use Learning about charging options, optimisation		Operating Costs, Energy Security
		Funding	Savings at individual level	Savings at individual level		
	The electrification of buses	Technology	All-electric fleet by 2027	Building and optimised use of charging capacity is achieved	1	Reduced Air Pollution, Quiet Operations
		Management, governance	Bus transport will be optimally accessible for commuters	Implementation of demand-driven start-up		
	Optimised logistic	Infrastructure	Understanding the spatial patterns of lorry traffic	Construction of city-side transfer stations	10	Improved Air Quality, Reduced Noise Pollution, Faster Delivery Times
		Governance, regulation	Diverting freight traffic from inner urban spaces	Diverting freight traffic from inner urban spaces, carbon contribution		
	Electrification of lorries	Technology	decarbonising truck transport, building charging capacity, testing mercury technology	decarbonising truck transport, building charging capacity, using hydrogen technology	2	Noise Reduction, Energy Security
		Education, attitude shaping	Hydrogen ecosystem build-up	Optimisation of transhipment techniques		
	Building renovations	technology	5% per year building stock renovation, implementation of test projects, smart meter roll-out	5% per annum building stock renovation continues, microgrid systems, energy communities in operation	4	Health Benefits, Increased Property Value, Enhanced Comfort

Buildings and heating	New, energy-efficient buildings	Governance	Operation of the Green Office, introduction of a building renovation passport scheme, building stock survey,	Progress on building stock renovation in cooperation with the Green Office		Lower Operating Costs, Environmental Sustainability, Improved Indoor Comfort, Innovation and Job Creation
		Education, attitude shaping	Tools to achieve energy efficiency at household level, learning how the energy community works	Tools to achieve energy efficiency at household level		
		technology	Buildings meeting at least BB standard, fossil fuel free buildings	Buildings meeting at least BB standard, fossil fuel free buildings		
	Efficient lighting and appliances	Education, attitude shaping	Building decarbonisation options, low carbon building material options, green walls, green roof options	Building decarbonisation options, low carbon building material options, green walls, green roof options	1	
		Technology, infrastructure	Start LED replacement of urban street lighting, LED bulb replacement in buildings	Full decarbonisation of urban street lighting, widespread use of smart solutions, full use of LED lighting in buildings, substitution of natural gas for cooking in prefabricated buildings		Longer Lifespan, Environmental Benefits, Improved Lighting Quality
	Optimised logistic	Education, attitude shaping	LED lighting and large consumers, savings potential, energy efficiency effects	LED lighting and the potential savings and energy efficiency impacts of large consumers	14	

Buildings and heating	New, energy-efficient buildings	Technology	district heating for institutional actors, substitution of natural gas for heating with heat pump systems, piloting of ground source heat pump systems	Replacement of natural gas heating with heat pump systems, no new gas boiler installation	74	Improved Air Quality, Energy Security
		Shaping attitudes, education	Presentation of alternative systems, information on panel reconstruction, application of heat pump systems	Presentation of alternative systems, information on panel reconstruction, application of heat pump systems		
Electricity	Decarbonising electricity generation	Technology, infrastructure	Increasing utility-scale and domestic, institutional solar capacity Building hydrogen storage and electrolysis capacity, microgrid systems, storage capacity, energy community test projects	Implementing carbon-free electricity supply for urban consumption Use of hydrogen capacity in renewable energy mix, microgrid systems, storage capacity, development of energy communities	139	
		Education, attitude shaping	Information on the deployment of small household power plants, microgrid systems, storage options, energy communities	Information on the deployment of small household power plants, microgrid systems, storage options, energy communities		Improved Air Quality, Energy Security
Waste	Increased waste recycling	Technology	Further investments in the waste and waste water sector to improve the efficiency of selective waste treatment	Biogas utilisation in waste treatment, development of solar drying capacity in the wastewater sector, increasing the efficiency of selective waste treatment	1	Resource Conservation, Economic Opportunities, Lower Pollution
		Shaping mindsets, social innovation	Waste prevention education Other options for selective waste management	Waste prevention centre		

B-1.2: Presentation of impact pathways

Reduced demand for motorised passenger transport

The main barriers to carbon neutralisation in the subsector are influenced by attitudinal, habitual and constraint factors. The use of private cars is an integral part of everyday life, and its partial or total abandonment can only be expected if the population can carry out their daily routine to the same standard without the car.
Results can be achieved through regulatory and governance interventions on the one hand, and education and social innovation interventions on the other. Regulatory and governance measures include the development of various incentive schemes, testing of zero-emission zones, modification of parking systems, while a strong emphasis needs to be placed on understanding spatial patterns of individual car use and car use patterns. The first years of action are expected to result in behavioural changes, adoption as a result of community planning, and a reduction in the number of on-street parking spaces.
In addition, education and social innovation tools will contribute to reducing private car use. Dialogue with car owners, community planning sessions and the introduction of test periods will help to shape public attitudes and the optimal structures of the compact city. The measures will lead to the medium-term introduction of alternative modes of transport.

Reducing motorized passenger transportation contributes to cost savings, enhanced mobility options, reduced greenhouse gas emissions. Reduced personal vehicle use can lead to lower fuel and maintenance costs for individuals, making transportation more affordable. Promoting alternatives like public transportation, biking, and walking provides residents with more diverse and sustainable mobility options, increasing accessibility to jobs, education, and services. Although the primary goal is to reduce transportation-related emissions, it is worth reiterating that reducing motorized passenger transportation need significantly contributes to climate change mitigation.
Co-benefits:

- **Improved Air Quality:** Fewer vehicles on the road can lead to reduced air pollution, resulting in better air quality and decreased respiratory illnesses, especially in urban areas.
- **Health Benefits:** Encouraging walking and cycling can promote physical activity, reducing the risk of obesity and related health conditions. This leads to improved public health and decreased healthcare costs.
- **Reduced Noise Pollution:** Fewer vehicles on the road result in reduced noise pollution, contributing to a quieter and more pleasant urban environment.
- **Economic Benefits:** Promoting non-motorized transportation can stimulate local economies by supporting small businesses and promoting local tourism.

Switch to public transport and non-motorised transport

A major obstacle is the route that the residents concerned wish to take and the extent to which public transport is optimised for them. Another important consideration is the convenience factor, which does not take into account waiting times. This requires the implementation of infrastructure, education and awareness-raising measures. On the infrastructure side, the integration of bus terminals and P+R and B+R car parks, facilitating the change from car to bus, and, in time, the availability of car-sharing systems will help to encourage people to change their mode of transport. There is a need for dedicated bus lanes at interchanges, as well as the further development of cycle lanes, which can be used by other alternative e-vehicles. Optimisation of routes and the introduction of demand-driven services will contribute to public acceptance and greater use of public transport. The introduction of bicycles and scooters on certain routes could also increase the take-up of public transport. In the field of education and awareness-raising, dialogue with car owners, a detailed understanding of their needs and choices, and the introduction of test periods will help to raise public awareness and shape the optimal structures of the compact city.

Within 3-4 years, a large proportion of commuters will use public transport for work purposes, but the proportion will also increase significantly among the urban population.
Shift to Public & Non-Motorized Transport contributes to reduced traffic congestion, reduced energy consumption, and cost savings. Increased use of public transportation and non-motorized modes like walking and cycling can reduce traffic congestion, leading to shorter commute times and reduced stress for commuters. Public transport systems are generally more energy-efficient per passenger km than private vehicles, contributing to energy conservation and reducing greenhouse gas emissions. Using public and non-motorized transportation options can save individuals money on fuel, parking, and vehicle maintenance, making transportation more affordable.
Co-benefits:

- **Improved Air Quality:** A shift away from private vehicles can lead to reduced air pollution, resulting in better air quality and improved respiratory health for residents.
- **Health Benefits:** Promoting non-motorized transport encourages physical activity, reducing the risk of obesity and related health issues, which leads to improved public health and reduced healthcare costs.
- **Urban Livability:** Encouraging public and non-motorized transport can lead to more pedestrian-friendly and bike-friendly cities, fostering vibrant and connected communities.

Enhanced car-pooling communities

Car use is currently dominated by individual car use, with an average of 1.3 people using each car, which is attributed to convenience and quality of life factors. These barriers can be addressed primarily through management and regulatory interventions, but also through educational and social innovation interventions. The development of managed options to increase the popularity of car sharing, such as contracts with large employers and the development of related apps, can be developed to provide clear benefits to users. Education and social innovation will focus on awareness-raising, communicating the benefits of car-sharing and thus improving the uptake of car-sharing solutions. In the medium term, car-sharing systems will be made available in parking centres, major bus stations and interchanges, and will be supported by an appropriate application system.
Increased Carpooling contributes to reduced traffic congestion, cost savings, and emissions reduction. Carpooling reduces the number of vehicles on the road, easing traffic congestion and improving commute times. Carpooling allows individuals to share transportation costs, such as fuel and tolls, leading to financial savings for participants. Fewer vehicles on the road means reduced greenhouse gas emissions and improved air quality.
Co-benefits:

- **Reduced Traffic Congestion:** Carpooling reduces the number of vehicles on the road, easing traffic congestion and improving commute times.
- **Social Interaction:** Carpooling fosters social interactions among commuters, potentially reducing feelings of isolation and promoting community building.
- **Reduced Stress:** Sharing the commute can reduce stress for participants by allowing them to relax or socialize during the journey.

Electrification of passenger cars and motorcycles

The uptake of electric cars in private transport is currently facing technological, attitudinal and financing barriers. Although the number of electric cars in Pécs is increasing year on year, their availability is not yet sufficient to allow their widespread use, given the income situation. On the one hand, as technology develops, the uptake of electric cars is expected to accelerate and the related charging capacity will be developed by the business sector in cooperation with the city. However, education and awareness-raising are also needed to familiarise the public with the specificities of electric car use, so that they can make the right choices when buying an electric car.

Education also includes charging facilities, including two-way charging where appropriate. There is also a significant financing barrier to the uptake of electric cars, depending on the evolution of electricity prices and the potential payback of the recharging option. The need to make leasing and other financing and partial support schemes available to accelerate uptake.

Electrification of Cars and Motorcycles contributes to reduced greenhouse gas emissions and energy efficiency. Electric vehicles produce fewer or no tailpipe emissions, contributing to a reduction in greenhouse gas emissions. Electric vehicles are often more energy-efficient than traditional internal combustion engine vehicles, reducing energy consumption.
Co-benefits :

- **Noise Reduction:** Electric vehicles are quieter, contributing to reduced noise pollution in urban areas.
- **Lower Operating Costs:** Electric vehicles generally have lower operating costs, including lower f fuel and maintenance expenses.
- **Energy Security:** Electrification of transportation reduces dependency on fossil fuels, enhancing energy security.

The electrification of buses

To offset the emission value of diesel buses, Tüke Busz Zrt. has developed a decarbonisation plan to convert its fleet to electric buses by 2027 and provide the related charging capacity. The government programme provided the opportunity to use a test mode in 2020, so the first vehicles were put into operation in Pécs as a six-month experience. Experience is being gathered and adapted on an ongoing basis. In addition to the technology, management and steering tasks will be addressed to optimise the availability of bus transport for commuters, and progress is being made in the implementation of demand-driven bus services.
Electrification of Buses contributes to reduced operating costs, energy efficiency and emissions reduction. Over the long term, electric buses can have lower operating costs due to lower fuel and maintenance expenses. Electric buses are often more energy-efficient than traditional diesel buses. Electrifying bus fleets significantly reduces greenhouse gas emissions, contributing to climate change mitigation.
Co-benefits:

- **Reduced Air Pollution:** Electric buses produce no tailpipe emissions, improving air quality and reducing health risks for passengers and communities along bus routes.
- **Quiet Operations:** Electric buses are quieter than conventional buses, reducing noise pollution in urban areas.

Optimised logistics

Road 6 runs through the centre of Pécs, causing significant traffic congestion. Several plans have already been made to solve this problem, and an alternative route of the main road 6 has been identified, but its construction can only be planned in the very long term.The city can plan with the current road network until 2030, taking into account the capital situation of domestic enterprises and the investment constraints of micro and small enterprises. For infrastructure interventions in the short term, it is necessary to understand the spatial pattern of both small and large trucks, split between transit vehicles and the destination traffic in Pécs. It is necessary to have a detailed picture of the patterns of use over time, as well as the utilisation rates of trucks, the categories of goods. On this basis, measures can be defined to optimise logistics. Transhipment stations are being built in the three industrial areas, which will allow a higher proportion of goods arriving in the city by diesel vehicle to be transported by electric vehicles. As a result of the regulatory and management measures, through traffic will be completely diverted away from residential areas along the M60 motorway, with only vans allowed to enter the inner urban area. A carbon contribution scheme will also be introduced, which will feed into the implementation of carbon offsetting.

Optimized Logistics contributes to efficiency gains and reduced emissions. Optimizing logistics reduces transportation-related inefficiencies, leading to cost savings and reduced energy consumption. Streamlining supply chains and logistics operations can lead to reduced greenhouse gas emissions and improved sustainability.
Co-benefits :

- **Improved Air Quality:** Fewer vehicles on the road can lead to reduced air pollution, resulting in better air quality and decreased respiratory illnesses, especially in urban areas.
- **Reduced Noise Pollution:** Fewer vehicles on the road result in reduced noise pollution, contributing to a quieter and more pleasant urban environment
- **Faster Delivery Times:** Optimized logistics can result in faster and more reliable delivery times, benefiting businesses and consumers.

Electrification of lorries

The switch to electrification of trucks even raises technological barriers in addition to income and price availability. In long-distance transport, the electrification of heavy goods vehicles is not yet feasible with current technology, although improvements are expected in the coming years. For vans, the income situation of micro and small enterprises is a barrier. Another issue to be addressed is that transhipment is only possible for certain goods. The decarbonisation of vans should be encouraged to the greatest extent possible, with favourable leasing and other financing schemes, and partial subsidies. The development of filling capacity is also a prerequisite for uptake. In parallel, hydrogen technology is being tested, a hydrogen ecosystem is being built, and preparations are being made to convert vehicles operated by city operators, taxi operators, transport companies and the local cement plant's logistics provider to hydrogen cells by assessing charging needs, capturing solar capacity for green hydrogen production, and building demonstration electrolysers and charging stations. The deployment of hydrogen refuelling capacity is a prerequisite for the uptake of hydrogen vehicles and is planned. In addition to investment in technology and infrastructure, there is also a need for awareness-raising and education to provide information on the feasibility of hydrogen vehicles and the optimisation of transhipment techniques. This will be facilitated by the training of fuel cell and hydrogen technology engineers/ technicians, which is only available at the University of Pécs. The training of specialists will also provide a solid technical basis for the University's electrolyser development RDI project, which will be implemented in several stages in cooperation with Kontakt-Elektro Kft., ranging from a few kW to 1 MW.Regulatory instruments are needed to stimulate the uptake of electric and hydrogen cell vehicles.
Electrification of Trucks contributes to reduced emissions, cost savings and energy efficiency. Electrification of trucks reduces greenhouse gas emissions and air pollution, improving environmental and public health outcomes. Over the long term, electric trucks can have lower operating costs due to reduced fuel and maintenance expenses. Electric trucks are often more energy-efficient than traditional diesel trucks.
Co-benefits :

- **Noise Reduction:** Electric trucks are quieter, reducing noise pollution in urban and residential areas.
- **Energy Security:** Electrification of truck fleets reduces dependency on fossil fuels, enhancing energy security.

Building renovations

One of the biggest challenges is the deep renovation of the building stock, which faces significant funding gaps. The accounting system for solar power plants, the lack of technological solutions for the storage capacity beyond the sun, the lack of regulation of energy communities and the barriers to the use of microgrid systems are important obstacles.

On the technology and infrastructure side, a number of tests and pilot projects are being carried out for both conventional and pnael buildings, which can be scaled up to increase the volume of renovated buildings. It is necessary to encourage the spread of smart meters, which provide building owners with up-to-date information on energy consumption and the potential for efficiency measures. Financing schemes and subsidies should be made available, and there should be ongoing contact and communication with the public. The Green Office will take the lead in this, responsible for implementing the building renovation passport scheme, surveying the building stock, providing information on subsidy opportunities, coordinating package renovation. The measures will result in the deep renovation of 5% of buildings per year. A number of educational and awareness-raising measures are needed to ensure that the public's knowledge of energy efficiency, the potential of energy communities and the potential of smart and microgrid systems is as comprehensive as possible.
Building Renovations contributes to improved energy efficiency and energy cost savings. Renovations that focus on building envelopes (e.g., insulation, windows, roofing) enhance energy efficiency, reducing heating and cooling costs for occupants. Reduced energy consumption leads to lower utility bills for building occupants, which can result in long-term cost savings.
Co-benefits:

- **Health Benefits:** Improved insulation and ventilation can lead to better indoor air quality, reducing the risk of respiratory issues and enhancing occupant health and well-being.
- **Increased Property Value:** Energy-efficient building renovations often increase the market value of properties, benefiting homeowners and landlords.
- **Enhanced Comfort:** Properly insulated and sealed building envelopes contribute to more comfortable indoor environments by minimizing drafts and temperature fluctuations.

New, energy-efficient buildings

For new buildings, many of the requirements for decarbonisation can already be met. Buildings that meet at least the BB standard will be constructed and will include a fossil-free heating solution, with district heating or heat pump systems. An obstacle is that restrictive criteria can only be set at the level of the municipality, which has limited discretion. The income situation can also be a constraint due to the higher one-off investment costs, but the medium to long-term payback is more favourable overall.
Through awareness-raising, ecosystem building and the development of circular business models, the city will also pay attention to explore and implement zero carbon building options (use of electric machinery, waste disposal, recycled building material rates), test low carbon building material options, expect green walls and green roofs to meet the carbon offset obligation.
New Energy-Efficient Buildings contributes to lower operating costs and environmental sustainability. New energy-efficient buildings are designed to consume less energy, resulting in reduced operating costs for heating, cooling, and lighting.Energy-efficient buildings have a smaller carbon footprint, contributing to climate change mitigation and sustainability goals.
Co-benefits:

- **Lower Operating Costs:** New energy-efficient buildings are designed to consume less energy, resulting in reduced operating costs for heating, cooling, and lighting.
- **Environmental Sustainability:** Energy-efficient buildings have a smaller carbon footprint, contributing to climate change mitigation and sustainability goals.
- **Improved Indoor Comfort:** High-performance building designs prioritize occupant comfort through optimized temperature control, daylighting, and acoustics.
- **Innovation and Job Creation:** The construction and maintenance of energy-efficient buildings can stimulate economic growth and job creation in the green building sector.

Efficient lighting and appliances

Around one third of the city's street lighting is currently LED, and full modernisation is underway. LED bulb replacements in buildings, residential properties and institutions are also ongoing, and appropriate financing and subsidy schemes need to be secured. The full decarbonisation of urban street lighting, the widespread use of smart solutions, the full use of LED lighting in buildings, the replacement of cooking gas in prefabricated buildings. Educational and awareness-raising measures will be implemented on LED lighting and large consumers, their potential for savings and energy efficiency effects.
Efficient Lighting & Appliances contributes to reduced energy consumption. Energy-efficient lighting and appliances use less electricity, leading to lower energy bills for households and businesses.
Co-benefits:

- **Longer Lifespan:** Efficient lighting and appliances often have longer lifespans, reducing the frequency of replacements and associated costs.
- **Environmental Benefits:** Lower energy consumption results in reduced greenhouse gas emissions and decreased strain on the electricity grid.
- **Improved Lighting Quality:** Energy-efficient lighting solutions often provide better quality and adjustable lighting, contributing to enhanced comfort and productivity in commercial and residential spaces.

Decarbonising heating production

Decarbonising heating, in particular the phasing out of natural gas, is a major challenge. Alternatives to natural gas heating are still limited, technology, access to suitable fuels is limited, hydrogen is not yet an alternative for home heating. Solutions include the connection of institutions and new buildings to the district heating network, and the spread of heat pump systems. Testing ground source heat pump systems and their effectiveness could also be an alternative. Regulatory measures will be taken to limit the installation of new gas boilers. A number of awareness-raising and information events should be organised to provide detailed information on available solutions, technologies and their costs, including information on alternative systems, panel reconstruction, heat pump systems and the use of heat pumps.
Decarbonizing Heating Generation contributes to emissions reduction and energy efficiency. Shifting to low-carbon or carbon-neutral heating sources reduces greenhouse gas emissions, contributing to climate change mitigation. Decarbonized heating systems are often more energy-efficient, resulting in lower energy consumption and cost savings.
Co-benefits:

- **Improved Air Quality:** Cleaner heating sources lead to improved local air quality, reducing health risks and related healthcare costs.
- **Energy Security:** Diversifying heating sources can enhance energy security by reducing dependency on fossil fuels.

Decarbonising electricity generation

Greening of electricity generation is ongoing under national measures, resulting in a steadily increasing share of renewables in the energy mix. In addition, the development of decentralised green energy generation capacity to compensate for consumption in Pécs is an opportunity, partly through utility-scale and partly through the increase of domestic and institutional solar capacity.

There are a number of regulatory barriers, limited feed-in capacity, unfavourable billing system for households, no/ only partial marketing of surplus energy, limited storage capacity and limited technological options.

Hydrogen adaptation will include the construction of hydrogen storage and electrolysis capacity, microgrid systems, storage capacity, energy community test projects, resulting in the provision of carbon-free electricity to cover urban consumption. Several educational and awareness-raising actions will support the transfer of appropriate knowledge and information to the public and other actors on the deployment of small household power plants, microgrid systems, storage facilities, energy communities.

Hydrogen technological developments will also be presented under the Energy Theme PA2 of the EU Strategy for the Danube Region, for which the EUSDR Steering Group has been filmed on 31.08.2023.

Decarbonizing Electricity Generation contributes to emissions reduction. Transitioning to low-carbon or renewable electricity generation significantly reduces greenhouse gas emissions and air pollution.
Co-benefits:

- **Improved Air Quality:** Cleaner electricity generation contributes to better air quality, reducing health-related issues and healthcare costs.
- **Energy Security:** Diversifying electricity sources enhances energy security and resilience against supply disruptions.

Increased waste recycling

The waste sector has been restructured as of 1 July, which raises a number of questions about the further operation of the system. In Pécs, a number of positive measures and investments have been implemented in recent years, which contribute to the low emission value of the waste and waste water sector. Further investments in the waste and wastewater sector will continue along the same lines, the efficiency of selective waste treatment will be further improved, biogas recovery in waste treatment will increase and solar drying capacity in the wastewater sector will be developed.

In the field of waste management, it is important to transfer knowledge about waste prevention and recycling, to build ecosystems and to raise public awareness. In line with the possibilities offered by the legislation, a waste prevention centre will be set up to improve, transform and recycle waste that can still be recycled, thus preventing it from entering the waste stream.

Increased Waste Recycling contributes to reduced landfill use, energy savings and lower pollution. Increased recycling diverts waste from landfills, extending the lifespan of landfill sites and reducing associated environmental risks. Recycling often requires less energy than manufacturing products from raw materials, leading to energy conservation. Reducing the amount of waste sent to landfills or incineration helps mitigate land and water pollution.
Co-benefits:

- **Resource Conservation:** Recycling reduces the need for virgin raw materials, conserving natural resources and reducing environmental impacts associated with resource extraction.
- **Economic Opportunities:** Recycling programs create jobs in the recycling and waste management sectors, contributing to economic growth.
- **Lower Pollution:** Reducing the amount of waste sent to landfills or incineration helps mitigate land and water pollution.

4.2 Module 4-2: Climate Neutrality Portfolio Design

Buildings and heating: Building renovations, New energy-efficient buildings, Efficient lighting & appliances, Decarbonizing heating generation

Energy systems: Decarbonizing electricity generation

Transport: Reduced motorized passenger transportation need, Shift to public & non-motorized transport, Increased car pooling, Electrification of cars + motorcycles, Electrification of buses, Optimized logistics, Electrification of trucks

Waste: Increased waste recycling

Circular economy: new business models in construction and secondary material utilisation

Green infrastructure development and NBS: climate resilient green parks and other spaces, tree planting, greening the city infrastructure, green roofs, green walls

Figure 37: Climate neutrality investments

Table 22a: Climate Neutral Portfolio – Building stock

Buildings, heating Phasing out fossil fuels	
Building renovation	
Energy utility developments	network expansion, storage capacity, energy community implementation capacity, utility network upgrades, special control transformers on an experimental basis. Making distribution networks ever smarter by installing sensors and automation. Special control transformers on a pilot basis
Promoting smart meters, developing a digital platform, ensuring real-time traceability of energy consumption.	Survey in cooperation with energy service providers to map the smart meter coverage of the housing stock in Pécs, development of a support programme for the full smart metering Training programme and energy consumption monitoring programme as a condition for support Dashboard development to track individual consumption
Building a downtown energy community with institutional actors	Energy community of institutional actors with downtown properties, sample area designation Providing preconditions: Enabling policy and regulatory frameworks Simplification of administrative processes Ensuring access to finance Capacity building within the community Implementation of a pilot model for a downtown conventional apartment building

University of Pécs Decarbonisation of building stock	Design of energy upgrades for 18 university buildings by May 2023, upgrading of remaining buildings Design and implementation of 11 solar panels by the end of 2023
University of Pécs Energy Community Project	Energy sharing of University buildings by building storage capacity
Complex energy development project in Pécsbánya-Karolina	In the Pécsbánya-Karolina area, the aim is to create a green energy solar park based on the principles of 21st century energy efficiency, cost-effectiveness, affordability and security of supply, as well as various energy storage capacities (battery, gravity, hydro and carbon-graphene research-based processes), and to explore the potential applications of hydrogen, and the establishment of a related energy community for the University of Pécs and the city of Pécs to achieve significant energy savings and energy efficiency.
LEGOFIT project	The LEGOFIT project aims to design, implement and validate an adaptable and dynamic integrative approach to achieve energy performance in multi-family residential buildings.
Energy efficiency solutions with intelligent systems	Automated buildings for balance Exploring the possibility of micro-grid development, with a focus on the possibility of installing active houses. Examining local energy storage models and alternatives. Consideration of local green energy production alternatives, calculation of energy production potential and integration into the Micro-grid and local heat flow.
Testing local energy supply models - microgrid	
Testing local energy supply models - energy storage	
Retrofitting 35% of existing buildings	Modelling of residential building types, energy efficiency intervention options, development of package solutions
Energy efficient appliances	Promotion of energy efficient appliances (washing machines, TVs, refrigerators), air conditioners, heating systems
Replacement of summer hot water supply for multi-storey buildings with renewable hot water	Replacing the summer hot water supply of multi-storey buildings with renewable hot water produced by special solar collectors in the off-grid district heating network.
Pilot project to decarbonise a prefabricated building: installing renewable energy sources to replace cooling, lighting and cooking in a ten-storey prefabricated building.	Sample project: installation of renewable energy capacity to replace cooling, lighting and cooking, investigating wind turbine/solar options for 10/5 storey prefabricated buildings. Building self-sufficiency for newer panels in the suburbs, installation of storage capacity.
Mechanical retrofitting of prefabricated buildings for individual heat use and efficiency	Mechanical retrofitting of prefabricated buildings for individual heat use and efficiency
Gas substitution for cooking purposes	Substitution of cooking gas in the case of domestic buildings built with insulated technology by the installation of electric cookers and hobs
Energy security support programme for families on social assistance to replace fossil fuels.	In cooperation with the energy supplier, adapting the distribution network and installing prepayment meters to improve security of supply, An education programme and an energy consumption monitoring programme as a condition of support to increase consumers' energy awareness

Energy support programme model for disadvantaged families in partnership with energy suppliers	every family with a child under 3 has at least one room that is heated safely and technically safe for the child's health during the cold winter months
Wood-fired home conversion programme	Developing a support programme, including education and awareness-raising, to replace wood and fuel heating in buildings. A total of 3 674 dwellings are heated with wood, a further 4 051 dwellings are heated with wood as a fuel in addition to natural gas, and 1 394 properties use other fuels in addition to natural gas and electricity. Conversion to district heating if the property is located along a district heating network, otherwise individual condensing boiler or heat pump, central heating with boiler or heat pump (supplemented by solar panels) with the possibility of individual heat volume control Detailed survey and development of renovation plans prior to implementation
New energy efficient buildings	
New build properties along district heating networks	in the case of new dwellings built along the district heating network, the building permit is conditional on not using fossil fuels, on heating the dwelling with district heating or a heat pump system.
Setting minimum requirements for new buildings, providing information	Setting minimum requirements for new buildings, providing information
Decarbonising new buildings, passive and active houses - education, awareness raising	Decarbonising new buildings, passive and active houses - education, awareness raising
Energy efficient lighting and devices	
Developing smart street lighting	Deploying an intelligent urban lighting system, achieving savings of up to 30-70%.
LED burning program	Promoting energy efficient lighting in households and institutions
Optimising household large consumers through smart grid, microgrid systems, related education, awareness raising.	Optimising household large consumers through smart grid, microgrid systems, related education, awareness raising.
Decarbonising heating	
Pétáv development: replacement of 5 MW gas boiler	Replacement of a 5 MW gas boiler in Komlói út operated by Pétáv
Increasing the efficiency of heat production by reducing losses	Increasing heat production efficiency by reducing losses
Connection of institutional actors to district heating	Phase-out of natural gas for institutional customers along the district heating network
Cleantech project : energy production and storage with deep geothermal storage - preparatory R&D project	Energy production and storage with deep thermal storage preparatory R&D project: geothermal energy storage (ATES) the use of underground mine shaft systems as energy buffers underground storage of hydrogen
Cleantech project : Conversion of hydrocarbon wells into geothermal wells	The project aims to develop a pair of geothermal production and recovery wells by converting existing barren hydrocarbon wells (pilot project) and builds on the results of the Interreg Central Europe international cooperation project TRANSGEO, which started in 2023.

Cleantech project : Exploration of geothermal energy sources in the Pécs region	Design and development of sustainable geothermal projects in the southern foothills of the Mecsek, with a complex approach from energy extraction to multi-purpose use. This includes: assessment of the geothermal potential in Pécs, investigating the feasibility of developing thermal wells, feasibility study of associated water-to-water and ground-source heat pump systems identification of the engineering interventions needed for geothermal energy recovery.
Cleantech project: Exploration, extraction and exploitation of secondary raw materials with a strong geological background	Development of technologies for secondary raw material exploration, extraction and utilisation with an emphasis on geological background, generation and implementation of such projects: Market exploitation of the raw material of the Mecsek heaps by the production of desilting and dust binding material (CMA) Innovative economic use of waste raw materials (fly ash, gypsum) in the cement industry Utilisation of waste raw materials (fly ash, andesite dust, red mud) for agricultural purposes
Cleantech project: The comprehensive development of the university knowledge base and competences for geological projects requiring a significant technical and expert base.	Full development of the university knowledge base and competences for geological projects requiring a significant technical and expert base (e.g. clean coal technologies, CO2 sequestration, remediation, Li and other critical element extraction from thermal waters, hydrogen storage in geological environments), preparation of the necessary experimental background (e.g. Smartlab tools), etc.
Experimental application of a soil probe heat pump system	Conversion of urban heating: preparation of a ground source heat pump map. Training and advice on installation. Implementation of a pilot project in a 20-apartment building in the city centre
Decarbonising electricity	
Building solar park capacity	Development of city-wide solar park capacity, with connection to the electricity grid Construction of 100 MWp of capacity on the Western bypass on land provided by the municipality through private investment, with a municipal management contract Combining a hydroelectric power plant park with green space
Developing urban energy storage capacity in cooperation with energy suppliers	Construction of energy storage capacity connected to the municipal utility solar park
Building electrolysis capacity in Tüskésrét	Building electrolysis capacity in Tüskésrét linked to the existing solar park capacity
Building the hydrogen ecosystem	Assessing the demand for hydrogen from large consumers, modelling the hydrogen capacity of Pécs

Preparing inter-regional innovation investments in the Central European Green Hydrogen Value Chain by developing a stakeholder participation scheme and establishing an IoT framework.	Preparing inter-regional innovation investments in the Central European Green Hydrogen Value Chain by developing a stakeholder participation scheme and establishing an IoT framework.
Building solar capacity for city operations	Construction of new renewable energy photovoltaic capacities at PÉTÁV Pécsi Távfűtő Kft., Biokom, Tüke Busz Zrt. New renewable energy photovoltaic capacity building at Tettye Forrásház Zrt headquarters (Western Industrial road 8.) energy renovation
Institutional solar capacity building	Replacement of electricity consumption in institutional buildings (TEÁOR M, N, O, Q, P, R) with renewable energy. In total, 29 MWp of capacity is needed for total replacement
Building solar capacity for industrial and commercial entities	Individual projects to provide a total of 33 MWp of renewable energy capacity
Building solar capacity - with individual capacity expansion (small household power plants)	The aim is to make small-scale household power available to 50% of single-family homes, which means an additional 9,500 homes with a total capacity of 20 MWp. Domestic solutions could include wind energy, with the installation of wind turbines.
Building residential storage capacity in partnership with energy suppliers	Building up storage capacity in shared housing with support, on a trial basis, in order to disseminate the yert experience at city level

Building renovations

Interventions to decarbonise the energy sector
For the decarbonisation of the energy sector and the building stock, expanding renewable capacity, increasing energy efficiency, phasing out fossil energy sources where possible and preparing for a hydrogen economy are the backbone of the interventions.

In the transition of the energy sector, the focus will be on the main energy suppliers in Pécs, namely EoN Hungária Dél-Dunántúli Directorate, the operator of the energy network, and Pétáv.
The energy provider is implementing a number of measures to increase the green share of the national energy mix, EON aims to increase the share of renewable energy sources in its own balance sheet as much as possible, and to serve nearly 30% of total customer consumption by 2025 and nearly 44% by 2030 with electricity of origin guarantees or physical green transport.

The Municipality of Pécs MJV is closely cooperating with energy utilities and is looking for opportunities to connect with the solutions provided by the energy supplier.

In the South Transdanubian region, EON has sufficient spare capacity, so it is possible to issue additional renewable energy capacity feed-in permits in accordance with the relevant government regulations.

EON is making its distribution networks smarter by installing sensors and automation to provide a more detailed and constantly updated picture of energy flows, which not only means better quality data, but also avoids further network expansion by enabling remote intervention. Smart grids are the basis for a number of innovative technological solutions that also help to achieve the clean energy transition needed to achieve carbon neutrality. They also play a role in helping to manage even instantaneous changes in energy demand much more quickly and efficiently, and help the development and deployment of energy storage solutions. They also have a major role to play in making the energy distribution network more decentralised and flexible. The growing demand for electrification, together with smart solutions, requires network development, so the total length of overhead lines and cables is increasing year on year.

A programme of high/medium voltage transformer replacements is underway, aimed at reducing technological grid losses and thus our indirect carbon emissions.

Utility integrated smart grid platform: interconnection of utility plant databases, dashboard-based, linking and reporting of data content for climate adaptation, real-time monitoring for decision making.

In response to the new challenges in the energy sector, EON is actively involved in the development of the domestic regulatory framework for energy communities and is also involved in the preparation of several joint pilot projects.

Developing an energy community in a mixed inner city area with the involvement of condominiums and institutional consumers, designating a model area

Ongoing cooperation with institutions to develop further renovations, renewable capacity, associated storage capacity and energy community schemes will be carried out, including a detailed institutional energy consumption and emission reduction survey by 2024. A questionnaire survey of institutional actors will cover their energy consumption, waste management and emissions data, and will be carried out on an annual basis to plan and implement investments in the sector (see questionnaire in annex).

To promote system stability, the organisation of an energy community organised by PTE, but extending beyond PTE, which can also support H2 production in Spikes, making efficient use of PV peaks, thus promoting clean urban H2-based mobility.

In the area of Pécsbánya-Karolina, a green energy solar park based on the principles of 21st century energy efficiency, cost-effectiveness, affordability and security of supply, as well as the creation of various energy storage capacities (battery, gravity, hydro and carbon-graphene research-based processes), the investigation of hydrogen applications and the establishment of a related energy community will be implemented in order to achieve significant energy savings and energy efficiency for the University of Pécs and the city of Pécs.

Among the institutions, the development of city-operated institutional real estate represents a separate segment. Some institutions are preparing investments to build solar energy capacity to cover their own consumption:

- Construction of new renewable energy photovoltaic capacities at PÉTÁV Pécsi Távfűtő Kft., Biokom, Tüke Busz Zrt.
- Development of new renewable energy photovoltaic capacities at Tettye Forrásház Zrt
- Energy renovation of Tettye Forrásház Zrt. headquarters (Nyugati ipari út 8.)

Decarbonisation of the University of Pécs energy efficiency of buildings Design of energy modernisation of 18 university buildings by May 2023, modernisation of the remaining buildings, design and implementation of solar panels by the end of 2023

Conventional housing stock - pilot projects

To address the many specific challenges of deep renovation, the city plans to implement a number of pilot projects. All of the technologies that are available today, but we do not have extensive experience with, require us to gather empirical results before their widespread application and adaptation can take place. To this end, the following pilot projects are planned to be implemented, evaluated and, in case of a positive decision, implemented city-wide:

The funded LEGOFIT project will design, implement and validate an adaptable and dynamic integrative approach to achieve energy performance in multi-family residential buildings (mainly prefabricated buildings). A complete energy renovation of the smaller wing of the prefabricated building at 9-10 Nagy Ferenc Square will be carried out.

Piloting of a ground source heat pump system: based on the available geothermal heat map, assess which neighbourhoods have favourable conditions and where there is technical potential for the solution. Based on the assessment, a ground source heat pump map will be produced, which will include suitable housing sites for installation. A sample investment will be carried out in a 20-apartment block of flats in the city centre, accompanied by education and advice.

In the 2nd half of the decade: the use of so-called “H2-ready” gas heating systems, i.e. heating systems that can be 100% converted to hydrogen

Energy efficiency solutions using smart systems: automated buildings to achieve balance

- Automated buildings to balance - intermittent renewable energy sources require a greater focus on energy consumption and the ability to increase flexibility to balance the energy supply to buildings - remote monitoring of energy consumption for example for heating, ventilation and cooling, and integration of local energy production e.g. from solar panels and batteries.

- Analytical software platform - reports on energy, indoor climate and maintenance needs in real time by analysing the large amount of data generated by building management. Action reports cover. Can result in annual energy savings of up to 5%

- EU building regulations support and enable consumers to participate in demand response activities through aggregator building management systems. Smart meters and hourly billing contribute to consumer engagement and demand-responsive behaviour.

- Investigate the possibility of developing a smart system for building energy, whereby programmed consumers (e.g. washing machines) are automatically switched on when electricity becomes cheaper due to an increase in the green energy rate within a day. This would increase grid balancing on the supplier side and reduce the electricity bill on the consumer side, which would help increase the green energy share in the energy mix in the medium term.

- Exploring the possibility of dynamic pricing to attract the public and industry to SMART developments. The conceptual objective is to consume more when local green energy production units produce more.

Piloting local energy supply models - microgrid Exploring the possibility of micro-grid development, with a focus on the possibility of installing active houses. These are local grid sub-systems that try to maximise local electrical energy self-sufficiency and take minimal energy from the main grid and give minimal energy away. This will significantly reduce energy transmission losses, make the system cheaper and increase the green energy ratio.

Piloting local energy supply models - energy storage Testing local energy storage models, alternatives. Taking into account local green energy production alternatives, calculating energy production potential and integrating it into the micro-grid and local heat flow. Design of individual metering points in garages, installation of chargers and batteries in garages and their integration into smart grid systems is becoming increasingly important in energy management (e.g. daytime electricity consumption of buildings is from batteries, charging of gk's and batteries is from night/green electricity.

Interventions to support energy efficiency

Of the 24626 residential buildings 6248, and of the remaining 49429 dwellings 16613 have an energy certificate, which represents 30.78% of the housing stock in Pécs. Based on this, 2.27% of the dwellings currently achieve at least type BB, i.e. near net energy use, certification. 42.59% of the housing stock can be classified as modern and 55.14% as sub-standard, which is the focus of the Action Plan.

5% of dwellings will be deep renovated each year. At this rate 5% of the housing stock in focus will be deep renovated by 2030 and 55% by 2035.

Modelling of residential building types, energy efficiency intervention options, development of package solutions: condominium segmentation: family house, semi-detached house, terraced house, large condominium: turn of 19th-20th century apartment buildings, small condominium: brick built before 1950s, brick built in the 2nd half of the 20th century , prefabricated housing

Renovation solutions for heating, cooling and ventilation systems in different types of dwellings:

Family house, semi-detached house, terraced house (1-3 apartments)

- Heating system Individual condensing boiler or heat pump (supplemented with solar panel)
- Cooling systems If present, renovation recommended, new installation not supported A heat pump heating system is recommended and is also suitable for cooling
- Ventilation systems Heat recovery ventilation installation

Small apartment building (3-10 apartments)

- Heating system Individual condensing boiler or heat pump Central heating with boiler or heat pump (supplemented by solar panel) with the possibility of individual heat volume control
- Cooling systems If present, renovation recommended, new installation not supported A heat pump heating system is recommended and is also suitable for cooling
- Ventilation systems If there is a ventilation system, upgrade the system, install heat recovery ventilation If not, install heat recovery ventilation per apartment or install a heat recovery ventilation system for the whole building

Large apartment building (more than 10 apartments), traditional construction

- Heating system Renovation of the heat transfer, control and related systems of the existing heating system Provision of individual heat quantity control Central heating with boiler or heat pump (supplemented by solar panels), Individual condensing boiler if chimney available Connection to district heating, renovation of heat transfer, control and related systems in case of district heating building
- Cooling systems If present, renovation recommended, new installation not supported A heat pump heating system is recommended and is also suitable for cooling
- Ventilation systems If there is a ventilation system, upgrade the system, install heat recovery ventilation If not, install heat recovery ventilation per apartment or install a heat recovery ventilation system for the whole building

Industrialised technology building (prefabricated, tunnel formwork, etc.)

- Heating system Renovation of the heat transfer, control and related systems of the existing heating system, system regulation Provision of individual heat quantity control In case of central heating, boiler replacement
- Cooling systems If any, renovation proposed, new installation not supported
- Ventilation systems Upgrading the system, using heat recovery ventilation Replacing old exhaust roof fans with energy efficient ones

Primary energy consumption in residential buildings averages 215 kWh/m2 /year, with a target to reduce it by 20%. This can be achieved through renovation and by increasing energy awareness through the installation of smart meters.

Smart metering of dwellings to optimise energy consumption and energy efficiency, cooperation with EON: survey in cooperation with energy suppliers to map the smart metering of the housing stock in Pécs, development of a support programme for the full smart metering of dwellings. Affected homeowners will participate in an education programme and an energy consumption monitoring programme as a condition of the support.

Smart meters work in a similar way to normal electricity meters, but they can communicate with the energy supplier via a two-way data link. Users can monitor on the smart meter display how much energy has been used or fed back into the distribution network when operating a small household power plant (CSP). This will ensure that energy efficiency can be increased through conscious energy use.

Creating smart homes, including smart features to save energy: (based on the Pécs district heating pilot project):

- Automated, remote-controlled operation of underfloor heating and towel dryer radiators
- Automated, remote-controlled operation of split air conditioners
- Domestic hot water and heat meters for remote reading, consumer monitoring
- Centrally coordinated, energy-efficient management of system-integrated devices
- Shutter control, shading control
- Weather monitoring, weather dependent shading

- ventilation
- intelligent lighting (reception lights, night lights, alarm lights, mood lighting, etc.)
- home security (smart lock, motion detection, opening detection, silent alarm, etc.)
- control smart devices (TV, household appliances, multi-room audio, etc.)

In terms of natural gas consumption, we look at the residential, institutional and commercial sectors, which account for 88% of total urban natural gas consumption, the residential sector for 71%, service providers for 13% and institutions for 4%.

Institutional customers and service providers will commit to atransition roadmap, to be completed by 30 June 2024. This will cover not only natural gas but also the greening of electricity and the replacement of the vehicle fleet.

New-build properties along the district heating network For new-build dwellings along the district heating network, the building permit is conditional on not installing fossil fuels or on heating the dwelling with a district heating connection or a heat pump system.

One of the solutions to replace natural gas is to replace heating demand with electricity, which will be 50% by 2030, supplying 250 GWh of annual consumption with electricity, mainly using heat pumps.
Substitution of heating natural gas with heat pump systems: feasibility study of water-to-air heat pump systems, mainly in the urban areas where small domestic power plants are concentrated: Mecsek-Nyugat, Mecsek-Közép, Mecsek-Kelet, Újhegy and the southern areas of the Southern part of the city. The aim is to supply a total of 22,000 dwellings with heat pumps.

No new fossil-fired boilers will be sold from 2030 unless they are compatible with hydrogen.
If a gas stove needs to be replaced, it can only be replaced with an electric stove, from 2030 onwards, gas stoves will not be sold

Repairs allowed for gas boilers in case of non-new construction, only second-hand gas boilers can be installed on the basis of a minimum standard for replacement, or payment of a carbon fund contribution

Gas heating for renovation - leasing system, long-term rental system. A total of 35703 conventional dwellings are involved in deep renovation as follows:

a) Electric heating up to 30 m^2 (880 dwellings)

b) Electric heating up to 50 m^2 or gas heating or central heat pump with solar panels in a condominium (4908 dwellings)

c) Gas heating up to 100 m^2 or electric heating combined with solar panels or heat pumps (16906 dwellings)

d) Electric underfloor heating with thermal storage or heat pumps combined with solar panels over 100 m^2 (10622 dwellings)

Decarbonisation of prefabricated buildings

Part of the remaining 250 GWh of annual consumption of natural gas is cooking gas, mainly in industrialised residential buildings, and concerns 28562 households in 870 buildings. Assuming an average annual consumption of 240 m3 / 2533 kWh, 28562 dwellings require an additional 2533 kWh of capacity per year, for a total consumption of 72 319 MWh and a capacity of 48 MW. For condominiums, this implies a consumption of 7750 MWh per hour per 3061 apartments and an additional 5 MW capacity demand. It is necessary to assess whether the additional capacity demand can be provided by the current building services systems.

Adaptation of the renovation programme developed by Pécs Távfűtő and implemented on several model houses for 10-storey prefabricated buildings:

Mechanical retrofitting of prefabricated buildings for individual heat use and efficiency
Content of deep renovation work carried out:

- Façade and slab insulation
- Upgraded heating system with horizontal distribution per floor
- Heat metering per dwelling
- Renovated domestic hot water and circulation system
- Smart heat and DHW quantity measurement with internet access
- Electricity supply with solar panels for the lift and common room

As a result of the renovation content, the heat consumption of a district-heated, insulated, upgraded building with cost-sharing accounting was reduced by 30%, while the heat consumption of a district-heated, uninsulated building without heating upgrade was reduced by 50%.

Sample project: installation of renewable energy capacity to replace cooling, lighting and cooking, investigating wind turbine/solar options for 10/5 storey prefabricated buildings. Building self-sufficiency for newer panels in the suburbs, installation of storage capacity.

Projects to support the fight against energy poverty

For families/residential properties covered by social assistance, a support programme to ensure security of energy supply and to replace polluting, high-emission fuels In cooperation with energy utilities, to improve security of supply by adapting the distribution network and installing prepayment meters, an education programme and an energy consumption monitoring programme as a condition of the support, which will increase consumers' energy awareness

A model energy efficiency programme in partnership with energy utilities to ensure that every family with children under 3 has at least one room heated safely and without risk to their health during the cold winter months

Wood-fuelled housing conversion programme Development of a support programme, including education and awareness-raising, to replace wood and fuel heating in buildings

Industrial, commercial actors' emission reduction interventions

Ecosystem building with commercial actors

The greening of the commercial property stock can be done in partnership with the relevant economic operators. The commercial operators cover the categories G, H, I, J, K, L, S of the NACE, treating as a separate segment properties with headquarters and establishments larger and smaller than 250 sqm. The two largest commercial centres in Pécs are the Pécs Plaza with 60.000 sqm and the Árkád shopping centre with 50.000 sqm.

A detailed energy consumption and emission reduction survey will be carried out in cooperation with commercial suppliers until 2024. The questionnaire survey of institutional actors will cover their energy consumption, waste management and emissions data, and will be provided on an annual basis to ensure the planning and implementation of investments in the sector.

Ecosystem building with industry

Assessment of the emission values and energy consumption practices of the companies established in the industrial park, resulting in the adoption of a carbon reduction action plan by the industrial players joining the park

- Building solar energy capacity for industrial units
- Establishing a circular economy
- Assessing and preparing freight transport needs, relocation, assessing the transport needs of businesses with a separate city centre site
- Estimation of transport capacity and traffic for non-centrally located transport green energy sales (guarantee of origin and physical green electricity) for companies

New, energy-efficient buildings

Newly built properties along district heating networks: for newly built properties, as long as they are located along the district heating network, the first option is to offer a connection to district heating. For these properties, heating with fossil fuels is not allowed.

Setting minimum requirements for new buildings, providing information, Decarbonisation of new buildings, passive and active houses - education, awareness raising

For new buildings, measures to promote climate neutrality include the integration of sustainable and energy efficient design, construction and operation practices. Key measures include:

Optimal orientation: buildings are designed to maximise natural daylight and minimise heat gain from sunlight through careful consideration of building orientation and window placement. Quality insulation to reduce winter heat loss and summer heat gain, resulting in less heating and cooling energy.

Energy-efficient HVAC systems: install energy-efficient heating, ventilation and air conditioning (HVAC) systems with programmable thermostats, zoned controls and regular maintenance to optimise performance. Use energy-efficient windows and glazing with low U-values and high solar heat gain coefficients (SHGC) to minimize heat transfer.

The use of energy recovery ventilation (ERV) systems, which recover heat or cold from the outgoing air and transfer it to the incoming fresh air, improving indoor air quality while saving energy.

Use sustainable materials with low emissions of volatile organic compounds (VOCs). Recycled and local materials: favour the use of recycled and local materials to reduce transport emissions.

Use of low-flow fittings to reduce water consumption, installation of rainwater harvesting systems for non-drinking water uses such as garden irrigation and toilet flushing.

Building design reduces the need for mechanical cooling by allowing natural cross-ventilation.

Education and involvement of residents:

- Educate homeowners on sustainable practices and energy efficient behaviour.
- Provide real-time feedback to residents on energy and resource consumption to encourage conservation.
- Install energy monitoring systems to monitor building performance and identify areas for improvement.

Efficient lighting and appliances

Deploying an intelligent urban lighting system, achieving savings of up to 30-70%.
The deployment of an intelligent urban lighting system contributes to climate adaptation by significantly reducing energy consumption, lowering carbon emissions, improving environmental monitoring, promoting energy efficiency and creating opportunities for the integration of renewable energy sources. These systems not only address climate challenges but also improve the overall quality of urban life through better lighting and security.

LED lighting: these consume significantly less energy than conventional lighting technologies such as incandescent bulbs or fluorescent tubes. LED lamps are highly efficient, converting a larger proportion of the electricity they use into visible light, resulting in lower energy consumption and fewer greenhouse gas emissions.

Lower energy consumption: by replacing conventional street lighting with LED lamps and introducing intelligent control systems, cities can achieve significant reductions in lighting energy consumption. This directly results in lower carbon emissions as less electricity needs to be generated, especially if the energy comes from fossil fuel sources.

Dynamic control: intelligent lighting systems can dynamically adjust the brightness of street lights based on real-time conditions. They can dim or brighten lights based on pedestrians, vehicles or ambient light levels. This results in additional energy savings and less light pollution, with environmental benefits.

