Kraków

CLIMATE CITY CONTRACT OF KRAKOW

NET ZERO CITIES

EU MISSION PLATFORM | CLIMATE NEUTRAL AND SMART CITIES

Climate City Contract of Krakow

Roadmap for climate neutrality by 2030

Kraków

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Summary

The Climate Contract Action Plan is a document that comprehensively describes the pathway for Kraków to achieve climate neutrality by 2030.

It is therefore a document showing the approach to the gap between ongoing and planned projects and the further actions needed to achieve climate neutrality.

The contract is based on the Economic Model prepared for us by experts from the Technical University of Madrid (*Universidad Politécnica de Madrid)* and data from our own Emissions Inventory, as well as strategic management documents at various levels, the City Budget and the Multiannual Financial Forecast.

The target adopted in the Climate Contract for Krakow is to reduce greenhouse gas emissions by 80% by 2030 compared to 2018. A large part of the emission reduction (approx. 4 473 thousand tCO_2e) will result from actions implemented after 2018 or planned in strategic documents of the city and the Polish government. The contract includes a detailed description of an additional 58 actions that should be taken to achieve additional emission reductions of approximately 1,614 thousand tCO_2e. The cost of these measures was estimated at PLN 28,769 million.

However, the calculations of the Economic Model indicate that the total financial, direct and indirect benefits (reduced energy expenditure, health care, additional jobs, etc.) outweigh the costs of the transition. Emission reductions will overwhelmingly result from the implementation of national strategies, implemented by private actors: energy companies, businesses and building owners and managers. Eight key types of action on the road to climate neutrality:

1. Decarbonisation of the district heating system;
2. The development of citizen energy communities;
3. Renovation of municipal public buildings;
4. Modernisation of road and square lighting;
5. The construction of the metro and the development of rail transport;
6. Renovation of residential buildings and development sites;
7. Increasing resilience to the effects of climate change;
8. Involving citizens, entrepreneurs in city management.

The document shows what needs to be done to achieve climate neutrality for the city, while recognising the scale and complexity of the challenge and the difficulties that implementation may encounter.

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Abbreviations and acronyms

Abbreviations and acronyms	Definition
AFOLU	Agriculture, forestry and land use
AMP	ArcerolMittal Poland
CO_2	Carbon dioxide
CO2e	Carbon dioxide equivalent
c.o.	Central heating
c.w.u.	Domestic hot water
CCS	Carbon capture and storage (carbon sequestration)
CCU	Carbon capture and utilisation
e.c.	Thermal energy
e.e.	Electricity
g	Gram
CE	Circular Economy
GPC	Global Protocol for Community-Scale Greenhouse Gas Inventories
GWh	Gigawatt hour
i.e.	Included elsewhere
IPPU	Industry and industrial processes
IPCC	Intergovernmental Panel on Climate Change
KHK	Krakow Municipal Holding S.A.
KOBiZE	National Balancing and Emission Management Centre
KEGW	Climate - Energy - Water Management
KPEiK	National Energy and Climate Plan until 2030
KW	Kilowatt

KWh	Kilowatt hour
KWp	Kilowattopik
MPEC	Municipal Heating Company S.A.
MPK	Municipal Public Transport Company S.A.
MW	Megawat
MWh	Megawatt hour
NGO	Non-governmental organisations
N/D	Not applicable
NZC	NetZeroCities
RES	Renewable energy sources
PEP2040	Energy Policy of Poland until 2040
PGE	Polish Energy Group
RPDKiE	Regional Climate and Energy Action Plan
SECAP	Sustainable Energy and Climate Action Plan
SMK	Krakow Metropolis Association
t	Ton
WMK	Waterworks of the City of Krakow S.A.
ZBK	Municipal Buildings Administration
ZIT	Integrated Territorial Investments
ZTPO	Thermal Waste Treatment Plant.

1 Introduction

Global challenges

The climate crisis is the result of global warming, resulting from greenhouse gas emissions at a rate not previously known in the history of the world. It is anthropogenic in nature and its main cause is the burning of fossil fuels (coal, natural gas, oil). The climate crisis is deeply linked to lifestyles (the way we consume and produce). It stems from structural flaws in our economic system (growth based on resource exploitation) and social system (inequitable distribution of wealth).

Global warming is accompanied by an environmental crisis resulting from the overexploitation of natural resources. The earth is limited in size and resources, and economic development is based on their exploitation. We are facing the sixth great extinction of species, the scale of extinction is 1000 times faster than the average for the biosphere. Every hour, 3 species are disappearing worldwide. The main causes are the degradation and disappearance of habitats suitable for species, the invasion of non-native species in a given environment that displace native species, the proliferation of barriers in the form of roads or dams and the overexploitation of economically exploited species.

Another challenge is the social crisis resulting from the unequal distribution of earned value. Profits are captured by a small group of people. Social inequalities are growing. The poorest half of the world owns only 2% of global wealth, while the richest 10% own 76%, with the richest 1% owning 38% of global wealth. The bottom 50% of the population receives only 8% of the value of global income, while 52% of income goes to the 10% richest, with the 1% richest receiving as much as 19%.

The actions planned by individual countries to reduce greenhouse gas emissions will not be sufficient to achieve the targets agreed under the 2015 Paris Agreement. According to World Energy Outlook 2021 (WEO 2