Environmental sensors: these systems can also include environmental sensors that monitor factors such as air quality, temperature and humidity. Cities can use this data to make informed decisions about urban planning and resource allocation to reduce overall environmental impacts.

Precise lighting: intelligent urban lighting systems direct light exactly where it is needed, reducing light spill and glare. This not only saves energy but also minimises light pollution, which has a negative impact on ecosystems, wildlife and human health.

Energy saving: by reducing the energy demand for street lighting, cities free up electrical capacity that can be used to integrate renewable energy sources, such as solar panels on street lamp posts. This will promote the use of cleaner energy sources.

Safety and security: adaptive lighting can improve safety in urban areas. Well-lit streets can reduce accidents and crime and encourage walking and cycling rather than driving, further reducing greenhouse gas emissions.

LED lighting replacement programme:

LED lighting replacements involve the replacement of conventional incandescent or fluorescent luminaires with energy efficient LED (light emitting diode) lighting. LEDs consume significantly less energy and have a longer lifetime, reducing electricity consumption and associated greenhouse gas emissions. By switching to LED lighting, both institutions and residents can reduce their energy bills. LEDs are more energy efficient, providing the same level of illumination while using less electricity. LED lighting typically provides better quality and more controllable lighting. Although LED lighting may have higher initial costs compared to conventional lighting, the longer lifetime and reduced maintenance requirements result in long-term cost savings.

Optimising household energy consumption through smart grid, microgrid systems, related education, awareness raising.

Optimising large household consumers through smart grid and microgrid systems means adopting advanced energy management technologies and practices. The deployment of smart meters and real-time monitoring systems will enable large household consumers to better track their energy consumption patterns. This information will empower residents to make informed decisions about their energy use. Smart grid systems enable demand response programmes for large household consumers. At times of high energy demand or peak periods, residents can automatically adjust their energy use to reduce peak load.

Decarbonising heating production

Pannon Thermal Power Plant Ltd. is responsible for the operation and maintenance of the units of the Pécs power plant. Currently, two biomass-fired units are in operation: the 49.9 MW woodchip-fired boiler and the 35 MW baled herbaceous agricultural by-products-fired boiler. The two plants provide the green district heating supply for Pécs, which has thus reached the maximum 95% emission-free level. Keeping the gas boilers in operation as a back-up is responsible for the remaining residual emissions, which must be maintained for security of supply.

Pannon Thermal Power Plant Zrt. supplies district heating to about 31.5 thousand district-heated apartments and 460 other consumers (e.g. hospitals, schools, shopping centres, etc.).

In the case of Pécsi Távfűtő, smaller-scale investments are needed to reduce emissions: the replacement of the 5 MW gas boiler on Komlói út will be carried out, as well as an investment to increase the efficiency of heat production with planned loss reduction. In addition, the replacement of six additional owned natural gas boiler houses, backbone extension, distribution lines, own boiler house area connection lines and heat centres, and the connection of two institutions (Meszesi Secondary School and Gymnasium and Gandhi Gymnasium and Sports Hall) to district heating and thus the elimination of natural gas consumption will be carried out. By replacing the natural gas boiler houses of the own boilers and the planned new users, an annual reduction of approximately 700,000 m3 of gas consumption will be achieved. This will mean the elimination of approximately 1,350 t of CO2 emissions per year in the municipality.

Pécs Távfűtő supplies about 50% of the housing stock in Pécs, no further large-scale expansion is expected, and in the case of new housing along the network, the building permit is conditional on not using fossil fuels or on connecting to district heating or heat pump systems.

The phasing out of natural gas for institutional customers along the district heating network will be achieved by connecting them to district heating.

In addition to the above interventions, research and development projects will be carried out using the capacities of the University of Pécs. The Cleantech project explores the possibilities of energy production and storage through deep thermal storage. The disused coal mining sites were located in the eastern part of the city (Pécsbánya, Széchenyi shaft, István shaft, Somogy, Vasas plants). These facilities, which are of international importance, are now largely disused, but provide a suitable location for the deployment of advanced energy storage solutions by replacing under-utilised brownfield sites.

Although solar energy is the primary renewable energy in Pécs, geothermal capacities should also be considered, including the development of sustainable geothermal projects, participation in them from energy extraction to multi-purpose use, testing the potential of geothermal water-water and ground-source systems.

The mining history of Pécs is the basis for secondary raw material exploration, extraction and utilisation (recycling of the material of tailings piles, innovative economic use of waste raw materials in the cement industry and agriculture), the development of technologies aimed at this, the generation of projects of this kind.ments, preparation of the necessary experimental background (Smartlab instruments), etc.

A special alternative to air source heat pumps is the ground source heat pump, which in principle offers the possibility of additional natural gas extraction. As part of this, the city is carrying out a survey in cooperation with Mecsekérc Zrt., which will result in a detailed heat map of the area where the solution can be applied, the available area and the possibility of installing boreholes. Based on this, a pilot programme will be implemented for a downtown condominium.

In addition to the residential buildings, the application in the Western Industrial Park is also being investigated, where preliminary information suggests that the technology may be an appropriate means to phase out natural gas use in the industrial area.

An educational programme will be linked to the demonstration of the ground source heat pump solution for both residential and industrial target groups.

Decarbonising electricity generation

One of the biggest challenges of the green energy transition in Pécs, which is based on renewable energy sources, mainly solar energy, is to ensure the continuous use of weather-dependent energy sources. Solar panels, which are continuously expanding, are a useful and environmentally friendly alternative to electricity generation, but if a large number of solar panels suddenly start feeding back into the grid in a given grid section and the energy generated is not used locally, grid voltage problems can occur. The primary purpose of installing energy storage is to help accommodate more renewable energy generation units in the electricity system. To this end, the impact of the operation of the storage facilities on the electricity grid needs to be continuously assessed, which could prevent or even eliminate grid problems in order to increase security of supply.

Pécs' energy supply will be based on solar energy, and the aim is to fully green the current electricity generation. A wind turbine is in operation, the experience of which is being studied and pilot projects for the construction and complementary use of additional wind energy capacity are being developed. This said, it can be argued that wind capacity in Pécs can only provide a small renewable energy source in addition to solar energy. Potential of geothermal energy is assessed and examined.

The total energy consumption of Pécs in 2021 was 399887 MWh, which requires 266.6 MW of capacity to supply the full solar capacity. Currently, 15.8 MW of capacity is available at city level, of which 8 MW of capacity is in the form of a solar power plant/solar park. This implies the construction of an additional 250 MW of capacity. 1 MW of solar capacity produces on average 1500 MWh of energy per year. Calculated 2030 solar capacity demand for residential (additional compared to current): 82 MWp, commercial: 58 MWp, institutional: 23 MWp, industrial 33 MWp.

As a utility-scale solar power plant, a solar farm with a capacity of 100 MWp will be built on a municipally-owned site along the Western Bypass, as part of a private investment. The site will be provided by the Municipality and the solar park will be operated under a long-term contract with the private investor selected through a competitive tender. The selected site is located on the water base, an area that can be taken out of agricultural production. The solar park will be installed in combination with either agricultural production or other green space.

An experimental energy storage unit capacity will be built in connection with the urban solar park to be developed, in cooperation with the energy provider.

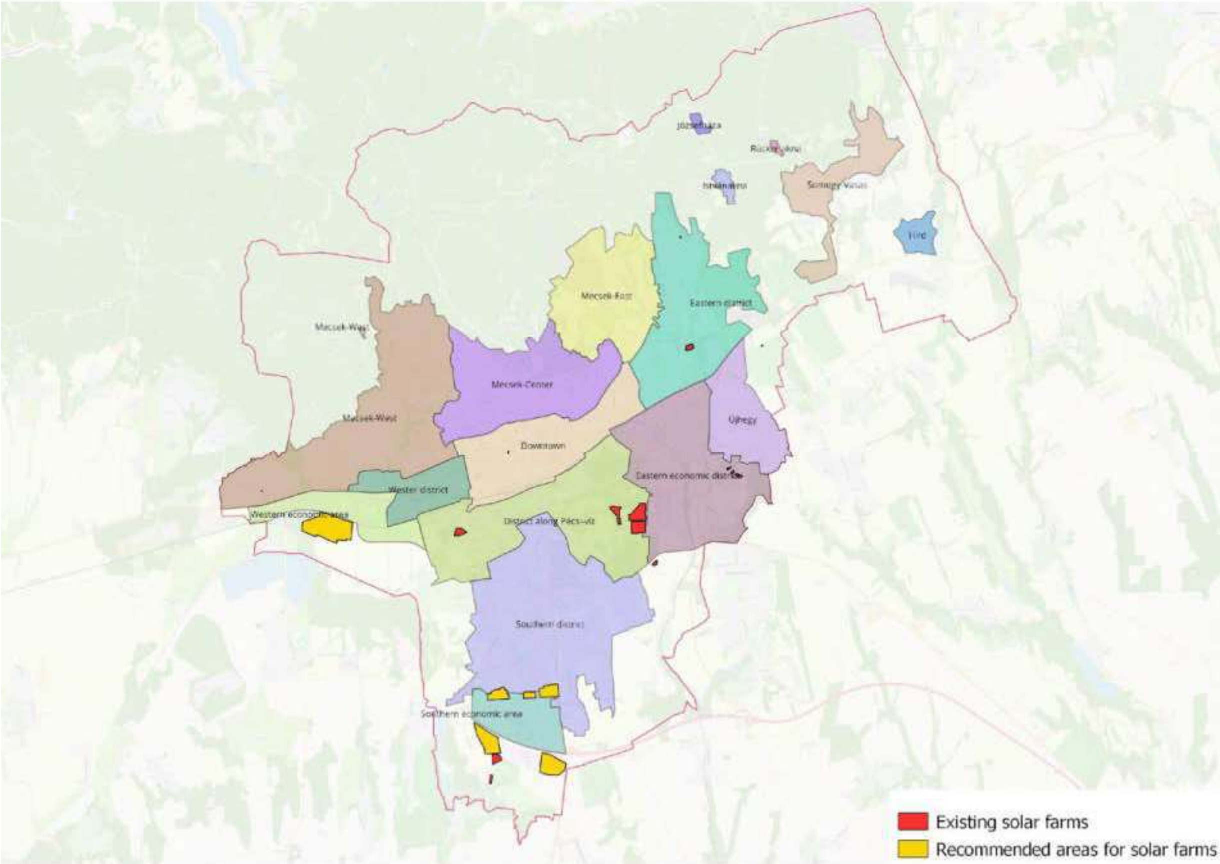


Figure 38: Planned solar farm

Source: own editing

In June 2023, the University of Pécs submitted two RDI projects to the Hungarian Hydrogen Technology Association: the first project aims at the demonstration-scale construction of an electrolyzer in the Tüskésrét area. The first phase of the project would involve the installation of a 1MW electrolysis plant with the necessary hydrogen storage infrastructure and a refuelling station fed from it. Phase 2 of the project would include the installation of a 750 kW electrolyzer to increase the water separation capacity and a 1 MW gas-to-power plant. With the addition of the electrolysis capacity and the commissioning of the small power plant, the flexibility of the system will be increased to provide dispatching services to the electricity grid operator. The project would use the surplus energy from the existing 10 MW solar farm owned by MVM for water decomposition, with the green hydrogen produced being injected into the energy chain as fuel in fuel cell vehicles. The following local companies have indicated their annual demand for hydrogen for mobility: Tüke Busz Zrt (Pécs public transport company, 63 t), Biokom Kft (Pécs city management company, 63 t), Transolut Kft (transport company of Királyegyházi cement plant, 15 t), University of Pécs (5 t), MEVID Zrt (0.5 t), Beteg Taxi Kft. (1.65t), Holcim Magyarország Kft (0.2t), Pécsi Városfejlesztési Zrt (0.15t). The estimated annual hydrogen demand is close to 150t, but the university is currently negotiating with several other companies. The project will reduce GHG emissions in the region by: replacing fossil fuels, replacing fossil fuel power plants, using waste heat from the electrolysis plant in the greenhouse gardening activities of Biokom Kft and possibly using part of the waste heat to meet part of the heat demand of the district heating system of Pécs. The model and the results of the Tüskésrét demonstration project will be studied in other Hungarian municipalities, helping to identify the technical, financial, legal and human conditions for the development of a decentralised energy system based on renewable energy.

The service infrastructure associated with the electrolysis equipment will become an integral part of another electrolysis product family development project at the University of Pécs, the prototypes of which would be located in Tüskésrét, also in the several hundred kW and MW power range, using and expanding the hydrogen storage and charging capacities. The project aims at developing PEM/AEM type electrolysers in the power range 1kW-1MW. Following a step-by-step approach, the project will start with the construction of a hydrogen energy container in which complete electrolysers purchased from the market will be installed to gain experience of the technology during operation. The project would then continue with the development of a small-scale (in the 1-10kW range) in-house electrolysis plant, followed by the construction of a 100-120kW plant and finally a 1MW plant. The project will involve the design, system integration, installation and development into operational prototypes of the balance of plant (BoP) equipment to complement the stacks, in collaboration with the partners.

The aim of the H2 production capacity development in Tüskésréti is to establish and study the sustainability of public transport and other types of local mobility solutions in Pécs. The Tüskésrét demonstration project will create the basis for the H2 livingLab and a test environment for a potential industrial development project. Assessing the demand for hydrogen from large consumers, modelling the hydrogen capacity of Pécs Closely linked to the Tüskésrét demonstration project, the aim is to develop and manufacture a family of electrolysis equipment in cooperation with Kontakt-Elektro and PTE, and to develop and test a waste transport vehicle based on the Tüskésrét electrolyzer capacity in Pécs.

The cooperation with institutional consumers (TEÁOR M, N, O, Q, P, R) ensures that the City of Pécs has up-to-date information on the opportunities and challenges of carbon reduction in the institutional stock. The Municipality of Pécs operates around 270 administrative, educational, health, cultural, etc. institutions. Primary energy consumption in public buildings averages 214 kWh/m2 /year. 93 buildings of the 51 institutions of the municipality of Pécs MJV are classified in energy class A-D. Experience shows that energy consumption in public institutions can be reduced by around 15-30% within 5 years.

As a result of EU tenders for the 2014-20 cycle, a number of public buildings have been renovated for energy efficiency (ANNEX), in most cases with the installation of renewable capacity. In Pécs, the current annual electricity consumption of the institutions is 44052 MWh, plus 555 MWh of solar energy, corresponding to 0.37 MWp of renewable capacity.

The current capacity demand can be met by about 29 MWp of renewable energy, which is provided by a mix of building own solar capacity, connecting to energy communities and guaranteed electricity supply through the municipal utility solar park.

Residential buildings account for 41% of total urban electricity consumption. This includes not only lighting but also heating electricity for properties already equipped with heat pumps. Current heat pump capacity: 1237 units (census data). The current residential demand can be supplied by 110 MW of capacity, of which 5.3 MW is currently available, which is roof-mounted solar PV capacity.

The annual consumption of commercial properties in 2021 was 111438 MWh, with a renewable energy input of 1276 MWh hours, equivalent to 0.85 MWp. The current capacity demand can cover about 74 MWp, but considering future trends, the volume to be dispatched is lower, estimated at about 58 MWp. Primary energy consumption in the service sector is estimated to be around 200 kWh/m2 /year on average.

Commercial - service economic areas have become the dominant element of the urban fabric, especially in the gateway areas. The three prominent economic areas - the eastern, western and the c. 400 ha of IPARK - are well connected to the main transport axes of the city and can provide jobs around the residential areas of the city with an appropriate structural structure.

In the sectors of construction, manufacturing, energy, agriculture, forestry and fisheries , fugitive emissions from coal mining, processing, storage and transport, and fugitive emissions from oil and gas systems, the switch to renewable energy is mainly an industry-specific task, requiring the construction of a total of 33 MWp of additional capacity (individual assessments). In terms of natural gas consumption, the annual consumption volume is 64 GWh, for which biomass and biogas solutions are available in addition to solar energy.

We can expect a further increase in the capacity of small household power plants, especially in the area of detached houses. At present, household solar capacity is installed in Mecsek Nyugat and Újhegy at a rate of more than 10%, but this volume is approached also in the suburban areas of Mecsek Central and Mecsek East and in the southern suburban areas of the Southern part of the city. Further significant expansion is expected in the coming years, subject to regulatory conditions, reaching a total capacity of 20 MWp.

In the central, western, inner city and eastern city segments, the number of household-sized solar panels is lower, following the nature of the development. A higher number of panel dwellings are located in the western and inner districts and in the central segment of the southern district, where there are also traditionally built condominiums, and where the aim is to promote energy community solutions rather than individual capacities. As things stand, 351 dwellings in prefabricated housing have solar panels installed, while 2,940 detached houses in conventional housing have been installed. The target is to have 50% of single-family residential properties covered by small household solar, which means an additional 9,500 properties.

The construction of residential storage capacity in Pécs in a model city centre apartment building in cooperation with energy utilities, the results of which will be continuously monitored and the evaluation of the experience and the possibility of expanding the developments will be assessed. A pilot project for residential storage in a downtown condominium: construction of a new metering site for the storage, installation of energy storage and inverter. The energy supplier will control the device in order to ensure that the necessary charge for its operation is always available. Charging and discharging of the storage facility will depend on the needs of the electricity system.

Figure 39: Tüskésrét

Figure 40: Electric buses at Széchenyi square

Transport

Table 22b: Climate Neutral Portfolio - Transport

Transport	
Reducing the amount of private motorised transport	
Testing of zero-emission zones where only electric, hydrogen and biogas cars can run.	The first step will be the establishment of a green zone in the city centre through regulatory instruments, followed by a gradual extension of the zone
Rethinking the parking system	Rethinking the parking system in inner urban spaces when designing restricted zones
Design of car parks	Parking slabs on the edge of the city centre as parking spaces at interchanges
Increasing the share of public transport and non-motorised transport	
E-bike, scooter, moped project	E-bringa project Phase II, installation of additional docking stations on the completed cycle routes (POTE, Kertváros, Megyeri tér, Vásártér), purchase of bicycles
Supporting access by public transport from the agglomeration with targeted services	Facilitating the use of public transport through traffic management tools
Separate bus lanes on main transport routes	Reducing car use through traffic management tools, favouring public transport
The use of hydrogen technology in long-distance bus transport	The use of hydrogen technology in long-distance bus transport
Increasing the share of car sharing	Setting up contractual schemes with large employers, tendering contractors to operate a shared fleet
Electrification of motor vehicles and engines	
Provision of electric charging infrastructure for cars	Developing a charging network to promote the uptake of electric cars
Awareness raising and information transfer on electric cars	Awareness raising and information transfer on electric cars
Electric car fleet support programmes	Develop an incentive scheme for the purchase of electric cars
Decarbonising public transport	
Replacement of the diesel bus fleet of Tüke Busz Zrt. with electric buses in line with the decarbonisation plan.	In order to optimise the age composition of the fleet, the 10 buses entering service in 2020 and the 8 buses entering service in 2022 will be replaced after 16 years of service, with 12 and 10 new solo electric buses respectively. 63 solo electric vehicles will be purchased from 2027.
Construction of a charging network for the operation of the electric bus fleet of Tüke Busz Zrt.	The development of the charging infrastructure does not only mean the installation of charging poles and their connection to the electricity grid, but also the capacity to take the energy needed for charging from the distribution grid, which typically requires a permit, payment of a grid extension fee and the installation of a transformer with sufficient capacity.
Developing an intelligent urban energy management and spatial information system - Optimising the use of public transport	The planned component aims to strengthen the concept of “green urban transport”, in the framework of: equipping buses with smart meters, thus ensuring continuous environmental monitoring.
The electrification of metropolitan transport by developing infrastructure to support environmentally friendly private and public transport.	For the proper management of urban transport, it is necessary to improve the urban charging infrastructure and, in line with this, to modernise the built transport infrastructure: bus stations, bus shelters, bus stops, modernisation of electronic passenger information.

Optimised logistics	
Smart columns: real-time data generation from IoT sensors, network remote control and automation systems: sensor deployment	Smart poles: real-time data generation from IoT sensors, remote network control and automation systems: deployment of sensors in combination with street lighting poles
Reducing congestion in urban transport through traffic management tools	Establishment of bus station centres on the outskirts of Pécs, which will also serve as P+R parking and create opportunities for commuting by electric public transport in the Pécs area
Diverting traffic from Route 6 by easing congestion in the downtown and Garden City.	In order to reduce urban traffic congestion, it is necessary to link the roads along the new Route 6 route with regulatory instruments that will allow the city centre to be decongested.
Construction of interchange stations at 3 sites	Transhipment stations will be built on the outskirts of the city, connecting to industrial areas in the East, West and South.
Electrification of freight transport	
Electrification of the conventional vehicle fleet of the public service system in Pécs	Purchase of vans and utility vehicles with better emission standards for BIOKOM NKft.'s urban management tasks
Electric van replacement programme	Developing an incentive scheme for the purchase of electric vans

The City of Pécs intends to achieve the reduced demand for motorised passenger transport by shifting to public transport and non-motorised transport, increased carpooling, and increasing the electric share of cars and motorcycles.

To this end, a survey of transport habits and needs will be carried out over a year, testing the behavioural, attitudinal and financial options that are key determinants of daily transport patterns. A detailed survey of space use patterns, spatial and temporal distribution, transport habits, including walking, cycling, car use and public transport, will be carried out to provide the basis for a rethink of individual car travel patterns, parking and long-term urban land use. To this end, in addition to the survey, community planning sessions, awareness-raising and educational events will be organised. The survey will be complemented by the deployment of sensors, partly on existing lampposts, to provide measurement by means of smart poles in copper. The data to be measured will include the measurement of the volume of car, bicycle and pedestrian traffic, its density during the day and over time.

In Pécs, the electrification of the public transport fleet is accompanied by an increasing share of electric cars in urban transport. Therefore, for the proper management of urban transport, it is of utmost importance to develop the urban charging infrastructure, which is a prerequisite for the replacement of the petrol car fleet. Intelligent traffic management: the introduction of intelligent traffic management systems can help optimise traffic flow, reduce congestion and shorten journey times. Smart traffic lights, real-time traffic updates and dynamic routing systems can all contribute to more efficient transport networks.

In Hungary, E.ON Hungária serves its electric car customers with more than 350 public charging points operated by members of the E.ON Hungária Group. From 2021, the e-charging network will be powered by green energy, so the energy used for charging will also serve long-term sustainability goals from both alternating current (AC) and direct current (DC) chargers. In the future, high capacity (150/300 kW) chargers are planned to be added to the national charging network. For dedicated e-car drivers, the home charging solution offers the opportunity to balance leisure and mobility. With a comfort package, 1 MWh of energy consumed per month is covered by renewable or high-efficiency energy sources, with a Green Future origin guarantee.

Zero emission zones to be tested, where only electric, hydrogen and biogas cars can be driven, increasing share of electric cars

Pilot area : Hungária - Petőfi - Rákóczi - 6 y intersection, including the statue of Zsolnai, in the South Mártírok tere, Veres Endre - Tüzér - Kodály - Aradi vértanúk to Lánc street. Tools: One-way traffic, road alignment. The first step will be the creation of a green zone in the city centre, through regulatory instruments, followed by a gradual extension of the zone, with the creation of a zone north of the Spike Square, free of diesel and petrol vehicles. Destination traffic will be allowed. P+R parking, electric vehicle sharing systems need to be made available. Higher parking charges or congestion charges could discourage car use.

A further significant impact on the continuity of traffic could be the deployment of a parking space occupancy monitoring system, which will inform drivers heading to the city centre about the location and number of available parking spaces via an app. When parking spaces are fully occupied, the city centre and its surroundings will be relieved of significant congestion-generating traffic. This system is partly deployed, further development is underway.

In the context of the climate-proofing of the parking system, the aim is to limit parking to concentrated areas and to phase out individual parking spaces in public spaces. Parking should be managed primarily by creating parking slabs, and by providing green space and absorption capacity for the parking slabs.

To this end, the parking system in the city centre will be reviewed, and the possibility of removing on-street parking spaces will be considered. Existing parking spaces with green walls, roofs and solar panels: parking spaces next to the DOMUS building, next to the Post Office building, the Arcade car park.

Commuters to Pécs for work (expanding agglomeration population) use private transport to get to work in higher proportions than those living in Pécs. The reason for this is that public transport is a less attractive alternative for commuters, and the solution to this problem lies in the further development of the three suburban decentralised centres (Uranváros in the west, Kertváros in the south and Buda Station in the east), the installation of an electric carsharing and e-bike sharing system, and the optimisation of public transport for commuters. A study will be carried out to assess the cost-effectiveness of extending Tüke Busz Zrt. services to the agglomeration and harmonising agglomeration and local services in consultation with the long-distance transport operator.

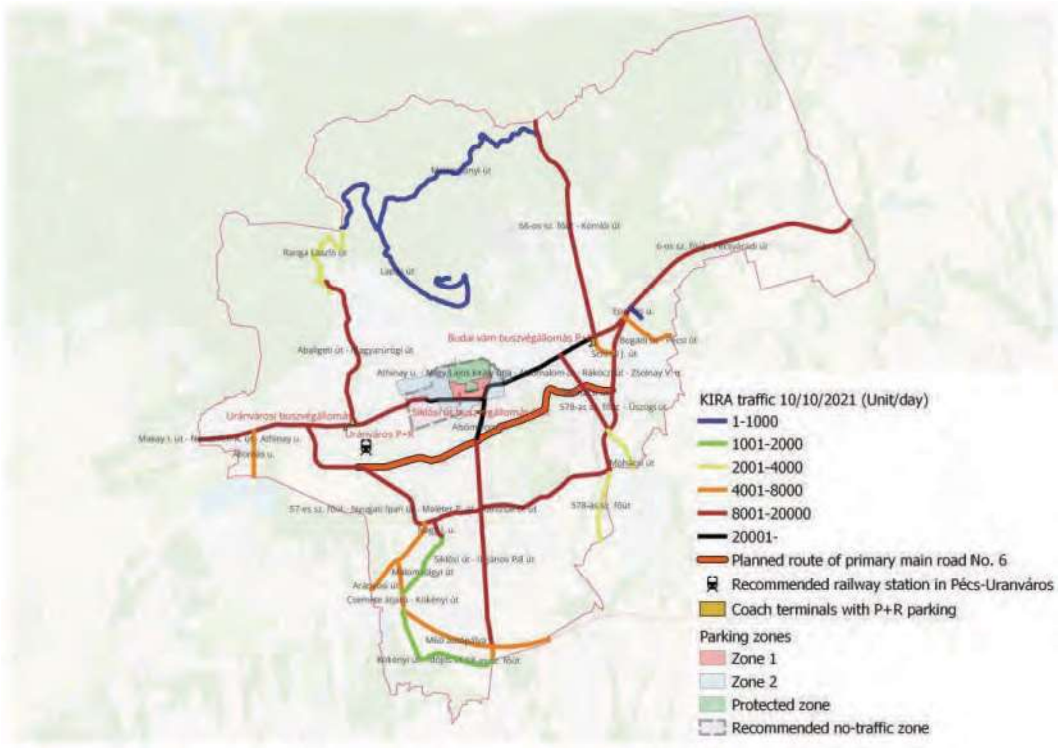


Figure 41: Planned zero emission zone and P+R parking places
Source: own editing

A related task is the continuation of the electric public shuttle programme started in previous years (E-public shuttle, Pécsike), and the extension and promotion of individual environmentally friendly modes of transport. E-bringa project, phase II, installation of additional docking stations on the completed cycle routes (POTE, Kertváros, Megyeri tér, Vásártér), purchase of bicycles.

Survey of transport habits of employees with more than 50 employees: long-term rental of e-bikes by employers and provision of e-bikes to employees as part of the benefit scheme, and development of electric car-sharing schemes in cooperation with large urban employers. An app will be developed to ensure the routing and utilisation of routes.

The new station will bring the railway within walking distance of around 30,000 residents near the Uranio housing estate. We therefore propose a stop at the height of Fern Street (at the waste yard) in Uranváros (Kovácstelep vmh). There is currently no local public transport service close to the railway. If feasible, it is proposed to provide a pick-up and drop-off solution (e.g. a bus service to the stop bypassing the housing estate) - this development could also link to the Community Transport Network Development proposals which also propose Páfrány Street as a public transport route. In the future, the development of Közraktár utca and the construction of the Fern Street flyover could also lead to a dramatic improvement in the road connections and public transport services to the stop.

Green urban public transport - Electrification of buses

Providing bus transport with electric buses for the diesel bus fleet of Tüke Busz Zrt. is environmentally friendly in line with the decarbonisation plan. To optimise the age composition of the fleet, the replacement of the 10 buses put into service in 2020 and the 8 buses in service in 2023 after 16 years of service will be replaced by 12 and 10 new solo electric buses respectively. 63 solo electric vehicles will be purchased from 2027 onwards. The operation of the electric bus fleet of Tüke Busz Zrt. will also require the construction of a charging network.

The development of the charging infrastructure does not only mean the installation of charging poles and connection to the electricity grid, but also the capacity to take the energy needed for charging from the distribution grid, which typically requires a licence, payment of a grid extension fee and the installation of a transformer with sufficient capacity.

This will be complemented by the development of an intelligent urban energy management and spatial information system. For bus optimisation, the fitting of smart meters on buses to ensure continuous environmental monitoring, and the fitting of load monitoring cameras on buses to optimise bus traffic (if there are few passengers, less frequent departures on a given line). Together, these will significantly reduce environmental impacts. The modernisation of the built transport infrastructure will also take place: bus stations, bus shelters, bus stops, modernisation of bus stops, improvement of electronic passenger information.

Optimised logistics, Increasing the electric share of trucks

Zero emission goods and service vehicles

The aim of the measure is to reduce emissions from vans in Pécs by speeding up the transition to electric vans. In cooperation with commercial and industrial actors, the pattern, spatial and temporal distribution of urban transport space use in Pécs will be assessed in a year-long process. As part of this, all farmers using trucks of less than 3.5 t and more will be consulted on the possibility of using a suburban transhipment centre - for which goods transhipment is feasible and for which not.

On this basis, a package of measures will be drawn up to ban vehicles of more than 3.5 t from inner urban areas, possibly by transferring goods to electric vans or by paying a carbon contribution with time bands (night, day, rush hour and off-peak periods). The same assessment will be made for vans of less than 3.5 t, but their ban will not be fully implemented. An inner zone will also be created, with stations for loading and unloading zero-emission goods vehicles. A changeover plan for vehicles of less than 3.5 t will need to be developed after the catching-up period.

Other elements of the package include the provision of business parking spaces for electric vans, the installation of charging points and fast chargers at transfer stations and other interchanges, and free parking for electric vans. Initiate discussions with the government to set up a subsidy scheme for the purchase of electric vans and related standard charging.

Planned locations for interchange stations, which require a detailed capacity needs assessment to establish their feasibility: southern industrial area, in the area of the Áper barracks, in the eastern part of the city, east of the Üszögpuszta roundabout.

Figure 42: Planned transfer sites
Source: own editing

Establishing a hydrogen economy in transport, Building a hydrogen ecosystem, Application of hydrogen technology in long-distance bus transport.

The Municipality, the PTE, the Chamber of Commerce, BIOKOM, Tüke Busz Zrt., the Police, the Taxi Company are working together to build and operate the hydrogen ecosystem in Pécs, while seeking funding and cooperation opportunities with other EU countries to expand the exchange of experience and cooperation opportunities.

Preparing inter-regional innovation investments for the Central European Green Hydrogen Value Chain by developing a stakeholder participation scheme and setting up an Internet of Things framework. The thematic focus of the project is to stimulate the uptake of local hydrogen ecosystems to increase innovation capacity in line with the above-mentioned priorities of the S3 strategies, by supporting the exchange of economic, technical and networking experiences between EU regions at different levels of development. The analysis of the project has identified the following .

The aim is to use fossil fuels in hydrogen industrial solutions to reduce fossil fuel use by developing hydrogen fuel cell propulsion systems. In addition, priority will be given to the development of scalable and mobile energy storage capabilities.

The University of Pécs is analysing the potential of producing green H2 in the 10 MW solar power plant of the "Tüskésrét" in Pécs. The university organised a B2B meeting and established close relations with the innovation business unit of MVM Hungarian Electricity Ltd. and the most important local industrial player in the fuel cell sector, Kontakt Elektro Kft. The work continued with a needs assessment of the use of hydrogen for various purposes: fueling of garbage collection vehicles, public buses, various transport vehicles (e.g. for the Lafarge cement plant near Királyegyháza). There was a clear demand from MVM for the use of hydrogen as a grid balancing storage capacity and from Lafarge and the regional waste management company for the replacement of their conventional vehicles with fuel cell electric vehicles. At the same time, an innovation ecosystem needs to be created, involving a wide range of actors in the quadriplex, adapting successful economic and technological solutions from other EU regions, and building a solid network with other EU regions interested in the hydrogen economy. This will allow testing different technological and organisational solutions in different geographical, social and regulatory contexts.

Electrification of the conventional vehicle fleet of the public service system in Pécs

Air pollution in the inner areas of Pécs is a major problem, for which the EU has launched infringement proceedings against Hungary, with nitrogen oxides, PM10 and CO2 pollutants from traffic being a significant part of the problem. A gradual solution to this problem could be to replace the significant fleet of vehicles owned by municipal companies with hybrid vehicles with much more favourable emission standards or with electric vehicles that are essentially zero-emission.

The replacement of the car fleet of both municipalities and public service institutions with electric cars will be completed by 2030, including taxis and shared service vehicles. The City will also initiate consultations with health and other care systems to assess their fleets and their replacement options and timing.

Ecosystem building with industry

The Municipality has good relations with the city's economic organisations, and through its Economic Development Department it maintains regular contacts and participates in investment promotion activities. However, further broadening of cooperation is needed to achieve the net zero target. There is a lack of information on the business sector about their carbon credits and related plans, and in many cases smaller businesses need education and information support. To this end, extensive cooperation, surveys and workshops will be organised in 2023-24 on the following topics:

- Assessment of the emission values and energy consumption practices of the enterprises established in the industrial park, resulting in the adoption of a carbon reduction action plan by the industrial actors joining the park (see Annex)
- Plans to build solar capacity in industrial units, ensuring greening of electricity consumption
- Establishing a circular economy
- Assessing and preparing freight transport needs, relocation, assessing the transport needs of businesses with a separate city centre site
- Estimation of transport capacity and traffic for non-centrally located transport

The City of Pécs will require fossil-free transport of bulk materials to and from construction sites in its own projects from 2030. In addition, rewards will be given for the use of electricity, hydrogen and biogas, and for minimising the distances travelled.

Reducing congestion in urban transport through traffic management tools

The most important land-use task is to reduce carbon emissions by diverting as much as possible of the freight and through traffic from the national Route 6 through the city centre, partly by providing alternative routes and by using modal shifting. This intention coincides with the linking of the three industrial areas with the bypass.

The south-western bypass of Pécs ensures the circulation of vehicles weighing more than 7.5 tonnes, which has made it possible to ban them from the inner city main road, which passes through major residential areas. It is necessary to clarify the conditions and phasing-in of the ban on vehicles over 3.5 tonnes.

Making the entire section of the M60 motorway free for lorries, and at the same time making the inner city section of the 6 toll road toll-free, and contributing to a carbon fund, which the city will reinvest in the development of charging infrastructure and a transhipment station for lorries.

Figure 43: Biokom waste management fleet

Waste, waste water	
Smart solutions for waste management and urban operations	Purchase of smart waste bins, "smart" waste transport vehicles, smart traffic lights, traffic lights, further development and expansion of smart parking program in the city
Fermentation of the highly biodegradable fraction separated by mechanical treatment with biogas recovery	Development of the Kökényi Regional Waste Treatment Centre, anaerobic treatment of the fraction with high biodegradable content, collection and utilisation of the biogas generated
Pre-treatment of the highly biodegradable fraction, selection of energy recovery fractions, selection of inert components	Pre-treatment of the highly biodegradable fraction, selection of energy recovery fractions, selection of inert components
Development of an intelligent urban energy management and spatial information system - Stormwater and wastewater spatial information system improvements	Network modelling for the spatial development of stormwater and wastewater and the development of a technical action plan. Developing a connected, modern public service customer support platform.
Waste Prevention Centre	Reuse, repair and conversion of already non-recycled assets based on well-established models for the introduction of waste prevention in the home
Development of intelligent diagnostics and monitoring in water management in Pécs	Development of intelligent diagnostics and monitoring for water management in Pécs
Increasing wastewater treatment capacity in Pécs	Construction of a solar dryer at the Állomás street wastewater treatment plant in Pécs
Development of technologies for the exploration, extraction and utilisation of secondary raw materials (e.g. slag recycling, geothermal recycling of abandoned wells, etc.) based on geological background and the establishment of such projects;	Development of technologies for the exploration, extraction and utilisation of secondary raw materials (e.g. slag recycling, geothermal recycling of abandoned wells, etc.) based on geological background and the establishment of such projects;

Table 22c : Climate Neutral Portfolio – Waste management

Increased waste recycling

Collection and selection:

The municipality provides public recycling programmes where residents separate recyclable materials such as paper, cardboard, glass, plastic and metals from general waste. A recycling prevention centre is available for residents and businesses to drop off recyclable materials.

Collected recyclables are transported to recycling facilities where they are sorted, cleaned and processed to prepare them for recycling.

Types of recyclable materials:

- Paper and cardboard: This includes newspapers, magazines, cardboard boxes, office paper and other paper products
- Plastics: various types of plastic containers, bottles and packaging materials.
- Glass: glass bottles and containers.
- Metals: aluminium cans, steel cans and other metal packaging materials.
- Organic waste: some cities are implementing organic waste recycling programmes to compost food waste and garden waste.

Other waste and waste water projects

Smart solutions for waste management and urban operations

Purchasing smart waste containers: by measuring the saturation of waste containers, transport frequencies and routes could be more predictable, thereby optimising deliveries to significantly reduce the distance travelled, saving energy and emissions and allowing more cost-effective operations. Smart bins also have the added advantage of being lockable, which can help to reduce illegal dumping, and can be placed in a more uniform and aesthetically pleasing urban environment. The price of bins varies depending on size and manufacturer.

Waste transport vehicle "smarting": standardised saturation measurement allows for more predictable vehicle emptying intensity and reduction of congestion, thereby optimising deliveries and significantly reducing the distance travelled, saving energy and emissions and enabling more cost-efficient operations.

Developing smart traffic, traffic lights and a unified remote monitoring system: the advantage of the system is that it provides automated traffic counting at major intersections, allowing not only pre-programmed, optimised traffic management, but also real and actual traffic events to determine traffic management, ensuring traffic flow and thus reducing the amount of pollutants emitted by vehicles.

Improvements should include the further development and expansion of the smart parking programme that has been launched in the city, ensuring the further uptake of smart parking and reducing air pollution.

An important preparatory task related to the exploitation of renewable energies is to continue geothermal exploration studies - mainly in the Tüskésrét area, in addition to the large-scale investments planned in this area.

Fermentation of high biodegradable fraction separated by mechanical treatment with biogas recovery

In the current technology used in the waste treatment centre in Kekény, the high biodegradable fraction (around 60 thousand tonnes per year) is treated by stabilisation, which is a controlled biodegradation process lasting on average 1-1.5 months, with the aim of preventing methane generation. The process does not involve any recovery elements, but does involve CO2 emissions.

The development would ensure the anaerobic treatment of the fraction with high biodegradable content, and the collection and utilisation of the biogas produced. The biogas could be used to generate electricity using a gas engine, which could be used on-site to meet part of the energy needs of the Kökényi Regional Waste Treatment Centre (2.2 MW installed capacity).

Development of the Kökényi Regional Waste Treatment Centre, anaerobic treatment of the fraction with high biodegradable content, collection and utilisation of the biogas generated

Pre-treatment of high biodegradable fraction, selection of fractions with energy recovery, selection of inert components

The high biodegradable fraction separated by mechanical treatment at the waste treatment centre in Kekény has been experimentally measured to contain around 20-30% of energy recoverable components (plastics, paper, textiles, etc.) and around 10% of inert materials (stone, concrete, glass, etc.), depending on the sieve size. The separation of these components makes the biological treatment (stabilisation or anaerobic fermentation) more efficient and the 30-40% of material separated before treatment reduces the volume to be treated, thus saving energy, and increases the volume of energy recovery.

Development of the Regional Waste Treatment Centre in Kökényi, which will both save energy and increase the volume of energy that can be recovered.

Development of intelligent diagnostics and monitoring for water management in Pécs

The Municipality of Pécs and its companies do not have a geographic information system as detailed below, which would facilitate the planning and execution of the tasks related to stormwater drainage and treatment covering the whole city.

Network modelling for the spatial development of stormwater and wastewater and the development of a technical action plan.

The development of a connected, modern public service customer care platform,

Extend investments in rainwater harvesting and flash flood reduction at municipal level.

Support for households, farmers and smallholders in peri-urban areas within the framework of a social cooperative system to be set up to use rainwater for irrigation in connection with water management.

Developing an intelligent urban energy management and geospatial information system - stormwater and wastewater geospatial improvements

The need to develop a technical action plan for the spatial development of stormwater and wastewater, network modelling and related technical measures: the subsequent implementation of the action plan could lead to energy savings and at the same time to savings in emissions, by significantly reducing the amount of wastewater to be treated or the work required to restore stormwater drainage systems caused by erosion.

BIOKOM NKft. does not have such a geographic information system, which would facilitate the planning and execution of city-wide stormwater drainage and management tasks.

Network modelling for the spatial development of stormwater and wastewater and the development of a technical action plan. Development of a related modern public service customer support platform.

Support for households, farmers and smallholders in peri-urban areas within the framework of a social cooperative system to be set up to use rainwater for irrigation in connection with water management.

Extend investments in rainwater harvesting and flash flood reduction at municipal level.

Construction of a solar dryer at the Pécs, Állomás utca wastewater treatment plant: development of a biogas plant with gas engine, gas tank and sludge receiving station; development of the wastewater treatment plant (e.g. as a municipal receiving station) for the purpose of increased reception of biological waste A 22% s.a. sludge with a content of 22% solar energy and waste heat from gas engines could reduce the amount of sludge to be disposed of by a third by building 6 halls, carrying out installation works, developing sludge reception infrastructure and investing in biogas recovery (waste reception point, construction of 1 additional gas engine and gas tank).

Figure 44: Waste water facility in Pécs

Creating a circular economy	
Converting industrial parks to renewable, zero-emission, circular	Converting industrial parks to renewable, zero-emission, circular
Climate Partnership, a long-term, active cooperation between the business sector and the municipality of Pécs to reduce carbon emissions in the city of Pécs	Climate Partnership, a long-term, active cooperation between the business sector and the municipality of Pécs to reduce carbon emissions in the city of Pécs
Pilot circular construction project, circular building materials marketplace	The online marketplace for secondary materials provide an open access platform to facilitate the growth of the secondary materials market within the city
Collection, sorting and recovery of urban construction and demolition waste at the waste treatment plant in Kekényes	Collection and sorting of urban construction and demolition waste and its recovery at the Kökényes waste treatment plant
Installation of a construction waste centre	Construction waste hub deployment
Recycling of mining waste	Recycling of mining waste material
Decomposition and utilisation of fly ash from spiked cedar in cement, technological testing	Demolition of a fly ash tip in Tüskésréti and its material recovery in the cement industry, technology testing
The use of landfilled mine waste for the production of dust binders, slurry control agents and fertilisers (circular economy)	Recovery of landfilled mining waste for the production of dust binders, anti-slurry and fertilisers (circular economy)

Table 22d : Climate Neutral Portfolio – Circular economy

Circular economy:

- Implementation of a pilot circular construction project, circular building materials marketplace
- Study of the theoretical background of circular architecture, assessment of local applications, strategy development
- The online marketplace for secondary materials
- Provide an open access platform to facilitate the growth of the secondary materials market within the city by
- Coordinates the supply and demand of residue flows. Information on secondary raw materials increases the use of these materials in construction projects. Connecting producers and users of demolition materials through a digital platform
- Resource and circular criteria will be integrated into cities' infrastructure and building investments, systematic audits will be introduced before demolition, and the use of material passports will be gradually introduced
- Strengthening the capacity of construction operators to reuse.
- Collection and sorting of urban construction and demolition waste and its recovery at the Kökényes waste treatment plant
- Industrial park conversion to renewable, zero emission, circular in cooperation with IPark Kft.

The pilot circular construction project aims to demonstrate and test circular construction principles and practices, which focus on reducing waste, conserving resources, and promoting sustainability throughout the entire lifecycle of a building. As a first step an optimal site is to be selected. Material sourcing, construction practices, waste reduction and management are the key aspects. Materials will be sourced, including the use of recycled or reclaimed materials and materials with high circularity potential. Construction methods will be designed that promote circularity, such as minimizing waste, optimizing resource use, and implementing efficient logistics. Strategies will be outlined for reducing construction waste and diverting materials from landfills through recycling, reuse, or repurposing. Demolition and Deconstruction aspects will also be considered, plans for the end-of-life phase will be prepared, including deconstruction techniques that facilitate material recovery and reuse.

A secondary construction material marketplace, or materials exchange platform, is an online or physical marketplace where individuals and organizations can buy, sell, trade, or donate surplus or reclaimed construction materials. The primary goal of such a marketplace is to promote the reuse and recycling of construction materials, reduce waste, and contribute to a more sustainable and circular construction industry. Individuals or organizations with surplus or reclaimed construction materials list their available materials on the marketplace. Users looking for construction materials can search and browse the marketplace's listings to find materials that match their project needs. They can often filter search results based on location, material type, quantity, or other criteria. The marketplace will offer tools and services to facilitate transactions, including secure payment processing, delivery coordination, and documentation of the exchange. Secondary construction material marketplaces contribute to more sustainable construction practices, resource conservation, waste reduction, and the promotion of a circular economy within the construction industry. They provide a platform for individuals and organizations to actively participate in sustainable building practices while realizing economic and environmental benefits.

Transforming an industrial park into a zero-emission and circular facility is a complex goal. It involves addressing various aspects of operations, resource management, and infrastructure. A comprehensive assessment of the industrial park's current operations, emissions, and resource flows is needed as a first step. Engagement with industrial park tenants, owners, and local communities is a key to gather input, assess their sustainability goals, and ensure alignment with the transformation plan. Transition to renewable energy sources such as solar, wind, or hydroelectric power to meet the park's energy needs

Implement energy-efficient technologies to reduce consumption. A circular resource management strategy is needed that focuses on reducing, reusing, and recycling materials. Promotion of sustainable transportation options, such as electric vehicle charging stations, bike-sharing programs, and public transportation access, to reduce emissions from commuting and logistics. The transformation of an industrial park into a zero-emission and circular facility is a collaborative effort that requires the commitment and cooperation of all stakeholders. It's important to set realistic goals, prioritize actions, and continuously monitor and adapt strategies to achieve sustainability objectives over time.

Table 22e: Climate Neutral Portfolio – Green Infrastructure

Green infrastructure development	
Green wall, green roof	Strategically identify the neighbourhoods and types of buildings in which green walls and green roofs should be encouraged from an urban design and building conservation perspective • In the case of commercial properties larger than 250 sqm, the possibility of installing a green roof / green wall on the property will be assessed, consultation with commercial properties - green wall/green roof projects will be implemented if technical conditions are suitable, see Tesco store • Knowledge Centre, Fair Hall model project green wall / green roof • Assessment of municipal, university-owned buildings for suitability for green wall/green roof installation Piloting green roofs for prefabricated buildings (for a total of 870 buildings, based on 80% surface area)
Expansion and renovation of urban parks based on climate resilience criteria	The climate-resilient development of existing green spaces and green areas, as well as the creation of new ones. Natural stormwater management in green spaces: the use of green infrastructure such as rain gardens, bioswales and permeable pavements can sequester carbon in stormwater management.
Greening along busy roads, green walls	Green walls along main roads with planting: green walls provide noise and dust pollution abatement and increase the absorption capacity of emissions • Road 6 west of Tüzér street • Garden city along bypass • Access sections to main roads • Along bypasses Siklósi road access section
Greening of car parks	For commercial properties larger than 250 sqm, the current parking capacity will be assessed, the extent to which they can become a hub and replace on-street public parking spaces under a cooperation agreement with the municipality, and the potential for additional green space on the property
Converting vacant or underused land into green space	Improves the urban landscape, reduces the heat island effect and sequesters carbon through vegetation growth. Preserving undeveloped urban areas as parks, nature reserves or protected areas preserves carbon-rich ecosystems and prevents urban sprawl
Model projects implemented: urban gardens, urban agriculture, composting programmes	Urban gardens: community gardens and urban agriculture projects use open spaces to grow crops that sequester carbon while providing fresh, local produce. Urban agriculture: growing crops in urban areas improves soil health and organic matter, which leads to increased carbon sequestration. Composting programmes: encouraging the composting of organic waste diverts waste from landfills and enriches the soil, helping to sequester carbon.

Green infrastructure development

Promote green roofs/green walls that absorb pollutants and reduce excessive heat gain. Strategically identify neighbourhoods and types of buildings where green walls and green roofs should be encouraged, from an urban design and building conservation perspective. Implementing pilot projects as a first step:

- In the case of commercial properties larger than 250 sqm, the possibility of installing a green roof/green wall on the property will be assessed, consultation with commercial properties - green wall/green roof projects will be implemented if technical conditions are suitable, see Tesco store
- Knowledge Centre, Fair Hall model project green wall/ green roof
- Assessment of municipal, university-owned buildings for suitability for green wall/green roof installation
- Piloting green roofs for prefabricated buildings (for a total of 870 buildings, based on 80% surface area)
- 10-storey prefabricated building showcase project: combination of green roof and wind turbine to increase energy efficiency. Roof reinforcement, installation of sprinkler system
- Implementation of a green wall pilot project for a 10-storey panel on a supporting structure

Green walls along main roads with planting: green walls provide noise and dust pollution abatement and increase the absorption capacity of emissions.

- Road 6 west of Tüzér street
- Garden city along bypass
- Access sections to main roads
- Along bypasses
- Siklósi road access section

Greening of parking lots: for commercial properties larger than 250 sqm, the current parking capacity will be assessed, the extent to which they can become a hub parking lot and replace on-street off-street parking spaces under a cooperation agreement with the Municipality, what additional green space can be added to the property.

Expansion and renovation of urban parks using climate-resilient approaches: climate-resilient upgrading of existing green spaces and green areas, as well as the creation of new ones. Natural stormwater management in green spaces: the use of green infrastructure such as rain gardens, bioswales and permeable pavements can bind carbon in stormwater management.

Converting vacant or underused land into green space can improve the urban landscape, reduce the heat island effect and sequester carbon through increased vegetation. Preserving undeveloped urban land as parks, nature reserves or protected areas preserves carbon-rich ecosystems and prevents urban sprawl.

Implementing sample projects:

Urban gardens: community gardens and urban agriculture projects use open spaces to grow crops that sequester carbon while providing fresh, local produce.

Urban agriculture: growing crops in urban areas improves soil health and organic matter, which leads to increased carbon sequestration.

Composting schemes: encouraging composting of organic waste diverts waste from landfills and enriches the soil, helping to sequester carbon.

In the above categories, pilot projects will be implemented in the first two years, and experience will be used to implement full scaling-up. A detailed strategy and a feasibility study will be developed to improve the absorption capacity of the green space system by the end of 2024, resulting in 79 kt CO_2 sequestration by 2030. The results of the HungAiry project will support the identification and selection of suitable sites.

This will result in a more attractive cityscape. Existing green spaces will be rehabilitated and maintenance will be improved. New public green spaces will be created in undeveloped areas and in neighbourhoods lacking green space. Rising daily maximum and minimum temperatures and heat waves will be offset. Expected summer and autumn rainfall deficits will be remedied through planned management of urban stormwater runoff, on the one hand, and by increasing the urban share of green spaces and unpaved surfaces that facilitate infiltration, on the other.

The following aspects will be taken into account in the development of climate-resilient green spaces:

The average carbon sequestration capacity of a 1 hectare (ha) park can vary greatly depending on a number of factors, including vegetation type, climate conditions and management practices. Carbon sequestration capacity refers to the ability of a park to absorb and store carbon dioxide (CO_2) from the atmosphere through the growth of trees, plants and other vegetation. Here are some general considerations:

Vegetation types: parks with a variety of mature trees and dense vegetation tend to have a higher carbon sequestration capacity. Trees, especially large and long-lived species, store significant amounts of carbon.

Species diversity: diverse plant species can contribute to a park's carbon sequestration capacity. Different plant species have different growth rates and carbon sequestration potential.

Climate: climatic conditions, such as temperature, precipitation and length of growing season, can affect the rate of carbon sequestration. Parks in regions with more favourable growing conditions sequester carbon more quickly.

Soil quality: the quality and health of the park's soil also plays a role in carbon sequestration. Healthy soil supports vigorous plant growth and carbon storage.

Management practices: the way the park is managed, including pruning, mulching and fertilisation practices, can affect the carbon sequestration potential of the park.

Age of vegetation: older, well-established trees tend to store more carbon than younger trees. As a park matures, its carbon sequestration capacity may increase.

Applying nature based solutions:

Parks improve air quality by filtering pollutants and reduce the urban heat island effect. They reduce urban noise, act as stormwater retention areas and provide vital habitat for declining flora and fauna

- Establishment of a network of urban meteorological - comfort-related - measuring stations to map heat islands, dry spots, the effects of natural units, different potentials of wind, solar radiation, etc. for the urban fabric.
- Sustainable management protocols: Integrated pest and weed management, Integrated and ecological pest management, Habitat and refuge creation and preservation to support habitats, Sustainable fertilizer use, Composting of organic waste and reuse of composted material, Protection of aquifers from pollution
- Soil conservation and soil quality management: slope replanting, cover crops, windbreaks, conservation tillage practices, permaculture, deep-rooted perennials, organic enrichment (manure, biosolid manure, green manure, compost, etc.), inorganic soil conditioners and soil improvers (biochar, vermiculite, etc.)
- Stormwater management to deal with the effects of flash flooding, designing the soil to retain large amounts of rainwater and channel it to green areas or beyond

● Developing sensor-assisted irrigation systems that can monitor plant health and optimise water use based on real-time data on soil moisture, temperature and light conditions

● Stormwater management - providing larger facilities with green roofs, rain gardens and permeable pavements that can absorb most of the rainfall from flash floods

● Developing urban farms: there is a need to explore the feasibility of locations. Value added: shortening the food supply chain, utilisation of under-utilised land, public involvement, increasing green space, carbon reduction through reduced transport routes, reduced costs. In contrast to community gardens, this is a city-planned, coordinated solution that makes a real contribution to the urban food supply and creates jobs

● Separate collection of urban food and bio-waste, for use as compost on urban farms and in urban parks

● Expanding the network of community composting frames

● Replacing concrete surfaces that have lost their function with high quality green areas (more efficient use of rainwater)

● Designing a coherent green space system - including, in addition to parks and existing green spaces, greening of disused asphalt and concrete surfaces, urban green roofs and walls that need to be regulated, and roadside tree belts

● The aim is to develop a complex stormwater management infrastructure for the complex management of floods and droughts, focusing on sustainable water management and water conservation, creating cooperation between the sectors concerned (municipalities, water institutions, farmers, businesses, the population), modernising the infrastructure for the management of stormwater in public areas and encouraging the population to use stormwater locally.

Figure 45: Pécs, Balokány Park

4.3 Module B-3: Indicators for Monitoring, Evaluation and Learning

Pécs applies the **Monitoring, Evaluation**, and **Learning (MEL)** of NetZero cities.

Monitoring relates to the development and application of quantitative indicators to track and analyse Pécs' progress towards direct impacts and indirect impacts, as well as the setup, management and maintenance of data collection tools and infrastructure.

Evaluation denotes the analysis and assessment of monitoring information against set goals, targets, and benchmarks, with the aim of determining the degrees to which critical milestones, intermediate outcomes, and final impacts have been achieved.

Learning implies a structured and continuous process of stock-taking and synthesis to generate real-time insights help cities understand which solutions are working, in what contexts, for whom and why. In doing so, these activities will generate evidence and knowledge to enable reflexive governance and correct/refine the course of action.

Setting up and designing an effective monitoring system for urban climate transition is crucial for tracking progress, assessing the impact of climate initiatives, and making data-driven decisions. Here are the key steps and considerations for establishingthe Climate Monitoring System for Pécs Climate Action Plan:

Clear Objectives and Indicators: defining the specific objectives of the monitoring system and identifing key performance indicators (KPIs) and metrics relevant to the climate transition goals.

Data Collection: identifing the data sources required to measure the selected indicators. This involves leveraging existing data from governmental agencies, utilities, and research institutions, and will involve installing sensors, conducting surveys or assessments. In order to ensure data accuracy and consistency, data quality standards and protocols will be established.

Data Management: a centralized data management system is to be established where all collected data is stored, organized, and accessible to relevant stakeholders. Using data management software or Geographic Information Systems (GIS) to facilitate data storage and analysis is to be implemented. It will also involve data analysis tools and software to process and analyze the collected data. Data analytics can reveal trends, patterns, and correlations. Visualizations such as graphs, maps, and dashboards will be created to make the data more accessible and understandable for decision-makers and the public.

Real-Time Monitoring: where applicable, real-time monitoring capabilities will be established using IoT sensors and other technologies to capture immediate data and respond to emerging climate-related events.

Regular reports will summarize the monitoring results and progress toward climate goals. These reports will be easily understandable by a non-technical audience. Data and reports will be shared with relevant stakeholders, including government officials, community organizations, businesses, and the public.

The monitoring system will be designed to be adaptable to changing circumstances and emerging technologies. Climate transition is an evolving field, and the monitoring system should evolve with it.

Data privacy and security protocols will be in place to protect sensitive information collected through the monitoring system.

Training and capacity-building programs will be organized for municipal staff and stakeholders responsible for data collection, analysis, and interpretation.

A feedback loop will be established where data analysis results inform decision-making, policy adjustments, and the development of new climate initiatives.

Transparency in data collection, analysis, and reporting is important to build trust among stakeholders. Accountability measures should be in place to ensure progress is on track.

The monitoring system e will be regularly reviewed and evaluated in order to ensure effectiveness and make necessary adjustments to improve its efficiency and impact.

Following these steps and principles, an effective monitoring system will support Pécs' urban climate transition efforts, facilitates informed decision-making, and demonstrates progress toward sustainability and resilience goals.

Pécs targets 2030

Energy sector Fuel burning within the city limits	• Access to renewable energy for 50% of households • 85% decarbonisation of electricity consumption • the share of renewable energy sources increases to 60% • electricity demand rises by 40% to replace natural gas consumption • 200 MWp of solar PV capacity to be built for electricity generation
Building energy Fuel burning within the city limits	• Emissions from buildings reduced by 50% by 2030 • 35% of the existing building column is retrofitted • all new buildings meet zero carbon standards • Over 80% of appliances sold are the most energy efficient models available • No new fossil fuel boilers will be sold from 2030 unless they are hydrogen compatible • Use of natural gas for heating to fall by 50% by 2030 • Design of solar panels for residential buildings of categories A - C • Consumption of natural gas for cooking is phased out
Building energy Grid-supplied energy within the city limits	• Renewable share in the building sector 70% • 66% of energy use in buildings is provided by electricity • Energy savings of 40% of final energy consumption • 65% of homes heated by heat pumps
CO2 emission performance standards for cars and vans	• 50% of vans of less than 3.5 t and 40% of trucks of more than 3.5 t will be replaced by electric vehicles • 35% reduction in car use by 2030
Renewable energy in transport	• Electric buses, public transport 100% reduction • Hydrogen in transport, about 40% of transport energy use by 2030 in non-specific transport (urban public transport, urban operations, freight, taxis)

Figure 46: Pécs targets

B-3.23: Impact pathways

Outputs, effects	Action	Indicator identifier	Indicator name	Target		
				2025	2027	2030
Access to renewable energy	Decarbonizing electricity generation	E1	Renewable energy capacity	10 Mwp	50 Mwp	200 Mwp
Increased energy efficiency	Building renovations, New energy-efficient buildings, Efficient lighting & appliances	E2	Energy savings as a share of final energy consumption	10%	20%	40%
Emissions reduction	All actions	E3	CO2 reduction	-10%	-30%	-80%
Increasing the share of renewable energy	Building renovations, Decarbonizing electricity generation	B1	Share of renewables in the buildings sector	15%	30%	70%
Fossil fuel phase out	Decarbonizing heating generation	B2	Substitution of residential natural gas consumption	-10%	-20%	-50%
Increase in electricity consumption due to a reduction in the share of fossil fuels	Building renovations	B3	Share of electricity in energy use in buildings	10%	30%	66%
Increased energy efficiency	Building renovations	B4	Reduction of emissions from buildings	-10%	-20%	-50%

B-3.23: Impact pathways						
Awareness of the circular approach, ecosystem building	Circular economy	C1	Recycled construction material as a percentage of total construction material	10%	20%	50%
Enabling the uptake of electrically powered public transport	Electrification of buses	T1	Carbon reduction in public urban transport	10%	80%	100%
Enabling the uptake of electric private transport	Electrification of cars + motorcycles	T2	Increase the share of electric cars among privatly owned cars	0%	+10%	+35%
Encouraging modal shift	Shift to public & non-motorized transport	T3	Increase the share of low emission vehicles	10%	20%	40%
Reducing individual and freight traffic in the city centre	Reduced motorized passenger transportation need, Optimized logistics	T4	Traffic load on road 6	0%	-10%	-35%
Increasing climate resilient land use	Green infrastructure development	T5	Strengthening sink capacity	5%	20%	60%
Better waste management	Waste management	W1	Reducing the amount of waste going to landfill	0%	-10%	-20%
Waste prevention, recycling	Increased waste recycling	C2	Amount of waste recycled	+10%	+30%	+50%

Monitoring, evaluation, and learning (MEL) play crucial roles in the success and effectiveness of Pécs' climate transition efforts. Here's how each component contributes to the process:

Monitoring:

Tracking Progress: Monitoring involves systematically collecting data and information on various aspects of urban climate transition.

Early Warning: Monitoring provides early warning of any deviations from the planned trajectory, allowing cities to identify issues and challenges in a timely manner.

Data-Driven Decision-Making: Real-time or periodic monitoring data allows decision-makers to make informed, data-driven decisions. It provides insights into the effectiveness of climate policies and initiatives.

Accountability: Monitoring results can be shared with the public, stakeholders, and governing bodies, enhancing transparency and accountability in urban climate efforts.

Continuous Improvement: By regularly assessing and measuring various parameters, cities can identify opportunities for improvement and optimize their climate transition strategies.

Evaluation:

Assessing Impact: Evaluation involves a more comprehensive analysis of the outcomes and impacts of climate transition initiatives. It helps answer questions like, "Are we achieving our intended outcomes?" and "What are the wider effects of our actions?"

Cost-Benefit Analysis: Evaluation assesses the cost-effectiveness of climate projects, helping cities prioritize investments and allocate resources efficiently.

Identifying Successes and Challenges: Evaluation identifies both successful elements and challenges within climate transition efforts. It provides insights into what is working and where adjustments are needed.

Learning from Experience: Evaluation is a critical tool for learning from past experiences, whether they resulted in success or setbacks. It enables cities to avoid repeating mistakes and replicate successful strategies.

Adaptive Management: Through evaluation, cities can adapt their climate strategies and policies based on lessons learned and changing circumstances. It allows for course corrections when necessary.

Learning:

Knowledge Sharing: Learning involves sharing insights, best practices, and experiences among stakeholders, both within the city and with other cities facing similar challenges. This knowledge sharing can occur through workshops, conferences, publications, and online platforms.

Capacity Building: Learning initiatives enhance the capacity of city officials, staff, and community members to understand and address climate issues effectively.

Innovation and Experimentation: Learning encourages experimentation and innovation in climate transition strategies. Cities can learn from experiments and pilot projects to identify scalable solutions.

Adaptive Governance: Learning supports adaptive governance, where cities continuously evolve their policies and actions based on new information, emerging trends, and feedback from stakeholders.

Cross-Sector Collaboration: Learning facilitates collaboration across sectors and disciplines, fostering a holistic approach to urban climate transition.

MEL are integral components of urban climate transition strategies. They enable Pécs to assess its progress, make informed decisions, enhance accountability, and continually adapt to changing circumstances. By monitoring, evaluating, and learning from its experiences, Pécs can develop more effective and sustainable approaches to address the challenges of climate change and contribute to a more resilient and sustainable urban future.

5 Part C - Enabling Climate Neutrality by 2030

5.1 Module C-1: Organizational and Governance Innovation Interventions

C.1.24: Organizational and governance interventions					
Intervention	**Description**	**Responsible**	**Stakeholder**	**Impact**	**Indirect impact**
Operation of the Pécs Climate Neutrality Platform	Cooperation with climate change stakeholders, mutual information exchange and monitoring of the implementation of the action plan	Municipality of Pécs	All sectors	Strengthening democratic institutions	Strengthening social capacities
Climate Partnership, a long-term, active cooperation between the business sector and the Pécs Municipal Authority to reduce the carbon footprint of the city of Pécs	Education activities on decarbonisation for the business sector	Municipality of Pécs	Pécs-Baranya Chamber of Commerce and Industry, Chamber of Engineering, Industrial Park, IPark Kft, economic operators	Strengthening the ecosystem	Strengthening social capacities
Cooperation with the public sector - the climate ambassador scheme.	Climate ambassadors are responsible for sustainability activities, monitoring and communication on energy consumption and reduction in their institution	Municipality of Pécs	Educational institutions, Health and Social institutions, Commercial organisations	Energy efficiency	Strengthening social capacities
Citizens' Climate Forum - green gratitude scheme	Education and awareness-raising modules on decarbonisation and sustainability	Municipality of Pécs	Citizens, NGOs	Strengthening social cohesion	Strengthening sustainable urban living
ClimGovCities	ClimGovCities builds on stake-holder mapping to develop, promote and support better understanding, engagement and perception of climate action, with the aim of identifying key stakeholders at national, European and global level, including policy and decision makers and civil society actors.	Municipality of Pécs	Municipality, academia, NGOs	Strengthening social capacities	Strengthening social capacities

C.1.24: Organizational and governance interventions					
Intervention	**Description**	**Responsible**	**Stakeholder**	**Impact**	**Indirect impact**
GreenInCities	The aim of the project is to demonstrate the value of collaborative design methods to implement greening and re-greening interventions towards greener, safer, mixed/multi-purpose and shared urban (public) spaces and built environments	Municipality of Pécs	Citizens, Biokom	Strenghtening the green infrastructue	Strengthening sustainable urban living
Preparing inter-regional innovation investments for the Central European Green Hydrogen Value Chain by developing a stake-holder participation scheme and setting up an IoT frame-work.	Preparing inter-regional innovation investments for the Central European Green Hydrogen Value Chain by developing a stake-holder participation scheme and setting up an IoT frame-work.	Municipality of Pécs	University, businesses	Developing the hydrogene sector	Ensuring energy safety
Green Office service package	Energy and green advice Assistance - advice and information on energy renovation; Coordination - coordinating all market players, suppliers and providing information; All-inclusive service - where OSS is the supplier of the complete refurbishment package	Municipality of Pécs	The public, construction umbrella organisations and businesses	Better access to information	Strengthening sustainable urban living

C.1.24: Organizational and governance interventions

Intervention	Description	Responsible	Stakeholder	Impact	Indirect impact
Urban building renovation passport scheme	Partnering with the residents of Pécs to ensure that buildings are renovated to an average CC level.	Municipality of Pécs	Residential building owners, Institutional property owners, Construction industry	Energy efficiency	Strengthening sustainable urban living
Building the digital infrastructure: infrastructure, data connectivity, data sharing and data security standards	The establishment and operation of a digital technology-based management system and data-base is a prerequisite for a sound emission reduction process. The integration of data available in separate systems and not yet available in one system will allow for the proper preparation of emission reductions and climate adaptation in different sectors, in particular buildings, transport and green space	Municipality of Pécs	All sectors	Better access to information	Strengthening sustainable urban living
Setting up an urban carbon modelling and monitoring system	To display and update the carbon inventory developed in the action plan, the underlying data series, scenarios and indicators in a unified modelling system, which provides a continuous monitoring system for reviewing and adapting the carbon reduction pathway.	Municipality of Pécs	All sectors	Better access to information	Strengthening sustainable urban living
Municipal measures to reduce emissions from buildings	Development of municipal regulatory measures to ensure the implementation of a carbon neutral building stock from 2030	Municipality of Pécs	Residential building, institutional building owners and operators	Energy efficiency	Strengthening sustainable urban living

C.1.24: Organizational and governance interventions					
Intervention	**Description**	**Responsible**	**Stakeholder**	**Impact**	**Indirect impact**
Development of an intelligent urban energy management and spatial information system - Optimising the use of public transport	The planned component aims to strengthen the concept of "green urban transport"	Municipality of Pécs	Tüke Busz Zrt., Biokom Nkft	Better access to information	Strengthening sustainable urban living
Measures to reduce car traffic	Contract with large employers - shared electric cars, mini-buses, hydrogen minibuses for commuting to work (as part of remunerations)	Municipality of Pécs	Biokom, Car owners	Encouraging modal shift	Strengthening sustainable urban living
Municipal measures in the field of transport	Developing an incentive scheme to encourage the phasing out of petrol and diesel vehicles from inner urban areas	Municipality of Pécs	Biokom, Car and truck owners, operators in the transport sector	Encouraging modal shift	Strengthening sustainable urban living
Citizens' Climate Forum - green gratitude scheme	Education and awareness-raising modules on decarbonisation and sustainability	Municipality of Pécs	Citizens, NGOs	Strengthening social cohesion	Strengthening sustainable urban living
Green public procurement	In line with the measures set out in the national public procurement strategy, develop a local green public procurement framework that incorporates carbon reduction considerations in e.g. transport, construction, catering, investment and other services. Environmental considerations will be taken into account in public procurement, in addition to the mandatory requirements generally applicable to the goods / services / works in question.	Municipality of Pécs	Economic operators involved in public procurement	Improved social cohesion	Strengthening sustainable urban living

C.1.24: Organizational and governance interventions					
Intervention	**Description**	**Responsible**	**Stakeholder**	**Impact**	**Indirect impact**
Green budget	Audit local government budgets for climate neutrality and take appropriate measures in line with the European Union's Green Budget Framework	Municipality of Pécs	Citizens	Improved social cohesion	Strengthening sustainable urban living

C1.-2.: Description of management and governance interventions

Pécs Climate Neutrality Platform was established in September 2022. The transition of the city of Pécs to climate neutrality by 2030 will require radical changes in a number of sectors, including energy, mobility, waste, construction, but also in public procurement, regulation and financing systems. This type of change requires significant cooperation and concerted action, involving actors in different sectors and areas at national and local level, as well as consumers and citizens in Pécs. The local government, in cooperation with local actors, can accelerate the processes and the achievement of the net-zero target.

The Climate Platform was commissioned by the Municipality of Pécs and PVF Zrt., in 100% ownership of the Municipality is responsibe for design and implementation. Transition team operates within PVF Zrt. to manage the process.

The Steering Group plays a key role in the development and management of cooperation with the Municipality and local stakeholders, the operation of the Climate Platform Forums, the necessary governance and communication tasks, the preparation and subsequent implementation of the Climate Neutral Contract and its annex. In addition to the Steering Group, a five-member Expert Group is responsible for the development, biannual monitoring and implementation of the Action Plan and Investment Plan. The city of Pécs implements the Mission Group model, with dedicated capacities within PVF Zrt and continuous consultation with key local actors in the Steering Committee and working groups.

The Steering Committee oversees the whole process and includes organisations and institutions that

- The largest urban emitters,
- Provide a background for research and development,
- Provide innovation support,
- Provide support at different levels of government decision-making (legislation, regulation, funding),
- The Committee also ensures cross-disciplinary synergies.

The working groups are responsible for providing input into the development of the Climate Neutral Action Plan and Investment Plan, according to the competences of their institution or organisation:

- Provide data to develop a carbon inventory,
- Identify available and applicable technologies,
- Developing a portfolio of projects,
- Identifying alternative impact pathways, technological options,
- Identification of the residual emission value by sector,

- The definition of measures to redeem the residual value,
- Identifying opportunities for cooperation between ecosystem actors,
- Identifying circular economy models,
- Assessing the feasibility of the project portfolio,
- Analysis of the necessary legal conditions,
- Proposing a funding model for the project portfolio elements, identifying business solutions beyond grant funding,
- Ensuring synergies between sectors.

Within the framework of the Climate Neutrality Platform, the city operates independent climate partnerships with institutional actors, commercial service providers and industry. Within the framework of the Action Plan, an updated version of the city's carbon inventory has been prepared in cooperation with the relevant stakeholders, but further details on the path to net zero need to be understood, which only continuous cooperation and coordination can ensure. To this end, a long-term, active partnership between business, service providers and institutions, as well as the city authority, will be established within the urban climate partnership. In this context, an energy consumption and emissions questionnaire and a transition timetable will be completed at the organisational level under the guidance of PVF Zrt, with the involvement of the Municipality and the Baranya County Chamber of Commerce and Industry. These will be completed by 30 June 2024 and will serve as a basis for the development of more detailed interventions and financing solutions. Education activities on decarbonisation and mentoring of the transition roadmaps will also be carried out (questionnaire and transition roadmap structure in annex).

Cooperation with educational institutions beyond the transition timetable will also be pursued through the establishment of the Climate Safety Net scheme. A Climate Belt is one teacher and one student per school, who are responsible for the schools' sustainability-related activities, monitoring energy consumption, waste generation and implementing actions that contribute to energy efficiency, educational and recreational activities and actions.

The Climate Neutrality Platform's Climate Forum, which brings together the public, is developing a green climate awareness system. The aim is to get the largest possible number of Pécs residents to become members in the next two years. Green Climate Awareness credits can be obtained by participating in Climate Platform related programmes, attending training and other awareness-raising events, and by documented reduction of individual climate footprints (measured by the Climate Balance app). The Green Climate Awareness credits obtained can be redeemed for the following services, which in their absence are paid services: energy certificate, building renovation passport

The cornerstone of the climate transition is the development of effective cooperation and involvement, and the City of Pécs is implementing a number of projects to this end:

ClimGovCities builds on stakeholder mapping to develop, promote and support better understanding, engagement and perception of climate action, with the aim of identifying key stakeholders at national, European and global level, including policy and decision makers and civil society actors.

The GreenInCities project aims to demonstrate the value of collaborative design methods to deliver greening and reforestation interventions towards greener, safer, mixed/multi-purpose and shared urban (public) spaces and built environments across Europe, supporting the transition to climate neutrality.

Establishing in each participating city collaborative platforms (e.g. living laboratories) representing multi-level and multidisciplinary governance structures, and involving local authorities, citizens, stakeholders and relevant actors[4] and experts[5] in the joint urban regeneration, regeneration, (re)use or (re)transformation plans that apply greening and reuse approaches to promote more climate-neutral, resilient, livable, sustainable and functional cities with thriving nature, communities and economic activities;

Ensure that the regional dimension of climate change adaptation is adequately taken into account through the continued and smooth involvement of the relevant regional authorities responsible for the planning and implementation of regional climate change and adaptation measures, so as to ensure cross-level (city/region) compatibility and coherence of city/regional climate change and adaptation plans.

Actions should also provide for quantitative and qualitative ex-ante and ex-post evaluation of the impact of the combination and integration of different greening and re-naturalisation interventions and actions, both at local and regional level, based on reliable monitoring systems, using existing methods and indicators where appropriate.

In addition to developing the above-mentioned plans, the "lead" demonstration cities will also have to ensure the actual implementation of the jointly-created interventions during the project period. To this end, the specific implementation measures and the associated costs should be described in a separate work package or task.

The replicator/cities will develop their jointly-created plans, measures and interventions under the proactive guidance and mentoring of the lead cities, and will not be obliged to actually implement them during the project period.

To support the integrated planning process and facilitate citizen involvement in the decision-making process, measures should make effective use of digital tools (e.g. digital twins) that integrate static, real-time and historical data from observations, modelling and simulation across multiple domains, while applying open standards and technical specifications.

Actions should engage in cluster activities with other like-minded projects funded under this theme, other relevant projects and projects funded under the Climate Neutral and Smart Cities and Climate Change Adaptation Mission to promote synergies and complementarity.

Preparing inter-regional innovation investments for the Central European Green Hydrogen Value Chain by developing a stakeholder participation scheme and setting up an IoT framework.

The Green Office currently operates within the Municipality with 1 person, capacity development and extension of its remit is needed to enable it to play a significant coordinating role in the deep renovation of the city's housing stock, providing energy and green advice. The aim is to implement the three-tier model in stages:

Assistance - providing advice and information on energy renovation;

Coordination - coordinate market players, suppliers and provide information;

All-inclusive service - Green Office is the supplier of the complete renovation package, with contracted contractors to renew residential buildings.

Building renovation passport based on energy certificate - Individual survey of the housing stock, creation of a layer in the digital city management system to record the building stock data. 4 types of buildings for apartment buildings: Panel - district heating, cooking gas, air conditioners (number of renovated panels, number of non-renovated panels), Sliding shutter (convector), Brick apartment building (convector or individual gas boiler), New brick - individual gas boiler or central heating. For these building types and sub-types, following a survey, develop building renovation schedules and issue a building enrichment "passport" setting out the steps needed for long-term energy efficiency improvements. Project owner Green Office, who will support the renewal of the city's residential building stock through this advice. Energy certification for all buildings until 2030. Benefits: detailed information and data on the housing stock, information for the building industry, information on financing and legislative possibilities, networking

Modelling energy consumption patterns at household level, creating energy consuming zones: selection of pilot building, training on specific energy consumption, saving opportunities, condition of individual measurability. Develop incentive scheme: redeem credits for service or put into renovation fund and become eligible for renovation subsidy.

The establishment and operation of a digital technology-based management system and database is a prerequisite for a sound emission reduction process. The integration of data available in separate systems and not yet available into one system will allow for the proper preparation of emission reductions and climate adaptation in different sectors, in particular buildings, transport and green space.

Main layers: drone survey of building stock, census data based on housing questionnaire, building cadastre, traffic census, traffic reduction zones, corridor optimisation, green space cadastre, renewable energy sources, additional areas for deployment, exposure of agricultural areas to climate change, noise, water and waste water and storm water cadastre, institutional land register. GIS-based planning and development system to promote economical and optimal land use

The modelling system for the digital governance system allows you to decide which solution is proposed for implementation, based on the evolving technology, available resources, legal constraints and other external conditions. Ongoing modelling can ensure that carbon reduction solutions build on each other, support each other and that the investments made do not increase emissions due to an indirect, unintended impact.

Transforming information from data into value, for example identifying patterns in energy consumption.

The data can also be used to develop products and services that allow end-users to consume energy when it is green and cheap.

Setting up an urban carbon modelling and monitoring system

To display and update the carbon inventory developed in the action plan, the underlying data series, scenarios and indicators in a unified modelling system, which provides a continuous monitoring system for reviewing and adapting the carbon reduction pathway.

Developing municipal regulatory measures to ensure the implementation of a carbon neutral building stock from 2030.

Development of self-governance measures, preparation and implementation of an energy impact study:

- Only district heating or electricity is allowed in new buildings
- Cooking gas not applicable, electric stove, possibly wood pellet stove
- If a gas stove needs to be replaced, it can only be replaced by an electric stove, from 2030 onwards, gas stoves will not be sold
- No new fossil fuel boilers will be sold from 2030 unless they are hydrogen compatible

Expectations for new construction

- The building structure, the passive design, is designed to minimise energy demand.
- Flexible design to allow for adaptation to alternative uses.
- Site management to ensure the right level of sustainability, water use of the property, on-site transport, waste reuse and recycling, sustainable use of materials and construction techniques.
- Ensuring the resilience of properties to known climatic factors.
- Implement measures to reduce the life-cycle CO_2 equivalent impact.
- Optimising the use of local renewable or low-carbon energy Decentralised energy system preferred.

Development of municipal measures, impact assessment and implementation in the field of transport:

- For freight transport, carbon offsetting obligation with monitoring - from 2030, unless switching to electric or hydrogen vehicles
- New cars will pay higher taxes from 2030 if they are petrol or diesel and not zero-emission, which will go into a carbon fund
- Zero emissions legislation for the transport of goods and services

Development of an intelligent urban energy management and spatial information system - Optimising the use of public transport

The planned component aims to strengthen the concept of "green urban transport", in the framework of:

- Equipping buses with smart meters, thus allowing continuous environmental monitoring
- Equipping buses with load monitoring cameras, so that bus traffic can be optimised (if there are few passengers, less frequent departures on a given line are sufficient)
- Conversion of traffic signals, focus on reducing air pollution and emissions rather than journey times

Measures to reduce car use: introduction of a mobile application to support climate-friendly mobility through a partnership of public institutions, private companies and transport service providers, using a data-driven application to continuously monitor and support the transport of users, with the aim of reducing car use, backed up by a contractual scheme with these large employers - shared electric cars, minibuses, and later hydrogen minibuses for commuting (as part of a remunerative scheme)

Green public procurement

In line with the measures set out in the national public procurement strategy, develop a local green public procurement framework that incorporates carbon reduction considerations in e.g. transport, construction, catering, investment and other services. Environmental considerations will be taken into account in public procurement, in addition to the mandatory requirements generally applicable to the goods/services/works in question.

Green budget

Audit local government budgets for climate neutrality and take appropriate measures in line with the European Union's Green Budget Framework.

5.2 Module C-2: Social and Other Interventions

C.2.25: Enabling social interventions					
Intervention	**Description**	**Responsible**	**Stakeholder**	**Impact**	**Indirect impact**
Communication campaign with activities	Targeting the general public, businesses and young people	Municipality of Pécs	Adult population, 6-23 years old, SMEs, NGOs	Better access to information	Strengthening sustainable urban living
Lifestyle advice on the impact of different lifestyle habits on our carbon footprint and our health a nd happiness	Lifestyle advice on the impact of different lifestyle habits on our carbon footprint and our health and happiness (e.g. beef consumption, vegetarianism, coffee consumption, buying food or other products from other continents, etc...). Information campaigns	Municipality of Pécs	Climate Platform, Citizens, NGOs	Better access to information	Improved physical and mental health
Development of a climate balance app	Study for the development of a climate balance application. A mobile application that measures the daily climate impact of the residents' mobile phone and sends daily automatic recommend-ations for further reduction.	Municipality of Pécs	Citizens, Green Office	Better access to information	Strengthening sustainable urban living
Developing a home mental health system and linking it to the home medical system.	Developing a home mental health system and linking it to the home medical system, resulting in reduced psychosomatic illness, reduced overconsumption, improved overall happiness levels, reduced health burden (and hence GHG emissions), and reduced traffic congestion.	Municipality of Pécs	Health institutions, NGOs	Better access to information	Improved physical and mental health

C.2.25: Enabling social interventions					
Intervention	**Description**	**Responsible**	**Stakeholder**	**Impact**	**Indirect impact**
Developing a sustainability education programme for 3-6, 6-18 and 18-23 year olds	Developing a sustainability education programme for 6-23 year olds	Eco-city, Ecoregion Foundation, Green Bridge Foundation, PTE	Ages 6-23, educational institutions, PTE	Better access to information	Behaviour change
Promoting behavioural measures in transport	Promoting behavioural measures in transport, both for cars and lorries	Biokom	Biokom, citizens	Engagement of citizens and communities	Behaviour change
Learning-design-implementation programme for the development of energy communities	Learning-design-implementation programme for the development of energy communities	Municipality of Pécs	PTE, Green Office, energy community residents, homeowners	Better access to information	Behaviour change
Action for energy efficiency with a residential test group	Action for energy efficiency with a residential test group	Municipality of Pécs	Citizens	Strengthening social cohesion	Behaviour change
Contract scheme with large employers to reduce car use	Contract scheme with large employers to reduce car use	Municipality of Pécs	High-employment institutions and enterprises, their employees	Engagement of citizens and communities	Strengthening sustainable urban living
Education programme to end energy poverty	Education programme to end energy poverty	KRTK	Disadvantaged population	Strengthening social cohesion	Improved physical and mental health

C.2.25: Enabling social interventions					
Intervention	**Description**	**Responsible**	**Stakeholder**	**Impact**	**Indirect impact**
Community planning programme to promote climate-friendly land use	Community planning programme to promote climate-friendly land use	Municipality of Pécs	Citizens, NGOs, Biokom, Transport providers	Engagement of citizens and communities	Strengthening sustainable urban living
Information campaigns, events on technological and technical knowledge in the fields of energy efficiency and climate transition	Information campaigns, events on technological and technical knowledge in the field of energy efficiency and climate transition (e.g. on rooftop solar installations, storage capacity, heat pump systems)	Municipality of Pécs	Citizens, institutions	Better access to information	Strengthening sustainable urban living
Survey of consumer habits through a communication campaign	Survey of consumer habits through a communication campaign (building use, large consumer equipment, consumer behaviour, land use, individual transport components)	Municipality of Pécs	Citizens	Better access to information	Behaviour change
Social habits, conduct a behavioural survey	Social habits, conduct a behavioural survey	Municipality of Pécs	Citizens	Better access to information	Behaviour change

C2.-2.: Description of social interventions

The climate-neutral transition can only be achieved through broad societal cooperation, and for this, continuous dialogue and communication with the public, the business sector, the energy sector, the institutional sector and local government institutions is essential. Following the submission of the Climate Neutral Contract, a three-month communication campaign and action is planned for three target groups: the general public, young people (kindergarten - high school), reaching them through educational institutions, students in cooperation with the PTE, and businesses, reaching them through the Economic Development Department and the Chamber of Commerce. The three target groups will be invited to join the Climate Neutral Pécs programme, with the aim of reaching as many stakeholders as possible to create long-term commitment. Registration can be done on the sub-homepage operated by PVF Zrt:

Population:

- Completing a mini energy audit questionnaire that you can do yourself
- Participates in climate-neutral training programmes (on energy efficient and low-emission homes, reducing transport emissions, sustainable consumption)
- Completing a questionnaire on their transport habits

Youth (pre-school, primary, secondary, upper secondary) : sessions on three themes, with activities according to age groups:

- Types of energy, energy consumption, what is renewable energy, what is carbon emissions
- Transport habits, how to be environmentally friendly - commitments to cycling and walking to school
- Waste knowledge, circular options, projects

Institutions:

- Carry out your own energy audit based on a questionnaire
- Survey of the traffic habits of school children and teachers based on given criteria and questionnaire
- School waste audit, organisation of reuse and recycling events

Business sector:

- Provide regular energy consumption and emissions data to the municipality
- Commit to carbon reduction measures
- Commit to sharing your waste management practices and circular options

Those who fulfil the pledge will receive a Green Gratitude, which can be redeemed for specific services and carbon reduction advice. The campaign will be repeated annually with updated content based on experience.

Further cooperation with target groups in the framework of city events, e.g. Learning City

- Survey of consumer habits through a communication campaign (building use, large consumer equipment, consumer behaviour, land use, individual transport components)
- Social habits, conduct a behavioural survey
- Lifestyle advice on the impact of different lifestyle habits on our carbon footprint and our health and happiness (e.g. beef consumption, vegetarianism, coffee consumption, buying food or other products from other continents, etc...). Information campaigns
- Developing a home-based mental health system and linking it to the GP system, resulting in reduced psychosomatic illness, reduced overconsumption, improved overall happiness levels, reduced health burden (and hence GHG emissions), reduced traffic congestion
- Promotions: power generation with sports equipment, Car-free week, Online travel matchmaking
- Community landscaping, Community gardening, Community garbage collection, Community composting
- Awareness-raising campaign
- Conscious shopping and consumption

- Shaping awareness and raising awareness through fashion and art
- Awareness-raising and education campaign on (selective) waste collection rules and options
- Household and business voucher/reward scheme for selective waste collection and recycling
- Cooperation with companies, supermarkets and hypermarkets in Pécs to encourage conscious purchasing behaviour

Social action in transport :

- Promoting behavioural measures in transport, both for cars and lorries
- Community planning programme to promote climate-friendly land use: Participatory planning process to rethink the urban space in the action area - traffic reduction through traffic engineering, architectural solutions, pedestrianisation, missing links, alternative transport, green space system rethinking, connecting, alleviation of parking problems, possibility of installing on-street chargers in zones suitable for on-street parking, obstacles and opportunities for the spread of electric cars, possibility of introducing and expanding electric bicycles and scooters (lessons learned from the Pécsike system, experiences), examination of the possibility of introducing an electric minibus system

Social action in urban agriculture

- Promoting local producers and products and cooperation
- Precision farming awareness raising, advice
- Sustainable management advice

Activities related to the Green Office:

- Development of a climate balance application that measures the daily climate impact of residents' mobile phones and sends daily automatic recommendations for further reduction.
- Learning-design-implementation programme for the development of energy communities
- Information campaigns, events on technological and technical knowledge in the field of energy efficiency and climate transition (e.g. on rooftop solar installations, storage capacity, heat pump systems)

Develop and implement educational programmes:

- The Ökováros-Ökorégió Association is developing a sustainability education programme for children aged 6-18, which will be implemented in every class in every school in Pécs as part of the annual Sustainability Week. Consultation with the heads of institutions and the Klebersberg institution on the introduction of a one-hour sustainability track per week.
- Introduction of a sustainability course in general education at the university in cooperation with PTE
- Education programme to eradicate energy poverty in cooperation with the KRTK.

5.3. Module C-3: Financing of Action Portfolio

As described in the previous sections the Action Plan identified the following key intervention packages that ensure the fulfillment of the set objectives.

- Reduced motorized passenger transportation need
- Shift to public & non-motorized transport
- Increased car pooling
- Electrification of cars + motorcycles
- Electrification of buses
- Optimized logistics
- Electrification of trucks
- Building renovations (envelope)
- New energy-efficient buildings
- Efficient lighting & appliances
- Decarbonizing heating generation
- Decarbonizing electricity generation
- Increased waste recycling
- Circular economy
- Green Infrastructure and nature based solution

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Pécs has applied a two-way planning, a top-down economic modelling and a bottom-up project identification with the involvement of the stakeholders. The planning of the business model is done at a first stage for each of the following projects and further elaboration is commencing after submission. The following table states the project owner for each identified project, however the budgeting table focuses on the key intervention packages as defined. The summary finance table included the GHG reduction capability of each intervention package, Operational cost/savings at NPV between 2020-2050, monetized co-benefits at NPV between 2020-2050 and Total investment cost also at NPV between 2020-2050. Further details and elaboration can be found in the Investment Plan.

Table 26: Project owners

General, sector-independent governance and social projects	
Operation of the Pécs Climate Platform	Municipality of Pécs
ClimGovCities	Municipality of Pécs
Green Office service package	Municipality of Pécs
Green public procurement	Municipality of Pécs
Green budget	Municipality of Pécs
Building a digital infrastructure: infrastructure, data connectivity, data sharing and data security requirements	Municipality of Pécs
Establishing an urban carbon modelling and monitoring system	Municipality of Pécs

Establishing an urban carbon modelling and monitoring system	Municipality of Pécs
Citizens' Climate Forum - Green gratitude scheme	Municipality of Pécs
Communication campaign with activities	Municipality of Pécs
Lifestyle advice on the impact of different lifestyle habits on our carbon footprint, health and happiness (e.g. beef consumption, vegetarianism, coffee consumption, buying food or other products from other continents, etc...). Information campaigns	Municipality of Pécs
Developing a home mental health system and linking it to the GP system, which reduces psychosomatic illness, reduces overconsumption, improves overall happiness levels, reduces the burden on the health system (and thus greenhouse gas emissions) and reduces traffic congestion.	Municipality of Pécs
Study for the development of a climate balance application. A mobile application that measures the daily climate impact of residents' mobile phones and sends daily automatic recommendations for further reductions.	Municipality of Pécs
Develop a sustainability education programme for 3-6, 6-18, 18-23 year olds	Eco-City, Eco-Region Foundation, Green Bridge Foundation, University of Pécs
Survey of consumer habits in the context of a communication campaign (building use, major appliances, consumer behaviour, land use, certain transport elements).	Municipality of Pécs
Conducting social habits and behavioural surveys	Municipality of Pécs
Buildings, heating Phasing out fossil fuels	
Building renovation	
Governance and social projects	
Municipal measures to reduce emissions from buildings	Municipality of Pécs
Cooperation with institutional actors - climate web system	Municipality of Pécs
Introduction of a passport system for building renovation	Municipality of Pécs
Information campaigns, events on technological and technical knowledge in the field of energy efficiency and climate change (e.g. rooftop solar installations, storage capacity, heat pump systems).	Municipality of Pécs
learning-design-implementation programme for the development of energy communities	Municipality of Pécs
Energy efficiency action with a residential test group	Municipality of Pécs
Education programme to end energy poverty	MTA KRTK (MTA KRTK Centre for Economic and Regional Development Research)
Institutional energy consumption and emissions survey	Institutions, Municipality Green Office
Investment projects	
Energy utility upgrades: network expansion, storage capacity, energy community implementation capacity, utility network upgrades, special control transformers on an experimental basis.	Energy utilities
Promoting smart meters, developing a digital platform, ensuring real-time traceability of energy consumption.	Utility companies, Municipality Green Office, Homeowners
Building a downtown energy community with institutional actors	Institutions, homeowners
University of Pécs Decarbonisation of building energy	University of Pécs

University of Pécs Decarbonisation of building energy	University of Pécs
PTE Energy Community Project	University of Pécs
Complex energy development project in Pécsbánya-Karolina	University of Pécs
The LEGOFIT project aims at designing, implementing and validating an adaptable and dynamic integrative approach to achieve energy performance in multi-family residential buildings.	Housing cooperative
Energy efficiency solutions with intelligent systems	Municipality of Pécs, Homeowners, Housing cooperatives, Energy suppliers
Testing local energy supply models - microgrid	Municipality Green Office, Institutions, Homeowners
Testing local energy supply models - energy storage	Municipality Green Office, Institutions, Homeowners
Retrofitting 35% of existing buildings	PÉTÁV Pécsi Távfűtő Kft., homeowners
Residential purchases of energy-efficient appliances (washing machines, TVs, refrigerators), air conditioners, heating systems	Municipality Green Office, Institutions, Homeowners
Replacing the summer hot water supply for multi-storey buildings with renewable hot water produced by special solar collectors in New York City, outside the district heating system.	PÉTÁV Pécsi Távfűtő Kft., homeowners
Pilot project to decarbonise a prefabricated building: installing renewable energy sources to replace cooling, lighting and cooking in a 10-storey prefabricated building.	Municipality Green Office, Homeowners
Mechanical retrofitting of prefabricated buildings for individual heat use and efficiency	Pétáv, Homeowners
Cooking gas substitution	Municipality Green Office, Homeowners
Energy security support programme for families on social assistance to replace fossil fuels.	Municipality Green Office, Homeowners
Energy support programme model for disadvantaged families in partnership with energy suppliers	Municipal Green Office, Homeowners, energy suppliers
Wood-fired housing conversion programme - study	MTA KRTK (MTA KRTK Centre for Economic and Regional Development Research)
New energy efficient buildings	
New build properties along district heating networks	Pétáv, homeowners
Setting minimum requirements for new buildings, providing information	Municipality Green Office, Homeowners
Decarbonising new buildings, passive and active houses - education, awareness raising	Municipality Green Office, Homeowners
Energy efficient lighting and devices	
Developing smart street lighting	Local government
LED burning program	Energy utilities, Municipal Green Office
Optimising household energy consumption through smart grid, microgrid systems, related education, awareness raising.	Energy suppliers, Municipal Green Office, homeowners

Decarbonising heating	
Pétáv development: replacement of 5 MW gas boiler	PÉTÁV Pécsi Távfűtő Kft
Increasing the efficiency of heat production by reducing losses	PÉTÁV Pécsi Távfűtő Kft.
Connection of institutional actors to district heating	PÉTÁV Pécsi Távfűtő Kft, Municipality of Pécs
Cleantech project : energy production and storage with deep geothermal storage - preparatory R&D project	PTE University of Pécs, AFK (University of Pécs)
Cleantech project : Conversion of hydrocarbon wells into geothermal wells	PTE TTK, AFK
Cleantech project : Exploration of geothermal energy sources in the Pécs region	PTE TTK, AFK
Cleantech project: Exploration, extraction and exploitation of secondary raw materials with a strong geological background	PTE TTK, AFK
Cleantech project:The comprehensive development of the university knowledge base and competences for geological projects requiring a significant technical and expert base.	PTE TTK, AFK
Experimental application of a soil probe heat pump system	Municipality of Pécs, Mecsekérc Zrt.
Decarbonising electricity	
Building solar park capacity	Municipality of Pécs
Developing urban energy storage capacity in cooperation with energy suppliers	Municipality of Pécs, energy suppliers
Building electrolysis capacity in Tüskésrét	PTE, MVM, Kontakt-Elektro Kft.
Building the hydrogen ecosystem	PTE with the involvement of MVM
Preparing inter-regional innovation investments in the Central European Green Hydrogen Value Chain by developing a stakeholder participation scheme and establishing an IoT framework.	Municipality of Pécs
Building solar capacity for city operations	Institutions
Institutional solar capacity building	Institutions
Building solar capacity for industrial and commercial entities	Businesses
Solar PV farm capacity building - individual capacity expansion (small household power plants)	Homeowners
Building residential storage capacity in partnership with energy suppliers	Municipal Green Office, Energy Suppliers, Homeowners

Transport	
Reducing the amount of private motorised transport	
Governance and social projects	
Community planning programme to promote climate-friendly land use	Municipality of Pécs
Promoting traffic behaviour measures, both for cars and lorries.	Biokom Nkft
Contract scheme with large employers to reduce car use	Municipality of Pécs
Developing an intelligent urban energy management and spatial information system - Optimising the use of public transport	Municipality of Pécs
Measures to reduce vehicle traffic	Municipality of Pécs
Municipal measures in the field of transport	Municipality of Pécs
GreenInCities	Municipality of Pécs
Investment projects	
Testing of zero-emission zones where only electric, hydrogen and biogas cars can run.	Municipality of Pécs
Rethinking the parking system	Municipality of Pécs
Design of car parks	Municipality of Pécs
Increasing the share of public transport and non-motorised transport	
E-bike, scooter, moped project	Biokom NKft, Businesses
Supporting access by public transport from the agglomeration with targeted services	Tüke Busz Zrt.
Separate bus lanes on main transport routes	Municipality of Pécs
The use of hydrogen technology in long-distance bus transport	Volán Zrt., Kontakt-Elektro Kft.
Increasing the share of car sharing	Biokom Ltd Businesses
Electrification of motor vehicles and engines	
Providing electric charging infrastructure for cars	Municipality of Pécs, Biokom NKft.
Awareness raising and information transfer on electric cars	Municipality of Pécs, Biokom NKft.
Electric car fleet support programmes	Citizens

Decarbonising public transport	
Replacement of the diesel bus fleet of Tüke Busz Zrt. with electric buses in line with the decarbonisation plan.	Tüke Busz Zrt.
Construction of a charging network for the operation of the electric bus fleet of Tüke Busz Zrt.	Tüke Busz Zrt.
Developing an intelligent urban energy management and spatial information system - Optimising the use of public transport	Tüke Busz Zrt.
Electrification of metropolitan transport by developing infrastructure to support environmentally friendly private and public transport.	Biokom NKft.
Optimised logistics	
Smart columns: real-time data generation from IoT sensors, network remote control and automation systems: sensor deployment	Municipality of Pécs
Reducing congestion in urban transport through traffic management tools	Biokom NKft.
Diverting traffic from Route 6 by easing congestion in the downtown and Garden City.	Municipality of Pécs
Construction of interconnection points at 3 sites	Municipality of Pécs, economic operators
Electrification of freight transport	
Electrification of the conventional vehicle fleet of the public service system in Pécs	Biokom NKft.
Electric van replacement programme	Businesses
Waste, waste water	
Smart solutions for waste management and urban operations	Biokom NKft.
Fermentation of the highly biodegradable fraction separated by mechanical treatment with biogas recovery	Biokom NKft.
Pre-treatment of the highly biodegradable fraction, selection of energy recovery fractions, selection of inert components.	Biokom NKft.
Development of an intelligent urban energy management and spatial information system - Stormwater and wastewater spatial information system improvements	Biokom NKft.
Waste Prevention Centre	Biokom NKft.
Development of intelligent diagnostics and monitoring in water management in Pécs	Biokom NKft.
Increasing wastewater treatment capacity in Pécs	Tettye Forrásház Zrt
Development of technologies for the exploration, extraction and utilisation of secondary raw materials (e.g. slag recycling, geothermal recycling of abandoned wells, etc.) based on geological background and the establishment of such projects;	PTE TTK, AFK

Creating a circular economy	
Converting industrial parks to renewable, zero-emission, circular	Municipality of Pécs, Pécs-Baranya County Chamber of Commerce, Ipark Kft.
Climate Partnership, a long-term, active cooperation between the business sector and the municipality of Pécs to reduce carbon emissions in the city of Pécs.	Municipality of Pécs
Pilot circular construction project, circular building materials marketplace	Municipality of Pécs, Pécs-Baranya County Chamber of Commerce, Holcim Magyarország Kft.
Collection, sorting and recovery of urban construction and demolition waste at the waste treatment plant in Kekényes.	Municipality of Pécs, Biokom NKft.
Installation of a construction waste centre	Municipality of Pécs, Biokom NKft, Pécs-Baranya County Chamber of Commerce
Recycling of mining waste	Municipality of Pécs, Biokom NKft, Pécs-Baranya County Chamber of Commerce, University of Pécs
Decomposition and utilisation of fly ash from spiked cedar in cement, technological testing	
the use of landfilled mine waste for the production of dust binders, slurry control agents and fertilisers (circular economy)	
Green infrastructure development	
Green wall, green roof	Municipality of Pécs, Biokom NKft.
Expansion and renovation of urban parks based on climate resilience criteria	Municipality of Pécs, Biokom NKft.
Greening along busy roads, green walls	Municipality of Pécs, Biokom NKft.
Greening of car parks	Municipality of Pécs, Biokom NKft.
Converting vacant or underused land into green space	Municipality of Pécs, Biokom NKft.
Model projects implemented: urban gardens, urban agriculture, composting programmes	Municipality of Pécs, Biokom NKft.

C-3.27: Summary of interventions and associated costs									
						Impact			
Interventions	**Actions and results 2030 assumptions**		**Responsible**	**Start/ End**	**Sector**	**GHG reduction** (kt CO2e)	**Operational cost/savings** (OPEX) (MEUR - NPV 2020-2050)	**Co-benefits** (MEUR - NPV 2020-2050)	**Total Invest-ment cost** (CAPEX) (MEUR - NPV 2020-2030)
Reduced demand for motorised passenger transport	35%	reduction	Municipality, citizens, NGOs	2020-2030	Transport	32	€ 388	€ 105	€ -
Switch to public transport and non-motorised transport	10%	reduction in passenger car kilometres	Municipality, citizens, NGOs, Tüke Busz Zrt.	2020-2030	Transport	5	€ 30	€ 47	€ (5)
Enhanced car-pooling communities	20%	increase in the average number of passengers per car	Municipality, citizens, businesses	2020-2030	Transport	9	€ 109	€ 29	€ -
Electrification of passenger cars and motorcycles	35%	electric cars + motorcycles until 2035	Citizens	2020-2035	Transport	13	€ 53	€ 7	€ (22)
Electric buses	100%	electric buses	Tüke Busz Zrt.	2020-2030	Transport	3	€ 13	€ 11	€ (6)
Optimised logistics	30%	a reduction in total kilometres travelled by lorries	Municipality, businesses, Chamber of Commerce	2020-2030	Transport	10	€ 1	€ 15	€ -
Electric trucks	50%	light trucks (<3.5t) until 2035	Businesses	2020-2035	Transport	2	€ 9	€ 2	€ (101)
	40%	heavy goods vehicles (>3.5t) until 2035	Businesses	2020-2035	Transport				
Building renovations	5.0%	annual renewal rate	Municipality, citizens, institutions, businesses	2020-2030	Buildings	4	€ 71	€ 3	€ (171)

New, energy-efficient buildings	20%	the proportion of new buildings built to the best performing building standards	Citizens	2020-2030	Buildings	1	€ 13	€ 1	€ (3)
Efficient lighting and appliances	100%	the proportion of renovations that result in ~40% efficiency improvements	Municipality, institutions, citizens, businesses	2020-2030	Buildings	14	€ 25	€ 1	€ (78)
Decarbonising heating production	65%	the share of local heating produced by electric heat pumps	Municipality, institutions, citizens, businesses, energy utilities	2020-2030	Buildings	74	€ 32	€ 28	€ (236)
Decarbonising electricity generation	85%	the share of electricity produced from fossil fuels replaced by renewable energy sources	Municipality, institutions, citizens, businesses, energy utilities	2020-2030	Electricity	142	€ 144	€ -	€ (23)
Increased waste recycling			Municipality, utility companies, citizens, Biokom NKft.	2020-2030	Waste	1	€ 0	€ 0	€ 0
Total						**310**	**€ 887**	**€ 249**	**€ (645)**

6 Outlook and next steps

The City of Pécs understands the commitment and responsibility on its journey towards the net zero target. The Municipality submits its Climate City Contract, Action Plan and Investment Plan to the NetZero Consortium, however understands that it is a moment in time, and iterative process with the involvement of the key stakeholders regarding the planning, implementation, monitoring, evaluation and feedback cycle continues. The City of Pécs monitors its results and achievments semiannually, and comits to a minimum of 2-year review cycle.

As next steps the following measures are taken:

Communication and Socialization of the NetZero project portfolio with citizens, youngsters and businesses

Following the submission of the Climate Neutral Contract, the City of Pécs invites the general public, young people (kindergarten - university), (reaching them through educational institutions), students in cooperation with the Pécs University, and businesses, (reaching them through the Economic Development Department of the Municipality and the Chamber of Commerce) to join the Climate Neutral Pécs programme to support the city as it transitions to Net Zero by taking three simple actions. Whilst actions of awareness might seem inconsequential, if all city residents do them, they will make an enormous impact on Pécs' citywide emission levels.

Enabling conditions for ensuring digital tracking and monitoring of data is to be set up

Digital modeling and monitoring, along with a robust data system, play a crucial role in urban climate transition by providing Pécs with the tools and information needed to plan, implement, and track climate mitigation and adaptation efforts. Here's an overview of these concepts:

Energy and Emissions Modeling: Pécs intends to use digital models to estimate current and future energy consumption and greenhouse gas emissions. These models help identify opportunities for energy efficiency improvements and emissions reductions in various sectors, including transportation, buildings, and industry. Digital models also allow cities to explore different climate mitigation and adaptation scenarios. Geographic Information Systems (GIS) are used for spatial planning, allowing cities to analyze land use, zoning, and infrastructure development in the context of climate resilience and sustainability.

Monitoring and Data Systems: Cities collect real-time data from various sensors, such as weather stations, air quality monitors, and traffic cameras, to monitor current conditions and assess the immediate impact of climate-related events. Data from multiple sources are integrated into a centralized system to provide a comprehensive view of urban conditions and analysed helping identifing trends, anomalies, and areas requiring intervention. Data systems provide decision-makers with valuable information to prioritize and plan climate actions and track the performance of climate initiatives.

Detailed surveys related to the measures identified are to be conducted

During the planning process of the action plan large amount of data and detailes were identified. However, in order to reach the set targets, further details and surveys are needed related to all sectors. Examples are attitudes and underlying reasons for motorised passenger transportation, spatial patterns of passenger travel and freight transport, utilization of vans and truck providing logistics in Pécs, attitudes towards net zero zones within the city. Regarding the building stocks a detailed survey is ongoing for the municipal and state owned buildings, however survey on citizen building stock is to be carried out. Applicability of geothermal energy for heating purposes and survey on storage capacities also require further efforts. Surveys also cover the waste prevention options and attitude of citizens.

Eco-system building with institutions and businesses

The eco-system building has already started, however it takes time to cover all the granularities needed. Continuous cooperation with industry actors, commercial stakeholders and institutions is covered in order to get detailed energy consumption and emission data and set up a transition plan for enabling the fulfillment of the objectives set by the City.

Further detailed planning of the project portfolio and and its financing model

Currently a two-way approach was applied, an economic modelling tool was applied to identify the investment needs for the reach of the 80% emission reduction goal. This way the key intervention envelopes were identified, and a bottom -up approach was used to identify the relevant projects implementing the “envelope”'s. The economic modelling also identified the investment needs, potential savings that guides further planning. The business models and business plans will be planned for the project as an ongping work, while grant financing monitoring and market investment financing negotiations are initiated. The further elaboration of the project plan is a pre-requisite for the implementation of proper financing and investment.

Stakeholder involvement via the Pécs Climate Neutrality Platform

The Platform will continue operating as described in the Action Plan providing the key forum for stakeholder engagement both via the Steering Committee and the working group. The Climate Neutrality Platform ensures the framework for planning, implementation, monitoring, evaluation and feedback.

7 Annexes

- Indicator Metadata
- Individual action outlines (see in separate document)

Annex 1: Indicator Metadata

B-3.2: Indicator Metadata	
Indicator Name	Renewable energy capacity
Indicator Unit	MWp
Definition	Renewable energy capacity provided by solar parks/ panels
Calculation	Data provision by EoN Dél-Dunántúli Áramhálózati Zrt.
Indicator Context	
Does the indicator measure direct impacts (i.e. reduction in greenhouse gas emissions?)	yes
If yes, which emission source sectors does it impact?	Decarbonization of electricity
Does the indicator measure indirect impacts (i.e. co- benefits)?	No
If yes, which co-benefit does it measure?	n.r.
Can the indicator be used for monitoring impact pathways?	yes
If yes, which NZC impact pathway is it relevant for?	access to renewable energy
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	Yes
Data requirements	
Expected data source	EoN Dél-Dunántúli Áramhálózati Zrt.
Expected availability	Available
Suggested collection interval	Annual
References	
Deliverables describing the indicator	Dataset on renewable energy fed into the energy network
Other indicator systems using this indicator	

B-3.2: Indicator Metadata	
Indicator Name	Energy savings as a share of final energy consumption
Indicator Unit	%
Definition	As a result of energy efficiency measures, volume of energy savings as a share of final energy consumption
Calculation	Comparing energy total city level energy consumption between two consecutive years

Indicator Context	
Does the indicator measure direct impacts (i.e. reduction in greenhouse gas emissions?)	Yes
If yes, which emission source sectors does it impact?	Building sector
Does the indicator measure indirect impacts (i.e. co- benefits)?	Yes
If yes, which co-benefit does it measure?	Health Benefits, Increased Property Value, Enhanced Comfort
Can the indicator be used for monitoring impact pathways?	Yes
If yes, which NZC impact pathway is it relevant for?	increased energy efficiency
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	Yes
Data requirements	
Expected data source	EoN Dél-Dunántúli Áramhálózati Zrt.
Expected availability	Available
Suggested collection interval	annual
References	
Deliverables describing the indicator	Dataset on energy consumption on city level (electricity, heating)
Other indicator systems using this indicator	

B-3.2: Indicator Metadata	
Indicator Name	CO2 reduction
Indicator Unit	tCO2e
Definition	Emission reduction capacity of climate neutrality interventions
Calculation	Each investment project has a reduction calculation that is gathered by the Transition Team, and is aggregated
Indicator Context	
Does the indicator measure direct impacts (i.e. reduction in greenhouse gas emissions?)	yes
If yes, which emission source sectors does it impact?	Buildings, decarbonization of heating, decarbonization of electricity, transport, waste, other
Does the indicator measure indirect impacts (i.e. co- benefits)?	yes
If yes, which co-benefit does it measure?	improved air quality, reduced noise pollution, positive health effects, economic benefits
Can the indicator be used for monitoring impact pathways?	Yes
If yes, which NZC impact pathway is it relevant for?	emissions reduction
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	Yes

Data requirements	
Expected data source	City monitoring system
Expected availability	To be developed
Suggested collection interval	Annually
References	
Deliverables describing the indicator	Dataset download from City monitoring system
Other indicator systems using this indicator	

Building renovations, Decarbonizing electricity generation

B-3.2: Indicator Metadata	
Indicator Name	Share of renewables in the buildings sector
Indicator Unit	%
Definition	Share of renewable energy in the building stock's energy supply
Calculation	renewable energy consumed/ total energy consumption (electricity and heating)
Indicator Context	
Does the indicator measure direct impacts (i.e. reduction in greenhouse gas emissions?)	yes
If yes, which emission source sectors does it impact?	Buildings, electricity
Does the indicator measure indirect impacts (i.e. co- benefits)?	yes
If yes, which co-benefit does it measure?	Health Benefits, Increased Property Value, Enhanced Comfort
Can the indicator be used for monitoring impact pathways?	yes
If yes, which NZC impact pathway is it relevant for?	Increasing the share of renewable energy
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	yes
Data requirements	
Expected data source	EoN Dél-Dunántúli Áramhálózati Zrt.
Expected availability	Available
Suggested collection interval	Annually
References	
Deliverables describing the indicator	Dataset on renewable consumption, dataset on total energy consumption (heating, electricity)
Other indicator systems using this indicator	

B-3.2: Indicator Metadata	
Indicator Name	Substitution of residential natural gas consumption
Indicator Unit	%
Definition	Share of residential natural gas consumption as compared to residential total heating energy consumption
Calculation	Residential natural gas consumption divided by total residential heating energy consumption
Indicator Context	
Does the indicator measure direct impacts (i.e. reduction in greenhouse gas emissions?)	yes
If yes, which emission source sectors does it impact?	Decarbonization of heating
Does the indicator measure indirect impacts (i.e. co- benefits)?	yes
If yes, which co-benefit does it measure?	Improved Air Quality, Energy Security
Can the indicator be used for monitoring impact pathways?	Yes
If yes, which NZC impact pathway is it relevant for?	fossil fuel phase out
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	Yes
Data requirements	
Expected data source	EoN Dél-Dunántúli Áramhálózati Zrt., PÉTÁV
Expected availability	Available
Suggested collection interval	Annually
References	
Deliverables describing the indicator	Dataset on residential gas consumption, dataset on district heating consumption, dataset on solar energy consumption used by heat pump systems
Other indicator systems using this indicator	

B-3.2: Indicator Metadata	
Indicator Name	Share of electricity in energy use in buildings
Indicator Unit	%
Definition	The share of electricity consumption in the total energy consumption of buildings
Calculation	electricity consumption of buildings/ total energy consumption of buildings

Indicator Context	
Does the indicator measure direct impacts (i.e. reduction in greenhouse gas emissions?)	yes
If yes, which emission source sectors does it impact?	Buildings
Does the indicator measure indirect impacts (i.e. co- benefits)?	yes
If yes, which co-benefit does it measure?	Improved Air Quality, Energy Security
Can the indicator be used for monitoring impact pathways?	yes
If yes, which NZC impact pathway is it relevant for?	increase in electricity consumption due to a reduction in the share of fossil fuels
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	
Data requirements	
Expected data source	EoN Dél-Dunántúli Áramhálózati Zrt., PÉTÁV
Expected availability	Available
Suggested collection interval	Annually
References	
Deliverables describing the indicator	Dataset on residential gas consumption, dataset on district heating consumption, dataset on solar energy consumption used by heat pump systems
Other indicator systems using this indicator	

B-3.2: Indicator Metadata	
Indicator Name	Reduction of emissions from buildings
Indicator Unit	tCO2
Definition	tCO2 emission reduction as a result of building sector investments
Calculation	Reduced fossil fuel consumption as a result of building retrofit + reduced fossil fuel consumption as a result of decarbonization of heating + fossil fuel consumption as a result of decarbonization of electricity
Indicator Context	
Does the indicator measure direct impacts (i.e. reduction in greenhouse gas emissions?)	yes
If yes, which emission source sectors does it impact?	Building sector
Does the indicator measure indirect impacts (i.e. co- benefits)?	yes
If yes, which co-benefit does it measure?	Health Benefits, Increased Property Value, Enhanced Comfort
Can the indicator be used for monitoring impact pathways?	yes
If yes, which NZC impact pathway is it relevant for?	increased energy efficiency
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	

Data requirements	
Expected data source	EoN Dél-Dunántúli Áramhálózati Zrt., PÉTÁV
Expected availability	Available
Suggested collection interval	Annually
References	
Deliverables describing the indicator	Dataset on residential gas consumption, dataset on district heating consumption, dataset on solar energy consumption used by heat pump systems
Other indicator systems using this indicator	

B-3.2: Indicator Metadata	
Indicator Name	Recycled construction material
Indicator Unit	%
Definition	Recycled construction material as a percentage of total construction material
Calculation	Recycled construction material/ total construction material
Indicator Context	
Does the indicator measure direct impacts (i.e. reduction in greenhouse gas emissions?)	yes
If yes, which emission source sectors does it impact?	Waste
Does the indicator measure indirect impacts (i.e. co- benefits)?	yes
If yes, which co-benefit does it measure?	Reduced resource depletion, energy savings, less landfill waste
Can the indicator be used for monitoring impact pathways?	
If yes, which NZC impact pathway is it relevant for?	Circular economy can be monitored, however not built in in impact pathways awareness of the circular approach, ecosystem building
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	No
Data requirements	
Expected data source	City monitoring system
Expected availability	To be developed
Suggested collection interval	Annually
References	
Deliverables describing the indicator	Dataset download from City monitoring system
Other indicator systems using this indicator	

B-3.2: Indicator Metadata	
Indicator Name	Carbon reduction in public and urban transport
Indicator Unit	tCO2
Definition	Emission reduction from electrification of buses
Calculation	emission reduction from diesel bus phase out
Indicator Context	
Does the indicator measure direct impacts (i.e. reduction in greenhouse gas emissions?)	Yes
If yes, which emission source sectors does it impact?	Transport
Does the indicator measure indirect impacts (i.e. co- benefits)?	yes
If yes, which co-benefit does it measure?	improved air quality, reduced noise pollution, positive health effects
Can the indicator be used for monitoring impact pathways?	Yes
If yes, which NZC impact pathway is it relevant for?	enabling the uptake of electrically powered public transport
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	Yes
Data requirements	
Expected data source	Tüke Bus Zrt.
Expected availability	available
Suggested collection interval	Annually
References	
Deliverables describing the indicator	Dataset download from Tüke Bus Zrt.
Other indicator systems using this indicator	

B-3.2: Indicator Metadata	
Indicator Name	Reducing petrol and diesel consumption
Indicator Unit	%
Definition	Reduced petrol and diesel consumption by passenger cars on the territory of Pécs
Calculation	Number of new electric cars' capacity for petrol and diesel substitution
Indicator Context	
Does the indicator measure direct impacts (i.e. reduction in greenhouse gas emissions?)	Yes
If yes, which emission source sectors does it impact?	Transport

Does the indicator measure indirect impacts (i.e. co- benefits)?	Yes
If yes, which co-benefit does it measure?	Health benefits, improved air quality
Can the indicator be used for monitoring impact pathways?	Yes
If yes, which NZC impact pathway is it relevant for?	enabling the uptake of electric private transport
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	
Data requirements	
Expected data source	City monitoring system
Expected availability	To be developed
Suggested collection interval	Annually
References	
Deliverables describing the indicator	Dataset download from City monitoring system
Other indicator systems using this indicator	

B-3.2: Indicator Metadata	
Indicator Name	Increase the share of low emission vehicles
Indicator Unit	%
Definition	increase the share of low emission vehicles as a result of shift to public & non-motorized transport
Calculation	Measuring with sensors
Indicator Context	
Does the indicator measure direct impacts i.e. reduction in greenhouse gas emissions?)	Yes
If yes, which emission source sectors does it impact?	Transport
Does the indicator measure indirect impacts (i.e. co- benefits)?	Yes
If yes, which co-benefit does it measure?	Health benefits, improved air quality
Can the indicator be used for monitoring impact pathways?	Yes
If yes, which NZC impact pathway is it relevant for?	encouraging modal shift
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	
Data requirements	
Expected data source	City monitoring system
Expected availability	To be developed
Suggested collection interval	Annually

References	
Deliverables describing the indicator	Dataset download from City monitoring system
Other indicator systems using this indicator	

B-3.2: Indicator Metadata	
Indicator Name	Traffic load on road 6
Indicator Unit	%
Definition	Reduced traffic load on Road 6 in inner city
Calculation	Measured by sensors
Indicator Context	
Does the indicator measure direct impacts (i.e. reduction in greenhouse gas emissions?)	Yes
If yes, which emission source sectors does it impact?	Transport
Does the indicator measure indirect impacts (i.e. co- benefits)?	Yes
If yes, which co-benefit does it measure?	Improved Air Quality, Reduced Noise Pollution
Can the indicator be used for monitoring impact pathways?	Yes
If yes, which NZC impact pathway is it relevant for?	reducing individual and freight traffic in the city centre
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	No
Data requirements	
Expected data source	City monitoring system
Expected availability	To be developed
Suggested collection interval	Annually
References	
Deliverables describing the indicator	Dataset download from City monitoring system
Other indicator systems using this indicator	

B-3.2: Indicator Metadata	
Indicator Name	Strengthening sink capacity
Indicator Unit	%
Definition	Annual sink capacity of the green surfaces in Pécs
Calculation	Annually developed/ renewed green surfaces including tree planting - calculation based on green cadastre

Indicator Context	
Does the indicator measure direct impacts (i.e. reduction in greenhouse gas emissions?)	Yes
If yes, which emission source sectors does it impact?	Residual emissions
Does the indicator measure indirect impacts (i.e. co- benefits)?	Yes
If yes, which co-benefit does it measure?	Health benefits
Can the indicator be used for monitoring impact pathways?	Yes
If yes, which NZC impact pathway is it relevant for?	Increasing climate resilient land use
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	yes
Data requirements	
Expected data source	City monitoring system – city green cadastre
Expected availability	To be developed (city green cadastre under development)
Suggested collection interval	Annually
References	
Deliverables describing the indicator	Dataset download from City monitoring system
Other indicator systems using this indicator	

B-3.2: Indicator Metadata	
Indicator Name	Reducing the amount of waste going to landfill
Indicator Unit	%
Definition	Reduced share of waste in landfill as compared to previous year
Calculation	Waste in landfill/ waste in landfill in previous year
Indicator Context	
Does the indicator measure direct impacts (i.e. reduction in greenhouse gas emissions?)	Yes
If yes, which emission source sectors does it impact?	Waste sector
Does the indicator measure indirect impacts (i.e. co- benefits)?	Yes
If yes, which co-benefit does it measure?	Health benefits
Can the indicator be used for monitoring impact pathways?	Yes
If yes, which NZC impact pathway is it relevant for?	better waste management
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	Yes

Data requirements	
Expected data source	Biokom NKft
Expected availability	Available
Suggested collection interval	Annually
References	
Deliverables describing the indicator	Dataset download from Biokom NKft
Other indicator systems using this indicator	

B-3.2: Indicator Metadata	
Indicator Name	Amount of waste recycled
Indicator Unit	%
Definition	Annual waste recycling volume reduction
Calculation	Volume of waste recycled/ volume of waste recycled in previous year
Indicator Context	
Does the indicator measure direct impacts (i.e. reduction in greenhouse gas emissions?)	Yes
If yes, which emission source sectors does it impact?	Waste sector
Does the indicator measure indirect impacts (i.e. co- benefits)?	Yes
If yes, which co-benefit does it measure?	Co-Benefits
Can the indicator be used for monitoring impact pathways?	Yes
If yes, which NZC impact pathway is it relevant for?	waste prevention, recycling
Is the indicator captured by the existing CDP/ SCIS/ Covenant of Mayors platforms?	Yes
Data requirements	
Expected data source	Biokom NKft
Expected availability	Available
Suggested collection interval	Annually
References	
Deliverables describing the indicator	Dataset download from Biokom NKft
Other indicator systems using this indicator	

Quantitative data input for modelling carbon emission and planning the reduction measures and financial framework

The preparation of the Climate Neutral Action Plan and Investment Plan is based on modelling, using an urban climate transition economic model developed in collaboration with the University of Madrid under the NetZero Programme. The tool is scientifically based and provides the opportunity to develop a robust climate finance framework for the climate transition of Pécs, taking into account climate science, with emission values and associated costs broken down by target groups (city, population, institutions, university, business, transport, energy and other public services) to show the necessary investment costs and the savings over the time horizon up to 2030. The investment needs identified at the level of the investment measures (see key measures above) provide a continuous feedback loop to harmonise the top-down framework with the corresponding bottom-up projects, to ensure a precise implementation of the programme set out in the Action Plan and Investment Plan. For further reference on the economic model used, see the NetZero Portal group "Capability Building Programme: building a strong economic case" at the following link:

https://netzerocities.app/group-capabilitybuildingprogrammebuildingastrongeconomiccase

Data - Pécs input sheet	Preferred unit	Data used in model
Demographic data		
Population	Capita	138,420
Expected annual population growth (up until 2030)	% per year	-0.2%
City Area	km2	163
Passenger transportation		
Transportation need		
Total transportation need - passenger transport		
Transport need - passenger cars + motorcycles	Million passenger-kilometers / year	703
Transport need - buses	Million passenger-kilometers / year	695
Transport need - trains/metro	Million passenger-kilometers / year	13
Transport need - walking/cycling	Million passenger-kilometers / year	215
Number of passengers per vehicle		

Average passengers per car + motorcycle	passengers / car + motorcycle	1.3
Average passengers per bus	passengers / bus	75
Average passengers per metro train	passengers / metro train	40
Emission factors		
Passenger car / motorcycle fleet (current average fleet)		
CO2 emissions	grams / kilometer	267
NOx emissions	grams / kilometer	0.61
PM 2.5 emissions	grams / kilometer	0.02
PM 10 emissions	grams / kilometer	0.03
Buses (average fleet)		
CO2 emissions	grams / kilometer	249
NOx emissions	grams / kilometer	3.22
PM 2.5 emissions	grams / kilometer	0.07
PM 10 emissions	grams / kilometer	0.10
Passenger cars - other data		
Total number of cars + motorcycles in city	Number of cars + motorcycles	58,928
Share of fleet that is less than 2 years old	% of fleet	12%
Share of fleet fully electric (not including hybrids)	% of fleet	4.3%
Buses - other data		
Number of buses in city bus fleet	Nmbr of buses	191
Share of bus fleet as fully electric buses (not including hybrids)	% of bus fleet	5.2%
Share of bus fleet - biobased	% of bus fleet	0.0%
Freight transport (road)		
Transportation need		
Total transportation need within city - Road freight transport		
Light duty trucks <3.5 tonnes	Million tonne-kilometers/year	25
Heavy duty trucks >3.5 tonnes	Million tonne-kilometers/year	4
Utilisation/loading		
Average utilisation		
Light duty trucks <3.5 tonnes	% of max load	23%
Heavy duty trucks >3.5 tonnes	% of max load	45%
Emission factors from transportation		
Light duty trucks <3.5 tonnes		

CO2 emissions	grams / kilometer	267
NOx emissions	grams / kilometer	0.68
PM 2.5 emissions	grams / kilometer	0.04
PM 10 emissions	grams / kilometer	0.05
Heavy duty trucks >3.5 tonnes		
CO2 emissions	grams / kilometer	249
NOx emissions	grams / kilometer	1.61
PM 2.5 emissions	grams / kilometer	0.05
PM 10 emissions	grams / kilometer	0.07
Other data		
Number of trucks registered within city		
Light duty trucks <3.5 tonnes	Number of trucks	197
Of which less than 2 years old	%	6%
Heavy duty trucks >3.5 tonnes	Number of trucks	6,959
Of which less than 2 years old	%	13%
Buildings		
Existing building stock		
Total floor area		
Total floor area (residental & non-residential)	Thousand squaremeters	11,700
Energy use in existing buildings		
Average heat use in existing buildings (space heating + domestic hot water)	kWh/m2 & year	113
Average electricity use for lighting & appliances	kWh/m2 & year	26
Renovation rate (building envelope)		
Share of building stock renovated each year	%	2.9%
Energy efficiency improvements from building renovations		
Minor heating renovations (0-30% improvement)	% of kWh / m2	30%
Extensive heating renovations (30-60% improvement)	% of kWh / m2	30%
Cost of energy renovations		
Minor heating renovations (0-30% improvement)	EUR/m2	70
Extensive heating renovations (30-60% improvement)	EUR/m2	150
New buildings		
Building standards for new buildings		
Minimum building standard (heat use)	kWh / m2 & year	76
Top performing building standard (heat use)	kWh / m2 & year	30

Share of new buildings built with minimum standard (today)	% of new buildings	90%
Share of new buildings built with "better than minimum" standard (today)	% of new buildings	10%
		100%
Building costs - new buildings		
Minimum building standard	EUR / m2	1,500
Top performing building standard	EUR / m2	2,600

Heating (of buildings)		
Heat demand & production		
Total heating demand (space heating + domestic hot water)	GWh / y	887
Heating technologies		
Share of heating as district heating	%	36%
Share of heating as local heating	%	64%
Total	*%*	*100%*
Share of district heating as		
Fossil (oil, coal, gas) + inefficient electric heating (not heat pumps)	%	5%
Electric heat pumps / geothermal	%	0%
Bio (biogas, biomass)	%	95%
Waste (fossil & non-fossil waste)	%	0%
Total	*%*	*100%*
Share of waste used in district heating that is fossil / non-fossil		
Fossil share	%	0%
Non-fossil share	%	0%
		0%
Share of local heating as		
Fossil (oil, gas, coal) + inefficient electric heating (not heat pumps)	%	98%
Electric (heat pumps)	%	2%
Biobased	%	0%
Total	*%*	*100%*
Emission factors from heat production		
District heating		
CO2 emissions	g / kWh	17
NOx emissions	g / kWh	0.139
PM 2.5 emissions	g / kWh	0.003
PM 10 emissions	g / kWh	0.005

Local heating		
CO_2 emissions	g / kWh	202
NOx emissions	g / kWh	0.24
PM 2.5 emissions	g / kWh	0.02
PM 10 emissions	g / kWh	0.03
Electricity		
Demand of electricity		
Total demand		
Total electricity demand within city boundaries	GWh / y	400
Share of total electricity demand produced by fossil/renewables		
Renewable sources	%	9%
Fossil sources	%	29%
Other (e.g. nuclear)	%	62%
Total	Share	*100%*
Emission factors from electricity generation		
CO_2 emissions	g / kWh	364
NOx emissions	g / kWh	0.14
PM 2.5 emissions	g / kWh	0.00
PM 10 emissions	g / kWh	0.01
Other		
Spot price electricity	EUR/MWh	100
Solar PV		
Solar electricity produced by solar PVs	kWh per year/kW	23,689
Yearly average of solar electricity generated by 1 m2 solar PV	kWh/m2	214
Waste		
Waste generation / collection		
Total collected waste within city boundaries	tonne	44,277
Total collected waste within city boundaries		
Paper and cardboard	tonne	1,123
Metal	tonne	1,073
Plastics	tonne	2,458
Glass	tonne	711
Organic waste	tonne	5,272
Other waste (e.g. textiles, rubble, wood etc)	tonne	33,640
Share recycling/incineration/landfill		
Paper waste		
Share of paper waste - other (e.g. landfilled)	Share	28%

Share of paper waste - incinerated (e.g. energy recovery)	Share	16%
Share of paper waste - recycled	Share	56%
Total	Share	*100%*
Metal waste		
Share of metal waste - landfilled	Share	42%
Share of metal waste - incinerated (e.g. energy recovery)	Share	0%
Share of metal waste - recycled	Share	58%
Total	Share	*100%*
Plastic waste		
Share of plastic waste - landfilled	Share	28%
Share of plastic waste - incinerated (e.g. energy recovery)	Share	16%
Share of plastic waste - recycled	Share	56%
Total	Share	*100%*
Glass waste		
Share of glass waste - landfilled	Share	1%
Share of glass waste - incinerated (e.g. energy recovery)	Share	0%
Share of glass waste - recycled	Share	99%
Total	Share	*100%*
Organic waste		
Share of organic waste - landfilled	% of total waste, or tonnes	29%
Share of organic waste - incinerated (e.g. energy recovery)	% of total waste, or tonnes	0%
Share of organic waste - composted	% of total waste, or tonnes	71%
Total	% of total waste, or tonnes	*100%*
Other waste (e.g. textiles, rubble, wood)		
Share of "other" waste - landfilled	Share	64%
Share of "other" waste - incinerated (e.g. energy recovery)	Share	34%
Share of "other" waste - recycled	Share	2%
Total	Share	*100%*
Emission factors from waste management		
Incineration		
CO2 emissions	kg / tonne waste incinerated	337

NOx emissions	kg / tonne waste incinerated	0.53
PM 2.5 emissions	kg / tonne waste incinerated	0.00
PM 10 emissions	kg / tonne waste incinerated	0.00

Other price data		
Energy prices		
Retail price of electricity	€/kWh	0.08
Retail price of heating	€/MWh	152.00

Greenhouse gases (CO2 emissions other greenhouse gases)		
Total greenhouse emissions (GHG)		
Total emissions (scope 1 & scope 2; scope 3 only for waste disposed of outside city boundaries)	kton CO2e / year	469
Emissions from road transportation		
Total emissions from road transport	kton CO2e / year	172
Passenger cars + motorcycles	kton CO2e / year	117
Light duty trucks <3.5 tonne	kton CO2e / year	0
Heavy duty trucks >3.5 tonne	kton CO2e / year	32
Buses	kton CO2e / year	19
Other motorized transport	kton CO2e / year	4
Emissions from buildings & heating		120
Heating & hot water	kton CO2e / year	120
Cooling	kton CO2e / year	-
Other building-related emissions	kton CO2e / year	-
Emissions from electricity		
Total emissions from electricity demand	kton CO2e / year	148
Buildings	kton CO2e / year	144
Other	kton CO2e / year	4
Emissions from waste (including waste disposed of outside of city boundaries)	7	
Incineration of waste	kton CO2e / year	-
Organic decay (waste)	kton CO2e / year	7
Landfill gas	kton CO2e / year	-
Other waste management	kton CO2e / year	-
Emissions from other sectors		22
Industry	kton CO2e / year	12
Agriculture	kton CO2e / year	5
Other sources	kton CO2e / year	5

PART 2: Pécs assumptions 2030

Key assumptions for levers		
1. Passenger transportation levers		
1.1 Reduced motorised passenger transportation need		
Transportation need reduction by 2030 from urban planning, digital meetings and other transport-reducing initiatives	%	35%
1.2 Shift to public and non-motorised transport		
Reduced passenger kilometres by car through shift to public and non-motorised transport		
Reduced Pkm cars + motorcycles by 2030	%	10%
Share of car + motorcycle km reduced shifted towards other modes		
Buses	%	50%
Trains/metro	%	0%
Walking/cycling	%	50%
Total	*%*	*100%*
1.3 Car pooling		
Percentage increase in avg. passengers per car + motorcycles (2030) due to improved transport efficiency from better Car pooling and Mobility as a Service	%	20%
1.4.1 Electrification of passenger cars		
What is the maximum share of the passenger car + motorcycle fleet that can be electrified?	%	35%
At what year can we expect the city to reach the maximum value specified above?	Year	2035
1.4.2 Electrification of buses		
Expected procurement schedule for buses		
2020	% of fleet exchanged	0%
2021	% of fleet exchanged	5%
2022	% of fleet exchanged	0%
2023	% of fleet exchanged	5%
2024	% of fleet exchanged	0%
2025	% of fleet exchanged	0%
2026	% of fleet exchanged	7%

2027	% of fleet exchanged	0%
2028	% of fleet exchanged	57%
2029	% of fleet exchanged	0%
2030	% of fleet exchanged	26%
Total	*%*	*100%*

2. Freight transportation levers		
2.1 Optimisation of logistics		
Utilisation of trucks in decarbonisation scenario		
Light duty trucks	% of max load weight	45%
Heavy duty trucks	% of max load weight	60%
Reduction of total distance travelled through route optimisation	% of distance	30%
2.2 Electrification of trucks		
Light duty trucks <3.5 tonne		
What is the maximum share of the truck fleet that can be electrified?	%	50%
At what year can we expect the city to reach the maximum value specified above?	Year	2035
Heavy duty trucks >3.5 tonne		
What is the maximum share of the truck fleet that can be electrified?	%	40%
At what year can we expect the city to reach the maximum value specified above?	Year	2035

3. Buildings & heating		
3.1 Buildings renovations		
Renovation rate - decarbonisation scenario	% of building stock / year	4.0%
Assumed share of type of renovation in lever		
Minor heating renovations (0-30% improvement)	%	50%
Extensive heating renovations (30-60% improvement)	%	50%

		100%
3.2 Energy efficient new buildings		
Improvement in energy efficiency relative to minimum requirement	%	30%
Share of new buildings built with high energy efficiency standards		
Minimum building standard	Share	80%
Top performing building standard	Share	20%
		100%
3.3 Efficient lighting & appliances		
Renovation rate - decarbonisation scenario	% of building stock / year	4.0%
Assumed share of type of efficiency programme for lever		
Minor efficiency improvements for lighting and appliances (~15%)	%	0%
Aggressive efficiency improvements for lighting and appliances (~40%)	%	100%
		100%
3.4 Decarbonising heating		
Heating technologies in 2030		
Share of heating as district heating, 2030	%	55%
Share of heating as local heating, 2030	%	45%
Total	*%*	*100%*
Share of district heating in 2030 as		
Fossil (oil, coal, gas) + inefficient electric heating (not heat pumps)	%	5%
Electric heat pumps / geothermal	%	0%
Bio (biogas, biomass)	%	95%
Waste (fossil & non-fossil waste)	%	0%
Total	*%*	*100%*
Share of waste in 2030 used in district heating that is fossil / non-fossil		
Fossil share	%	0%
Non-fossil share	%	0%
Total	*%*	*0%*

Share of local heating in 2030 as		
Fossil (oil, coal, gas) + inefficient electric heating (not heat pumps)	%	25%
Electric (heat pumps)	%	65%
Biobased	%	10%
Total	*%*	*100%*

Share of current fossil production that would need to be re-invested in by 2030, if current production where to continue		
District heating - fossil re-investments need	%	0%
Local heating - fossil re-investments need	%	50%

4. Electricity		
Share renewable/fossil electricity production in 2030		
Share of current fossil production replaced by renewables	%	85%

Distribution of type of new renewables		
Local solar PV (e.g. rooftops)	%	30%
Centralised Solar PV/wind farms	%	70%
Total	*%*	*100%*

5. Waste		
5.1. Increased recycling of waste		
Treatement of paper, 2030		
Landfill	%	0%
Incineration	%	16%
Recycling	%	84%
Total	*%*	*100%*

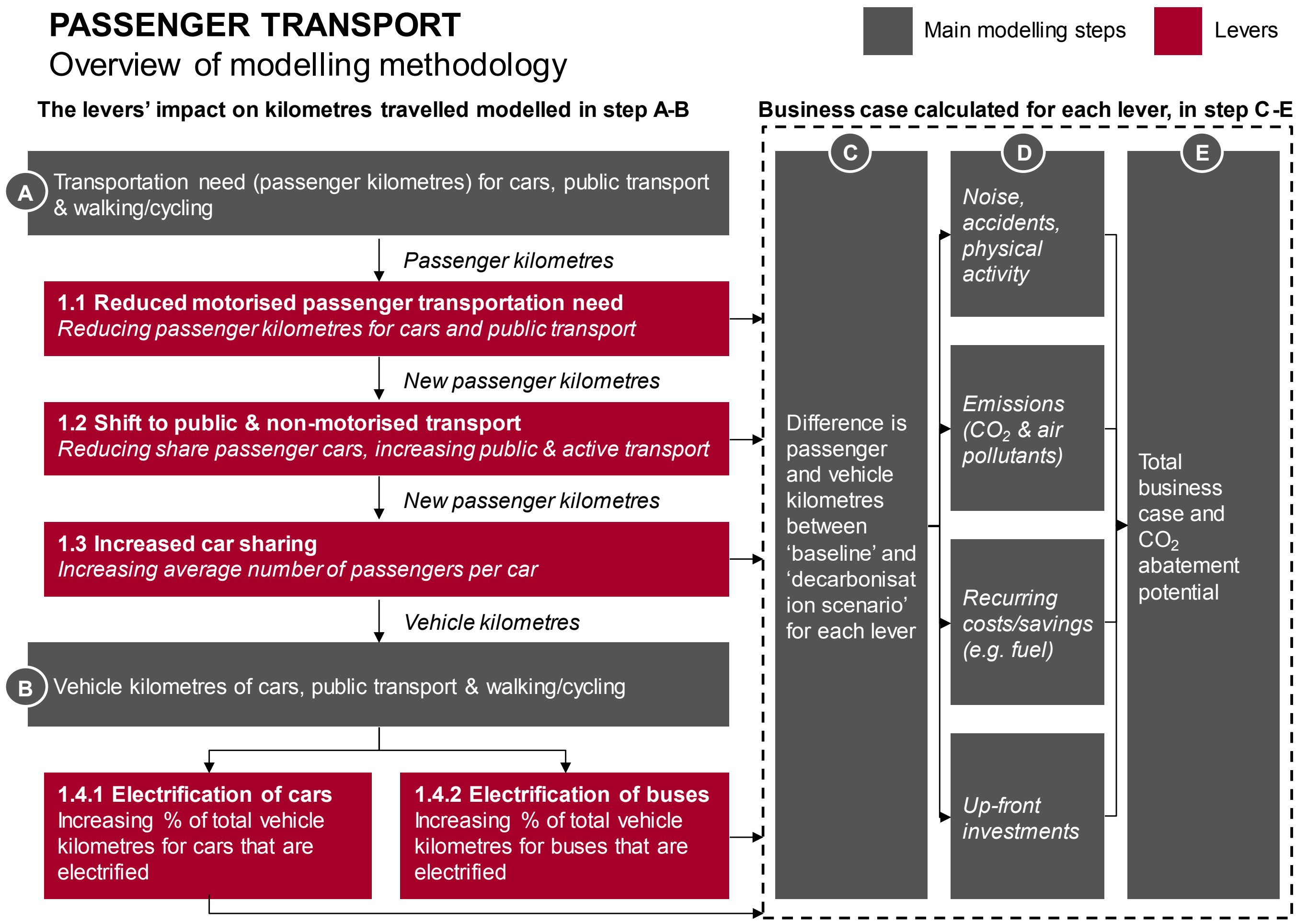
Treatment of metals, 2030		
Landfill	%	10%
Incineration	%	0%
Recycling	%	90%
Total	*%*	*100%*

Treatment of plastics, 2030

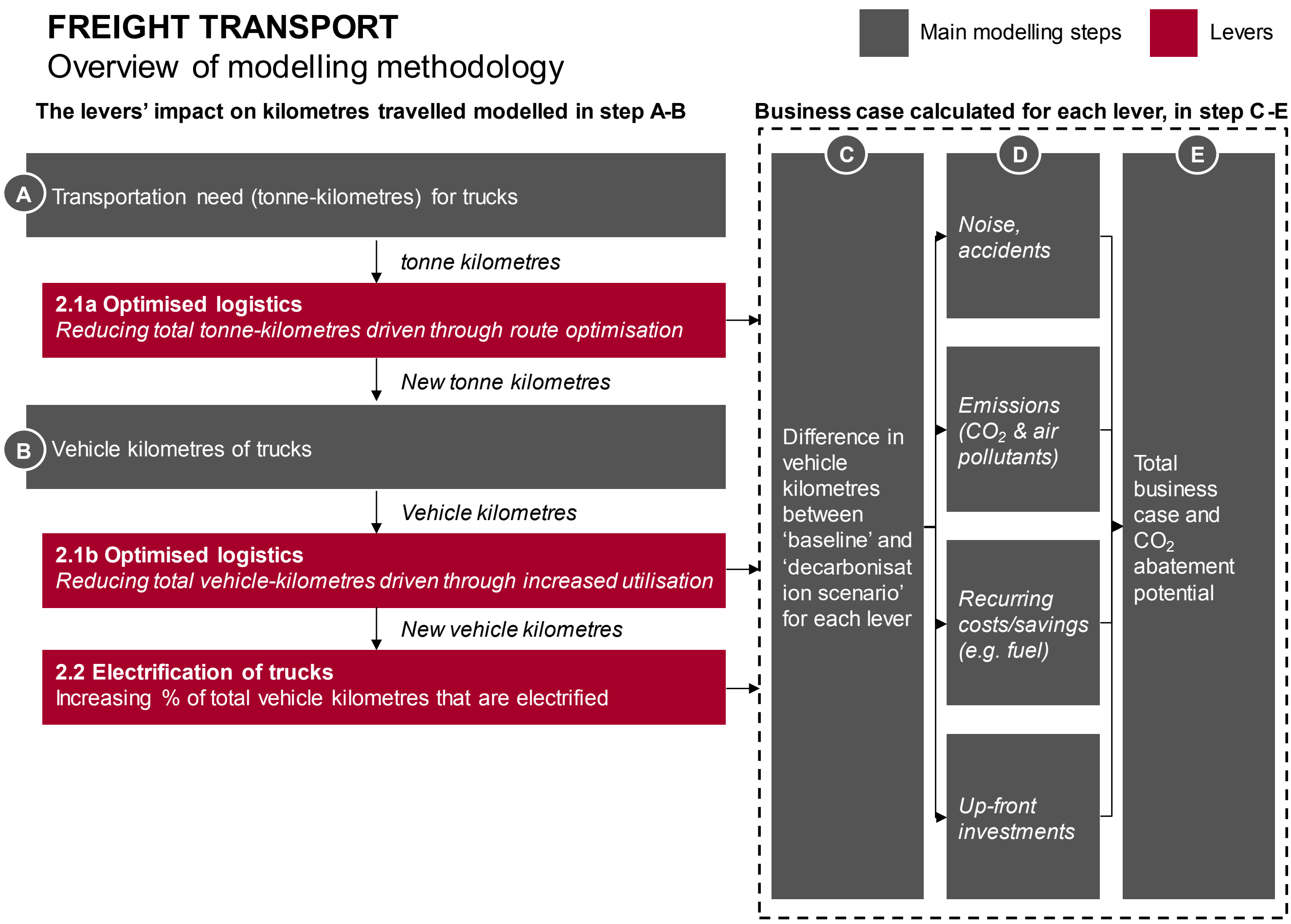
Landfill	%	10%
Incineration	%	16%
Recycling	%	74%
Total	*%*	*100%*
Treatment of glass, 2030		
Landfill	%	1%
Incineration	%	0%
Recycling	%	99%
Total	*%*	*100%*
Treatment of organic, 2030		
Landfill	%	16%
Incineration	%	0%
Composting	%	84%
Total	*%*	*100%*
Other (Emissions from other sectors: industry, agriculture etc.)		
Reduced CO2e emissions committed by Industry, Agriculture, etc. in Other sector		
Percentage CO2e reduction by 2030 in Other sector	%	80%

Methodology

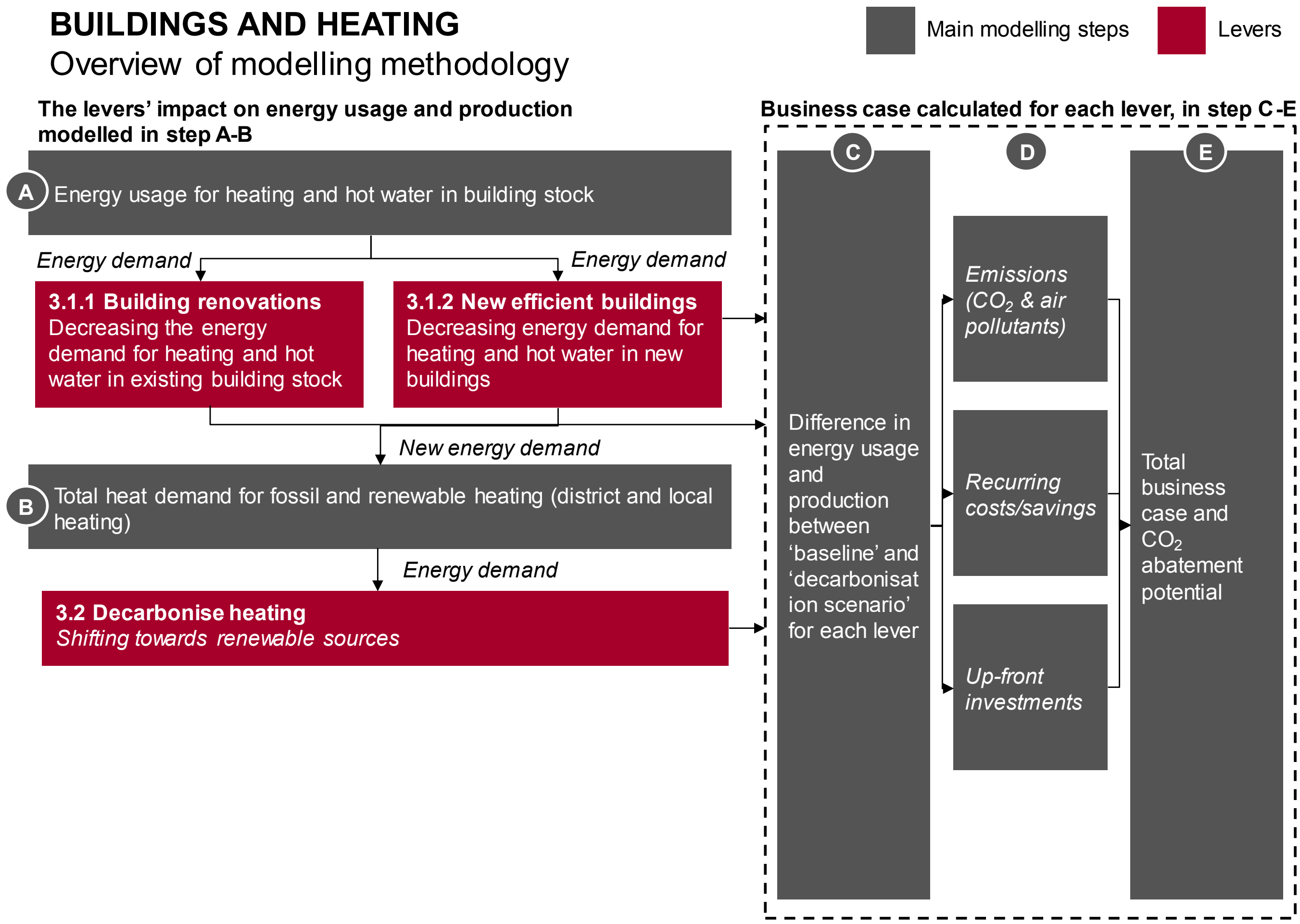
1. Passenger transport



2. Freight transport



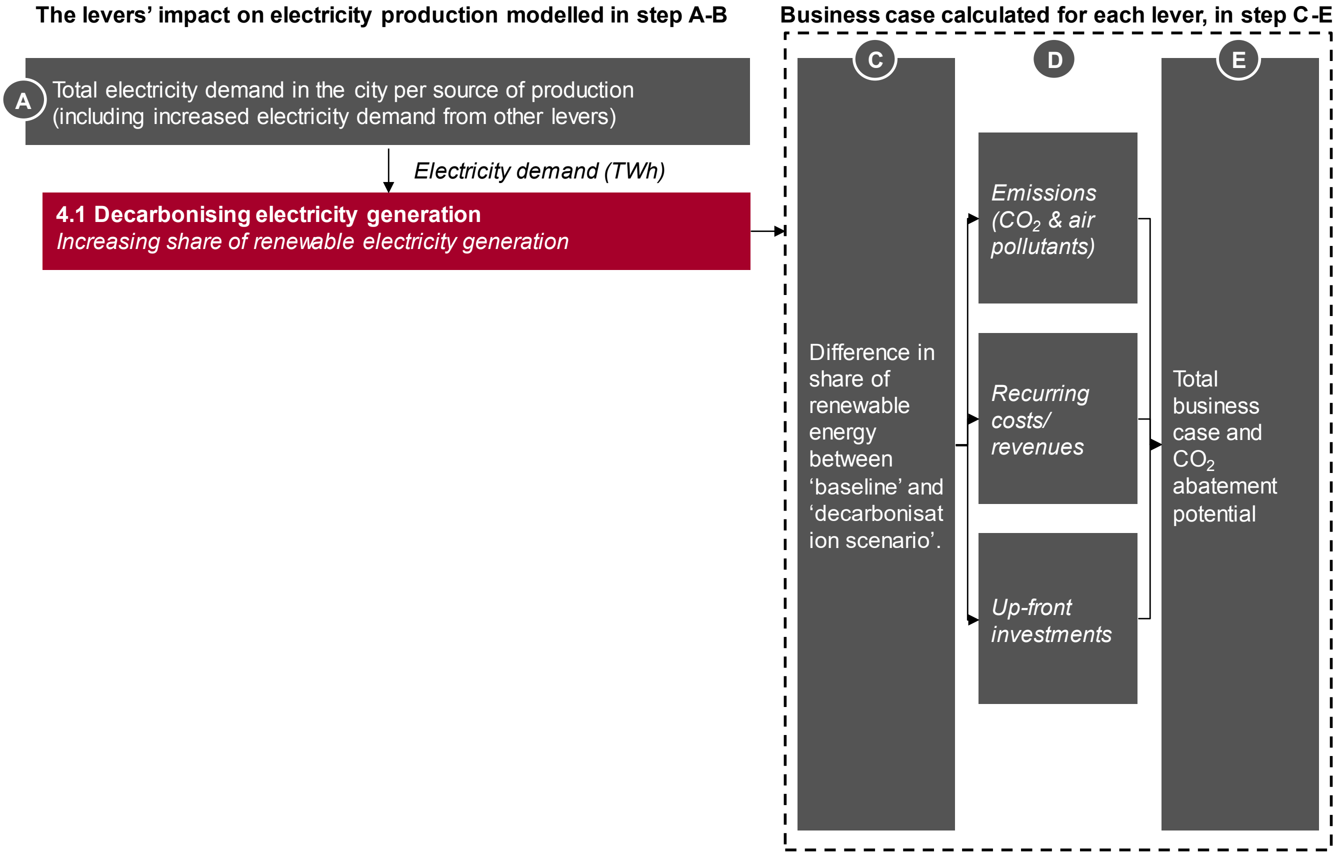
3. Buildings & heating



4. Electricity

ELECTRICITY
Overview of modelling methodology

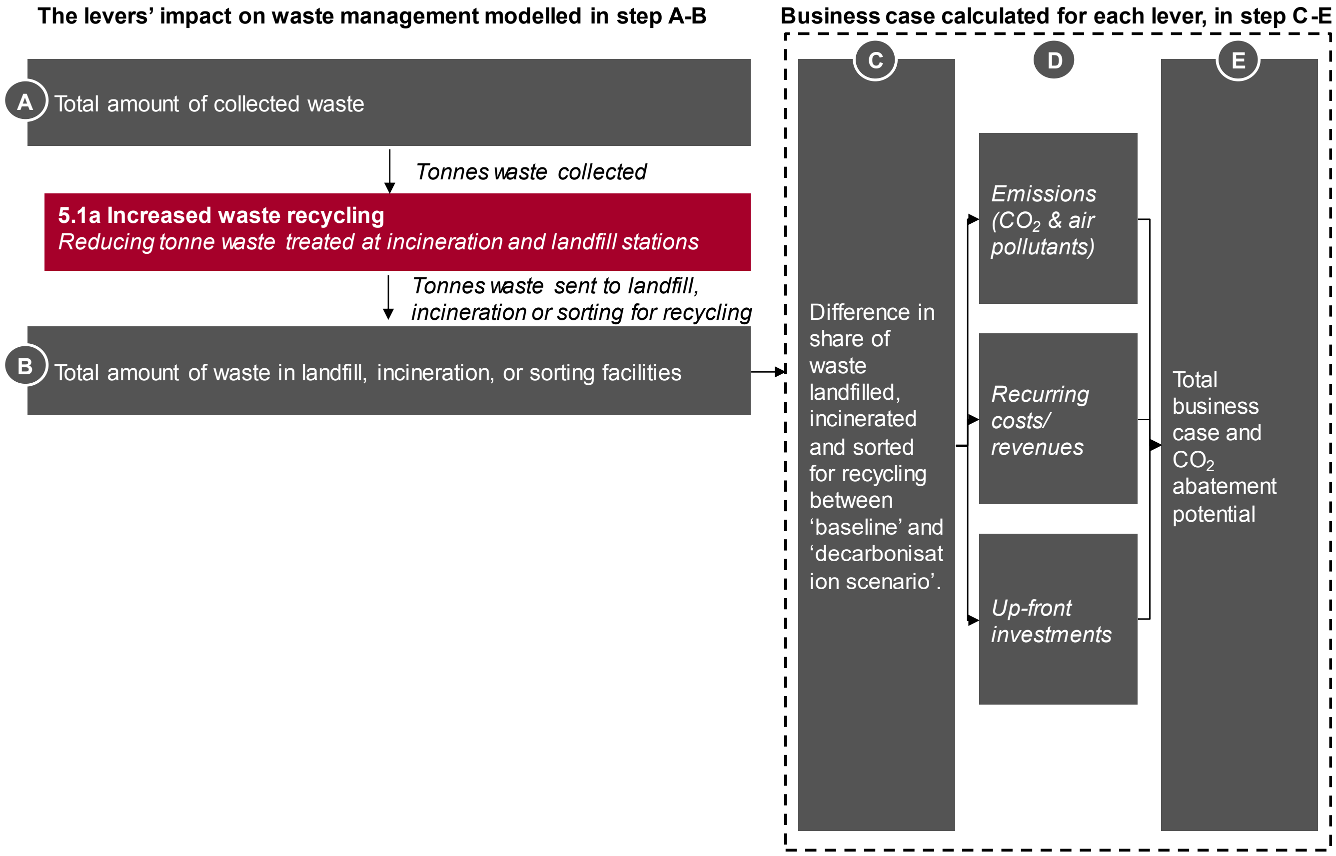
Main modelling steps | Levers



5. Waste

WASTE MANAGEMENT
Overview of modelling methodology

Main modelling steps | Levers



Annexes 2: Individual action outlines

B-2.2: Individual action outlines 1.		
Action outline	Action name	Reduced motorized passenger transportation need
	Action type	Management, governance
	Action description	Testing of zero-emission zones where only electric, hydrogen and biogas cars can run. Rethinking the parking system Design of car parks
Reference to impact pathway	Field of action	Transport
	Systemic lever	Regulation, governance, Education, social innovation
	Outcome (according to module B-1.1)	Incentive schemes, testing of zero-emission zones, modification of parking schemes, understanding spatial patterns of car use, Dialogue with car owners, Behavioural change, adoption as a result of community planning, Reduction in public parking spaces, The spread of alternative transport modes
Implementation	Responsible bodies/person for implementation	Municipality of Pécs
	Action scale & addressed entities	City wide
	Involved stakeholders	Citizens, businesses, institutions
	Comments on implementation	Community planning and testing periods are needed before implementation
Impact & cost	Generated renewable energy (if applicable)	Not applicable
	Removed/substituted energy, volume or fuel type	35% reduction in petrol/diesel use
	GHG emissions reduction estimate (total) per emission source sector	32 kton
	Total costs and costs by CO2e unit	Investment costs (NPV): MEUR 0 CO2 unit cost (NPV): MEUR 0

B-2.2: Individual action outlines 2.		
Action outline	Action name	Shift to public & non-motorized transport
	Action type	Management, governance, investment
	Action description	E-bike, scooter, moped project Supporting access by public transport from the agglomeration with targeted services Separate bus lanes on main transport routes The use of hydrogen technology in long-distance bus transport
Reference to impact pathway	Field of action	Transport
	Systemic lever	Infrastructure, Education, social innovation
	Outcome (according to module B-1.1)	P+R, B+R parking spaces at the bus terminus, Dialogue with car owners, Commuters use public transport in large proportions, The spread of alternative transport modes
Implementation	Responsible bodies/person for implementation	Biokom NKft
	Action scale & addressed entities	City wide
	Involved stakeholders	Businesses, Tüke Busz Zrt., Municipality of Pécs, Kontakt-Elektro Kft., Volán Zrt.
	Comments on implementation	Ongoing implementation
Impact & cost	Generated renewable energy (if applicable)	Not applicable
	Removed/substituted energy, volume or fuel type	10% reduction of petrol/diesel
	GHG emissions reduction estimate (total) per emission source sector	5 kton
	Total costs and costs by CO2e unit	Investment costs (NPV): MEUR 5 CO2 unit cost (NPV): MEUR 0.93

B-2.2: Individual action outlines 3.		
Action outline	Action name	Increased car pooling
	Action type	Management, governance
	Action description	Increasing the share of car sharing: contractual incentive systems with large employers, both businesses and institutions
Reference to impact pathway	Field of action	Transport
	Systemic lever	Governance, regulation, Education, social innovation
	Outcome (according to module B-1.1)	Large employer partnerships, Progress in the adoption of car-sharing solutions, Private car use rate decreases, Car sharing systems in parking centres, major bus stations
Implementation	Responsible bodies/person for implementation	Municipality of Pécs
	Action scale & addressed entities	City-wide
	Involved stakeholders	Biokom NKft., citizens, businesses
	Comments on implementation	Governance interventions and behaviour change is needed
Impact & cost	Generated renewable energy (if applicable)	Not applicable
	Removed/substituted energy, volume or fuel type	Reduced petrol/diesel use
	GHG emissions reduction estimate (total) per emission source sector	9 kton
	Total costs and costs by CO_2e unit	Investment costs (NPV): MEUR 0 CO_2 unit cost (NPV): MEUR 0

B-2.2: Individual action outlines 4.		
Action outline	Action name	Electrification of cars + motorcycles
	Action type	Investment
	Action description	Provision of electric charging infrastructure for cars Awareness raising and information transfer on electric cars Electric car fleet support programmes
Reference to impact pathway	Field of action	Transport
	Systemic lever	Technology, Education, attitude shaping, Funding
	Outcome (according to module B-1.1)	Decarbonising car transport, building charging capacity, Decarbonising car transport, building charging capacity, Getting to know electric car use Learning about charging options, optimisation, Getting to know electric car use, Savings at individual level
Implementation	Responsible bodies/person for implementation	citizens
	Action scale & addressed entities	City wide
	Involved stakeholders	Biokom NKft., citizens, Municipality
	Comments on implementation	Incentive schemes are needed, optimal charging infrastructure is a prerequisite
Impact & cost	Generated renewable energy (if applicable)	Not applicable
	Removed/substituted energy, volume or fuel type	35% of cars will be electric substituting petrol/diesel use
	GHG emissions reduction estimate (total) per emission source sector	13 kton
	Total costs and costs by CO2e unit	Investment costs (NPV): MEUR 22 CO2 unit cost (NPV): MEUR 1.67

B-2.2: Individual action outlines 5.		
Action outline	Action name	Electrification of buses
	Action type	investment
	Action description	Replacement of the diesel bus fleet of Tüke Busz Zrt. with electric buses in line with the decarbonisation plan. Construction of a charging network for the operation of the electric bus fleet of Tüke Busz Zrt. Developing an intelligent urban energy management and spatial information system - Optimising the use of public transport The electrification of metropolitan transport by developing infrastructure to support environmentally friendly private and public transport.
Reference to impact pathway	Field of action	Transport
	Systemic lever	Technology, Management, governance
	Outcome (according to module B-1.1)	All-electric fleet by 2027, Building and optimised use of charging capacity is achieved, Bus transport will be optimally accessible for commuters, Implementation of demand-driven start-up
Implementation	Responsible bodies/person for implementation	Tüke Bus Zrt.
	Action scale & addressed entities	City wide
	Involved stakeholders	Biokom NKft, citizens
	Comments on implementation	Implementation has already started and will be ongoing
Impact & cost	Generated renewable energy (if applicable)	Not applicable
	Removed/substituted energy, volume or fuel type	Public transportation will be 100% fossil fuel free
	GHG emissions reduction estimate (total) per emission source sector	1 kton
	Total costs and costs by CO_2e unit	Investment costs (NPV): MEUR 5.25 CO_2 unit cost (NPV): MEUR 6

B-2.2: Individual action outlines 6.		
Action outline	Action name	Optimized logistics
	Action type	Management, governance
	Action description	Smart columns: real-time data generation from IoT sensors, network remote control and automation systems: sensor deployment Reducing congestion in urban transport through traffic management tools Diverting traffic from Route 6 by easing congestion in the downtown and Garden City. Construction of interchange stations at 3 sites
Reference to impact pathway	Field of action	Transport
	Systemic lever	Infrastructure, Governance, regulation
	Outcome (according to module B-1.1)	Understanding the spatial patterns of lorry traffic, Construction of city-side transfer stations, Diverting freight traffic from inner urban spaces, Diverting freight traffic from inner urban spaces, carbon contribution
Implementation	Responsible bodies/person for implementation	Municipality of Pécs
	Action scale & addressed entities	Focusing on main transport roads : East-West, Southwards
	Involved stakeholders	Biokom NKft., bunisses
	Comments on implementation	Detailed survey on spatial pattern of transportation is a prerequisite
Impact & cost	Generated renewable energy (if applicable)	Not applicable
	Removed/substituted energy, volume or fuel type	30% reduction in truck kilometers resulting less diesel/ petrol use
	GHG emissions reduction estimate (total) per emission source sector	10 kton
	Total costs and costs by CO2e unit	Investment costs (NPV): MEUR 0 CO2 unit cost (NPV): MEUR 0

B-2.2: Individual action outlines 7.		
Action outline	Action name	Electrification of trucks
	Action type	Investment
	Action description	Electrification of the conventional vehicle fleet of the public service system in Pécs Electric van replacement programme
Reference to impact pathway	Field of action	Transport
	Systemic lever	Technology, Education, attitude shaping
	Outcome (according to module B-1.1)	decarbonising truck transport, building charging capacity, testing mercury technology, decarbonising truck transport, building charging capacity, using hydrogen technology, Hydrogen ecosystem build-up, Optimisation of transhipment techniques
Implementation	Responsible bodies/person for implementation	Businesses, Biokom Nkft
	Action scale & addressed entities	Impacts businesses
	Involved stakeholders	Businesses, utilities
	Comments on implementation	Charging capacity is a prerequisite
Impact & cost	Generated renewable energy (if applicable)	Not applicable
	Removed/substituted energy, volume or fuel type	50% of light duty truck and 40% of heavy duty trucks will be electrified resulting in less petrol/diesel need
	GHG emissions reduction estimate (total) per emission source sector	2 kton
	Total costs and costs by CO2e unit	Investment costs (NPV): MEUR 101 CO2 unit cost (NPV): MEUR 040.36

B-2.2: Individual action outlines 8.		
Action outline	Action name	Building renovations
	Action type	Investment, management
	Action description	Energy utility developments Promoting smart meters, developing a digital platform, ensuring real-time traceability of energy consumption. Building a downtown energy community with institutional actors University of Pécs Decarbonisation of building stock University of Pécs Energy Community Project Complex energy development project in Pécsbánya-Karolina LEGOFIT project Energy efficiency solutions with intelligent systems Testing local energy supply models - microgrid Testing local energy supply models - energy storage Retrofitting 35% of existing buildings Energy efficient appliances Replacement of summer hot water supply for multi-storey buildings with renewable hot water Pilot project to decarbonise a prefabricated building: installing renewable energy sources to replace cooling, lighting and cooking in a ten-storey prefabricated building. Mechanical retrofitting of prefabricated buildings for individual heat use and efficiency Gas substitution for cooking purposes Energy security support programme for families on social assistance to replace fossil fuels. Energy support programme model for disadvantaged families in partnership with energy suppliers Wood-fired home conversion programme
Reference to impact pathway	Field of action	Buildings and heating
	Systemic lever	Technology, Governance, Education, attitude shaping
	Outcome (according to module B-1.1)	5% per annum building stock renovation, implementation of test projects, smart meter roll-out, microgrid systems, energy communities in operation, Operation of the Green Office, introduction of a building

		renovation passport scheme, building stock survey, Tools to achieve energy efficiency at household level, learning how the energy community works
Implementation	Responsible bodies/person for implementation	Municipality Green Office
	Action scale & addressed entities	35% of building stock
	Involved stakeholders	Municipality of Pécs, Energy utilities, Utility companies, Homeowners, Institutions, University of Pécs, Housing cooperatives, PÉTÁV, MTA KRTK
	Comments on implementation	Energy audit of Municipality buildings in progress, pilot actions needed
Impact & cost	Generated renewable energy (if applicable)	Not applicable
	Removed/substituted energy, volume or fuel type	40% increase in energy efficiency
	GHG emissions reduction estimate (total) per emission source sector	4 kton
	Total costs and costs by CO_2e unit	Investment costs (NPV): MEUR 171 CO_2 unit cost (NPV): MEUR 40.43

B-2.2: Individual action outlines 9.		
Action outline	Action name	New energy-efficient buildings
	Action type	Investment
	Action description	New build properties along district heating networks Setting minimum requirements for new buildings, providing information Decarbonising new buildings, passive and active houses - education, awareness raising
Reference to impact pathway	Field of action	Buildings and heating
	Systemic lever	Technology, Education, attitude shaping
	Outcome (according to module B-1.1)	Buildings meeting at least BB standard, fossil fuel free buildings, Building decarbonisation options, low carbon building material options, green walls, green roof options
Implementation	Responsible bodies/person for implementation	Homeowners
	Action scale & addressed entities	20% of newly build buildings are top performing, annual newly built homes range between 120-320
	Involved stakeholders	Municipality Green Office, Homeowners, PÉTÁV
	Comments on implementation	Information provision on technology and funancing schemes is needed for acceleration

Impact & cost	Generated renewable energy (if applicable)	Solar panels may be installed
	Removed/substituted energy, volume or fuel type	Not applicable
	GHG emissions reduction estimate (total) per emission source sector	1 kton
	Total costs and costs by CO2e unit	Investment costs (NPV): MEUR 3 CO2 unit cost (NPV): MEUR 4.87

B-2.2: Individual action outlines 10.		
Action outline	Action name	Efficient lighting & appliances
	Action type	Investment
	Action description	Developing smart street lighting LED burning program Optimising household large consumers through smart grid, microgrid systems, related education, awareness raising.
Reference to impact pathway	Field of action	Buildings and heating
	Systemic lever	Technology, infrastructure, Education, attitude shaping
	Outcome (according to module B-1.1)	Start LED replacement of urban street lighting, LED bulb replacement in buildings, Full decarbonisation of urban street lighting, widespread use of smart solutions, full use of LED lighting in buildings, substitution of natural gas for cooking in prefabricated buildings
Implementation	Responsible bodies/person for implementation	Municipal Green Office, homeowners
	Action scale & addressed entities	City wide
	Involved stakeholders	Municipality, Energy utilities,
	Comments on implementation	Municipality systematic implementation, citizens need information and incentives
Impact & cost	Generated renewable energy (if applicable)	Not applicable
	Removed/substituted energy, volume or fuel type	30-70% energy efficiency can b reached
	GHG emissions reduction estimate (total) per emission source sector	14
	Total costs and costs by CO2e unit	Investment costs (NPV): MEUR 78 CO2 unit cost (NPV): MEUR 5.75

B-2.2: Individual action outlines 11.		
Action outline	Action name	Decarbonizing heating generation
	Action type	Investment, management
	Action description	Pétáv development: replacement of 5 MW gas boiler Increasing the efficiency of heat production by reducing losses Connection of institutional actors to district heating Cleantech project : energy production and storage with deep geothermal storage - preparatory R&D project Cleantech project : Conversion of hydrocarbon wells into geothermal wells Cleantech project : Exploration of geothermal energy sources in the Pécs region Cleantech project: Exploration, extraction and exploitation of secondary raw materials with a strong geological background Cleantech project: The comprehensive development of the university knowledge base and competences for geological projects requiring a significant technical and expert base. Experimental application of a soil probe heat pump system
Reference to impact pathway	Field of action	Buildings and heating
	Systemic lever	Technology, Shaping attitudes, education
	Outcome (according to module B-1.1)	district heating for institutional actors, substitution of natural gas for heating with heat pump systems, piloting of ground source heat pump systems, Replacement of natural gas heating with heat pump systems, no new gas boiler installation, Presentation of alternative systems, information on panel reconstruction, application of heat pump systems
Implementation	Responsible bodies/person for implementation	PÉTÁV, homeowners
	Action scale & addressed entities	65% of homes
	Involved stakeholders	PÉTÁV, Municipality of Pécs, PTE TTK, AFK, Mecsekérc Zrt.
	Comments on implementation	Geothermal energy involvement option is to be assessed, district heating volume increase is minor
Impact & cost	Generated renewable energy (if applicable)	Not applicable

	Removed/substituted energy, volume or fuel type	Natural gas in 65% of homes currently heated by natural gas will be phased out
	GHG emissions reduction estimate (total) per emission source sector	74
	Total costs and costs by CO2e unit	Investment costs (NPV): MEUR 236 CO2 unit cost (NPV): MEUR 3.18

B-2.2: Individual action outlines 12.		
Action outline	Action name	Decarbonizing electricity generation
	Action type	Investment
	Action description	Building solar park capacity Developing urban energy storage capacity in cooperation with energy suppliers Building electrolysis capacity in Tüskésrét Building the hydrogen ecosystem Preparing inter-regional innovation investments in the Central European Green Hydrogen Value Chain by developing a stakeholder participation scheme and establishing an IoT framework. Building solar capacity for city operations Institutional solar capacity building Building solar capacity for industrial and commercial entities Building solar capacity - with individual capacity expansion (small household power plants) Building residential storage capacity in partnership with energy suppliers
Reference to impact pathway	Field of action	Electricity
	Systemic lever	Technology, infrastructure, Education, attitude shaping
	Outcome (according to module B-1.1)	Increasing utility-scale and domestic, institutional solar capacity Building hydrogen storage and electrolysis capacity, microgrid systems, storage capacity, energy community test projects, Implementing carbon-free electricity supply for urban consumption Use of hydrogen capacity in renewable energy mix, microgrid systems, storage capacity, development of energy communities, Information on the deployment of small household power plants, microgrid systems, storage options, energy communities
Implementation	Responsible bodies/person for implementation	Municipality of Pécs, energy suppliers, Homeowners

	Action scale & addressed entities	City wide
	Involved stakeholders	PTE, Kontakt-Elektro Kft., Institutions, Businesses, Municipal Green Office
	Comments on implementation	Dependant on regulatory environment
Impact & cost	Generated renewable energy (if applicable)	200 MWp
	Removed/substituted energy, volume or fuel type	Not applicable
	GHG emissions reduction estimate (total) per emission source sector	139
	Total costs and costs by CO2e unit	Investment costs (NPV): MEUR 23 CO2 unit cost (NPV): MEUR 0.16

B-2.2: Individual action outlines 13.		
Action outline	Action name	Increased waste recycling
	Action type	Investment, management
	Action description	Smart solutions for waste management and urban operations Fermentation of the highly biodegradable fraction separated by mechanical treatment with biogas recovery Pre-treatment of the highly biodegradable fraction, selection of energy recovery fractions, selection of inert components. Development of an intelligent urban energy management and spatial information system - Stormwater and wastewater spatial information system improvements Waste Prevention Centre Development of intelligent diagnostics and monitoring in water management in Pécs Increasing wastewater treatment capacity in Pécs Development of technologies for the exploration, extraction and utilisation of secondary raw materials (e.g. slag recycling, geothermal recycling of abandoned wells, etc.) based on geological background and the establishment of such projects;
Reference to impact pathway	Field of action	Waste
	Systemic lever	Technology, Shaping mindsets, social innovation
	Outcome (according to module B-1.1)	Further investments in the waste and waste water sector to improve the efficiency of selective waste treatment, Waste

		prevention education, Biogas utilisation in waste treatment, development of solar drying capacity in the wastewater sector, increasing the efficiency of selective waste treatment Other options for selective waste management, Waste prevention centre
Implementation	Responsible bodies/person for implementation	Biokom NKft
	Action scale & addressed entities	City wide
	Involved stakeholders	Tettye Forrásház Zrt, citizens, PTE, businesses
	Comments on implementation	Ongoing modernization and emission reduction in utilities
Impact & cost	Generated renewable energy (if applicable)	
	Removed/substituted energy, volume or fuel type	Reaching 70% recycle rate
	GHG emissions reduction estimate (total) per emission source sector	1
	Total costs and costs by CO2e unit	Investment costs (NPV): MEUR 0 CO2 unit cost (NPV): MEUR 0.05

B-2.2: Individual action outlines 14.		
Action outline	Action name	Circular economy
	Action type	Investment, management
	Action description	onverting industrial parks to renewable, zero-emission, circular Climate Partnership, a long-term, active cooperation between the business sector and the municipality of Pécs to reduce carbon emissions in the city of Pécs. Pilot circular construction project, circular building materials marketplace Collection, sorting and recovery of urban construction and demolition waste at the waste treatment plant in Kekényes. Installation of a construction waste centre Recycling of mining waste Decomposition and utilisation of fly ash from spiked cedar in cement, technological testing the use of landfilled mine waste for the production of dust binders, slurry control agents and fertilisers (circular economy)
Reference to impact pathway	Field of action	Waste, circular economy
	Systemic lever	Technology, Shaping mindsets, social innovation

	Outcome (according to module B-1.1)	Evolving eco-system, new business models planned, new business models implemented
Implementation	Responsible bodies/person for implementation	Pécs-Baranya County Chamber of Commerce
	Action scale & addressed entities	businesses
	Involved stakeholders	Municipality of Pécs, Ipark Kft., Holcim Magyarország Kft., Biokom NKft., University of Pécs
	Comments on implementation	Planning and eco-system building phase is needed as a first step
Impact & cost	Generated renewable energy (if applicable)	Nd
	Removed/substituted energy, volume or fuel type	nd
	GHG emissions reduction estimate (total) per emission source sector	nd
	Total costs and costs by CO2e unit	Investment costs (cash flow): MEUR 60 CO2 unit cost (NPV): MEUR 2.11

B-2.2: Individual action outlines 15.		
Action outline	Action name	Green Infrastructure development
	Action type	Investment
	Action description	Green wall, green roof Expansion and renovation of urban parks based on climate resilience criteria Greening along busy roads, green walls Greening of car parks Converting vacant or underused land into green space Model projects implemented: urban gardens, urban agriculture, composting programmes
Reference to impact pathway	Field of action	Green Infrastructure
	Systemic lever	Technology, infrastructure, Education, attitude shaping
	Outcome (according to module B-1.1)	Cliamte resilient green infrastructured, increased volume of green surfaces also with innovative solutions, nature based solutions applied
Implementation	Responsible bodies/person for implementation	Biokom NKft.
	Action scale & addressed entities	City wide
	Involved stakeholders	Municipality of Pécs, citizens, institutions, businesses
	Comments on implementation	Piloting actions needed, involvement of citizens, businesses, institutions in greening is needed

Impact & cost	Generated renewable energy (if applicable)	Not applicable
	Removed/substituted energy, volume or fuel type	Not applicable
	GHG emissions reduction estimate (total) per emission source sector	79 kton
	Total costs and costs by CO2e unit	Investment costs (cash flow): MEUR 30 CO2 unit cost (NPV): MEUR 2.11

NET ZERO CITIES

EU MISSION PLATFORM | CLIMATE NEUTRAL AND SMART CITIES

Climate City Contract

2030 Climate Neutrality Commitments

Climate Neutrality Commitments of the City Pécs

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Disclaimer

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Dear Fellow Citizens of Pécs,

I stand before you today not just as your Mayor but as a fellow resident of this beautiful city, deeply concerned about our shared future. Our world is facing a critical challenge, one that affects us all, irrespective of our age, background, or profession. That challenge is climate change, and it requires our immediate and collective attention.

Attila Péterffy
Mayor of the City of Pécs

- **Why Climate Transition Matters:** Our city is not immune to the impacts of climate change. We've witnessed extreme weather events, rising temperatures, and changes in our local environment. But I believe that we have the power to make a positive change, to protect our homes, our health, and our children's future.

- **Our Shared Responsibility:** Climate transition is not a task for a select few; it's a responsibility we all share. Each one of us can make a difference, whether we're individuals, families, local businesses, or community organizations. It's not just about what our city government can do; it's about what we can achieve together.

- **The Benefits of Climate Action:** Let me emphasize that climate transition is not just about sacrifice; it's about opportunity. When we reduce our carbon footprint, we're also improving our quality of life. Cleaner air means better health. Sustainable transportation means less traffic. Renewable energy means cost savings. Green jobs mean economic growth. Climate-resilient infrastructure means safety for our families.

What We Can Do Together:

I invite you to join us on this journey towards a more sustainable and resilient city. Here's how you can get engaged:

- **Reduce Your Carbon Footprint:** Make small changes in your daily life, like conserving energy, using public transportation, or reducing waste. Every action counts.

- **Support Local Businesses:** Choose to support businesses that prioritize sustainability. By doing so, you're helping create green jobs and a thriving local economy.

- **Participate in Community Initiatives:** Join or start community projects aimed at reducing emissions, enhancing green spaces, or improving local resilience. Together, we can accomplish so much more.

- **Advocate for Change:** Use your voice to advocate for policies and initiatives that promote sustainability and climate action. Engage with your local representatives and encourage them to support climate-friendly measures.

- **Stay Informed:** Stay informed about climate issues, attend workshops, and share your knowledge with others. Education is a powerful tool for change.

Our Future Together:

In the face of climate change, our city can become a beacon of hope and innovation. We can show the world what's possible when a community comes together to protect the environment and create a brighter future for all.

I believe in the resilience, creativity, and determination of our citizens. Together, we can tackle the climate challenge head-on and build a city we're proud to pass down to the next generation. Let's embark on this journey together because, in the end, it's not just about changing the climate; it's about changing our future for the better.

Thank you, and let's all of us join this journey,
Attila Péterffy
Mayor of the City of Pécs

1 Introduction

Over nearly a decade, the City of Pécs has been steadfastly dedicated to a climate policy driven by a clear sense of purpose. The city, its economic partners, the research community and its society united in pursuit of ambitious goals laid out in the Sustainable Energy Action Plan (SEAP) to achieve a remarkable 20% reduction in emissions by 2020, compared to 2011 levels. In 2013, Pécs took its commitment a step further by joining the Covenant of Mayors, aligning itself with the 2030 targets. This next phase aimed to slash greenhouse gas emissions by an even more staggering 47.4% compared to 2019 in its Sustainable Energy and Climate Action Plan. The plan encompassed a spectrum of actions, spanning energy use, industrial emissions, transportation, waste management, and the strategic cultivation of forests and green spaces.

Building upon the targets set in the SECAP and the Climate Strategy, the City of Pécs embarked on an extensive consultation process. It brought together an array of professional, scientific, economic, institutional, and public stakeholders to draft a declaration of intent for the European Union Urban Mission initiative. This initiative sought to build upon the city's progress thus far and expedite the journey towards achieving the 2030 climate neutrality objective.

In January 2022, the Municipality of Pécs submitted its application for the European Union's "100 Climate Neutral and Smart Cities Mission" under the European Green Deal, an initiative set to unfold within Horizon Europe. Pécs stood alongside 99 other European Union cities chosen by the European Commission to partake in this program, each pledging to reach net-zero carbon emissions by 2030.

This pivotal opportunity positions the City of Pécs within a dynamic European community of cities. This partnership accelerates the multifaceted development process underpinning a comprehensive policy founded on economic, social, and environmental sustainability.

What can climate transition of the City of Pécs offer to all its citizens, institutions and businesses with active engagement in the climate journey?

- **Mitigating Climate Change:** Climate change poses a significant global threat, and cities are major sources of greenhouse gas emissions. Engaging in climate transition is essential for reducing these emissions and mitigating climate change impacts, such as extreme weather events and temperature increases.

- **Protecting Public Health:** Climate action can lead to improved air and water quality, reduced exposure to pollution, and better health outcomes for residents. Lowering emissions from transportation and industry can reduce respiratory and cardiovascular diseases.

- **Gaining Economic Benefits:** Climate transition can drive economic growth by creating green jobs, fostering innovation in clean technologies, hydrogen economy and increasing energy efficiency. It can also reduce energy costs for residents and businesses.

- **Becoming Resilient and Adaptable:** Cities are vulnerable to climate-related risks, including heatwaves, and storms. Engaging in climate transition includes building resilience and adapting to these challenges, making communities safer and more resilient.

- **Developing our City Sustainably:** Climate transition aligns with principles of sustainable development, ensuring that cities meet the needs of the present without compromising the ability of future generations to meet their own needs. It promotes a more balanced and equitable approach to development.

- **Enhancing Quality of Life:** Sustainable urban planning and green spaces can enhance the livability of cities, reduce traffic congestion, noise pollution, and improve overall quality of life for residents that attracts the young generation to start their adult life in our city.

- **Attracting Investment:** Cities that demonstrate a commitment to sustainability and climate action are often more attractive to investors, businesses, and tourists. This can boost the local economy and create opportunities for growth.

- **Innovation and Competitiveness:** Businesses and industries that embrace sustainability and green technologies are often more competitive in the global market. Engaging in climate transition will lead to innovation and market advantages.

- **Community Cohesion:** Climate transition projects often bring communities together, fostering a sense of cohesion and shared purpose. Collaborative efforts can build stronger, more connected neighborhoods.

By actively participating in climate action, individuals and organizations contribute to creating sustainable, resilient, and prosperous communities for the benefit of all.

What has the City of Pécs achieved so far?

Aligned with the Urban Development Concept, the Integrated Urban Development Strategy, and the Sustainable Urban Development Strategy of Pécs, the city drafted a Climate Neutral Action Plan and Investment Plan. These latter, scheduled for submission to the NetZero Consortium in September 2023, form the cornerstone for the Climate City Contract process on behalf of the European Commission.

The Climate City Contract succinctly outlines the city's aspirations, underscoring the necessity of a broad partnership with stakeholders. Beyond the Municipality of Pécs, other major emitters within the city are also making commitments, recognizing that achieving the net emission goal necessitates a collective endeavor.

Cities occupy a pivotal role in the journey towards sustainability and net-zero emissions. As centers of innovation and human activity, they bear a profound responsibility to lead by example and contribute to the global transition towards a more sustainable and resilient future. Pécs, too, accepts this responsibility wholeheartedly.

In line with its Urban Agenda to enhance the quality of life for its residents, Pécs emphasizes sustainability and climate action. These elements are integral to securing a high quality of life, both objectively and subjectively. A city that thrives in these dimensions can expect to witness significant reductions in carbon emissions, improved public health, greater climate-resilient green spaces, energy security, and the availability of clean energy. Together with its residents, Pécs is shaping an environment that promises long-term attractiveness and dynamism for businesses, inhabitants, and those who work and live within its boundaries.

Pécs is not just making commitments in words but translating them into action. The city's steadfast dedication over the past decade has borne fruit. Collaborative efforts with key partners such as the University of Pécs, Kontakt-Elektro Kft., and the local energy supplier have resulted in the exploration of hydrogen technology for local and regional transport, as well as various green initiatives.

Pécs understands that hydrogen technology's full potential can only be realized when all its components are utilized. This includes using oxygen from water purification in wastewater treatment and harnessing the heat generated by electrolysis in local greenhouses. Moreover, hydrogen production helps stabilize the electricity system as an energy storage solution.

Pécs's University's National Laboratory designation further supports research activities, including hydrogen research, and geological research focused on geothermal energy. The city aims to increase its energy storage capacity, investigating the possibility of geological hydrogen storage in the medium term.

In a bid to green its heating system, Pécs utilizes biomass as the energy source for district heating, providing 95% fossil-free district heating to nearly 50% of its housing stock. Energy suppliers, like EoN Hungária are consistently working to increase the renewable share of the electricity mix, with the installation of solar panels during municipal and public institution renovations.

Furthermore, the city's urban bus transport, managed by Tüke Busz Zrt. is transitioning to electric buses, with plans to replace the entire fleet with electric vehicles by 2027.

Collaborating with the University of Pécs, the RING 2017 project spearheads a sustainable raw material management network, focusing on secondary raw materials utilization and environmentally friendly applications. Key areas encompass wastewater and sludge recovery, low CO2 emission technologies, municipal solid waste as a secondary raw material source, and more.

The introduction of an electric urban bicycle rental system by Biokom Nkft, featuring 107 docking stations and 70 electric bicycles available for rent, has significantly reduced CO2 emissions in Pécs.

Ongoing initiatives like the HungAIRy-LIFE project explore smart parking systems, green space surveys, energy consumption measurement in public buildings, and more, aiming to further cut carbon emissions.

Regionally, the Mecsek-Dráva regional waste management project has established waste management centers and sorting facilities, advancing the sustainable management of waste.

Pécs also invests in awareness-raising and educational programs, partnering with the University of Pécs and civil organization stakeholders to engage the public in eco-friendly initiatives.

Despite its commitment, Pécs remains adaptable to changing conditions. It faces unique challenges, such as increased heatwaves and climate-related health issues, and is actively developing strategies to mitigate these risks.

In essence, Pécs's journey is one of purposeful transformation. It's a city steadfastly working towards a sustainable and carbon-neutral future, while improving the quality of life for its residents, attracting young people to continue their life in Pécs, and inviting investments in the sustainable industry with new green jobs and meanwhile leaving a positive imprint on the environment.

What are the underlying EU, national and local strategies, policies serving as a framework ?

In December 2019, the EU committed to achieving zero greenhouse gas emissions by 2050 in the frame of the Green Deal, and in December 2020 it was decided to increase the 40% emission reduction target to 55% (compared to 1990 levels) by 2030. Achieving this will require a comprehensive reform of EU climate policy and significant investment and support to ensure the transition to a carbon neutral economy. All 27 EU Member States including Hungary committed to turning the EU into the first climate neutral continent by 2050. The national level strategies and policies reflect the objectives of the EU, and offers guidance for the cities when designing their climate neutrality plans. Pécs built its Action Plan on the Second National Climate Change Strategy, the National Energy Strategy, the National Energy Strategy for Buildings, the National Forest Strategy, the National Hydrogen Strategy, the Waste Management Code among others. The Baranya County Climate Strategy, Climate Strategy of the City of Pécs and SECAP are the local focal points on the one hand, while the Sustainable Urban Development Strategy defines the vision and long term sustainable development objectives of Pécs. Two action plans in the transport sector assists the climate transition process, the Sustainable Uban Mobility Action Plan and Tüke Busz Zrt. Decarbonisation Plan.

2 Goal: Climate neutrality by 2030

Striving for Climate Neutrality by 2030: Unveiling the "Why" and the Intentions

The city's primary ambition is to make Pécs an even more liveable city, a city of choice for life, where the high quality of life, the exceptional past and present cultural values, the outstanding and recognised quality of education and the distinctive green environment provide a unique living space, while the vibrant cultural events, higher value-added jobs and competitive salaries convince young people to imagine their lives here.

The city of Pécs' climate neutrality ambition, green thinking and the future coordinated use of smart, intelligent systems will enhance the city's liveability. All these green objectives will be reflected in the opportunities for the city's residents, investors and visitors and tourists, with high added value and benefits. Pécs is a 15-minute city, where jobs, educational institutions, cultural opportunities, active recreation and entertainment alternatives are all within 15 minutes. The city of Pécs has a well-balanced infrastructure, including transport systems and their options, educational institutions, health services, shopping facilities and cultural activities.

In the quest for climate neutrality by 2030, the City of Pécs has a profound "Why" and clear intentions. This visionary endeavor aims to balance greenhouse gas (GHG) emissions, particularly carbon dioxide (CO2), with broadening sink capacity. Here's a deep dive into the core motivations and strategies driving this transformation:

I. Setting the Stage

- **The Ambitious Net Zero Target:** Pécs has set a remarkable target of reaching net zero GHG emissions by 2030 within the city boundary, comparing this with the emissions recorded in 2021.

- **A Comprehensive Approach:** Achieving this net-zero goal involves action in several critical domains: energy system, building sector emissions, industrial emissions, transportation waste management, and enhancing natural sink capacity through afforestation and green space expansion.

II. The "Why" Behind the Numbers

- **80% Emission Reduction:** Pécs is resolute in its mission to curtail emissions dramatically, aspiring to achieve an impressive 80% reduction in emissions by 2030, compared to 2021 levels, resulting in substantial carbon savings of 325 ktCO2.

- **Transport and Energy at the Helm:** The lion's share of emissions reduction efforts targets transport (35%) and electricity (32%) sectors, with heating buildings also a significant contributor (25%).

- **Neutralizing Transport Emissions:** Pécs aims to neutralize a substantial 68% of emissions from the transport sector through investment and innovative measures.

- **A Greener Electricity Mix:** The city aspires to slash electricity emissions by an impressive 85%.

- **Revolutionizing Heating Systems:** Pécs is committed to an ambitious 90% reduction in the carbon impact of heating buildings through a combination of investments and non investment measures.

- **Increased volumes of recycled waste:** Pécs aims to reduce the volume of waste ending up in landfills by upgrading recycling, contributing to a 17% emission reduction.

- **Greening the Economy:** By close and continuous collaboration with the industrial, commercial and agricultural partners, an ambitious 80% emission reduction goal is to be achieved until 2030.

III. The "How" - The Climate Neutral Action Plan

The Climate Neutral Action Plan of Pécs outlines a comprehensive roadmap, striving to:

- **Unlock Renewable Energy Access:** Targeting renewable energy access for 50% of households.
- **Decarbonize Electricity:** Striving for an 85% decarbonization of electricity consumption.
- **Promote Renewable Energy Sources:** Elevating the share of renewable energy sources to 60%.
- **Energy-Efficient Buildings:** Implementing measures to reduce emissions from buildings by 50% by 2030.
- **Phasing Out Natural Gas:** Reducing natural gas consumption for heating by 50% by 2030 and gradually phasing out its use for cooking.
- **Energy Savings:** Aiming for significant energy savings, equivalent to 40% of final energy consumption.
- **Revolutionizing Public Transport:** Committing to 100% emission reduction in public transport through electric buses.
- **Reducing Car Dependency:** Targeting a 35% reduction in car usage, emphasizing sustainable alternatives.
- **Electrifying Vehicle Fleets:** Electrifying 50% of vans (less than 3.5 t) and 40% of trucks (more than 3.5 t) to reduce emissions.

IV. The Role of Urban Carbon Fund

Pécs recognizes the importance of absorbing residual emissions (20%) primarily through the development of carbon sink capacities, accumulating contributions within the urban carbon fund. This fund forms the basis for interventions aimed at bolstering sink capacities.

V. The Collaborative Landscape

Achieving these multifaceted objectives necessitates a collaborative and multidimensional approach:

- **Governance and Regulation:** Pécs acknowledges the importance of governance and regulatory measures, including technology applicability, transportation management, and carbon reduction instruments.
- **Energy Efficiency:** Pécs is actively promoting energy-efficient technologies and retrofitting programs for buildings.
- **Renewable Energy Transition:** Transitioning to renewable energy sources, primarily solar energy and hydrogen is a cornerstone of the plan.
- **Urban Planning:** Urban planning prioritizes sustainable mobility, mixed land use, green spaces, and energy-efficient buildings.
- **Transport Transformation:** Pécs promotes green transport alternatives, invests in efficient public transport, and plans for electric vehicles, bicycles, scooters, and mopeds.
- **Innovation and Research:** Collaboration with the University of Pécs in research and innovation accelerates progress.
- **Waste Management:** Pécs champions effective waste management practices by its management company, Biokom Nkft., including recycling programs and waste reduction.

- **Community Engagement:** The city fosters community involvement, partnering with residents, businesses, and stakeholders for inclusive decision-making.

- **Economic Viability:** Pécs envisions sustainable economic growth and job creation through low carbon industries.

- **Adaptation to Climate Change:** Pécs is prepared to adapt to climate change, enhancing urban absorption capacity and mitigating heat, noise, and pollution.

- **Equity and Social Justice:** Ensuring equitable access to benefits and involving marginalized communities in decision-making are central principles.

- **Behavior Change:** Pécs endeavors to encourage sustainable behaviors among residents and businesses, promoting low-carbon practices.

In conclusion, Pécs's journey towards climate neutrality by 2030 is a holistic, multidimensional effort rooted in a profound sense of responsibility and a clear vision for a sustainable future. The city's strategy is built on collaboration, innovation, and inclusivity, addressing the "Why" while delineating a detailed roadmap for the "How."

3 Key priorities and strategic intervention

Charting a Sustainable Future: Unveiling Pécs Municipality's Why and How

The Municipality of Pécs is embarking on a transformative journey, driven by a profound "Why" - the pursuit of sustainability and carbon neutrality. To achieve these ambitious objectives, a series of strategic interventions and priorities have been outlined, each laden with purpose and intent:

I. Building Retrofitting for Sustainable Living

- Objective: Retrofit 35% of the city's building stock, committing to a 5% annual rate.

- Purpose: To drastically enhance energy efficiency and reduce carbon footprints, creating sustainable living spaces.

- Strategy: Initiating detailed energy audits for municipal and residential buildings, promoting smart meters, fostering digital platforms for real-time energy tracking, and establishing energy communities.

The municipality has started a detailed survey and energy audit of the municipal building stock, which will be followed by a residential building stock audit with the Green Office, which will be a one-stop-shop system to help renovate the residential building stock and introduce a system of building renovation passports. Energy efficiency interventions will be supported by the promotion of smart meters, the development of a digital platform, real-time traceability of energy consumption, the creation of a city centre energy community with institutional actors and the organisation of university buildings into an energy community to test the model. A number of solutions need to be tested before scaling up, such as energy efficiency solutions using smart systems, piloting of local energy supply models - microgrid, energy storage as a pilot project.There are 870 five and ten storey prefabricated buildings in Pécs, with a number of solutions for renovation, e.g. installation of renewable energy capacity to replace cooling, lighting and cooking in a ten-storey prefabricated building, mechanical retrofitting of prefabricated buildings for individual heat use and efficiency increase, replacement of cooking gas. For families on social assistance, a support programme is planned for energy security to replace fossil fuels.

II. Solar Power Revolution

- Objective: Scale up solar capacity to meet the entirety of urban electricity demand by 2030.

- Purpose: Decarbonize electricity generation, relying on renewable energy sources.

- Strategy: Implementing solar park capacity, boosting urban energy storage, and exploring electrolysis for surplus energy storage and hydrogen fuel production.

Decarbonisation of electricity is mainly achieved by building solar park capacity and urban energy storage capacity in cooperation with EoN Hungária. In connection with this, in order to make use of the electrical energy surplus of the valley seasons, electrolysis capacity will be built in Tüskésrét as part of the development of a hydrogen ecosystem, which will perform energy storage and hydrogen fuel production tasks. An assessment of the hydrogen refuelling needs for public transport and freight transport was carried out by the University of Pécs in June 2023, during which 180 t/year were identified. The utility-scale solar power plant will be complemented by the construction of institutional solar capacity, industrial and commercial solar capacity, and small-scale solar capacity for domestic small-scale solar power plants.

III. Decarbonizing Heating Systems

- Objective: Implement significant heating system transformations, including district heating connections, heat pump adoption, and ground source heat pumps.

- Purpose: To phase out fossil fuels, reduce carbon emissions from heating, and enhance energy efficiency.

- Strategy: To decarbonise heating, the main interventions include the connection of institutional actors to district heating, the replacement of natural gas for heating with heat pump systems, and the piloting of ground source heat pump systems.

Decarbonizing heating is probably the biggest challenge that need support from all citizens, institutions and businesses. While district heating is very advanced, natural gas consumption still covers about 50% of buidling supply. Heat pump systems have the most economic return and viability, however the Green Office of the Municipality with support of the University of Pécs continuously monitors technological developments that might accelerate the decarbonization of heating.

IV. Electrifying Transportation

- Objective: Electrify transportation options, including cars, motorcycles, and freight vehicles, while reducing private motorized transport.

- Purpose: Achieve emissions reduction and promote sustainable urban mobility.

- Strategy: Promote zero-emission zones, expand public transport options, and engage in education and support schemes.

In the field of transport, reducing the volume of private motorised transport is one of the important areas of intervention. To this end, a community planning programme to promote climate-friendly land use, the promotion of behavioural measures in the field of transport, both for cars and lorries, a contracting system with large employers to reduce car use, the testing of zero-emission zones where only electric, hydrogen and biogas cars can be used, and a rethinking of the parking system.

An important objective is to increase the share of public transport and non-motorised transport, partly by supporting access from the agglomeration by public transport through targeted services and by increasing the share of car sharing.

The electrification of cars and motorcycles and the electrification of freight transport is an important challenge, which requires the availability of a support scheme in addition to education.

The decarbonisation of public transport is underway, with Tüke Busz Zrt. decarbonising its entire bus fleet by 2027.

V. Optimizing Logistics

● Objective: Streamline logistics processes to reduce emissions, congestion, and enhance efficiency.

● Purpose: Minimize environmental impact and improve urban traffic flow.

● Strategy: Employ smart pylons, real-time data generation through IoT sensors, and divert traffic from congested areas.

Significant emissions reductions can also be achieved through optimised logistics. Smart pylons, real-time data generation from IoT sensors, network remote control and automation systems: installation of sensors, diverting traffic from Route 6 by relieving congestion in the city centre and Kertváros, and the construction of transfer stations at three locations at the outskirts of the city are key interventions in the area.

VI. Advancements in Waste Management

● Objective: Continue improving waste management practices, employing smart solutions, and focusing on biodegradable waste treatment and energy recovery.

● Purpose: Reduce waste, increase volume of recycling and promote sustainable urban operations.

● Strategy: Implement smart solutions, advance biogas recovery, develop capacities for increased recyclement of paper, metail, plastic and glass waste cycles, and enhance wastewater recovery capacity.

In the waste and wastewater sector, the city has already achieved a number of achievements, which it will continue to take forward, such as the application of smart solutions in waste management and urban operations, the fermentation of high biodegradable fraction separated by mechanical treatment with biogas recovery, pretreatment of high biodegradable fraction, selection of fractions for energy recovery, selection of inert components, waste prevention centre, increasing wastewater recovery capacity in Pécs by installing a solar dryer.

VII. Pioneering Circular Economy Initiatives

● Objective: Lay the foundations for a circular economy, incorporating pilot projects, a circular building materials marketplace, and industrial park conversion.

● Purpose: Foster sustainable practices, resource conservation, and zero-emission industrial processes.

● Strategy: Build the ecosystem by involving the stakeholders, opening up new business opportunities and implementing pilot activties.

The systematic building of the foundations of a circular economy will be initiated in cooperation with urban enterprises, through the implementation of pilot circular construction, the setup of a circular building materials marketplace and the conversion of the Industrial Park to a renewable, zero-emission, circular economy.

VIII. Greening the city - offsetting residual emission by developing green infrastructure

● Objective: develop network of greensurfaces by developing climate resilient parks, green walls, roofs, urban farming gardens, greening parking places and trees along the main roads

● Purpose: Increasing the volume of green surfaces within the city in order to decrease heat effects, increase the quality of life, and save climate resilients parks and green areas for our future.

● Strategy: Identifying the best-fit solutions for different parts of the city: greening rooftops, building walls, parking slots, planting trees along major traffic roads, adapting soil and plants to climate change in exosting parks and utilising abandoned areas by greening them.

Green surfaces have a significant sink capacity that contributes to 79 ktCO2 reduction, the residual emission of the City of Pécs. Developing green areas can contribute to the quality of life, have substantial health benefits and mitigates climate change.

This holistic approach to sustainability underscores Pécs Municipality's commitment to creating a greener, more sustainable, and carbon-neutral urban environment. The "Why" behind these endeavors is a vision of a healthier, more sustainable future, while the "How" involves strategic interventions designed to bring this vision to fruition.

4 Principles and processes

1. Partnership and Shared Responsibility

● Why? Pécs recognizes that the journey to carbon neutrality demands cooperation and collective action from local and national actors across various sectors.

● How? Pécs established the Climate Neutrality Platform, led by the Urban Development Company of Pécs (PVF Zrt) on behalf of the Municipality, fostering cooperation among stakeholders and accelerating the pursuit of net-zero emissions.

Pécs Climate Neutrality Platform was established in September 2022. The transition of the city of Pécs to climate neutrality by 2030 will require radical changes in a number of sectors, including energy, mobility, waste, construction, but also in public procurement, regulation and financing systems. This type of change requires significant cooperation and concerted action, involving local and national actors in different sectors and areas, as well as consumers and residents of Pécs. The local government, in cooperation with local actors, can accelerate the processes and the achievement of the net-zero target.

The Climate Neutrality Platform, including a Steering Group and numerous working groups plays a key role in the development and management of cooperation with the Municipality and local stakeholders, the operation of the Climate Neutrality Platform Forums, the necessary governance and communication tasks, the preparation and subsequent implementation of the Climate Neutral Contract and its annexes. An Expert Group is supporting the work of the Climate Neutrality Platform, the development, biannual monitoring and implementation of the Action Plan and Investment Plan. The City of Pécs implements the Mission's Transition Team model, with dedicated capacities within PVF Zrt and continuous consultation with key local actors in the Steering Committee and working groups.

2. Measurable and Transparent Targets

● Why? Transparency and quantifiable targets are essential to ensure accountability and monitor progress effectively.

● How? Pécs' strategy includes clear emission reduction targets and a robust monitoring and reporting system, enabling continuous progress tracking.

A smart data governance platform is to be developed that integrates all data measuring economic, social and environmental factors, incorporates the emission reduction targets, the goals enabling their implementation, and the financial metrics and investment made to ensure ongoing monitoring, feedback, evaluation, and iterative adoption in order to favour implementation along the set timeline.

3. Continuous Learning and Adaptation

- Why? Pécs acknowledges the importance of adaptation in response to changing circumstances and the need for ongoing education.

- How? The city plans educational programs, awareness campaigns, and collaboration with educational institutions to engage residents in sustainability and climate change awareness.

The city is planning a number of educational programmes, The Eco-City, Eco-Region Foundation is developing a sustainability education programme for 6-18 year old children and youngsters, which will be implemented in every class in every school in Pécs as part of the annual Sustainability Week. Introduction of a sustainability course in general education at the university in cooperation with Pécs University. An educational programme to eradicate energy poverty in cooperation with the Economic and Regional Development Research Institute of the Hungarian Academy of Sciences.

4. Public Communication and Continuous Education

- Why? Engaging the public and fostering awareness are vital to garner support for emission reduction efforts.

- How? Pécs employs public outreach, communication, and targeted campaigns to inform residents about the benefits of reducing emissions and involve them in the climate-neutral journey.

Following the submission of the Climate Neutral Contract, the City of Pécs invites the general public, young people (kindergarten - university), (reaching them through educational institutions), students in cooperation with the Pécs University, and businesses, (reaching them through the Economic Development Department of the Municipality and the Chamber of Commerce). to join the Climate Neutral Pécs programme to support the city as it transitions to Net Zero by taking three simple actions. Whilst actions of awareness might seem inconsequential, if all city residents do them, they will make an enormous impact on Pécs' citywide emission levels.

By adhering to these principles and fostering collaboration, Pécs is not only striving to meet its carbon reduction targets but also laying the foundation for a sustainable and inclusive future. This approach aligns with global climate goals while enhancing the well-being of Pécs' residents and promoting a greener, more sustainable world for all.

Citizen involvement is crucial for the success of urban climate transition initiatives. Engaging residents in the planning, implementation, and monitoring of climate actions not only fosters a sense of ownership but also brings diverse perspectives and innovative ideas to the table. By actively involving citizens in urban climate transition efforts, cities can harness local knowledge, build community resilience, and ensure that climate actions align with the needs and aspirations of their residents, ultimately leading to more successful and sustainable outcomes.

Citizen involvement in Pécs during the planning phase:

As of June 2022, we have involved the population in the following events, around 1700 people:

- City Children's Day
- City Centre Kindergarten "Together as One" integrated talent showcase closing conference
- Landscapes, Ages, Museums
- "We go to the house!" Foosball tournament
- Opening of the new Pécs Market Hall
- Szamárfül Festival

- Pécs Zoo Adoption Day
- Pécs Zoo Halloween
- Kindergarten of the Eastern City District Vasasi
- Learning Festival in the framework of the Unesco Learning City title

Further tool to be adapted during the next phase:

- Community Workshops and Meetings
- Citizen Advisory Groups
- Educational Campaigns
- Citizen Science Programs
- Community-Based Projects
- Youth Engagement
- Feedback Mechanisms

The City of Pécs understands, integrating marginalized groups into urban climate transition initiatives is essential to ensure that climate actions are inclusive and equitable. Marginalized communities often face disproportionate environmental and climate-related challenges, and their perspectives and needs must be prioritized in climate planning. Integrating marginalized groups in urban climate transition requires a commitment to social justice, equity, and inclusivity. By actively involving these communities and addressing their unique needs, Pécs creates climate policies and projects that promote resilience, reduce disparities, and contribute to a more equitable and sustainable urban future.

5. Future Iterations

The City of Pécs understands the commitment and responsibility on its journey towards the net zero target. The Municipality submits its Climate City Contract, Action Plan and Investment Plan to the NetZero Consortium, however understands that it is a moment in time, and iterative process with the involvement of the key stakeholders regarding the planning, implementation, monitoring, evaluation and feedback cycle continues. The City of Pécs monitors its results and achievments semiannually, and comits to a minimum of 2-year review cycle.

5 Signatories

Name of the institution	Sector / Area	Legal form	Person responsible	Position of the person responsible
Municipality of Pécs	Energy, buildings, transport, waste, green spaces	Local government	Attila Péterffy	Mayor
University of Pécs	Energy, buildings, transport, waste	University	Dr. Attila Miseta	Rector
National Renewable Energy Laboratory	Energy, transport	University entity	Attila Felinger	President
PTE Science and Innovation Park	Energy, building stock, waste management, circular economy	University	Dr. József Betlehem	Deputy Rector
Pannon Thermal Power Plant Zrt.	Energy	Private limited company limited by shares	Rudolf Péter	CEO
Pétáv Pécsi Távfűtő Kft.	Energy, buildings stock	Limited Liability Company	János Vida	Managing Director
Biokom Nkft.	Transport, waste, green spaces	Non-profit Limited Liability Company	Barna Meixner	Managing Director
Tettye Forrásház Zrt.	Waste water treatment	Private limited company limited by shares	Tamás Etele Farkas	CEO
Tüke Busz Zrt.	Transport	Private limited company limited by shares	Tibor Skutnik	CEO

Name of the institution	Sector / Area	Legal form	Name of the responsible person	Position of the responsible person
Pécs-Baranya Chamber of Commerce and Industry	Industrial and commercial organisations, circular economy	Chamber	Dr. Tamás Síkfői	President
Diocese of Pécs	Energy systems, buildings	Established church	László Felföldi	County Bishop of Pécs
Mecsekerdő Zrt.	Green areas, absorption capacity	Private limited company limited by shares	István Ripszám	CEO
DDRIÜ South Transdanubian Regional Innovation Agency Nonprofit Kft.	Energy, buildings, transport, waste, green spaces	Non-profit Limited Liability Company	Zoltán Haász	Managing Director
Mecsekérc Zrt.	Energy, circular economy	Private limited company limited by shares	József Csicsák	CEO
Logframe Kft.	Energy, circular economy	Limited Liability Company	György Márton Éva Szilágyi	Managing Director Managing Director
Platán Engineering Kft.	Energy, circular economy	Limited Liability Company	Dr. Ferenc Fedor László Kovács	Managing Director Managing Director
Ipark Pécs Kft.	Industrial and commercial organisations, circular economy	Limited Liability Company	Ádám Beimel	Managing Director

Name of the institution	Sector / Area	Legal form	Name of the responsible person	Position of the responsible person
Körber Hungária Kft.	Industrial and commercial organisations, circular economy	Limited Liability Company	Zalay Buda Balázs László Kósa	Company Manager Company Manager
Honsa Kft.	Industrial and commercial organisations, circular economy	Limited Liability Company	Andreas Koller	Managing Director
Geochem Kft.	Industrial and commercial organisations, circular economy	Limited Liability Company	Dr. Ferenc Fedor	Managing Director
Kontakt-Elektro Kft.	Industrial and commercial organisations, circular economy	Limited Liability Company	Ferenc Hirth Oliver Hirth	Managing Director Managing Director
Green Youth Association	Education, awareness-raising	Association	Júlia Konkoly-Thege Zulejka	President
House of Educators Association	Education, awareness-raising	Association	Csilla Anna Vincze Dr. László Kákai	Executive President President

Name of the institution	Sector / Area	Legal form	Name of the responsible person	Position of the responsible person
Ecocity-Ecoregion Foundation	Education, awareness-raising	Foundation	Rudolf Péter	President
Pécs Green Circle Association	Education, awareness-raising	Association	Norbert Horváth	President
Green Bridge Regional Energy Efficiency and Environment Foundation	Education, awareness-raising	Foundation	Dr. József Rudl	Chairman of the Board of Trustees

NET ZERO CITIES

EU MISSION PLATFORM | CLIMATE NEUTRAL AND SMART CITIES

Climate City Contract

2030 Climate Neutrality Investment Plan

Climate Neutrality Investment Plan of the City Pécs

NetZeroCities has received funding from the H2020 Research and Innovation Programme under the grant agreement n°101036519.

Disclaimer

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Glossary of terms

Acronym	Description
AP	Action Plan
IP	Investment Plan
KPI	Key Performance Indicator
MEL	Monitoring Evaluation & Learning
MRV	Monitoring Reporting Verification
WP	Work Package

1 Part A - Current State of Climate Investment

1.1 Module IP-A1: Existing Climate Action Funding and Financing

A-1.1 Current climate finance

Budget framework of the City of Pécs 2023: The minimum programme of the 2023 budget of the Municipality of Pécs is to maintain the functionality and the level of public services.In 2023, the municipality plans to spend HUF 54.561 billion and receive the same amount of revenue, which is more than ten percent more than last year. Investments will amount to HUF 13.8 billion, almost HUF 10 billion more than in 2022. The city government expects to raise HUF 8 billion from business tax, half a billion more than last year. Rising energy and fuel prices, loan repayments, the double solidarity contribution to the state and inflation-generated wage demands are the marginal conditions for the 2023 budget. To mitigate the effects of the energy price hike, the city expects a state compensation of HUF 5.4 billion. The city has set up a resilience programme with HUF 200 million for residents and HUF 100 million for businesses, an energy renovation programme for condominiums with a target of HUF 150 million, and a significant reduction in the building tax burden for residents from 2023. For residential properties below 50 square metres, the building tax has been abolished, affecting roughly 16,000 properties in Pécs (they used to pay a total of HUF 25 million to the city). For residential properties between 50 and 150 square metres, a "banded building tax reduction proposal" has been introduced, affecting a further 41,000 properties.

The city has set up a separate fund, under which the city will allocate half a billion forints in this year's budget - from a loan from the European Investment Bank - to finance the preparation and project management of domestic and international projects, most of which will hopefully be supported by the European Union.

In addition to EU projects, the city also launches developments from its own resources, depending on its financial possibilities - every year the city has launched separate development programmes in addition to EU developments (fair hall, new green buses, Misina roof renewal), e.g. János Pintér park renovation programme, road renovations, new pump station in Tüskésrét and the relocation of new companies to Pécs and the industrial parks, 12 companies by the end of 2022: international companies, SMEs.

The EIB credit facility was signed in 2014 and the city has used HUF 2.010 billion of the credit line until 2019. The remaining HUF 8.4 billion of the credit line was drawn down in 2021, of which HUF 4.48 billion is in a separate development account. HUF 2.090 billion serves development investments with return, like green bus, industrial park development.

Budgetary capacities of Municipalities

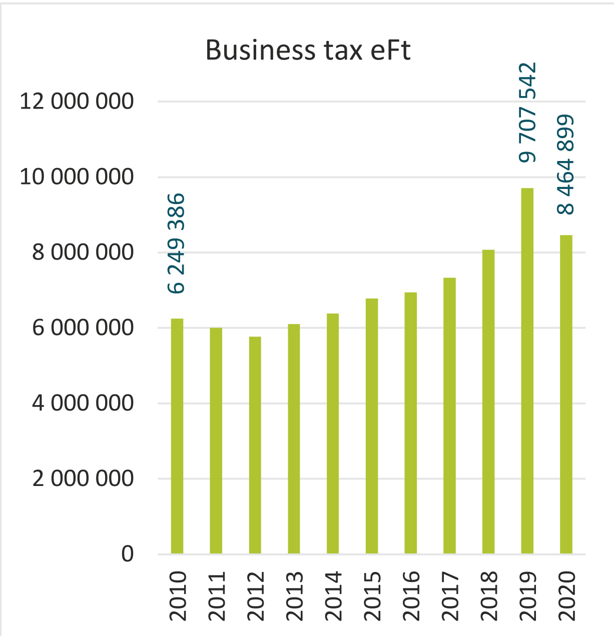
Hungarian municipalities have a low capacity to generate and manage their own revenues. From 2013, local public affairs is be supported by general subsidies depending on the revenue-generating capacity of local governments. The 2013 general consolidation of local governments by the government has led to a stabilisation of their management and financial situation. In general, local governments cover one third of their budget revenues from local tax revenues. Pécs levies local taxes: tourism tax, building tax, land tax and business tax to finance public functions and other economic development and urban policy objectives. From 2022, only 50% of the local business tax remains under municipal competence. Taxes are a burden on the taxpayer, so it is important that residents and businesses are not "overtaxed". The tax capacity of a relatively weaker economy is also proportionately weaker, so a lower tax burden can be a sensitive point, as business rates have repeatedly become a bone of contention on the business side in recent decades.

[1] *Applied EUR HUF conversion rate is 390*

Even after three decades, the weak tax capacity is still the result of the erosion of the economy during the transition period. The peripheral location of Pécs near the border and its delayed location, still without international motorway access to the south, has resulted in a lack of large international capital investment, which has also hindered the development of local SMEs (due to a lack of supplier opportunities).

All of these are also reasons for the repeated need for debt restructuring, as the urban, service and infrastructure sizes built up to support substantially higher GDP production could not be reduced commensurately. The lack of opportunities and eroding competitiveness of wages also caused significant out-migration and compositional deterioration. A high proportion of those who emigrated and moved to agglomerations were either workers with marketable skills or entrepreneurs.

The measures taken by the municipality have increased investor interest, and several significant investments have been made in the last medium term. Employment problems have eased as a result (and partly due to emigration). Today, the role of structural labour shortages is much more significant, which may cause problems in the supply of labour for further investment, so the municipality now needs to focus much more on increasing employability with reserves, and on communication, measures and incentives to retain and train the workforce and to encourage the return of those who have left.



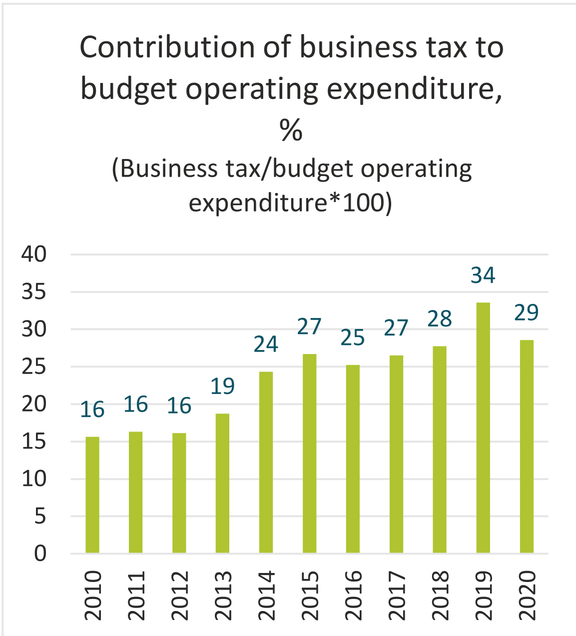
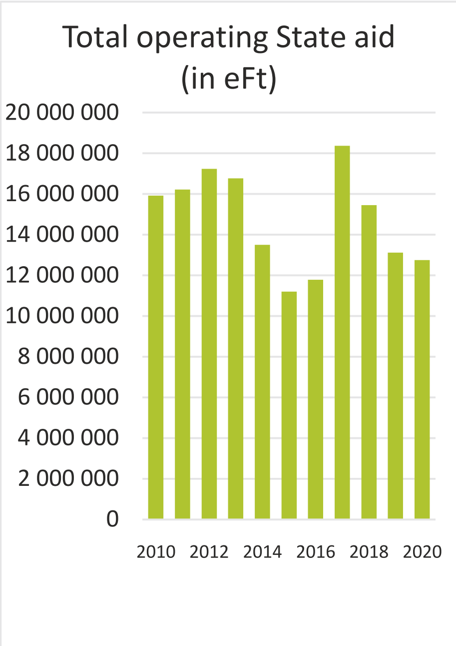


Figure 1: Evolution of business tax revenue and its contribution to the coverage of budget operating expenditure
Source: Pécs Urban Development Concept

Tax revenues generated by new middle-sized investors and the development of older local businesses improve the balance of the budget. Business tax now accounts for about twice as much of the budget's operating expenditure as it did 10 years ago, so the prospects for repayment of the outstanding debt, scheduled for repayment over several years, are considered realistic.

[1] *Applied EUR HUF conversion rate is 390*



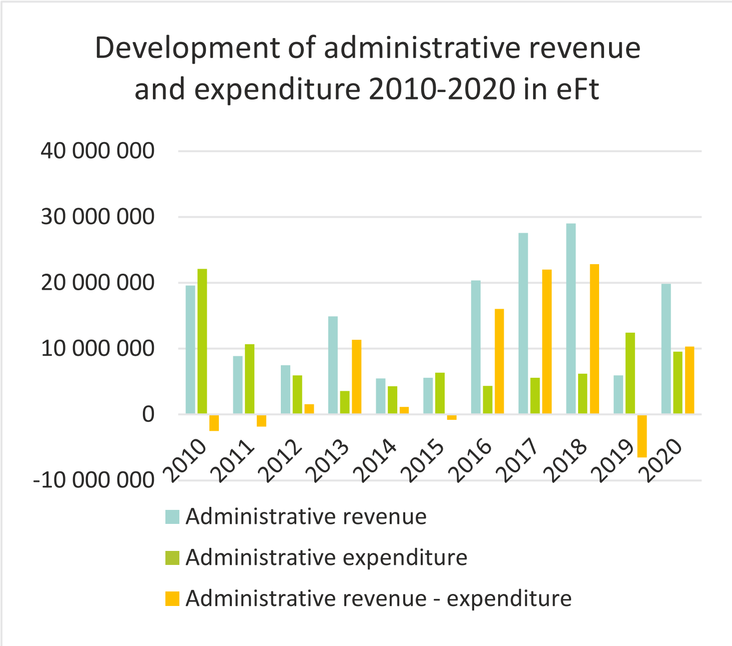


Figure 2: Evolution of operating government grants and of general government revenue, expenditure and balances
Source: Pécs Urban Development Concept

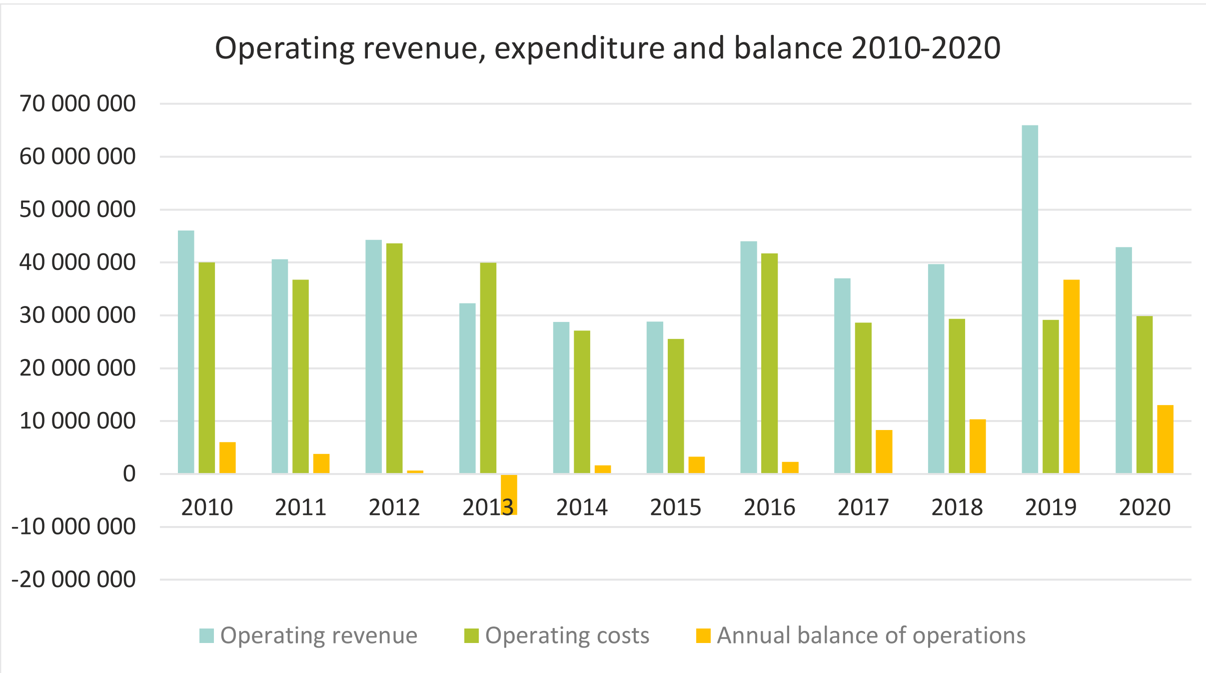


Figure 3: Evolution of operating revenue, expenditure and balances
Source: Pécs Urban Development Concept

In the last three EU funding cycles (2004-2006, 2007-2013 and 2014-2020), the City of Pécs has implemented the following volume via the Operational Programmes. The 311 winning projects have a total value of 81.1 billion, of which the value of the grants awarded is HUF 72.2 billion. (Applied EUR HUF conversion rate is 390)

Széchenyi 2020 funding (2014-2020)

- **KEHOP - Operational Programme for Environment and Energy Efficiency:** 21 winning projects worth HUF 16.3 billion, with a total value of HUF 14.3 billion.
- **TOP - Operational Programme for Spatial and Urban Development:** 46 winning projects with a total value of HUF 13.8 billion, with a total value of HUF 13.8 billion in grants.
- **IKOP - Integrated Transport Operational Programme:** o 1 project won for a total value of HUF 2.1 billion, with a total value of HUF 1.7 billion.

Széchenyi 2020 financial instruments

- **GINOP - Operational Programme for Economic Development and Innovation:** 135 winning projects worth HUF 3.8 billion, with a total value of HUF 5.6 billion.
- **KTIA - Research and Technological Innovation Fund:** 8 winning projects with a total value of HUF 0.04 billion, awarded grants worth HUF 0.07 billion.

Climate neutral investment items in the 2022 municipal budget:

Total for 2022 (HUF)					
Mandatory task	5,097,030,785	**Voluntary task**	728,903,170	**Total**	**5,825,933,955**
Investment	1,584,661,197	**Investment**	592,243,534	**Investment**	**2,176,904,731**
General public services (rental housing, social)	35,662,650	**General public services** (rental housing, social)	69,509,65	**General public services**	**105,172,300**
Economic affairs (local infrastucture)	21,347,518	**Economic affairs** (local infrastucture)	25,587,325	**Economic affairs** (local infrastucture)	**46,934,843**
		Environment	107,330,644	**Environment**	**107,330,644**
Housing and communal facilities	1,527,651,029	**Housing and communal facilities**	15,675,840	**Housing and communal facilities**	**1,543,326,869**
Renovation	1,934,522,384	**Renovation**	93,289,010	**Renovation**	**2,027,811,394**

Fields of Action	Sector Subsection	Current Budget Allocation (bn HUF)	% Current Budget Allocation
Transport	Reduced demand for motorised passenger transport	11.3	14%
	Switch to public transport and non-motorised transport		
	Enhanced car-pooling communities		
	Electrification of passenger cars and motorcycles		
	Optimised logistics		
	Electrification of lorries		
	The electrification of buses		
Building stock	Building renovations	28.8	36%
	New, energy-efficient buildings		
	Efficient lighting and appliances		
	Decarbonising heating production		
Energy system	Decarbonising electricity generation		
Green infrastructure development	Green space development	6	7%
Waste and waste water management	Increased waste recycling, Developments in public utilities	35.8	44%
Total 2004-2020		**81.1**	**100%**

Note: EUR-HUF conversion rate is 390
Table 1: Finance Sources by Field of Actions

1.2 Module IP-A2: Strategic Funding and Financing Evaluation

A-2.1 Strategic funding assessment

In Hungary, climate finance cannot be implemented from the Municipality budget or from Municipal revenues, the resources available here cover mandatory and voluntary local government tasks, which are only partially related to the climate transition. The European Union funds available under the Operational Programmes are the main source of climate investments, which are only a dedicated resource under the TOP Plus, but the other OPs are also well suited for application and investment implementation. Direct Brussels funding supports the implementation of a number of pilot projects, surveys, databases, education and cooperation.

The Horizon Europe programme requires a more complex set of skills and network, and the city has started to do this, mainly through the hydrogen theme, but the CCC process can bring many benefits through the expansion of the network of contacts.

Hungarian municipalities do not have experience with financial instruments, although initiatives have been taken in this respect. The EIB credit facility has also been used in the case of Pécs, firstly in connection with the European Capital of Culture programme, and then in 2014 with a development credit facility. The use of ESCO schemes has been used by Hungarian municipalities mainly for street lighting, while in the case of Pécs the practical application of the instrument will take place during the implementation of the climate portfolio.

The 2014-20 GINOP funds also included financial instruments, under which the Hungarian Development Bank implemented a number of loan, equity, guarantee and combined loan support schemes. The urban development fund referred to in the paper was also made available by the MFB, and was reorganised last year from city to national level. The capital fund invests in green investments by enterprises. However, there is also a Hungarian example of a capital instrument being used for urban investments with municipal ownership. The model can be adapted for Pécs.

Hungarian municipalities are currently not allowed to issue green bonds due to legal limitations, but state green bonds have already been issued, and it is necessary to further discuss the framework within which the financial return of this instrument can be realised.

The Municipality, like all Hungarian municipalities, has important learning tasks to perform in addition to the use of subsidies and financial instruments, for which the implementation of the climate portfolio provides an excellent opportunity.

Under Article 11, Sustainable Urban Development, of the ERDF Regulation, dedicated cities recieve funding and Pécs has been allocated a budget of HUF 23.551 billion for the 2021-27 cycle.

Article 11 of the ERDF Regulation:

(1) In order to address economic, environmental, climate, demographic and social challenges, the ERDF shall support integrated territorial development of urban areas, including functional urban areas, based on territorial or community-led local development strategies (hereinafter referred to as "sustainable urban development"). Particular attention shall be paid to addressing environmental and climate challenges (e.g. the transition to a climate-neutral economy by 2050), to exploiting the potential of digital technologies for innovation and to supporting the development of functional urban areas.

(2) At least 8 % of ERDF resources at Member State level should be devoted to sustainable urban development.

Resource map:

In addition to the TOP Plus, other sources of support available to Pécs under the Operational Programmes Economic Development and Innovation Operational Programme Plus, Infrastructure and Transport Operational Programme Plus, Environment and Energy Efficiency Operational Programme Plus, Croatia - Hungary Border Operational Programme, Recovery and Resilience Instrument

Direct involvement of Brussels funds: Horizon Europe funds, Interreg Central, Danube Programme, Hungarian-Croatian Cross-border Programme, Driving Urban Transiotion, Eurpean Urban Initiative, Life + Programme

Use of innovative financing instruments: the possibility of using innovative financing instruments is being explored by the municipality, which is open in principle, but further analysis is needed to determine which instruments the city can use effectively. These instruments will be taken into account in order to prepare comprehensively, and a decision on their inclusion will be developed in the final business plan by the end of 2024.

Tools to be tested:

- **ESCO funding**
- **PPP construction**
- **Credit facilities:** EIB loan, other loan facilities, green loan, green bond options
- **Capital investment into project finance for both entrepreneurial and urban projects with a return on project content**
- **Establish funds and support schemes from the municipal budget: e.g. investment incentive funds, real estate fund for municipal buy-outs, environmental fund**

In the summer of 2021, the Municipality set up a municipal capital fund in cooperation with MFB Invest Zrt. to provide HUF 3 billion in investment. The capital fund aims to provide capital financing on favourable terms, without sectoral restrictions, to businesses operating in the city and the region. The capital fund was managed by MFB Invest Zrt. and the City of Pécs is represented by Pécs City Development Zrt. The local project office was responsible for providing information to interested parties, reviewing investment proposals, receiving applications from the client, filtering out applications unsuitable for investment and forwarding suitable ones. A national reorganisation of the capital fund has taken place, with capital allocations no longer available at city level but at central level.

Pécs has developed a decarbonisation plan for its bus fleet in cooperation with Tüke Busz Zrt Company.

Between 2013-15, the Company implemented a comprehensive fleet development programme, which resulted in a share of EEV vehicles of over 70% and a significant step towards a zero-emission fleet with the purchase of 18 all-electric buses. Tüke Busz Zrt. aims to convert its entire fleet to electric propulsion by 2027. The investment programme is supported by the government through its Green Bus Programme.

Pécs has developed excellent financing cooperation with the European Investment Bank over the past decade and a half. The Municipality of Pécs and the EIB have signed two loan agreements: one for EUR 39 million to finance the European Capital of Culture programme and another for EUR 30 million to finance projects in the 2014-2020 EU development cycle. It is important to note that the availability of external financial resources, such as own contribution and pre-financing, pre-financing of investment expenditure, will be an important aspect in the implementation of the climate neutral programme.

Table 2: List of income sources for the city

Year	Income category	City income	% of city budget
2019	Building tax	2.882.773.783 HUF	4,33%
	Land tax	562.946.340 HUF	0,85%
	Business tax	9.707.542.094 HUF	14,57%
	Support for self-produced works	10.368.509.863 HUF	15,56%
	Total income	66.638.709.098 HUF	
	Investments	6.670.201.326 HUF	12,75%
	Environmental protection expenditure	1.411.931.956 HUF	2,7%
	Total expenditure	52.314.254.292 HUF	
	TOP	7.179.030 HUF	0,01%
	GINOP	465.882.800 HUF	0,7%
2020	Building tax	2.775.842.768 HUF	3,82%
	Land tax	548.425.434 HUF	0,75%
	Business tax	8.464.899.469 HUF	11,64%
	Support for self-produced works	9.525.003.467 HUF	13,1%
	Total income	72.740.523.175 HUF	
	Investments	7.525.391.515 HUF	15,22%
	Environmental protection expenditure	1.184.523.491 HUF	1,49%
	Total expenditure	49.428.038.074 HUF	
	TOP	606.000.000 HUF	0,83%
	GINOP	1.423.969.990 HUF	1,96%
	KEHOP	364,447,496 HUF	0,5%
2021	Building tax	2.824.211.058 HUF	3,2%
	Land tax	563.499.573 HUF	0,64%
	Business tax	8.556.410.085 HUF	9,7%
	Support for self-produced works	13.924.408.940 HUF	15,78%

Table 2: List of income sources for the city

Year	Income category	City income	% of city budget
2021	Total income	88.245.676.396 HUF	15,78%
	Investments	10.846.552.713 HUF	10,1%
	Environmental protection expenditure	158,028,710 HUF	0,26%
	Total expenditure	59.990.042.591 HUF	
	GINOP	644.630.527 HUF	0,73%
	GINOP Plus	3.511.655.931 HUF	3,98%
2022	Building tax	2.820.224.829 HUF	3,33%
	Land tax	565.799.854 HUF	0,67%
	Business tax	11.360.234.204 HUF	13,43%
	Support for self-produced works	14.838.775.952 HUF	17,54%
	Total income	84.608.185.076 HUF	
	Investments	4,244,866,241 HUF	6,71%
	Environmental protection expenditure	217.565.105 HUF	0,34%
	Total expenditure	63.251.473.878 HUF	
	TOP Plus	80.000.000 HUF	0,1%
	GINOP Plus	6.773.996.608 HUF	8,00%
2023	Building tax	2.500.000.000 HUF	3,13%
	Land tax	600.000.000 HUF	0,75%
	Business tax	8.000.000.000 HUF	10,02%
	Support for self-produced works	14.672.141.868 HUF	18,38%
	Total income	79.843.872.116 HUF	
	Investments	17.216.546.356 HUF	21,56%
	Environmental protection expenditure	278.172.125 HUF	0,35%
	Total expenditure	79.843.872.116 HUF	

Type	Size Range (bn HUF)	Level	Description
TOP Plus	23.551	Public	ERDF Article 11 envelope for Pécs
Other OP sources	20	Public	KEHOP+ and IKOP+ resources based on tender decisions (estimated value)
EIB loan	4.5	Public	Under a loan agreement concluded in 2014
Urban development grants	5	Public	Interreg, DUT, CBC, EUI, LIFE funds based on tender decisions (estimated value)
Horizon Europe	5	Public	Horizon Europe resources based on application decisions (estimated)
Capital fund	5	Private	Projects with return based on the project list
ESCO	10	Private	Projects with return based on the project list

Table 3: List of capital sources for the city

According to the allocation of the Baranya County Integrated Spatial Programme, the resources of Pécs in the Operational Programme for Spatial and Urban Development Plus 2021-27 are broken down by priority:

Total resources (HUF billion)	**Priority 1** (urban development)	**Priority 2** (energy efficiency)	**Priority 3** (human infrastructure development ESF)	**Priority 4** (human infrastructure development ERDF)
23,551	**14,553**	**1,961**	**0,625**	**6,412**

1.3 Module IP-A3: Barriers to Climate Investment

A-3.1 Barriers to climate investment

- **Limited funding and resources:** Insufficient public and private funding may limit the capacity of Pécs to invest in the climate-neutral project portfolio, especially for projects with higher upfront costs. While in the last decade a number of grants, loans and equity schemes were available, partly from EU sources but also from beyond, the development market is currently characterised by a scarcity of resources.

Previously, the Hungarian National Bank's Growth Loan Programme, the Home Warmth home renovation programme, government housing renovation schemes, household solar power schemes, etc. were available. We expect that the size of the funds will also change positively as the macroeconomic environment improves.

- **Lack of awareness and education:** Limited stakeholder knowledge about climate change and its impacts can be a barrier to supporting climate investment and sustainable initiatives. To this end, the project portfolio includes a number of general and specific educational elements for all main funding target groups (institutions, citizens, economic sector)

- **Complicated regulatory environment:** Unclear or complex regulations, permitting processes and bureaucratic hurdles can slow down or complicate the implementation of climate change projects. In addition to the legal constraints outlined in the Action Plan, municipal management and borrowing is limited by a number of legal constraints, and the legal framework for innovative financing solutions is either not yet developed or too restrictive.

- **Institutional capacity:** Pécs also lacks the appropriate capacity to effectively plan, implement and manage climate projects, the necessary technical expertise and human resources. To this end, the city intends to expand the project team supporting the CCC process and the Green Office by at least six people. Capacity constraints among stakeholders are also an obstacle.

- **Short-term focus:** Short policy cycles and a focus on immediate problems can hinder long-term planning and investment in climate projects with longer payback periods.

- **Access to finance:** Limited access to affordable finance, loans, grants and other financial mechanisms may hamper Pécs' ability to finance climate change initiatives.

- **Risk aversion:** Some investors and stakeholders may be reluctant to invest in innovative or unproven climate change projects because of perceived risks.

- **Lack of project bankability:** Proving the financial viability of climate change projects can be difficult, which can lead to difficulties in attracting investors.

- **Infrastructure constraints:** Ageing or inadequate infrastructure can pose challenges for the deployment of new climate-friendly technologies and systems.

- **Resistance to change:** Resistance to adopting new practices and technologies, especially from stakeholders used to traditional approaches, can slow progress.

- **Fragmented ownership and coordination:** Projects often require coordination between different stakeholders, and fragmented ownership can be a barrier to cooperation and joint investment.

- **Socio-economic factors:** Socio-economic inequalities and unequal distribution of resources can make it difficult to implement projects that benefit the whole community.

- **Market maturity:** The immaturity of the market for certain sustainable technologies or services can lead to higher costs and limited opportunities.

- **Lack of data and information:** Insufficient data on local climate risks, vulnerabilities and opportunities can hinder effective planning and investment decisions.

Overcoming these barriers requires a multi-faceted approach involving cooperation between different stakeholders, including local authorities, businesses, civil society and international partners. This includes improving policy frameworks, supporting capacity building, raising public awareness, and leveraging financial mechanisms to make climate investments more attractive and feasible.

Pécs capacities and capabilities

Planning investments for urban climate transition requires a range of capacities and capabilities to ensure that funding is allocated effectively and that climate goals are met. These capacities and capabilities involve a combination of technical, analytical, and organizational skills, as well as a deep understanding of climate science and urban planning. PVF Zrt. is responsible for the coordination of capacities and capabilities on behalf of the Municipality. PVF Zrt. has included capacity either directly or indirectly through experts to the Transition Team. Action Plan provides details on the funcitons within the Transition Team. Key capacities and capabilities Pécs considers as key to ensure in order to perform a high quality of investment plan:

Climate Science and Data Analysis: Understanding of climate change science, including the causes, impacts, and local manifestations of climate change. Ability to analyze climate data and projections to assess vulnerabilities and risks in urban areas.

Technical expertise: Expertise in urban planning, land use, and zoning regulations to integrate climate considerations into city development. Capacity to design climate-resilient and sustainable urban infrastructure and green spaces.

Investment Expertise: Knowledge of financing instruments, experience in negotiation of financing energy systems, including renewable energy technologies and energy efficiency measures, infrastructure, such as transportation, water supply, and waste management systems, capability of designing business plans is a key to design an investment plan.

Economic Analysis: Skills in conducting cost-benefit and cost-effectiveness analyses to evaluate the financial viability of climate projects and investments. Capacity to identify potential funding sources, including grants, public-private partnerships, and innovative financing mechanisms.

Innovation and Adaptability: Willingness to explore innovative financing models, technologies, and best practices in climate transition. Capability to adapt strategies and plans in response to changing climate conditions and evolving knowledge.

Financial Barriers to achieving Climate Neutrality	Typology of Barrier	Description	Sector and stakeholder involved
Municipal own resources minimal, only for compulsory tasks	Funding	Municipal management with own resources significantly limited	All sectors, Municipality of Pécs
Tax revenue only partially retained by local government, no reserves for development	Governance, financing	In addition to the compulsory and voluntary tasks, the Local Authority has the following development margins within its own budget	All sectors, Municipality of Pécs
Scheme used to support schemes	Perspectives, mindset	The use of support schemes is almost exclusive in the implementation of development projects, there is no experience or practice in the use of financial instruments	All sectors, Municipality of Pécs, Public institutions, public services
No practice in innovative financing scheme	Capacity, capability	Innovative financing schemes, such as the energy community model, crowdfunding, have not yet been used in practice	All sectors, Municipality of Pécs, Public institutions, public services
Legal barrier to certain innovative financing mechanisms	Governance, regulatory	There is no established legal framework to allow their regulated use	All sectors, Municipality of Pécs, Public institutions, public services
Legal limit on borrowing, also applies to green bond issuance	Governance, regulatory	Local government borrowing is subject to limits and government approval by law	All sectors, Municipality of Pécs
Funding limit for the establishment of VFAs	Funding	Public funding is required for the seed capital of the capital fund	All sectors, Municipality of Pécs, Public institutions, public services
Lack of capacity and expertise of local governments in financing issues	Capacity, capability	Municipal development investments are typically implemented through grant schemes, so the related expertise and capacity support this	All sectors, Municipality of Pécs, Public institutions, public services
No schemes currently available	Funding	The 2021-27 Operational Programme and RRF funds are not yet available	All sectors, all partners
Small number of loan schemes available	Funding	In the current macroeconomic environment, a large number of previously available schemes have closed, and new ones are expected to open mainly from 2024	All sectors, all partners
Network connection authorisation suspended	Governance, regulatory	Due to a lack of capacity in the electricity grid, grid connection is now limited nationwide	All sectors, all partners
Solar PV capacity can only be implemented in combination with storage capacity	Governance, regulatory	Government regulation also requires the installation of storage capacity for the licensing of small domestic power plants, which is self-financing and with an over 10-year return, making it an unattractive alternative.	All sectors, all partners

Table 4: Barriers to Climate Investment

2 Part B – Investment Pathways towards Climate Neutrality by 2030

2.1 Module IP-B1: Cost Scenarios for Climate Neutrality

B-1.1 Cost scenarios

The preparation of the Climate Neutral Action Plan and Investment Plan is based on modelling, using an urban climate transition economic model developed in collaboration with the University of Madrid under the NetZero Programme. The tool is scientifically based and provides the opportunity to develop a robust climate finance framework for the climate transition of Pécs, taking into account climate science, with emission values and associated costs broken down by target groups (city, population, institutions, university, business, transport, energy and other public services) to show the necessary investment costs and the savings over the time horizon up to 2030. The investment needs identified at the level of the investment measures (see key measures above) provide a continuous feedback loop to harmonise the top-down framework with the corresponding bottom-up projects, to ensure a precise implementation of the programme set out in the Action Plan and Investment Plan. For further reference on the economic model used, see the NetZero Portal group "Capability Building Programme: building a strong economic case" at the following link:

https://netzerocities.app/group-capabilitybuildingprogrammebuildingastrongeconomiccase

The majority of Governance projects are not sectoral, but serve to underpin the overall carbon reduction agenda. They are non-reimbursable projects in themselves and are within the scope of the Municipality, and need to be implemented as a first step during 2023-24 for a total amount of 11.5 MEUR.

On the one hand, this means the operation of the Climate Neutrality Platform, the adaptation of the organisation by extending the competences of the Green Office, the development of the digital platform, the development of modelling and monitoring systems, and the development of municipal packages of measures such as green public procurement, the development of a building renovation passport system, and the establishment of a system of municipal measures for transport and building renovation. This will be complemented by a capacity building budget from the Municipality, mainly for the implementation of the project, and for the staffing of the Green Office, with a minimum of six people, at an annual cost of €225,000.

The social projects are also non-revenue generating projects, which primarily serve communication, information, surveys, education and awareness raising, but also provide projects and applications for the general public to raise awareness and implement carbon reduction, for a total amount of 4.8 MEUR. These are also mainly projects under the responsibility of the Municipality, but other partners are involved in the implementation, such as Biokom, the Eco-City-Ecoregion Association and the Centre for Economic and Regional Research, which contribute to the implementation of social projects.

Total investment costs is 756 MEUR, including costs that directly contribute to the 80% carbon reduction target. In addition, the city has identified several projects that contribute to the achievement of a climate neutral Pécs, but the following is a breakdown of the costs needed to reach the target by municipality/institutional, residential, transport service provider, energy supplier and economic operator.

The municipality is directly responsible for only 9% of the funds, 69 MEUR, which includes the carbon neutralisation of the municipality's real estate and car fleet.

33% of the costs will have to be covered by citizens and institutions, requiring an investment of 251 MEUR. In addition to the citizens, this framework cost also includes public administration and public sector institutions, as well as the University of Pécs.

The transport operator will be responsible for 14% of the costs, 109 MEUR, and the utility companies for 29%, 222 MEUR.

The business sector is expected to provide 14% of the cost, 105 MEUR, mainly from its own resources and through financing mechanisms.

Municipality costs are divided along the following categories:

In order to achieve the carbon reduction target, the renewal of the building stock of the Municipality and its institutions, public service institutions and the University of Pécs is necessary. For many institutions this has already been done, for the remaining volume it is necessary to achieve at least CC level through retrofitting energy efficiency. Assessment of institutional energy consumption and emissions, development of a city centre and university energy community with the involvement of institutional stakeholders. Smart systems, building automation solutions, microgrid solutions are planned. As part of building renovations, we will increase the use of renewable energy by installing rooftop solar panels where possible.

The use of LEDs in building lighting, where this has not yet been done, will also make a significant contribution to increasing efficiency. Around one third of the city's street lighting has already been renewed, the remainder will need to be equipped with an intelligent street lighting system.

The costs include the connection to district heating of institutions located along the district heating network that currently still use natural gas heating, while for the other institutions the adaptation of the heat pump solution is necessary.

In the case of decarbonisation of transport, municipal and institutional costs include increasing the share of public transport and non-motorised transport, smart columns: real-time data generation from IoT sensors, network remote control and automation systems: installation of sensors, bus lanes, cycle lanes, bicycle, e-bike, e-moped sharing systems, P+R, B+R parking and sharing systems at public transport terminus hubs. On the other hand, the electrification of the fleet of municipal and institutional commercial vehicles and commercial vehicles, including the fleet of vehicles for city operations is in scope. In addition to electric, hydrogen cell solutions will be monitored and, if they become a cost-effective solution, their procurement will be pursued.

Residential, institutional costs are divided along the following categories:

90% of the cost of citizens represents the decarbonisation of the building stock. Retrofitting of 35% of the existing stock is needed to achieve the target, including the promotion of smart meters to ensure real-time monitoring of energy consumption, installation of small household power plants, building of residential storage capacity in cooperation with energy utilities, and the development of an energy community in condominiums, application of smart systems, piloting of microgrid and energy storage models, application of LED solution for household lighting, optimisation of large household consumers with smartgrid, microgrid system, related education, awareness raising, substitution of natural gas for heating with heat pump systems, with the use of ground source solution. The retrofitting of 870 prefabricated buildings offers a number of solutions, the replacement of summer hot water in prefabricated buildings with renewable energy using special solar collectors, the retrofitting of mechanical installations to increase individual heat use and efficiency, the installation of renewable energy capacity in a 10-storey prefabricated building to replace cooling, lighting and cooking, and the replacement of cooking gas. For new buildings, if they are located along the district heating network, a district heating solution will be implemented.

In the transport sector, the costs for the citizens are related to car sharing on the one hand, and to the replacement of private cars by electric cars on the other.

The costs of transport operators are divided along the following categories:

In Pécs, bus transport represents the public transport, the replacement of the bus fleet with electric buses has started and will be implemented by 2027 along the decarbonisation plan, the construction of the related charging network represents an additional cost, the development of an intelligent urban energy management and spatial information system - optimisation of the transport system, the electrification of urban transport by the development of infrastructure supporting individual and public environmentally friendly transport. In the context of increasing the share of public transport and non-motorised transport, the costs include the promotion of access from the agglomeration by public transport with targeted services, the use of hydrogen technology for long-distance bus transport. The replacement of freight traffic by electric stock will also affect transport operators, including public transport, long-distance bus services and rail transport.

Utility costs are divided along the following categories:

The decarbonisation costs of energy suppliers and other utilities concern the decarbonisation of heating and electricity. In Pécs, district heating is provided by Pécsi Távhő, while the biomass-based energy required is produced by Pannon Hőerőmű Zrt. Small-scale investments are needed here, replacement of the 5 MW gas boiler of Pétáv on Komlói road, increase of heat production efficiency by loss reduction. For natural gas, the need is to phase out, with heat pump systems currently being considered as an alternative. We will monitor the cost-effective use of this additional option. For non-substitutable natural gas heating volumes, hydrogen investment will be investigated, with the feasibility of hydrogen in heating to be explored in the future as technology develops. The development and applicability of CCSU technology will also be investigated.

Energy utilities is continuously increase the share of renewables in their energy mix, issuing a green guarantee of origin, playing a key role in the construction of the urban utility solar farm by providing grid connection and building storage capacity. Electrolysis capacity will be built in Tüskésrét.

The costs of the economic sector are divided along the following categories:

For economic operators, the costs of decarbonising their buildings and machinery is in focus on the one hand, and decarbonizing their activities on the other. The municipality is working closely with both industrial and commercial operators and expects an energy monitoring and decarbonisation plan to be drawn up. On this basis, energy efficiency renovation of the building stock, smart and microgrid systems, real-time monitoring of energy, and connection of commercial properties along the district heating network to district heating will be carried out. The replacement of lighting systems with LED solutions will also increase energy savings. The renovation of the housing stock will also be supported by the installation of solar energy capacity, and the replacement of natural gas will be facilitated mainly by the use of heat pump systems. In the case of the Western Industrial Park, the introduction of ground source heat pump systems could be an alternative to natural gas heating, and this option is also being explored in the other two urban industrial areas.

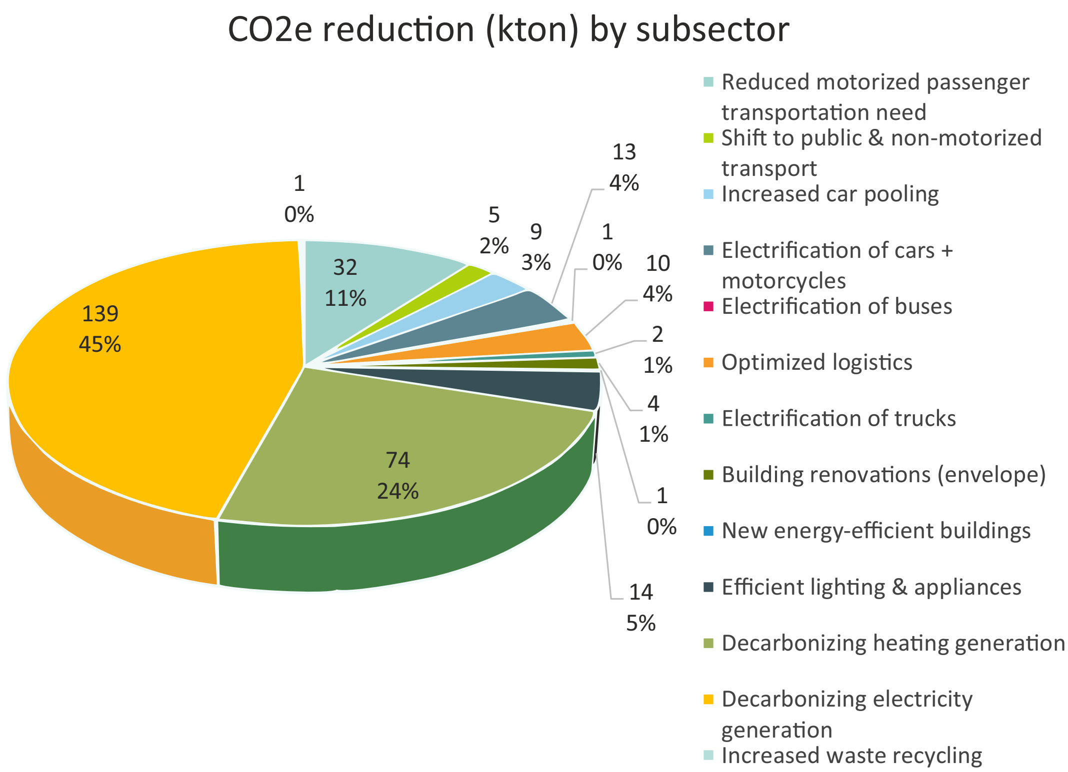
For industrial and commercial operators, the cost of electrification will be higher for the replacement of as many cars and vans as possible, while for heavy goods vehicles the transition will be even slower and require technological development.

For many sub-sectors, the switchover will lead to a reduction in costs, which will ensure that investment costs are reduced or recovered.

Reduced demand for motorised passenger transport, the use of enhanced car sharing schemes and optimised logistics will contribute to significant cost savings (232 MEUR -69 MEUR - 1 MEUR) with a significant emission reduction value.

The shift to public transport and non-motorised transport will result in savings of 36 MEUR at an investment cost of 6 MEUR over the 2020-2030 period, the electrification of cars and motorcycles will result in savings of 37 MEUR at an investment cost of 24 MEUR, the electrification of buses will result, in savings of 10 MEUR at an investment cost of 8 MEUR, while the electrification of trucks will result in savings of 7 MEUR at an investment cost of 119 MEUR.

The retrofitting of the building stock will save 29 MEUR at a cost of 201 MEUR, while decarbonising heating will yield a smaller result of 18 MEUR at an investment of 275 MEUR, showing that the full phase-out of natural gas is not yet feasible. However, efficient (public) lighting and decarbonisation of electricity will generate significant savings and revenues (18 MEUR - 63 MEUR) after initial investment costs (92 MEUR - 27 MEUR).



The above costs are necessary to achieve the 80% emissions reduction, while additional projects in waste management and circular economy are planned to achieve further emissions reductions. Planning investments of 60 MEUR, mainly pilot projects for the implementation of circular construction, circular building materials marketplace, collection and sorting of urban construction and demolition waste and its recovery in the waste treatment plant in Kökényes, recycling of mining waste material, Demolition and material recovery of fly ash in Tüskésrét for cement industry, technology testing, recovery of landfilled mining waste for the production of dust binding and anti-slump material and fertiliser (circular economy), Construction of waste hub development areas. A number of investments in waste management, water management and waste water management will also increase efficiency and energy savings (see AP).

The development of green infrastructure and the use of near-natural solutions will serve to offset the carbon footprint, with a total investment/compensation requirement of 166.69 MEUR (79 kt CO2 offset). Until the completion of the carbon offsetting strategy by the end of 2024, a subsidy of 30 MEUR is foreseen to implement the following projects: green walls, green roofs, expansion and renovation of urban parks with climate resilience, greening of busy roads, green walls, greening of parking lots, conversion of underused land into green spaces, implementation of pilot projects: urban gardens, urban agriculture, composting programmes.

Indirect impact per activity:

- **Indirect positive effects of transport investments and measures:** Improved air quality, reduced noise pollution, positive health effects

- **Improved air quality:** The shift to cleaner transport options, such as electric vehicles o hydrogen fuel cell vehicles, will reduce emissions of pollutants such as nitrogen oxides and particulate matter, resulting in better air quality and fewer respiratory illnesses.

- **Health benefits:** Cleaner air and reduced pollution levels lead to improved public health through reduced incidence of respiratory diseases, cardiovascular diseases and other health problems associated with poor air quality.

- **Noise reduction:** Electric vehicles and other low-carbon transport options are quieter than conventional internal combustion engine vehicles, leading to reduced noise pollution in urban areas.

- **Energy independence:** The transition to electric vehicles or the use of renewable fuels in transport reduces dependence on imported fossil fuels, increasing energy security and resilience.

- **Positive effects of building decarbonisation:** Increase in the number of skilled jobs and employment rate, Increased social justice, Improved social cohesion, Better functioning of democratic institutions.

- **Improved indoor air quality:** Many building decarbonisation strategies involve upgrading insulation, ventilation and heating/cooling systems. This can lead to improved indoor air quality by reducing pollutants and providing adequate ventilation, with positive effects on occupant health and comfort.

- **Health and well-being:** Upgrading building systems and materials can lead to a healthier indoor environment by reducing exposure to toxins, allergens and pollutants. Pleasant indoor temperatures and adequate ventilation can also contribute to improved mental and physical well being.

- **Job creation:** The transition to energy efficient technologies and renewable energy sources can create new jobs in sectors such as construction, manufacturing, renewable energy installation and retrofitting of buildings.

- **Economic growth:** Investments in decarbonising buildings can stimulate economic growth by creating demand for energy efficient products and services. Local businesses and industries related to construction, technology and clean energy can benefit.

- **Reduced urban heat island effect:** Energy-efficient buildings with better insulation and cooling strategies can contribute to reducing the urban heat island effect, where cities have higher temperatures due to excessive heat absorption and inadequate green spaces.

- **Resilience to energy price fluctuations:** Since energy costs can be a significant part of the running costs of buildings, reducing dependence on fossil fuels can protect building owners and occupants from the effects of fluctuating energy prices.

- **Increasing property values:** Energy efficient and environmentally friendly buildings are often more attractive to buyers and tenants. This can lead to an increase in property values and a reduction in vacancy rates.

C1 MANAGEMENT PROJECTS		MEUR
Operation of the Pécs Climate Platform	Municipality of Pécs	0.8
ClimGovCities	Municipality of Pécs	0.26
Green Office service package	Municipality of Pécs	0.53
Green public procurement	Municipality of Pécs	0.05
Green budget	Municipality of Pécs	0.05
Building the digital infrastructure: infrastructure, data connectivity, data sharing and data security standards	Municipality of Pécs	1
Setting up an urban carbon modelling and monitoring system	Municipality of Pécs	1
Municipal measures to reduce emissions from building	Municipality of Pécs	0.13
Development of an intelligent urban energy management and spatial information system - Optimising the use of public transport	Municipality of Pécs	1.3
Measures to reduce car traffic	Municipality of Pécs	0.8
Municipal measures in the field of transport	Municipality of Pécs	0.13
	Municipality of Pécs	0.37
Climate Partnership, a long-term, active collaboration between the business community and City Authority in the City of Pécs to reduce its carbon footprint	Municipality of Pécs	0.53
Collaboration with the public sector - system of Climate Ambassadors	Municipality of Pécs	0.8
Climate Forum for Citizens - System of green gratitude	Municipality of Pécs	0.8
System of city wide building renovation passports	Municipality of Pécs	2.6
Total Governance projects		**11.15**
Carbon Fund	**Municipality of Pécs**	**13**

Breakdown of costs for governance and social measures

C2 SOCIAL INNOVATION PROJECTS		MEUR
Communication campaign with activities	Municipality of Pécs	0.53
Lifestyle advice on the impact of different lifestyle habits on our carbon footprint and our health and happiness (e.g. beef consumption, vegetarianism, coffee consumption, buying food or other products from other continents, etc...) Information campaigns	Municipality of Pécs	0.13
Developing a home mental health system and linking it to the home medical system, which will reduce psychosomatic illness, reduce overconsumption, improve overall happiness levels, reduce the burden on the health system (and thus GHG emissions), and reduce traffic congestion.	Municipality of Pécs	1.3
Study for the development of a climate balance application. A mobile application that measures the daily climate impact of residents' mobile phones and sends daily automatic recommendations for further reduction.	Municipality of Pécs	0.53
Developing a sustainability education programme for 3-6 and 6-18 and 18-23 year olds	Eco-town, Eco-region Association, Green Bridge Association, University of Pécs	0.26
Promoting behavioural measures in transport, both for cars and lorries	Biokom Nkft	0.13
Learning-design-implementation programme for the development of energy communities.	Municipality of Pécs	0.05
Action for energy efficiency with a residential test group	Municipality of Pécs	0.05
Contract scheme with large employers to reduce car use	Municipality of Pécs	0.13
Education programme to end energy poverty	MTA KRTK	0.26
Community planning programme to promote climate-friendly land use	Municipality of Pécs	0.13
Information campaigns, events on technological and technical knowledge in the field of energy efficiency and climate transition (e.g. on rooftop solar installations, storage capacity, heat pump systems)	Municipality of Pécs	0.26
Survey of consumer habits through a communication campaign (building use, large consumer equipment, consumer behaviour, land use, individual transport components)	Municipality of Pécs	0.53
Social habits, conduct a behavioural survey	Municipality of Pécs	0.53
Total Social projects		**4.82**

Table 5: Sectorial Costing

B-1.1b: Breakdown of sectoral costs (local government,City, citizens, institutions, business sector, transport providers, utility companies)						
Sector	**Subsector**	**Investment (CAPEX) (MEUR - cash basis 2020-2030)**	**Operational cost/savings (OPEX) (MEUR - cash basis 2020-2030)**	**Total CAPEX + OPEX (MEUR - cash basis 2020-2030)**	**CO2e reduction (kton)**	**Indirect impacts (indicative indicators) Cost reduction as a result of indirect positive effects[1]**
Transport	Reduced demand for motorised passenger transport	€ -	€ 232	€ 232	32	€ 0
	Switch to public transport and non-motorised transport	€ (6)	€ 36	€ 30	5	€ (6)
	Enhanced car-pooling communities	€ -	€ 69	€ 69	9	€ 0
	Electrification of passenger cars and motorcycles	€ (24)	€ 37	€ 14	13	€ (24)
	The electrification of buses	€ (8)	€ 10	€ 2	1	€ (8)
	Optimised logistics	€ -	€ 1	€ 1	10	€ 0
	Electrification of lorries	€ (119)	€ 7	€ (112)	2	€ (119)
Bulding and heating	Building renovations	€ (201)	€ 29	€ (173)	4	€ (201)
	New, energy-efficient buildings	€ (4)	€ 7	€ 3	1	€ (4)
	Efficient lighting and appliances	€ (92)	€ 18	€ (74)	14	€ (92)
	Decarbonising heating production	€ (275)	€ 18	€ (257)	74	€ (275)
Electricity	Decarbonising electricity generation	€ (27)	€ 63	€ 33	139	€ (27)
Waste	Increased waste recycling	€ 0	€ 0	€ 0	1	€ 0
TOTAL		**€ (756)**	**€ 527**	**€ (229)**	**306**	**€ (756)**

[1]Factors underpinning cost reduction:
Transport sector: improved air quality, reduced noise pollution, positive health impacts
Building sector: increased social justice, improved social cohesion, improved quality of life

Details of the municipal share of the above costs:

Direct municipal costs include renovation of the building stock, decarbonisation of heating and electricity, decarbonisation of street lighting and replacement of the vehicle fleet with electric vehicles.

B-1.1a: Local government expenditure				
Sector	**Subsector**	**Investment (CAPEX) (MEUR - cash basis 2020-2030)**	**Operational cost/savings (OPEX) (MEUR - cash basis 2020-2030)**	**Total CAPEX + OPEX (MEUR - cash basis 2020-2030)**
Transport	Reduced demand for motorised passenger transport	€ -	€ -	€ -
	Switch to public transport and non-motorised transport	€ (0)	€ -	€ (0)
	Enhanced car-pooling communities	€ -	€ -	€ -
	Electrification of passenger cars and motorcycles	€ (0)	€ -	€ (0)
	The electrification of buses	€ -	€ -	€ -
	Optimised logistics	€ -	€ -	€ -
	Electrification of lorries	€ (3)	€ -	€ (3)
Bulding and heating	Building renovations	€ (10)	€ 1	€ (9)
	New, energy-efficient buildings	€ (0)	€ 0	€ (0)
	Efficient lighting and appliances	€ (5)	€ 1	€ (4)
	Decarbonising heating production	€ (51)	€ 4	€ (46)
Electricity	Decarbonising electricity generation	€ (0)	€ 0	€ 0
Waste	Increased waste recycling	€ 0	€ 0	€ 0
TOTAL		**€ (69)**	**€ 8**	**€ (61)**

Additional spending that is not directly necessary to meet the 81% CO_2 reduction commitment, but will contribute to it:

- **Green infrastructure - Compensation of 19% residual value**
- **Waste management, circular economy - plus contribution to decarbonisation**

Sector	Investment (CAPEX) (MEUR - cash basis 2020-2030)	Operational cost/savings (OPEX) (MEUR - cash basis 2020-2030)	Total CAPEX + OPEX (MEUR - cash basis 2020-2030)	CO2e reduction (kton)	Indirect impacts (indicative indicators)
Green infrastructure and nature-based solutions	€ (30)	€ 0	€ 30	79	*Improved quality of life, improved health*
Waste and circular economy	€ (60)	€ 20	€ 40	*n.d.*	*Improved quality of life, improved health*
Sector-independent costs	Governance and social projects			15.97 MEUR	

Additional sector costs

Compensation of residual emissions

	Residual emission offsets (ktn Co2)	
	(Absolute value)	(% of BAU 2030)
Transport	34	32%
Buildings and heating	11	10%
Electricity	25	15%
Waste	5	83%
Other	5	20%
TOTAL	**79**	**20%**

Breakdown of residual emissions by sectors

	Cost ratio	Proportiona value of residual emissions (kt Co2)	Proportional afforestation for average 8-12 year old trees, pcs	Proportional afforestation when planting saplings, pcs	Proportional afforestation for average 8-12 year old trees (ha)	Afforestation in proportion to the planting of saplings (ha)	Proportional compensatio n cost (MEUR)
Citizens, institutions	33%	27	367,569	1,001,749	717	1960	56
Businesses	14%	11	153,611	418,641	300	819	23
City	9%	7	98,750	269,127	193	527	15
Transport service providers	14%	11	153,611	418,641	300	819	23
Utility providers	29%	23	318,194	867,186	621	1697	48
TOTAL	**100%**	**79**	**1,097,222**	**2,990,296**	**2141**	**5852**	**166.69**

Offsetting of residual emissions

The average cost per 1 kt of emission reduction is 2.11 MEUR, which for a 79 kt CO2 offset represents a cost of 166.69 MEUR.

Pécs is a part of the Mecsek Hills, and forest covers 38.8% of the total area of 162.77 km2, that is 63.09 km2. This forest area has a sink capacity of 57 ktCO2e/year, which already today contributes to compensating the emissions in the administrative area of the city of Pécs. Out of the total forest area, 938 ha of forest and green areas registered as public land owned by the city as park forest and urban green area.

79 ktonnes of emissions can be offset by 1.1 million trees of 8-12 years of age on average, which would mean planting 2 million trees for 4-5 year old trees and 3 million trees for seedlings. The area required ranges from 2140 ha to 5800 ha depending on the age and type of trees.

The average carbon sequestration capacity of a 1 hectare (ha) park can vary greatly depending on a number of factors, including vegetation type, climate conditions and management practices. Parameters for calculating the sink capacity are: vegetation types, species diversity, climate, soil quality, management practices, vegetation age. To determine the specific carbon sequestration capacity of a given 1-hectare park, a detailed assessment is needed that takes into account the above factors. This assessment will include field measurements and data analysis. By the end of 2024, a detailed compensation strategy will be developed taking into account the above aspects.

2.2 Module IP-B2: Capital planning for climate neutrality

The table below shows, by sector/subsector/project, whether the project is profitable, profitable in the long term or not profitable, and the related capital investment required to implement the intervention/investment:

<table>
<tr><th>Intervention</th><th>Responsible</th><th>Form and source of capital</th></tr>
<tr><th colspan="3">General, non-sector-dependent governance and social projects</th></tr>
<tr><td>Operation of the Pécs Climate Platform</td><td rowspan="12">Municipality of Pécs</td><td rowspan="15">Non-reimbursable, feasible with grants.

Possible sources:
Interreg Central,
Danube Programme,
Hungarian-Croatian Cross-border Programme</td></tr>
<tr><td>ClimGovCities</td></tr>
<tr><td>Green Office service package</td></tr>
<tr><td>Green public procurement</td></tr>
<tr><td>Green budget</td></tr>
<tr><td>Building the digital infrastructure: infrastructure, data connectivity, data sharing and data security standards</td></tr>
<tr><td>Setting up an urban carbon modelling and monitoring system</td></tr>
<tr><td>Climate Forum for Citizens - System of green gratitude</td></tr>
<tr><td>Communication campaign with activities</td></tr>
<tr><td>Lifestyle advice on the impact of different lifestyle habits on our carbon footprint and our health and happiness (e.g. beef consumption, vegetarianism, coffee consumption, buying food or other products from other continents, etc...). Information campaigns.</td></tr>
<tr><td>Developing a home mental health system and linking it to the home medical system, which will reduce psychosomatic illness, reduce overconsumption, improve overall happiness levels, reduce the burden on the health system (and thus GHG emissions), and reduce traffic congestion.</td></tr>
<tr><td>Study for the development of a climate balance application. A mobile application that measures the daily climate impact of the residents' mobile phone and sends daily automatic recommendations for further reduction.</td></tr>
<tr><td>Developing a sustainability education programme for 3-6, 6-18, 18-23 year olds</td><td>Ökováros, Ökorégió Foundation, Green Bridge Foundation, University of Pécs</td></tr>
<tr><td>Survey of consumer habits through a communication campaign (building use, large consumer equipment, consumer behaviour, land use, individual transport components)</td><td rowspan="2">Municipality of Pécs</td></tr>
<tr><td>Social habits, conduct behavioural surveys</td></tr>
</table>

Intervention	Responsible	Form and source of capital
Building stock, heating Fossil fuel phase-out Building renovation Governance and Social projects		
Municipal measures to reduce emissions from buildings	Municipality of Pécs	Non-reimbursable, feasible with grants. **Possible sources:** Own source
Cooperation with institutional actors - climate web system		
Introduction of a building renovation passport scheme	Municipality of Pécs	Non-reimbursable, feasible with grants. **Possible sources:** Interreg Central, Danube Programme, Hungarian-Croatian Cross-border Programme
Information campaigns, events on technological and technical knowledge in the field of energy efficiency and climate transition (e.g. on rooftop solar installations, storage capacity, heat pump systems)		
Learning design-implementation programme for the development of energy communities		
Action for energy efficiency with a residential test group		
Education programme to end energy poverty	MTA KRTK (Economic and Regional Development Research Center of the Hungarian Academy of Sciences)	
Institutional energy consumption and emissions survey	Institutions, Municipality Green Office	Non-reimbursable, feasible with grants. **Possible sources:** TOP Plus Interreg Central, Danube Programme, Hungarian-Croatian Cross-border Programme

Intervention	Responsible	Form and source of capital
Investment project		
Energy utilities developments: network extension, storage capacity, energy community implementation capacity, utility network upgrades, special control transformers on pilot basis	Energy utilities	Investment with return, Energy utilities, own resources
Promoting smart meters, developing a digital platform, ensuring real-time traceability of energy consumption	Utility companies, Municipality Green Office, Homeowners	**Grant scheme:** DIMOP, Energy utilities, RRF
Developing a downtown energy community with institutional actors	Institutions, Homeowners	Investment with return, start-up support needed for micro-grid deployment, RRF resource. **Own resources:** Energy utilities, green loan with savings-based repayment
University of Pécs Decarbonisation of Building Energy	University of Pécs	Grant scheme
PTE Energy Community Project	University of Pécs	Investment with return, start-up support needed for micro-grid deployment, RRF resource **Own resources:** Energy utilities, green loan with savings-based repayment
Complex energy development project in Pécsbánya-Karolina		
The LEGOFIT project aims at designing, implementing and validating an adaptable and dynamic integrative approach to achieve energy performance in multi-family residential buildings.	Housing cooperative	Non-reimbursable, feasible with grants. **Possible sources:** Horizon Europe
Energy efficiency solutions using smart systems	Municipality of Pécs, Homeowners, Housing cooperatives, energy utilities	Investment with return in the long term, with blended finance, but requires support in the piloting phase. **Possible sources**: Interreg Central, Danube Programme, Hungarian-Croatian Cross-border Programme, Driving Urban Transition, Environment and Energy Operational Programme
Piloting local energy supply models - microgrid		
Piloting local energy supply models - energy storage		
Retrofitting 35% of existing buildings	Municipality Green Office, Institutions, Homeowners	Homeowners sources, banking coordinated loan facility, repayment from savings. Guarantee support
Residential purchase of energy efficient appliances (washing machine, TV, refrigerator), air conditioners, heating systems (new fossil boilers cannot be sold from 2025)		Investment with return: bill-based financing provided by utility providers

<table>
<tr><th>Intervention</th><th>Responsible</th><th>Form and source of capital</th></tr>
<tr><td colspan="3">Investment project</td></tr>
<tr><td>Replacement of summer hot water in multi-storey buildings with renewable hot water from special solar collectors outside district heating nework</td><td>PÉTÁV Pécsi Távfűtő Kft., Homeowners</td><td rowspan="2">In cooperation with housing associations and the Municipal Green Office, a bank loan scheme to ensure repayment from the return on investment, condominium / residential co-financing</td></tr>
<tr><td>Decarbonisation of a prefabricated building pilot project: installation of renewable energy sources to replace cooling, lighting and cooking in a 10-storey prefabricated building</td><td>Municipality Green Office, Homeowners</td></tr>
<tr><td>Mechanical retrofitting of prefabricated buildings for individual heat use and efficiency</td><td>Pétáv, Homeowners</td><td>Non-return investment, but savings in homeowners' bills, so can be achieved through blended finance: RRF grant, with a household contribution</td></tr>
<tr><td>Cooking gas substitution</td><td rowspan="3">Municipality Green Office, Homeowners, energy utilities</td><td>Non-return investment, subsidy scheme required with household contribution</td></tr>
<tr><td>For families on social assistance, a support programme for energy security to replace fossil fuels</td><td>Grant scheme, possible funding source: RRF</td></tr>
<tr><td>Model energy support programme for disadvantaged families in partnership with energy utilities</td><td>Energy utilities source</td></tr>
<tr><td>Wood-fired housing conversion programme - study</td><td>MTA KRTK (Economic and Regional Development Research Center of the Hungarian Academy of Sciences)</td><td>Grant scheme:
Possible funding:
Interreg Central, Danube Programme, Hungarian-Croatian Cross-border Programme</td></tr>
</table>

<table>
<tr><th>Intervention</th><th>Responsible</th><th>Form and source of capital</th></tr>
<tr><td colspan="3">New energy efficient buildings</td></tr>
<tr><td>New build properties along district heating networks</td><td>Pétáv, homeowners</td><td>Own resources,
bank green loan</td></tr>
<tr><td>Setting minimum requirements for new build properties, providing information</td><td rowspan="2">Municipality Green Office,
Homeowners</td><td rowspan="2">Non-reimbursable, feasible with grants.

Possible sources:
Interreg Central,
Danube Programme,
Hungarian-Croatian Cross-border Programme</td></tr>
<tr><td>Decarbonisation of new buildings, passive and active house options - education, awareness raising</td></tr>
</table>

<table>
<tr><th>Intervention</th><th>Responsible</th><th>Form and source of capital</th></tr>
<tr><td colspan="3">Energy efficient lighting, and devices</td></tr>
<tr><td>Developing intelligent street lighting</td><td>Local government</td><td>ESCO scheme, on a competitive basis</td></tr>
<tr><td>LED burning program</td><td rowspan="2">Energy utilities,
Municipality Green Office,
Homeowners</td><td>Invoice-based financing
Possibility of support from Energy utilities or a manufacturing company</td></tr>
<tr><td>Optimisation of large household consumers with smartgrid, microgrid systems, related education, awareness raising</td><td>Invoice-based financing</td></tr>
</table>

Intervention	Responsible	Form and source of capital
Decarbonisation of heating		
Pétáv development: replacement of a 5 MW gas boiler	PÉTÁV Pécsi Távfűtő Kft	PÉTÁV own resources
Increasing heat production efficiency by reducing losses		
Connection of institutional actors to district heating	PÉTÁV Pécsi Távfűtő Kft, Municipality of Pécs	Grant scheme, TOP Plus, RRF
Cleantech project : energy production and storage with deep thermal storage - preparatory R&D project	PTE TTK, AFK	Non-reimbursable, grant-funded research projects that can be adapted later as carbon reduction technologies. **Possible sources:** Horizon Europe
Cleantech project : Conversion of hydrocarbon wells into geothermal wells		
Cleantech project: Exploration of the Pécs area for geothermal energy		
Cleantech project: Secondary raw material exploration, extraction and exploitation with a strong geological background		
Cleantech project: Comprehensive development of the university knowledge base and competences for geological projects requiring a significant technical and specialist base		Bank-coordinated scheme with savings-based repayment, RRF additional support Underfloor heating system is cost-effective, also cost-effective due to above-average gas consumption costs, if a convector system has to be converted, only cost-effective in the long term, blended financing is required
Piloting a soil probe heat pump system	Municipality of Pécs, Mecsekérc Zrt.	Long-term payback, blended finance is necessary Bank-coordinated scheme with savings-based repayment, RRF additional support

Intervention	Responsible	Form and source of capital
Decarbonisation of electricity		
Building solar park capacity	Municipality of Pécs	Municipal land insurance, in return for an operating contract Competitive contractor development, energy utilities feed-in. Entrepreneurial financing can be green bond or bank loan based
Construction of urban energy storage capacity in cooperation with energy utilities	Municipality of Pécs, energy utilities	Energy utilities own resources
Building electrolysis capacity in Tüskésrét	PTE, MVM, Kontakt-Elektro Kft.	Horizon Europe source
Building a hydrogen ecosystem	PTE with MVM involvement	Non-reimbursable, feasible with grants. **Possible sources:** Interreg Central, Danube Programme, Hungarian-Croatian Cross-border Programme, Horizon Europe
Preparing inter-regional innovation investments for the Central European Green Hydrogen Value Chain by developing a stakeholder participation scheme and setting up an IoT framework	Municipality of Pécs	Non-reimbursable, feasible with grants. **Possible sources:** Interregional Innovation Instrument
Building solar energy capacity for city operations	Institutions	Investment with return: green bond, urban development fund, bank loan scheme KEHOP plus support combined with a loan ESCO scheme also applicable
Building institutional solar capacity		KEHOP plus support combined with a loan, in the case of municipalities
		TOP Plus support combined with a loan
Building solar energy capacity for industrial and commercial units	Businesses	**Investment with return:** own resources, green bond, urban development fund, bank loan scheme
Solar farm capacity building - with individual capacity expansion (small household power plants)	Homeowners	**Investment with return:** own, bank green loan, RRF blended facility. State aid schemes are occasionally available
Building residential storage capacity in partnership with energy utilities	Municipality Green Office, energy utilities, Homeowners	From energy utilities on a rental basis

<table>
<tr><th>Intervention</th><th>Responsible</th><th>Form and source of capital</th></tr>
<tr><td colspan="3">Transport
Reducing the volume of private motorised transport
Governance and social projects</td></tr>
<tr><td>Community planning programme to promote climate-friendly land use</td><td>Municipality of Pécs</td><td rowspan="5">Non-reimbursable, feasible with grants

Possible sources:
TOP Plus, Interreg Central, Danube Programme, Hungarian-Croatian Cross-border Programme, European Urban Initiative</td></tr>
<tr><td>Promoting behavioural measures in transport, both for cars and lorries</td><td>Biokom Nkft</td></tr>
<tr><td>Contract scheme with large employers to reduce car usensport</td><td rowspan="5">Municipality of Pécs</td></tr>
<tr><td>Development of an intelligent urban energy management and spatial information system - Optimising the use of public transport</td></tr>
<tr><td>Measures to reduce car traffic</td></tr>
<tr><td>Municipal measures in the field of transport</td><td>Non-reimbursable, feasible with grants.

Possible sources:
Own source</td></tr>
<tr><td>GreenInCities</td><td>Non-reimbursable, feasible with grants.

Possible sources:
Horizon Europe</td></tr>
</table>

<table>
<tr><th>Intervention</th><th>Responsible</th><th>Form and source of capital</th></tr>
<tr><td colspan="3">Investment projects</td></tr>
<tr><td>Zero emission zones to be tested, where only electric, hydrogen and biogas cars can be driven</td><td rowspan="3">Municipality of Pécs</td><td>Non-reimbursable, feasible with grants.
Possible sources:
Interreg Central, Danube Programme, Hungarian-Croatian Cross-border Programme, European Urban Initiative, Driving Urban Transition</td></tr>
<tr><td>Rethinking the parking system</td><td>Non-reimbursable, feasible with grants.

Possible sources:
Interreg Central, Danube Programme, Hungarian-Croatian Cross-border Programme</td></tr>
<tr><td>Design of parking houses</td><td>Investment with return:
bank green loan, green bond, urban development fund</td></tr>
</table>

Intervention	Responsible	Form and source of capital
Increasing the share of public transport and non-motorised transport		
E-bike, scooter, moped project	Biokom NKft, Businesses	**Grant scheme:** TOP Plus, Entrepreneurial source, operation with large employers on the basis of a rental contract
Supporting access from the conurbation by public transport with targeted services	Tüke Busz Zrt.	**Grant scheme:** Transport and Infrastructure Operational Programme Plus
Separate bus lanes on main transport routes	Municipality of Pécs	Non-reimbursable, feasible with grants **Possible sources:** TOP Plus
The use of hydrogen technology in long-distance bus transport	Volán Zrt., Kontakt-Elektro Kft.	**Grant scheme:** Environment and Energy Operational Programme
Increasing the share of shared vehicle use	Biokom NKft, Businesses	Non-reimbursable, feasible with grants **Possible sources:** Interreg Central, Danube Programme, Hungarian-Croatian Cross-border Programme, Transport and Infrastructure Operational Programme Plus On the basis of a municipal contract with large employers, as part of the wage

Intervention	Responsible	Form and source of capital
Conversion of cars and engines to electric		
Provision of electric charging infrastructure for cars	Municipality of Pécs, Biokom NKft	Transport and Infrastructure Operational Programme Plus
Awareness raising and information transfer on electric cars		Grant scheme needed, non-reimbursabel measure **Possible sources:** Interreg Central, Danube Programme, Hungarian-Croatian Cross-border Programme Manufacturer representatives, e-transport umbrella organisations may be involved
Electric car fleet support programmes	Citizens	Government support programme - available periodically, expected until 2030, financing schemes offered by manufacturers Bank green loans Residential co-payment

Intervention	Responsible	Form and source of capital
Decarbonising public transport		
Replacement of the diesel bus fleet of Tüke Busz Zrt. with electric buses in line with the decarbonisation plan	Tüke Busz Zrt.	**Grant scheme:** Transport and Infrastructure Operational Programme Plus
Construction of a charging network to operate the electric bus fleet of Tüke Busz Zrt.		
Development of an intelligent urban energy management and spatial information system - Optimising the use of public transport		
Electrification of metropolitan transport through the development of infrastructure to support environmentally friendly private and public transport	Biokom Nkft	

Intervention	Responsible	Form and source of capital
Optimised logistics		
Smart columns: generating real-time data from IoT sensors, network remote control and automation systems: deploying sensors	Municipality of Pécs	Non-reimbursable, feasible with grants. **Possible sources:** Digital Renewal Operational Programme, Life, Environment and Energy Operational Programme
Reducing congestion in urban transport through traffic management tools	Biokom Nkft	Non-reimbursable, feasible with grants. **Possible sources:** Interreg Central, Danube Programme, Hungarian-Croatian Cross-border Programme Road/ Congestion Charges in transport
Diverting traffic from Route 6 by relieving congestion in the city centre and Kertváros	Municipality of Pécs	
Construction of interchange stations at 3 sites	Municipality of Pécs, economic operators	**Investment with return:** green bond, urban development fund, green loan scheme, EIB loan scheme

Intervention	Responsible	Form and source of capital
Electrification of freight transport		
Electrification of the conventional vehicle fleet of the public service system in Pécs	Biokom Nkft	Long-term, blended finance - complementing the Urban Development Capital Fund with a grant scheme
Electric van replacement programme	Businesses	Government scheme - available from time to time, expected until 2030, manufacturer-friendly financing schemes Bank green loans Entrepreneurs' own resources

Intervention	Responsible	Form and source of capital
Waste, waste water		
Smart solutions for waste management and urban operations	Biokom Nkft	**Grant scheme:** Operational Programme Environment and Energy Plus/ TOP Plus
Fermentation of high biodegradable fraction separated by mechanical treatment with biogas recovery		
Pre-treatment of high biodegradable fraction, selection of fractions with energy recovery, selection of inert components		
Developing an intelligent urban energy management and geospatial information system - stormwater and wastewater geospatial improvements		**Grant scheme:** Digital Renewal Operational Programme Plus
Waste prevention centre		Non-reimbursable, feasible with grants. **Possible sources:** Interreg Central, Danube Programme, Hungarian-Croatian Cross-border Programme
Development of intelligent diagnostics and monitoring for water management in Pécs		**Grant scheme:** Digital Renewal Operational Programme Plus
Increasing wastewater treatment capacity in Pécs	Tettye Forrásház Zrt.	**Grant scheme:** Operational Programme Environment and Energy Plus/ TOP Plus
The development of technologies for the exploration, extraction and utilisation of secondary raw materials (e.g. recycling of tailings, geothermal reuse of abandoned wells, etc.) based on geological background, and the generation of such projects	PTE TTK, AFK	Non-reimbursable, feasible with grants. **Possible sources:** Horizon Europe

Intervention	Responsible	Form and source of capital
Establishing a circular economy		
Industrial park conversion to renewable, zero emission, circular	Municipality of Pécs, Pécs-Baranya County Chamber of Commerce, Ipark Kft.	Own resources, urban development capital fund, bank loan facility
Climate Partnership, a long-term, active collaboration between the business community and City Authority in the City of Pécs to reduce its carbon footprint	Municipality of Pécs	Non-reimbursable, feasible with grants. **Possible sources:** Interreg Central, Danube Programme, Hungarian-Croatian Cross-border Programme
Pilot circular construction project, circular building materials marketplace	Municipality of Pécs, Pécs-Baranya County Chamber of Commerce, Holcim Magyarország Kft.	The circular economy is essentially investment with return, financed by and benefiting from the investments of the mainly industrial players involved. The first steps may require the use of subsidies or seed financing. **Possible sources:** Environment and Operational Programme Plus Circular economies and sustainability - Green-blue infrastructure - Circular waste management - Developing a circular economy **Driving Urban Transitions:** circular economy Seed funds Urban Development Capital Fund
Collection and sorting of urban construction and demolition waste and its recovery at the Kökényes waste treatment plant	Municipality of Pécs, Biokom Nkft	
Construction waste hub deployment	Municipality of Pécs, Biokom NKft, Pécs-Baranya County Chamber of Commerce	
Recycling of mining waste material	Municipality of Pécs, Biokom NKft, Pécs-Baranya County Chamber of Commerce, University of Pécs	
Demolition of a fly ash tip in Tüskésrét and its material recovery in the cement industry, technology testing		
Recovery of landfilled mining waste for the production of dust binders, anti-slurry and fertilisers (circular economy)		

<table>
<tr><th>Intervention</th><th>Responsible</th><th>Form and source of capital</th></tr>
<tr><td colspan="3">Green infrastructure development</td></tr>
<tr><td>Green wall, green roof</td><td rowspan="6">Municipality of Pécs,
Biokom Nkft</td><td>Energy savings, but grant scheme is needed to achieve them
Possible sources:
Environment and Operational Programme Plus, Driving Urban Transitions, EUI
Residential own resources</td></tr>
<tr><td>Expansion and renovation of urban parks using climate resilience criteria</td><td rowspan="2">Grant scheme
Municipal own resources,
aid scheme</td></tr>
<tr><td>Greening along busy roads, green walls</td></tr>
<tr><td>Greening of car parks</td><td rowspan="3">Grant scheme
Municipal own resources,
aid scheme
Own contribution of economic operators</td></tr>
<tr><td>Converting vacant or underused land into green space</td></tr>
<tr><td>Sample projects implemented: urban gardens, urban agriculture, composting programmes</td></tr>
</table>

The distribution of grants, blended finance and market-based schemes in each intervention package

Grant schemes	Blended finance	Investments with return
General, non-sector-dependent governance and social projects Building stock, heating, fossil fuel phase-out Building renovation		
Municipal measures to reduce emissions from buildings	Developing a downtown energy community with institutional actors	Energy utilities developments : network extension, storage capacity, energy community implementation capacity, utility network upgrades, special control transformers on pilot basis
Cooperation with institutional actors - climate web system	PTE Energy Community Project	Complex energy development project in Pécsbánya-Karolina
Introduction of a building renovation passport scheme	Energy efficiency solutions using smart systems	Residential purchase of energy efficient appliances (washing machine, TV, refrigerator), air conditioners, heating systems
Information campaigns, events on technological and technical knowledge in the field of energy efficiency and climate transition (e.g. on rooftop solar installations, storage capacity, heat pump systems)	Piloting local energy supply models - microgrid	
Learning-design-implementation programme for the development of energy communities	Piloting local energy supply models - energy storage	
Action for energy efficiency with a residential test group	Retrofitting 35% of existing buildings	
Education programme to end energy poverty	Replacement of summer hot water in multi-storey buildings with renewable hot water from special solar collectors outside district heating nework	
Promoting smart meters, developing a digital platform, ensuring real-time traceability of energy consumption	Decarbonisation of a prefabricated building pilot project: installation of renewable energy sources to replace cooling, lighting and cooking in a 10-storey prefabricated building	
Institutional energy consumption and emissions survey		
University of Pécs Decarbonisation of Building Energy		
The LEGOFIT project aims at designing, implementing and validating an adaptable and dynamic integrative approach to achieve energy performance in multi-family residential buildings		
Cooking gas substitution		
For families on social assistance, a support programme for energy security to replace fossil fuels		
Model energy support programme for disadvantaged families in partnership with energy utilities		
Wood-fired housing conversion programme		

<table>
<tr><th>Grant schemes</th><th>Blended finance</th><th>Investments with return</th></tr>
<tr><td colspan="3">New energy efficient buildings</td></tr>
<tr><td>Setting minimum requirements for new build properties, providing information</td><td rowspan="2"></td><td rowspan="2">New build properties along district heating networks</td></tr>
<tr><td>Decarbonisation of new buildings, passive and active house options - education, awareness raising</td></tr>
</table>

<table>
<tr><th>Grant schemes</th><th>Blended finance</th><th>Investments with return</th></tr>
<tr><td colspan="3">Energy efficient lighting, and devices</td></tr>
<tr><td rowspan="3"></td><td rowspan="3"></td><td>Developing intelligent street lighting</td></tr>
<tr><td>LED light exchange program</td></tr>
<tr><td>Optimisation of large household consumers with smartgrid, microgrid systems, related education, awareness raising</td></tr>
</table>

<table>
<tr><th>Grant schemes</th><th>Blended finance</th><th>Investments with return</th></tr>
<tr><td colspan="3">Decarbonisation of heating</td></tr>
<tr><td>Connection of institutional actors to district heating</td><td>Piloting a soil probe heat pump system</td><td>Pétáv development: replacement of a 5 MW gas boiler</td></tr>
<tr><td>Cleantech project: energy production and storage with deep thermal storage - preparatory R&D project</td><td rowspan="5">Replacing natural gas for heating with heat pump systems</td><td>Increasing heat production efficiency by reducing losses</td></tr>
<tr><td>Cleantech project: Conversion of hydrocarbon wells into geothermal wells</td><td>Increasing heat production efficiency by reducing losses</td></tr>
<tr><td>Cleantech project: Exploration of the Pécs area for geothermal energy</td><td rowspan="3">Replacing natural gas for heating with heat pump systems</td></tr>
<tr><td>Cleantech project: Secondary raw material exploration, extraction and exploitation with a strong geological background</td></tr>
<tr><td>Cleantech project: Comprehensive development of the university knowledge base and competences for geological projects requiring a significant technical and specialist base</td></tr>
</table>

Grant schemes	Blended finance	Investments with return
Decarbonisation of electricity		
Building electrolysis capacity in Tüskésrét		Building solar park capacity
Building a hydrogen ecosystem		Building urban energy storage capacity in cooperation with energy utilities
Preparing inter-regional innovation investments for the Central European Green Hydrogen Value Chain by developing a stakeholder participation scheme and setting up an IoT framework.		Building solar energy capacity for city operations
		Building institutional solar capacity
		Building solar energy capacity for industrial and commercial units
		Solar farm capacity building - with individual capacity expansion (small household power plants)
		Building residential storage capacity in partnership with energy utilities

Grant schemes	Blended finance	Investments with return
Transport - Reducing the volume of private motorised transport		
Community planning programme to promote climate-friendly land use		Contract scheme with large employers to reduce car use
Promoting behavioural measures in transport, both for cars and lorries		Design of parking plates
Development of an intelligent urban energy management and spatial information system - Optimising the use of public transport		
Measures to reduce car traffic		
Municipal measures in the field of transport		
GreenInCities		
Zero emission zones to be tested, where only electric, hydrogen and biogas cars can be driven		
Rethinking the parking system		

<table>
<tr><th>Grant schemes</th><th>Blended finance</th><th>Investments with return</th></tr>
<tr><td colspan="3">Increasing the share of public transport and non-motorised transport</td></tr>
<tr><td>Support for access from the conurbation by public transport with targeted services</td><td>E-bike project</td><td rowspan="3"></td></tr>
<tr><td>Separate bus lanes on main transport routes</td><td rowspan="2">Increasing the share of shared vehicle use</td></tr>
<tr><td>The use of hydrogen technology in long-distance bus transport</td></tr>
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<tr><th>Grant schemes</th><th>Blended finance</th><th>Investments with return</th></tr>
<tr><td colspan="3">Increasing the share of public transport and non-motorised transport</td></tr>
<tr><td>Provision of electric charging infrastructure for cars</td><td rowspan="2"></td><td rowspan="2">Electric car fleet support programmes</td></tr>
<tr><td>Awareness raising and information transfer on electric cars</td></tr>
</table>

<table>
<tr><th>Grant schemes</th><th>Blended finance</th><th>Investments with return</th></tr>
<tr><td colspan="3">Decarbonising public transport</td></tr>
<tr><td>Replacement of the diesel bus fleet of Tüke Busz Zrt. with electric buses in line with the decarbonisation plan</td><td rowspan="4"></td><td rowspan="4"></td></tr>
<tr><td>Construction of a charging network to operate the electric bus fleet of Tüke Busz Zrt.</td></tr>
<tr><td>Development of an intelligent urban energy management and spatial information system - Optimising the use of public transport</td></tr>
<tr><td>Electrification of metropolitan transport through the development of infrastructure to support environmentally friendly private and public transport</td></tr>
</table>

Grant schemes	Blended finance	Investments with return
Optimised logistics		
Smart columns: generating real-time data from IoT sensors, network remote control and automation systems: deploying sensors		Increasing the share of shared vehicle use
Reducing congestion in urban transport through traffic management tools		
Diverting traffic from Route 6 by relieving congestion in the city centre and Kertváros		

Grant schemes	Blended finance	Investments with return
Electrification of freight transport		
	Electrification of the conventional vehicle fleet of the public service system in Pécs	Electric van replacement programme

Grant schemes	Blended finance	Investments with return
Waste, waste water		
Smart solutions for waste management and urban operations		Increasing wastewater treatment capacity in Pécs
Fermentation of high biodegradable fraction separated by mechanical treatment with biogas recovery		
Pre-treatment of high biodegradable fraction, selection of fractions with energy recovery, selection of inert components		
Developing an intelligent urban energy management and geospatial information system - stormwater and wastewater geospatial improvements		
Waste prevention centre		
Development of intelligent diagnostics and monitoring for water management in Pécs		
Development of technologies for secondary raw material exploration, extraction and utilisation (e.g. reprocessing of tailings, geothermal reuse of abandoned wells, etc.) based on geological background, and the generation of such projects;		

Grant schemes	Blended finance	Investments with return
Establishing a circular economy		
Climate Partnership, a long-term, active collaboration between the business community and City Authority in the City of Pécs to reduce its carbon footprint	Recycling of mining waste material	Industrial park conversion to renewable, zero emission, circular
	Demolition of a fly ash tip in Tüskésréti and its material recovery in the cement industry, technology testing	Pilot circular construction project, circular building materials marketplace
	Recovery of landfilled mining waste for the production of dust binders, anti-slurry and fertilisers (circular economy)	Collection and sorting of urban construction and demolition waste and its recovery at the Kökényes waste treatment plant
		Construction waste hub deployment

Grant schemes	Blended finance	Investments with return
Green infrastructure development		
Green wall, green roof		
Expansion and renovation of urban parks using climate resilience criteria		
Greening along busy roads, green walls		
Greening of car parks		
Converting vacant or underused land into green space		
Sample projects implemented: urban gardens, urban agriculture, composting programmes		

Investment ratio distribution of grants, blended finance and market-based schemes

Sector	Subsector	Investment (CAPEX) (MEUR - cash basis 2020-2030)	Grant schemes	Blended finance	Investments with return
Transport	Reduced demand for motorised passenger transport[1]	€ -	80%	0%	20%
	Switch to public transport and non-motorised transport	€ (6)	70%	30%	0%
	Electrification of passenger cars and motorcycles	€ (24)	20%	0%	80%
	The electrification of buses	€ (8)	100%	0%	0%
	Optimised logistics[2]	€ -	70%	0%	30%
	Electrification of lorries	€ (119)	0%	20%	80%
Bulding and heating	Building renovations	€ (201)	20%	40%	40%
	New, energy-efficient buildings	€ (4)	10%	0%	90%
	Efficient lighting and appliances	€ (92)	0%	0%	100%
	Decarbonising heating production	€ (275)	20%	30%	50%
Electricity	Decarbonising electricity generation	€ (27)	20%	0%	80%
Waste	Increased waste recycling[3]	€ 0	80%	10%	10%
TOTAL		**€ (756)**			
Additional interventions					
Sector independent investments	Governance and social projects	**€ (16)**	100%	0%	0%
Circular economy	Implementation of new business models, mainly in the fields of construction, construction sites, secondary raw materials and waste management	**€ (60)**	10%	20%	70%
Green space development, near-natural solutions	Green roofs, green walls, urban green spaces, greening of underused areas	**€ (30)**	100%	0%	0%

[1] There are no direct investment costs to achieve the emission reduction targets, but the city plans a number of supporting and enabling measures to achieve the results
[2] There are no direct investment costs to achieve the emission reduction targets, but the city plans a number of supporting and enabling measures to achieve the results
[3] There are no direct investment costs to achieve the emission reduction targets, but the city plans a number of supporting and enabling measures to achieve the results

Schedule of projects

Projects already running	Enabling projects and surveys in 2023-24	Pilot projects Listed in 2023-24, but with further examples of projects expected on a rolling basis until 2030	Ongoing projects	Investments from 2024
Building renovation				
Institutional energy consumption and emissions survey	Management Projects	Action for energy efficiency with a residential test group	Ecosystem building with institutions	Promoting smart meters, developing a digital platform, ensuring real-time traceability of energy consumption
Energy utilities developments: network extension, storage capacity, energy community implementation capacity, utility network upgrades, special control transformers on pilot basis	Social projects	Energy efficiency solutions using smart systems	Ecosystem building with industry	
University of Pécs Decarbonisation of Building Energy	Survey of individual transport habits and spatial patterns	Piloting local energy supply models - microgrid	Ecosystem building with commercial actors	Developing a downtown energy community with institutional actors
PTE Energy Community Project	Assessment of the spatial pattern of lorry traffic and capacity utilisation	Piloting local energy supply models - energy storage	Ecosystem building to build a circular economy	Complex energy development project in Pécsbánya-Karolina
The LEGOFIT project aims at designing, implementing and validating an adaptable and dynamic integrative approach to achieve energy performance in multi-family residential buildings	Carbon reduction action plan with institutional actors	Replacement of summer hot water in prefabricated buildings with renewable hot water from special solar collectors	Public communication and involvement	Retrofitting 35% of existing buildings

Projects already running	Enabling projects and surveys in 2023-24	Pilot projects Listed in 2023-24, but with further examples of projects expected on a rolling basis until 2030	Ongoing projects	Investments from 2024
Building renovation				
	Carbon reduction action plan with industry	Decarbonisation of a prefabricated building pilot project: installation of renewable energy sources to replace cooling, lighting and cooking in a 10-storey prefabricated building	Running a Green Office	Residential purchase of energy efficient appliances (washing machine, TV, refrigerator), air conditioners, heating systems (new fossil boilers cannot be sold from 2025)
	Carbon reduction action plan with commercial actors	Mechanical retrofitting of prefabricated buildings for individual heat use and efficiency	Cooperation with institutional actors - climate web system	Cooking gas substitution
	Municipal measures to reduce emissions from buildings		Introduction of a building renovation passport scheme	For families on social assistance, a support programme for energy security to replace fossil fuels
	Wood-fired housing retrofit programme - study		Information campaigns, events on technological and technical knowledge in the field of energy efficiency and climate transition (e.g. on rooftop solar installations, storage capacity, heat pump systems)	Model energy support programme for disadvantaged families in partnership with energy utilities
			Learning-design-implementation programme for the development of energy communities	
			Education programme to end energy poverty	

New energy efficient buildings				
			New build properties along district heating networks	
			Setting minimum requirements for new build properties, providing information	
			Decarbonisation of new buildings, passive and active house options - education, awareness raising	
Energy efficient lighting, and devices				
				Developing intelligent street lighting
				LED light exchange program
				Optimisation of large household consumers with smartgrid, microgrid systems, related education, awareness raising
Decarbonisation of heating				
		Piloting a soil probe heat pump system	Cleantech project: energy production and storage with deep thermal storage - preparatory R&D project	Pétáv development: replacement of a 5 MW gas boiler
			Cleantech project: Conversion of hydrocarbon wells into geothermal wells	Increasing heat production efficiency by reducing losses

Projects already running	Enabling projects and surveys in 2023-24	Pilot projects Listed in 2023-24, but with further examples of projects expected on a rolling basis until 2030	Ongoing projects	Investments from 2024
Decarbonisation of heating				
			Cleantech project: Exploration of the Pécs area for geothermal energy	Connection of institutional actors to district heating
			Cleantech project: Secondary raw material exploration, extraction and exploitation with a strong geological background	
			Cleantech project: Comprehensive development of the university knowledge base and competences for geological projects requiring a significant technical and specialist base	
Decarbonisation of electricity				
	Preparing inter-regional innovation investments for the Central European Green Hydrogen Value Chain by developing a stakeholder participation scheme and setting up an IoT framework.		Building a hydrogen ecosystem	Building solar park capacity
			Building solar energy capacity for city operations	Construction of urban energy storage capacity in cooperation with energy utilities
			Building institutional solar capacity	Building electrolysis capacity in Tüskésrét

			Solar farm capacity building - with individual capacity expansion (small household power plants)	
			Building residential storage capacity in partnership with energy utilities	
			Building solar energy capacity for industrial and commercial units	
Transport - Reducing the volume of private motorised transport				
GreenInCities		Zero emission zones to be tested, where only electric, hydrogen and biogas cars can be driven	Community planning programme to promote climate-friendly land use	Contract scheme with large employers to reduce car use
			Promoting behavioural measures in transport, both for cars and lorries	Rethinking the parking system
			Measures to reduce car traffic	Design of parking plates
			Municipal measures in the field of transport	
			Development of an intelligent urban energy management and spatial information system - Optimising the use of public transport	

Projects already running	Enabling projects and surveys in 2023-24	Pilot projects Listed in 2023-24, but with further examples of projects expected on a rolling basis until 2030	Ongoing projects	Investments from 2024
Increasing the share of public transport and non-motorised transport				
E-bike, scooter, moped project			Separate bus lanes on main transport routes	Support for access from the conurbation by public transport with targeted services
			Increasing the share of shared vehicle use	The use of hydrogen technology in long-distance bus transport
Conversion of cars and engines to electric				
			Awareness raising and information transfer on electric cars	The use of hydrogen technology in long-distance bus transport
				Increasing the share of shared vehicle use
				Provision of electric charging infrastructure for cars
				Electric car fleet support programmes

Decarbonising public transport				
Replacement of the diesel bus fleet of Tüke Busz Zrt. with electric buses in line with the decarbonisation plan				Development of an intelligent urban energy management and spatial information system - Optimising the use of public transport
Construction of a charging network to operate the electric bus fleet of Tüke Busz Zrt.				Electrification of metropolitan transport through the development of infrastructure to support environmentally friendly private and public transport
Optimised logistics				
				Smart columns: generating real-time data from IoT sensors, network remote control and automation systems: deploying sensors
				Reducing congestion in urban transport through traffic management tools
				Diverting traffic from Route 6 by relieving congestion in the city centre and Kertváros
				Construction of interchange stations at 3 sites

Projects already running	Enabling projects and surveys in 2023-24	Pilot projects Listed in 2023-24, but with further examples of projects expected on a rolling basis until 2030	Ongoing projects	Investments from 2024
Electrification of freight transport				
				Electrification of the conventional vehicle fleet of the public service system in Pécs
				Electric van replacement programme
Waste management				
				Smart solutions for waste management and urban operations
				Fermentation of high biodegradable fraction separated by mechanical treatment with biogas recovery
				Pre-treatment of high biodegradable fraction, selection of fractions with energy recovery, selection of inert components
				Developing an intelligent urban energy management and geospatial information system - stormwater and wastewater geospatial improvements

Waste prevention centre				
Development of intelligent diagnostics and monitoring for water management in Pécs				
Increasing wastewater treatment capacity in Pécs				
The development of technologies for the exploration, extraction and utilisation of secondary raw materials (e.g. recycling of tailings, geothermal reuse of abandoned wells, etc.) based on geological background, and the generation of such projects;				
Circular economy initiatives				
Industrial park conversion to renewable, zero emission, circular				
Pilot circular construction project, circular building materials marketplace				
Collection and sorting of urban construction and demolition waste and its recovery at the Kökényes waste treatment plant				
Recycling of mining waste material				

Projects already running	Enabling projects and surveys in 2023-24	Pilot projects Listed in 2023-24, but with further examples of projects expected on a rolling basis until 2030	Ongoing projects	Investments from 2024
Circular economy initiatives				
				Demolition of a fly ash tip in Tüskésréti and its material recovery in the cement industry, technology testing
				Recovery of landfilled mining waste for the production of dust binders, anti-slurry and fertilisers (circular economy)
				Construction waste hub deployment
Green infrastructure and nature based solutions				
		Green wall, green roof		Expansion and renovation of urban parks using climate resilience criteria
		Converting vacant or underused land into green space		Greening along busy roads, green walls
		Sample projects implemented: urban gardens, urban agriculture, composting programmes		Greening of car parks

As part of the capital planning attention is paid to both investment and non-investment type of measure financing.

As regards the enabling, non-investment type of costs, during the course of 2023-24 the following acitivites will be implemented where grant schemes (TOP Plus Interreg Central, Danube rogramme, Hungarian-Croatian Cross-border Programme, European Urban Initiative, Life+, Horizon Europe) are the financing sources as complementary to the Municipality's and businesses' own resources.

- As a first step the long-term operation of the transition team, currently working with eight people is to be ensured, and further capacity building is needed: expansion of the Green Office by 5 people, NetZero transition with 5-10 people. They will be financed partly from project revenues and partly by the Municipality.
- Based on the Action Plan and Investment Plan numerous surveys, baseline studies, feasibility studies, community planning, ecosystem building are to be implemented
- As more detailed work is continuing with institutions, commercial and industrial actors, transition plans are created
- Where technology and technical solution is to be tested, pilot projects, testing solutions for conventional and prefabricated housing are to be implemented in order to make a decision of scalability
- RDI projects within the capacities of the University of Pécs, and businesses are to be carried out continuously in order to support the technological transition of the heating and electricity system. Funding sources are Horizon Europe and domestic RDI funding, formerly Modern Cities programme
- The City of Pécs is aware that the high quality preparation of projects' feasibility and investment plan is a prerequisite of success, thus ensures a HUF 500 million local government fund as a framework for financing project preparation and project management tasks
- The funding team within the transition team is responsible for the continuous update of the resource map, who support the City and the Mayor in facilitating negotiations with the Government, banks, funding organisations. Implementation of a financing education programme for all stakeholders is on the agenda during the first years.
- Apart from the above specifically mentioned enabling projects, the listed governance and social projects will be further elaborated and implemented by applying for grant schemes.

As the feasibility studies, business plans and transitions plans are getting ready, investment decisons are taken, and implementation of investment/ infrastructure type projects are started.

The total cost of capital for the Municipality is 69 MEUR, which represents a saving of 12% over the time horizon to 2030. The possibility of setting up an urban development capital fund should be examined, and a gap analysis to be carried out. The urban development capital fund would finance the municipalities' investments with return on the one hand and invest in projects by local businesses on the other. While municipal projects generally generate a low return, the higher return on entrepreneurial projects ensures a good overall return for the UDF. The establishment of the capital fund requires the provision of seed capital, which needs to be negotiated with the government.

For projects that do not have a return, the revenue is provided by grant schemes. The replacement of the municipal vehicle fleet, including the fleet of municipal companies, with electric vehicles can be achieved through a grant scheme, for which the RRF can provide funding.

The renovation of municipal and institutional buildings can be partly financed by EU funds, the TOP Plus funds, but this does not cover the entire need. The volume not covered by grant funding can be covered by a deep renovation programme, managed jointly with residential buildings, including the decarbonisation of heating, which may involve the connection of district heating or the use of heat pumps. In the short term, a gas boiler may be used, but from 2030 only fossil-free heating solutions will be possible.

With the building segmentation and related renovation programmes developed by the Green Office, the Municipality will launch a competitive bidding process with commercial banks, who will take on the coordination role, offer a single loan structure for the housing stock to be renovated, even per category, and repayment through the rollover of savings - through account repayments (OBR). A 5% annual renovation volume is comitted by the City. Contract based on bank construction offers and ensure that the 5% annual volume is achieved. The possibility of using the energy utilities subsidy scheme to build storage capacity is an additional resource, the volume of which is to be further assessed.

The heat pump investments require a grant and a complementary loan facility, the subsidy part of which needs to be provided through a government programme. Typically, a mixed financing scheme is available from EU funds.

Financing scheme for energy communities can be provided under a government support scheme and under the energy utilities support scheme. Many governments provide financial incentives, grants or subsidies for community energy projects, reducing upfront costs and increasing the financial return over time. Energy community projects are projects with return, and one of the primary financial benefits of developing energy communities is the potential to reduce energy costs. Community members can collectively invest in renewable energy systems to generate their own electricity and reduce energy bills. Energy communities are crowdfunding schemes where residents can invest in their own energy production, focusing on renewable energy sources. It is estimated that energy communities could manage 21% of solar energy by 2030. Support is needed for the deployment of microgrids, and the municipality will contribute to the use of free space in public areas.

The implementation of efficient street lighting can be carried out in an ESCO scheme, for which ESCO companies are put out to tender. The ESCO scheme can play an important role in the implementation of energy efficient and sustainable solutions for the urban environment. When considering the participation of ESCO companies in urban green transition projects, it is important to carry out a thorough assessment and to put ESCO companies out to tender.

The following types of projects are examined to assess the economics and potential of ESCOs:

Building energy retrofits: ESCOs can retrofit existing buildings with energy-efficient lighting, HVAC systems, insulation, windows and other upgrades to reduce energy consumption and operating costs. This is in addition to a bank loanfacility.

Building automation and control: installing smart building technologies such as occupancy sensors, advanced HVAC controllers and energy management systems can optimise energy use and improve comfort.

Renewable energy installations: ESCOs can install solar panels in urban buildings or facilities, reducing dependence on non-renewable energy sources. This scheme should be considered for Biokom NKft, Tüke Busz Zrt., Tettye Forrásház Zrt. and Pétáv Távfűtő Kft.

Transport infrastructure efficiency: ESCOs can optimise transport systems such as traffic signal coordination and public transport to reduce energy consumption and improve efficiency.

For the construction of the municipal utility-scale solar power plant, the Municipality will provide land along the Western Bypass, where the construction of a 100 MWp solar farm will be carried out through a competitive bidding process and the conclusion of an operation contract with specialised companies. In cooperation withenergy utilities, it will require a guarantee of origin for the energy fed into the grid by the solar power plant. Negotiations will be required to build storage capacity next to the solar park in cooperation withenergy utilities.

Credit institutions' green loan schemes and government subsidies are available periodically for the construction of small household power plants, and the Green Office is responsible for monitoring, informing and advising the public.

For large domestic consumers, but also for heating and cooling systems, the Municipality is in discussion with utility providers to ensure bill-based financing. The service or product is financed through a utility provider, which is repaid by the consumer through a utility service. For example, energy efficient appliances (washing machines, TVs, refrigerators), air conditioners, heating systems.

The total investment cost of EUR 756 MEUR covers investments in the residential segment and the industrial and commercial segment, in addition to the municipal and public administration and public services, transport providers, utility sector. For the business sector we are mainly talking about the mobilisation of own resources and the financing schemes that contribute to this : urban development capital fund, credit facilities, ESCO solution. ESCOs can help industries optimise their production processes, reduce waste and increase energy efficiency, leading to lower operating costs and environmental impacts.

For the residential sector, it is also necessary to raise own resources, complemented by the building renovation bank scheme and grant schemes. In particular, a government scheme is needed for building renovation for disadvantaged social groups and for investment elements with very long payback periods. Just transition fund is one of the funding instruments.

A government scheme is also needed to encourage the purchase of electric cars, complemented by green leasing schemes.

Funding for the switch to public transport, the Tüke Busz Zrt. electric bus procurement programme, is provided by the national Green Bus Programme.

The purchase of electric bicycles, scooters, mopeds and electric car-sharing systems will be market-based, but could also be financed by an investment from the Urban Development Capital Fund.

A number of urban transport improvements are needed, such as bus lanes, bus and car P+R parking spaces at three suburban interchanges, which will require subsidies, while at the same time tolls for trucks. If they are not using electric trucks by 2030, they will have to pay designated zone charges, which will be put into a carbon fund and re-invested in greening transport projects.

The construction of parking slabs and the development of urban transfer stations are projects to be financed by the Urban Development Fund.

The Transport and Infrastructure Operational Programme Plus is a source for developing alternative fuelling infrastructure (e.g. e-charging stations), related green infrastructure and development and deployment of applications and databases that favour public transport - (e.g. demand responsive transport applications, equal opportunities travel applications).

Road/ Congestion Charges in transport

Congestion charging is a transport demand management measure adopted to reduce the impact of congestion on cities. It directly links road transport externalities to the travellers who cause them. Tolling schemes are set to influence short-term demand decisions, forcing travellers to switch to sustainable modes of transport and low-congestion routes.

Congestion charges can be introduced either in a specific geographical area or on a road network, resulting in two types of charges: area and network charges. The former can result in two toll configurations: zone charging and cordon charging. In the first case, the motorist pays a fixed charge for driving in the zone, regardless of the route. In the latter, the toll zone is delimited by a number of points. Each time these points are crossed, a toll is payable. With network charging, the motorist pays for the use of the facility.

The urban toll is determined by a number of applications: the district chosen, the basis and level of charging, the charging hours, the detection and recognition systems, the payment methods, etc.

Environmental road pricing, on the other hand, tends to reduce the number of kilometres travelled by favouring distance-based charging to reduce environmental impacts and by redirecting the revenue generated to public transport and modes such as walking and cycling. In addition, modulation by vehicle type according to the "Euro" pollution standards is possible. In this configuration, the most polluting vehicles are taxed more heavily.

Finally, there is another type of toll, the positive or reverse toll. The idea is to encourage motorists on main roads during peak hours to use other modes of transport or to postpone their journey to another time. In return, motorists are financially rewarded. The objectives of this type of toll are similar to congestion charging.

Table 6: Capital planning

Capital need	Possible Sources of Capital	Sector allocation
€ (6)	Subsidies	Switch to public transport and non-motorised transport
€ (24)	Blended financing: Government grants and green leasing schemes	Electrification of passenger cars and motorcycles
€ (8)	Green bus government programme	The electrification of buses
€ (119)	Blended financing: government grant programme and own financing bybusinesses, green credit schemes	Electrification of lorries
€ (201)	Subsidies for certain segments of society, green loan schemes from banks where cost savings ensure repayment.	Building renovations
€ (4)	Market financing	New, energy-efficient buildings
€ (92)	ESCO funding	Efficient lighting and appliances
€ (275)	Support and credit facility for heat pump installations	Decarbonising heating energy production
€ (27)	Market-based development and operation, land provided by the municipality	Decarbonising electricity generation
€ (756)		**TOTAL**

2.3 Module IP-B3: Economic and Financial Indicators for Monitoring, Evaluation and Learning

B.3.1: Textrual element

The backbone of the action plan and investment plan is the identified 13 package approach, that covers the carbon reduction objective of the City of Pécs. The City's reduction target is broken down to these interventions:

- Reduced motorized passenger transportation need
- Shift to public & non-motorized transport
- Increased car pooling
- Electrification of cars + motorcycles
- Electrification of buses
- Optimized logistics
- Electrification of trucks
- Building renovations (envelope)
- New energy-efficient buildings
- Efficient lighting & appliances
- Decarbonizing heating generation
- Decarbonizing electricity generation
- Increased waste recycling

The interventions cover transportation, building stock, decarbonization of heating and electricity and waste sector and involves all stakeholder groups : the Municipality, citizens, institutions, the business sector including industry, commerce and agriculture, transport providers, other public service providers and utilities. In order to be able to track the progress in decarbonization, the

Economic indicators are related to the intervention packages.

As for transport:

- Reduced demand for motorised passenger transport
- Reduce passenger car kilometres by shifting to public transport and non-motorised transport
- Creating car pools average number of passengers per car
- Electrification of cars and motorcycles by 2035 and the ratio of the fleet elecrtified, The electrified ratio for buses, the electrified ratio for light trucks <3.5t and heavy goods vehicles by 2035
- Average utilisation of the maximum load weight of light goods vehicles (< 3,5 t), and of heavy goods vehicles (< 3,5t)

As for buildings:

- Annual renovation rate (including lighting and appliances)
- Ratio of buildings built to the highest standards
- Regarding decarbonization of heating: share of local heating produced from fossil fuels, share of local heating produced by electric heat pumps, share of local heating produced using biofuels

As for decarbonization of electricity: share of electricity produced using fossil fuels

As for the waste emission reduction, recycling rate of various waste categories are tracked: paper, metal, plastic, glass, organic waste.

This approach enables the City to identify the relevant projects fitting each envelope and to prioritize among the potential projects.

The economic modelling resulted in the financial indicators, calculated on a net present value, that shows for each intervention package what is the initial investment need, and what is the return on investment. Overall for intervention packages need a net investment, that is electrification of trucks, building renovations, efficient lighting & appliances and decarbonizing heating generation. When the unit investment cost per ktonne is taken into account, electrification of trucks and building renovations are the most investment intensive, with above 40 MEUR/ kton. Electrification of buses, efficient lighting & appliances, decarbonizing heating generation and decarbonizing electricity generation ranges between 3 – 5 MEUR/ kton emission reduction, reaching an average of 2.11 MEUR/ktonne for the whole project portfolio.

Taking the economic and financial indicators as the cornerstones of the Pécs climate neutrality project portfolio, the alignment between the list of projects contributing implementing the interventions, the costs, and the capital planning is ensured.

B-3.1: economic indicators				
Sector	**Indicator**	**Unit of indicator**	**Initial value**	**Target 2030**
Transport	Reduced demand for motorised passenger transport	% reduction by 2030		35%
	Reduce passenger car kilometres by shifting to public transport and non-motorised transport	% reduction in passenger car passenger-kilometres by 2030		10%
	Creating car pools	Average number of passengers per car	1.3	1.6
	Electrification of cars and motorcycles by 2035	% of the fleet electrified	4%	35%
	The electrification of buses	Fleet % electrified	5%	100%
	Optimising truck logistics - light trucks (< 3.5 t)	Average utilisation of the maximum load weight of light goods vehicles (< 3,5 t)	23%	45%
	Optimising truck logistics - heavy trucks (> 3.5 t)	Average utilisation of the maximum load weight of heavy goods vehicles (< 3,5t)	45%	60%
	Electrification of light trucks <3.5t by 2035	As % of the electrified fleet	0%	50%
	Electrification of <3.5t heavy goods vehicles by 2035	% of the fleet electrified	0%	40%
Building and heating	Building renovation (cladding)	Annual renovation rate %	2.9%	5.0%
	Construction of new buildings to the best performance standards	% of buildings built to the highest standards	10%	20%
	Efficient lighting and appliances	Annual renovation rate %	2.9%	5.0%
	Heating technologies	Share of district heating %	50%	55%
	Decarbonising district heating	Share of district heating produced using fossil fuels %	5%	5%
	Decarbonising district heating	Share of district heating produced by electric heat pumps %	0%	0%
	Decarbonising district heating	Share of district heating produced using biofuels %	95%	95%

Sector	Indicator	Unit of indicator	Initial value	Target 2030
Building and heating	Heating technologies	Proportion of heating as local heating %	50%	45%
	Decarbonising local heating	Share of local heating produced from fossil fuels %	98%	25%
	Decarbonising local heating	Share of local heating produced by electric heat pumps %	2%	65%
	Decarbonising local heating	Share of local heating produced using biofuels %	0%	10%
Electricity Sector	Electricity generation from renewable/fossil fuels	Share of electricity produced using fossil fuels %	29%	4%
Waste	Paper recycling	% recycling rate	56%	84%
	Metal recycling	Recycling rate %	58%	90%
	Plastic recycling	Recycling rate %	56%	74%
	Recycling glass	% recycling rate	99%	99%
	Organic recycling	% recycling rate	71%	84%

Economic indicators of the complementary areas undertaken:

Area of intervention	Indicator	Indicator unit	Indicator baseline value	Indicator Target 2030*
Green infrastructure development and near-natural solutions	Proportion of climate-relevant green areas	ha	0%	80%
Waste management and circular economy	Number of circular business models	pcs	0	20

Table 7: Economic indicators

B-3-2: Financial indicators							
Sector	**Subsector**	**NPV total investment - CAPEX (MEUR)**	**NPV OPEX (MEUR)**	**NPV co-benefits (MEUR)**	**NPV Return on Investment (ROI) (MEUR)**	**Co2e reduction (kton)**	**NPV MEUR total investment per kton CO2e reduction**
Transport	Reduced demand for motorised passenger	€ -	€ 388	€ 105	€ 493	32	€ -
	Switch to public transport and non-motorised transport	€ (5)	€ 30	€ 47	€ 72	5	€ 0.93
	Enhanced car-pooling communities	€ -	€ 109	€ 29	€ 137	9	€ -
	Electrification of passenger cars and motorcycles	€ (22)	€ 53	€ 7	€ 38	13	€ 1.67
	The electrification of buses	€ (6)	€ 15	€ 13	€ 21	1	€ 5.25
	Optimised logistics	€ -	€ 1	€ 15	€ 10	10	€ -
	Electrification of lorries	€ (101)	€ 9	€ 2	€ (90)	2	€ 40.36
Bulding and heating	Building renovations	€ (171)	€ 71	€ 3	€ (97)	4	€ 40.43
	New, energy-efficient buildings	€ (3)	€ 13	€ 1	€ 10	1	€ 4.87
	Efficient lighting and appliances	€ (78)	€ 25	€ 1	€ (52)	14	€ 5.75
	Decarbonising heating production	€ (236)	€ 32	€ 28	€ (177)	74	€ 3.18
Electricity	Decarbonising electricity generation	€ (23)	€ 141	€ -	€ 118	139	€ 0.16
Waste	Increased waste recycling	€ 0	€ 0	€ 0	€ 0	1	€ (0.05)
TOTAL		**€ (645)**	**€ 886**	**€ 250**	**€ 491**	**306**	**€ 2.11**

** Note: negative numbers represent cash outflows (investment/cost), positive numbers represent cash inflows (savings/benefits).*

Financial indicators for the additional areas undertaken:

Area of intervention	Indicator	Indicator unit
Green infrastructure development and near-natural solutions	Private capital to public capital ratio	Share of private and public capital in carbon offsets from greenfield development %
Waste management and circular economy	Private capital to public capital ratio	Share of private and public capital in the circular economy %

Table 8: Financial indicators

3 Part C – Enabling Financial Conditions for Climate Neutrality by 2030

3.1 Module IP-C1: Climate Policies for Capital Formation and Deployment

CLIMATE PLATFORM

OBJECTIVES	COSTS	CAPITAL DEPLOYMENT
Access to renewable energy for 50% of households	Decarbonisation of electricity generation Decarbonisation of heating Reduced motorised passenger transport demand Covering 80% of CO2 reduction goals	Own resources of stakeholders (city, citizens, businesses, institutions, transport providers, energy utilities)
85% decarbonisation of electricity consumption	Additional envelopes having emission reduction targets	National grant schemes
The share of renewable energy sources increases to 60%	Extra activities contributing to reduction: waste, wastewater, circular economy	EU structural funding via operational programmes
Emissions from buildings reduced by 50% by 2030	Governance projects	EU Structural Funds via direct grant schemes
Natural gas consumption for heating will be reduced by 50% by 2030 and natural gas for cooking will be phased out	Extra activities contributing to reduction: waste, wastewater, circular economy	EU structural funding via operational programmes
Emissions from buildings reduced by 50% by 2030	Social projects	Loan/ credit facilities
Energy savings of 40% of final energy consumption	Offsetting projects	Invoice-based-financing
Electric buses, public transport 100% emission reduction	Offsetting projects	ESCO scheme
35% reduction in car use	Offsetting projects	Urban Development Fund
50% of vans of less than 3.5 t and 40% of trucks of more than 3.5 t will be electrified	Offsetting projects	Other innovative financing schemes, instruments

LEARNING, EDUCATION

C-1.1 Climate policies on capital formation and deployment

Capital formation objectives:

Ongoing grant scheme monitoring, matching of schemes with the climate neutral portfolio, ongoing grant applications and implementation

Ongoing monitoring of credit institutions facilities for housing, electric vehicles and other sustainable investments and ongoing negotiation with commercial banks, EIB on coordinated facilities

Ongoing negotiation with utilities and other relevant stakeholders for applicability of invoce-based-financingtives

Negotiation process with Government, with relevant line ministries, providing information on climate investment needs of cities, and getting the proper schemes and conditions for subsidy schemes

Broadening the application scope of ESCO facility, tendering market actors

Ongoing monitoring, and assessment of innovative financing schemes, learning process, testing their applicability regarding legal and economic factors, e.g. capital funds, green bonds

Cooperation with NetZero Capital Hub in order to get financing agreements on bankable projects

Capital formation objectives are linked to the activities with highest emission reduction potential and with the highest investment costs.

The following three carbon reduction envelopes cover 80% of CO2 reductions, so these interventions are the first priorities for climate action.

Decarbonisation of electricity generation 139 kton reduction goal

- **Capital formation policy**: mobilize market finance and responsible land planning. Additionally grant schemes application for innovative solutions, hydrogen application.

Municipal land provision in exchange for an operating contract, competitive bidding for contractor development, energy utilities feed-in. Contractor financing can be based on a green bond or bank loan, energy utilities own resources for storage capacity development.

Horizon Europe funding for the development of electrolysis capacity and hydrogen storage capacity.

- **Businesses:** solar power plant installation is investment with return: green bond, urban development fund, bank loan scheme, ESCO scheme also applicable

Installation of institutional, household solar power plants is an investment with return: own sources of institutions, households, credit institution green loan facility, RRF blended scheme. Grant schemes are occasionally available. KEHOP plus support combined with credit. Storage capacity on lease from energy utilities.

Decarbonisation of heating: 74 kton reduction goal, 275 MEUR

- **Capital formation policy:** Ongoing grant scheme monitoring, matching of schemes with the climate neutral portfolio, ongoing grant applications and implementation, funding sources : TOP Plus, RRF

- **Heat pump:** Bank-coordinated scheme with savings-based repayment, RRF additional support. Underfloor heating system pays off, also pays off due to above average gas consumption costs, if convector system has to be converted, only pays off in the long run, blended financing required

Reduced motorised passenger transport demand 32 kton reduction goal

- **Capital formation policy:** Ongoing grant scheme monitoring, matching of schemes with the climate neutral portfolio, ongoing grant applications and implementation

- **Funding sources:** TOP Plus, Interreg Central, Danube Programme, Hungarian-Croatian Cross-border Programme, European Urban Initiative, and road/congestion pricing in transport

Additional envelops with highest investment costs:

Retrofitting of 35% of the building stock 201 MEUR

- **Capital formation policy:** Municipality coordinated banking facility where repayment comes from savings. Guarantee scheme to be ensured by natonal subsidies guarantee schemes, supplementary resources arriving from Homeowners own source. Segment of society in need will be provided by dediated grant schemes.

Replacement of vans under 3.5 t with electric vans, total 119 MEUR

- **Capital formation policy:** Government support programme - available from time to time, expected until 2030, Producer-friendly financing schemes, Bank green loans, Entrepreneurial self-financing

Role of local government Coordination, ecosystem building, transport route planning, Road/ Congestion charging in transport

Energy efficient lighting and equipment 92 MEUR

- **Capital formation policy:** projects under the envelop are investments with return, ESCO scheme is to be applied as competitive tendering for the conversion of street lighting. ESCO scheme application for business lighting efficiency increase. Regarding household and institutional lighting, invoice-based financing scheme is to be negotiated and offered by utilities and manufacturers.

Cities face a number of challenges in accessing finance and implementing innovative financial approaches. These barriers may include limited regulation on the applicability of financial ideas, difficulties in accessing capital funds, limited capacity to structure bankable, climate-smart projects, or a lack of consistency in policies. Increase access to finance for cities by removing barriers. One way to remove barriers is to use innovative financial instruments. Possible approaches include pooling projects or investments through aggregation; raising finance through bond issues; or providing new incentives such as financial guarantees.

The application of the following innovative financing instrument is to be assessed during 2023-24, when a gap analyses and feasibility study is to be prepared on the applicability of following instruments for the designed climate portfolio.

Potential financial instruments:

Green bond issuance on national, regional of municipal level: The green programme announced by the Magyar Nemzeti Bank in 2020 aims to encourage the development of the domestic bond market and the use of green funds. In addition to the green bond issuance programme for corporates, additional financing instruments may also become available to municipalities through green bond issuance in the future. At present, this is still hindered by **the Act CXCIV of 2011 on the Economic Stability of Hungary**.

(Green, sustainable) credit facilities: The city cannot finance investments, especially the green and digital transition solely from grant schemes, and it is necessary to use financial instruments, one of which is credit facility. Local government borrowing **is limited by Act CXCIV of 2011 on the Economic Stability of Hungary, and municipalities typically use the borrowing ceiling.**

Credit institutions have already launched green loan products to expand their portfolio of green financing instruments, which will continue to grow in the coming years, becoming an important tool for financing municipal or urban investments.

EIB facilities: the EIB (European Investment Bank) is the EU's lending arm, the world's largest financial institution and one of the biggest players in climate finance. The organisation also provides loans to public sector actors, including local authorities, to support their priorities, including climate action: climate and environmental sustainability, innovation and skills, infrastructure, SMEs, territorial cohesion, development. Loans are granted at favourable interest rates and with long maturities (up to 30 years) for amounts above €25 million up to 50% of the investment amount. The organisation also provides financial and technical support during project preparation. Another advantage of borrowing is that it also acts as a quality mark, making it easy for eligible projects to obtain additional funding. The loan can be taken out with an investment period of up to 3 years.

Reducing GHG emissions, climate adaptation and projects that support environmental sustainability (sustainable management of natural resources, biodiversity and the environment) are all supported objectives.Since 2019, the EIB has a dedicated target to increase its climate and environmental sustainability financing and to increase its share of total operations to 50% by 2025. Within this, the aim is to allocate around 15% of climate finance to climate adaptation projects by 2025, a tripling of project finance for this purpose compared to the last 5 years. Support for climate adaptation is laid down in the EIB's Adaptation Plan, which supports the EU's Adaptation Strategy.

Urban Development Capital Fund: the capital fund is the most effective way for cities to leverage additional resources on top of grants. Urban project portfolios need to be matched with a combination of resources that is appropriate to the business plans resulting from the preparatory project, which may include a grant and loan in addition to the capital investment.

As a financial product, a capital fund is a market financial instrument with return that provides funding for projects on terms that are more favourable than market conditions. The Municipal Capital Fund finances projects that are a priority for the Municipality, projects with a return on investment, but the rate of return is below the market rate of return, so they cannot be financed from the market, typically providing a return of 3-7%. For certain types of projects (energy development, major economic development, urban real estate development, etc.), it is assumed that some grants can be allocated to the projects. The creation of the Urban Capital Fund is a significant step towards strengthening cooperation between the municipality and the business sector.

Compliance with State aid rules

The Fund may only invest if the investment has an incentive effect as defined in Article 6 of **Commission Regulation 2023/1315/EU**. The General Block Exemption Regulation (GBER) defines the categories of aid under which aid granted is considered compatible with the State aid rules. The Regulation lays down common rules on exclusion criteria, aid content, rules on aid cumulation, notification thresholds and publication and information requirements.

Relevant aid titles:

- Regional urban development aid (Article 16 of GBER)
- Regional investment aid (Article 14 of GBER)
- Investment aid for energy efficiency measures (Article 38 of GBER): a category of aid specifically for energy efficiency measures in enterprises.
- Investment aid for the production of renewable energy (Art. 41 of GBER): Investment aid for the promotion of energy from renewable sources, of renewable hydrogen and of high-efficiency cogeneration

Blue Planet Capital Fund

Capital investment in businesses in the following areas:

- **Green energy:** renewable sources and efficiency improvements
- **Circular economy:** cooling solutions, circular solutions, efficiency improvements, material improvements, composting
- **Smart cities:** energy efficiency, clean energy, cooling, water supply, green roofs
- **Health and education:** family planning, health reproduction, extensive education
- **Climate-smart agriculture and food:** reducing waste, vegetable-focused consumption
- **Green transport:** compact cities, active transport, electromobility
- **Water protection:** sustainable water management, water engineering, water protection

Capital investment below HUF 100 million
Founders who have a clear concept of the market need for their product or service are invited to apply. Our capital fund will help your business to enter the market and build the necessary sales and management capacity by investing up to HUF 100 million in capital, provided it has a climate-protection outcome.

Capital investment between HUF 100-350 million
As an investor, they help to strengthen the product or service in the market or enter new markets by investing between HUF 100 and 350 million. Applications are accepted if the climate-related product or service is already generating revenue and has overcome the difficult task of entering the market.

Capital investment above HUF 350 million
They finance international market expansion, product and service development or infrastructure investment for businesses that can clearly demonstrate stable operations and demand for their product/service. Importantly, we are looking for climate-related investments with a proven track record in business, where the investment needs are above HUF 350 million.

It can be seen that, although innovative and innovative financial instruments have not yet been used by the municipality and a wide range of urban stakeholders, and in many cases there are legal obstacles, investments can still be made using traditional instruments. Diversification of financing instruments can accelerate the delivery of investments.

Climate Policy	Description of the policy (sector, targeted audience, etc.)	Intended Outcome for Capital Formation
Urban Development Fund	To fund emerging carbon reduction projects	Availability of capital for ongoing financing of emerging projects, continuous liquidity
Urban Development Fund	To fund emerging carbon reduction projects	Additional funding sources for projects classified as green/ sustainable according to the green bond underlying standard
Bank green loan schemes package offer	To support the renovation of existing housing stock	Available investment envelope to be used by Pécs to finance return on investment projects
Governmental Grant Schemes	To support the renovation of existing buildings, For the purchase of electric vehicles	Income-related banding supplement for renovation of buildings and purchase of electric cars
Green leasing schemes	For the purchase of electric vehicles	Incentive schemes to accelerate the transition to electric cars and vans
Carbon Fund	Offsetting green, NBS projects to implement	An initial fund with public support for carbon offsetting projects, complemented by contributions from the public and economic operators, on the basis of criteria to be defined
Selling surplus energy	The surplus energy generated by community projects can be sold to the grid or to nearby businesses, providing an additional source of income	The revenue stream will provide the opportunity for further climate-neutral projects

Table 9: Climate policies for capital accumulation

Priority projects:

Decarbonisation of heating	Decarbonisation of electricity	Reducing the volume of private motorised transport
Pétáv development: replacement of a 5 MW gas boiler	Building solar park capacity	Community planning programme to promote climate-friendly land use
Increasing heat production efficiency by reducing losses	Construction of urban energy storage capacity in cooperation with energy utilities	Promoting behavioural measures in transport, both for cars and lorries
Connection of institutional actors to district heating	Building electrolysis capacity in Tüskésrét	Contract scheme with large employers to reduce car use
Cleantech project: energy production and storage with deep thermal storage - preparatory R&D project	Building a hydrogen ecosystem	Development of an intelligent urban energy management and spatial information system - Optimising the use of public transport
Cleantech project: Conversion of hydrocarbon wells into geothermal wells	Preparing inter-regional innovation investments for the Central European Green Hydrogen Value Chain by developing a stakeholder participation scheme and setting up an IoT framework	Measures to reduce car traffic
Cleantech project: Exploration of the Pécs area for geothermal energy	Building solar energy capacity for city operations	Municipal measures in the field of transport
Cleantech project: Secondary raw material exploration, extraction and exploitation with a strong geological background	Building institutional solar capacity	GreenInCities
Cleantech project: Comprehensive development of the university knowledge base and competences for geological projects requiring a significant technical and specialist base	Building solar energy capacity for industrial and commercial units	Zero emission zones to be tested, where only electric, hydrogen and biogas cars can be driven
Piloting a soil probe heat pump system	Solar farm capacity building - with individual capacity expansion (small household power plants)	Rethinking the parking system
	Building residential storage capacity in partnership with energy utilities	

1.1 Module IP-C2: Identification and Mitigation of Risks

C-2.1 Risk management

Equity and social inequalities:

- Risk: Initiatives to reduce carbon emissions can disproportionately affect low-income communities if not implemented fairly. For example, the increased costs of energy efficiency upgrades may affect residents who are already struggling financially.

- Mitigation: prioritising inclusive planning, involving communities in decision-making and ensuring that policies take into account the needs of all residents, especially those who may be disadvantaged.

Gentrification and displacement:

- Risk: As urban areas undergo efforts to reduce carbon emissions, property values may rise, leading to gentrification and potentially displacement of long-time residents who can no longer afford to live there.

- Mitigation: implementing policies that protect affordable housing and investing in strategies that promote community stability.

Economic impact on industries:

- Risk: Some industries, such as fossil fuel-related sectors, could face economic challenges due to reduced demand as cities shift to cleaner energy sources and modes of transport.

- Mitigation: developing transition plans that include retraining programmes for affected workers and strategies for economic diversification.

Technological and infrastructure challenges:

- Risk: Adopting new technologies and upgrading infrastructure can be complex and costly, leading to project delays or technological barriers.

- Mitigation: thorough feasibility studies, investment in technological research and development, and well-planned and coordinated infrastructure upgrades.

Public resistance and acceptance:

- Risk: Some carbon-reducing measures, such as congestion charging or changes to transport options, may face resistance from the public due to concerns about convenience or perceived negative impacts.

- Mitigation: implement effective communication and public engagement strategies to inform residents about the benefits of reducing carbon emissions and involve them in decision-making.

Unintended consequences:

- Risk: Some carbon reduction initiatives may have unintended consequences, such as shifting emissions to neighbouring areas or increasing demand for other resource-intensive solutions.

- Mitigation: carry out a thorough impact assessment before implementing initiatives, monitor progress regularly, adjust strategies if unintended consequences arise.

Related challenges:

- Risk: Efforts to reduce urban carbon emissions may intersect with other urban challenges such as housing affordability, transport infrastructure and public health issues.

- Mitigation: a holistic approach to urban planning, taking into account how initiatives to reduce carbon emissions fit in with wider urban development objectives.

Lack of funding and investment:

- Risk: Insufficient financial resources or changing policy priorities may hamper the implementation of carbon reduction projects and policies.

- Mitigation: developing clear financing mechanisms, seeking public-private partnerships and supporting sustained investment in carbon reduction initiatives.

A complex regulatory environment:

- Risk: Complex regulatory frameworks and legal challenges related to land use, transport and energy could hamper implementation.

- Mitigation: working with legal experts, streamlining regulatory processes and working with relevant stakeholders to remove legal barriers.

Behaviour change resistance:

- Risk: Encouraging residents and businesses to adopt new behaviours and habits to reduce carbon emissions can be challenging due to inertia and resistance to change.

- Mitigation: developing engaging education campaigns, providing incentives for positive behaviour change and promoting the benefits of sustainable practices.

Risks Identified	Description of Risk	Mitigation of Risk	Fields of Action	Sectoral Project
Transportation	Reduced motorized passenger transportation need	Behaviour change resistance	Adopt new behaviours and habits to reduce carbon emissions can be challenging due to inertia and resistance to change	Developing engaging education campaigns, providing incentives for positive behaviour change
		Public resistance and acceptance	Some carbon-reducing measures may face resistance from the public due to concerns about convenience or perceived negative impacts.	Implementing effective communication and public engagement strategies to inform residents about the benefits of reducing carbon emissions and involve them in decision-making
		Related challenges	Efforts to reduce urban carbon emissions may intersect with other urban challenges	A holistic approach to urban planning is needed, taking into account how initiatives to reduce carbon emissions fit in with wider urban development objectives
	Shift to public & non-motorized transport	Behaviour change resistance	Adopt new behaviours and habits to reduce carbon emissions can be challenging due to inertia and resistance to change	Developing engaging education campaigns, providing incentives for positive behaviour change
	Increased car pooling	Behaviour change resistance	Adopt new behaviours and habits to reduce carbon emissions can be challenging due to inertia and resistance to change	Developing engaging education campaigns, providing incentives for positive behaviour change
	Electrification of cars + motorcycles	Equity and social inequalities	Initiatives to reduce carbon emissions can disproportionately affect low-income communities	Prioritising inclusive planning, involving communities in decision-making
		Lack of funding and investment	Insufficient financial resources or changing policy priorities may hamper the implementation of carbon reduction projects and policiesesistance to change	Developing clear financing mechanisms
	Electrification of buses	Complex regulatory environment	Legal challenges related to land use, transport could hamper implementation	Streamlining regulatory processes and working with relevant stakeholders to remove legal barriers
	Optimized logistics	Complex regulatory environment	Legal challenges related to land use, transport could hamper implementation	Streamlining regulatory processes and working with relevant stakeholders to remove legal barriers
		Unintended consequences	Such as shifting emissions to neighbouring areas or increasing demand for other resource-intensive solutions	Thorough impact assessment before implementing initiatives

Table 10: List of Project level Risks

Risks Identified	Description of Risk	Mitigation of Risk	Fields of Action	Sectoral Project
Transportation	Electrification of trucks	Technological and infrastructure challenges	Adopting new technologies and upgrading infrastructure can be complex and costly, leading to project delays or technological barriers	Technological and infrastructure challenges
		Lack of funding and investment	Insufficient financial resources or changing policy priorities may hamper the implementation of carbon reduction projects and policies	developing clear financing mechanisms
Built environment	Building renovations	Equity and social inequalities struggling financially	Low income households might be disadvantaged	Special programmes, schemes, and grants to be ensured
		Gentrification and displacement	Property values may rise, leading to gentrification and potentially displacement of long-time residents	Investing in strategies that promote community stability.
		Complex regulatory environment	Legal challenges related to energy could hamper implementation	Streamlining regulatory processes and working with relevant stakeholders to remove legal barriers
		Lack of funding and investment	Insufficient financial resources or changing policy priorities may hamper the implementation of carbon reduction projects and policies	Developing clear financing mechanisms
	New energy-efficient buildings	Complex regulatory environment	Legal challenges related to energy could hamper implementation	Streamlining regulatory processes and working with relevant stakeholders to remove legal barriers
	Efficient lighting & appliances	Lack of funding and investment	Insufficient financial resources or changing policy priorities may hamper the implementation of carbon reduction projects and policies	Developing clear financing mechanisms
	Decarbonizing heating generation	Gentrification and displacement	Property values may rise, leading to gentrification and potentially displacement of long-time residents	Investing in strategies that promote community stability
		Economic impact on industries	Economic challenges due to reduced demand as cities shift to cleaner energy sources	Developing transition plans
		Technological and infrastructure challenges	Adopting new technologies and upgrading infrastructure can be complex and costly, leading to project delays or technological barriers	Thorough feasibility studies, investment in technological research and development

Risks Identified	Description of Risk	Mitigation of Risk	Fields of Action	Sectoral Project
Built environment	Decarbonizing heating generation	Public resistance and acceptance	Some carbon-reducing measures may face resistance from the public due to concerns about convenience or perceived negative impacts	Implementing effective communication and public engagement strategies to inform residents about the benefits of reducing carbon emissions and involve them in decision-making
		Complex regulatory environment	Legal challenges related to energy could hamper implementation	Streamlining regulatory processes and working with relevant stakeholders to remove legal barriers
		Lack of funding and investment	Insufficient financial resources or changing policy priorities may hamper the implementation of carbon reduction projects and policies	Developing clear financing mechanisms
Energy generation	Decarbonizing electricity generation	Economic impact on industries	Economic challenges due to reduced demand as cities shift to cleaner energy sources	Developing transition plans
		Technological and infrastructure challenges	Adopting new technologies and upgrading infrastructure can be complex and costly, leading to project delays or technological barriers	Thorough feasibility studies, investment in technological research and development
		Complex regulatory environment	Legal challenges related to energy could hamper implementation	Streamlining regulatory processes and working with relevant stakeholders to remove legal barriers
Waste	Increased waste recycling	Complex regulatory environment	Legal challenges related to energy could hamper implementation	Streamlining regulatory processes and working with relevant stakeholders to remove legal barriers
		Lack of funding and investment	Insufficient financial resources or changing policy priorities may hamper the implementation of carbon reduction projects and policies	Developing clear financing mechanisms
Circular Economy	Circular Economy	Technological and infrastructure challenges	Adopting new technologies and upgrading infrastructure can be complex and costly, leading to project delays or technological barriers	Thorough feasibility studies, investment in technological research and development
		Complex regulatory environment	Legal challenges related to energy could hamper implementation	Streamlining regulatory processes and working with relevant stakeholders to remove legal barriers

Risks Identified	Description of Risk	Mitigation of Risk	Fields of Action	Sectoral Project
Green infrastructure and Nature Based Solutions	Green infrastructure and Nature Based Solutions	Complex regulatory environment	Legal challenges related to energy could hamper implementation	Streamlining regulatory processes and working with relevant stakeholders to remove legal barriers
		Lack of funding and investment	Insufficient financial resources or changing policy priorities may hamper the implementation of carbon reduction projects and policies	Developing clear financing mechanisms
City Wide Risks (Cross Cutting)	City Wide Risks (Cross Cutting)	Infrastructure Vulnerability	Aging infrastructure systems are not adequately prepared for the impacts of climate change	Systematic planning and modernization
		Extreme Weather Events	Extreme weather events, can disrupt city services, damage infrastructure	Application of nature based solutions
		Economic Disruption	Carbon-intensive industries and transportation will be phased out	Start re-training and qualification in relevant skills and job markets
		Governance and Policy Challenges	Political challenges, policy conflicts, and governance gaps that hinder progress	Cooperation and partnership

3.3 Module IP-C3: Capacity Building and Stakeholder Engagement for Capital and Investment Planning

C-3.1 Capacity building and stakeholder involvement in capital and investment planning

Achieving common goals is only possible if stakeholders feel ownership of the goals and can contribute to their development. This will create the willingness of the citizens to participate in the implementation of improvements. The city is committed to collaborative, participatory planning, which it has practised in the design of the integrated urban development strategy and sectoral strategies. The Urban Development Strategy is prepared through a partnership survey in which the public can express their views. The city of Pécs has an extensive network of relations at both meso- and macro-level to achieve environmental and climate mitigation goals.

Stakeholder cooperations in implementing the project portfolio:

- At the meso-level, the city's most important partner is the Baranya County Government, with which Pécs has jointly planned the county's strategic objectives. In the 2021-2027 EU development cycle, the County Government will be the intermediary body for OP Plus funds for regional and urban development at county level. In addition, the city maintains close contacts with all municipalities in the region, for example in the implementation of the Mecsek-Drava Waste Management Programme.

- On a macro level, the main sectoral partner in Pécs is the Hermann Ottó Institute, as well as other large cities (see Life Hungairy project). Another important partner is the University of Pécs, with which it collaborated in the planning of the SEAP, SECAP and the Integrated Urban Development Strategy, and is currently a consortium partner in the Green Aura project.

- The European Investment Bank has also been an important partner, financing the city's investment projects, in particular the European Capital of Culture programme, as well as territorial and urban development projects.

- It is important to note that the city, as a local government, has limited influence on the research, development and innovation sector, and therefore works in close partnership with the University of Pécs. The city is linked to the R&D sector in several ways: research infrastructure; provision of pilot sites for experimental programmes (e.g. waste management innovation, noise protection, noise control, air pollution prediction system). The city has excellent professional links with the University of Pécs, which is also participating in the LIFE project's pilot programme on energy and green inventory. The University of Pécs also plays an important role in local climate neutrality measures.

- For non-reimbursable projects that can be implemented with grant schemes

  Interested stakeholders: PTE, local government, citizens, NGOs, educational institutions, KRTK

  Sources of funding: Interreg Central, Danube Programme, Hungarian-Croatian Cross-border Programme, Horizon Europe, Life +, DIMOP, energy utilities, RRF, KEHOP Plusz, KÖZOP Plusz, TOP Plusz

  Actions to take: Resource mapping, exploiting grant opportunities to implement the portfolio

● Projects that are viable in the long term, can be implemented with blended finance and require support in the piloting phase.

Interested stakeholders: commercial bank, state guarantee scheme, Municipality Green Office, citizens, businesses, utilities

Sources of funding: RRF, Environment and Energy Operational Programme

Mainly for the renovation of the building stock, energy efficiencymeasures: Homeowners own sources, coordinated credit facility with repayment from savings, guarantee support, bill-based financing provided by utility providers, Green Office contractors, certification scheme

● Energy Efficiency Programs: Cooperation between the Municipality and energy utilities to implement energy efficiency programs. These partnerships can involve incentives, subsidies, and financing options for businesses and homeowners to invest in energy-saving measures.

● Community-Led Initiatives: Non-governmental organizations (NGOs) and community groups can collaborate with municipalities to secure grants, donations, and volunteer support for climate projects that address local needs and concerns.

● Sustainable Urban Development: Real estate developers, in coordination with the Municipality invest in sustainable urban development projects that include energy-efficient buildings, green spaces, and transit-oriented development.

● Technology and Innovation Partnerships: The Municipality partners with the University of Pécs and its divers research centers, innovation hubs, research institutions, and startups to develop and finance innovative climate solutions. These collaborations will lead to the development of new technologies and business models, eg. Hydrogen adoption, geothermal use, circular economy model.

Further innovative partnership possibilities for capital financing that Pécs intends to test:

● Community-Based Funding Initiatives: Crowdfunding: Communities and local organizations sometimes use crowdfunding platforms to raise funds for climate-related projects. For instance, a neighborhood might crowdfund to install solar panels on community buildings.

● Climate Funds: Cities can join or create multi-stakeholder coalitions or climate funds involving local, regional, and national governments, philanthropic organizations, and private sector partners. These funds pool financial resources for climate mitigation and adaptation projects.

● Cap-and-Trade Programs: The Municipality plans to participate in cap-and-trade programs, where businesses are required to limit their carbon emissions. The revenue generated from selling emissions allowances can be reinvested in climate transition projects within the jurisdiction.

Capacity building and stakeholder engagement are essential elements for successful capital and investment planning for the urban green transition. These processes ensure that local governments, organisations, communities and investors have the knowledge, skills and cooperation needed to effectively plan, finance and implement sustainable and green projects in cities. Here's how capacity building and stakeholder engagement can be integrated into the capital and investment planning process for an urban green transition:

Learning and capability development will focus on the following fields:

● Understanding of climate change science, including the drivers

● Understanding of energy sources, consumption patterns, and opportunities for energy efficiency and conservation

● Knowledge of financial mechanisms, including grants, public-private partnerships, and carbon pricing

● Ability to assess climate-related risks and develop mitigation and adaptation strategies.

● Knowledge of financial risk assessment for climate investments

● Exploring innovative financing models, technologies, and best practices. Capability to adapt to emerging climate solutions and technologies

Capacity building:

● Training and workshops: workshops, training for stakeholders on sustainable development concepts, green technologies, financing mechanisms and project management.

● Technical assistance: providing technical support, expertise and resources to stakeholders to better understand green initiatives, investment opportunities and feasibility assessments.

● Skills development: offering skills development programmes for local officials, urban planners, engineers and finance professionals to enable them to effectively evaluate, design and implement green projects.

● Data and research: facilitating access to data and research on urban sustainability, carbon reduction strategies and the economic benefits of green investment.

● Capacity building partnerships: working with universities, research institutes and international organisations to provide specific training and education programmes on the urban green transition.

Stakeholder involvement:

● Multi-stakeholder workshops: Organizing workshops that bring together a variety of stakeholders, including government officials, businesses, community representatives, investors and NGOs, to discuss urban green initiatives and investment strategies.

● Community involvement: engaging local communities through public consultations, town hall meetings and participatory processes to gather input, build support and ensure that projects are in line with community needs.

● Information campaigns: raising awareness of the benefits of the urban green transition, highlighting the economic, social and environmental benefits.

● Involving the private sector: engaging private sector actors, including banks, corporations and venture capitalists, to explore investment opportunities in sustainable infrastructure and technologies.

● Muli-level-governmental cooperation: facilitating cooperation between different levels of government to coordinate policies, regulations and funding mechanisms to support urban green initiatives.

● International Partnerships: working with international organisations, development agencies and donor institutions to provide global expertise, knowledge and funding for urban green projects.

● Transparent communication: maintaining open and transparent communication with stakeholders throughout the planning and implementation process, ensuring that they are kept informed of project progress and results.

● Feedback mechanisms: mechanisms should be put in place to gather feedback from stakeholders to fine-tune project designs, address concerns and adapt strategies based on their input.

By building capacity and integrating stakeholder engagement into capital and investment planning, cities can create a collaborative and informed environment that supports a successful transition to a more sustainable and resilient urban future. This approach helps ensure that investments are aligned with local priorities, gain support and deliver significant economic, social and environmental benefits.

Partners involved	Network	Influence	Interest	How to get involved
Utility companies, energy utilities Pétáv, MVM	Energy services	Citizens, institutions, businesses	Biomass and electricity-based energy supply	Mobilising own resources, supporting schemes through various instruments
Utility companies	Energy services, Buildings, transport		Efficient lighting, energy efficiency, energy-efficient large consumers, increasing the share of electric transport	providing invoice-based financing
PTE, local government, citizens, NGOs, educational institutions, KRTK	Energy services, buildings, transport, waste management, Green infrastructure development		social cohesion, education, awareness-raising, ecosystem building, research and development, surveys, data security	Ongoing resource tracking, tendering, project implementation
Commercial bank, state guarantee scheme, retail, PVF Zrt, Green Office	Buildings, transport		Decarbonisation of energy efficient buildings, heating and lighting, decarbonisation of car parks	Implementation of a complex scheme for the renovation of landfill
Urban Development Fund	Energy services, Buildings, transport, waste management		Energy efficient buildings, decarbonisation of heating and lighting, decarbonisation of car fleet, circular business models	Providing capital reconstruction for bankable projects
ESCO companies	Energy services, Building stock		Decarbonisation of energy efficient buildings, heating and lighting	Securing a viable ESCO-funded scheme through competitive tendering
Building contractors	Building stock			Accredited contractors for building renovation

Table 11: Contact involvement matrix

Subsector and investee matrix of investment needs

C-3.2: Owners of assets - CAPEX / Pre-investment (current prices, EUR million)							
Sector	**Subsector**	**Citizens and institutions**	**Enterprises (industry and commerce)**	**Eco-government**	**Transport service providers**	**Energy producers**	**TOTAL**
Transport	Reduced demand for motorised passenger transport	€ -	€ -	€ -	€ -	€ -	€ -
	Switch to public transport and non-motorised transport	€ (3)	€ -	€ (0)	€ (3)	€ -	€ (6)
	Enhanced car-pooling communities	€ -	€ -	€ -	€ -	€ -	€ -
	Electrification of passenger cars and motorcycles	€ (20)	€ (3)	€ (0)	€ -	€ -	€ (24)
	The electrification of buses	€ -	€ -	€ -	€ (8)	€ -	€ (8)
	Optimised logistics	€ -	€ -	€ -	€ -	€ -	€ -
	Electrification of lorries	€ -	€ (19)	€ (3)	€ (98)	€ -	€ (119)
Bulding and heating	Building renovations (cladding)	€ (141)	€ (50)	€ (10)	€ -	€ -	€ (201)
	New, energy-efficient buildings	€ (1)	€ (2)	€ (0)	€ -	€ -	€ (4)
	Efficient lighting and appliances	€ (64)	€ (23)	€ (5)	€ -	€ -	€ (92)
	Decarbonising heating production	€ (20)	€ (7)	€ (51)	€ -	€ (197)	€ (275)
Electricity	Decarbonising electricity generation	€ (2)	€ (1)	€ (0)	€ -	€ (25)	€ (27)
Waste	Increased waste recycling	€ -	€ -	€ 0	€ -	€ -	€ 0
SUMMARY		**€ (251)**	**€ (105)**	**€ (69)**	**€ (109)**	**€ (222)**	**€ (756)**
% OF TOTAL		**33%**	**14%**	**9%**	**14%**	**29%**	**100%**
Euro per capita (2030 citizens)		**€ (1,844)**	**€ (771)**	**€ (507)**	**€ (797)**	**€ (1,625)**	**€ (5,545)**

** Note: negative numbers represent cash outflows (investment/cost), positive numbers represent cash inflows (savings/benefits).*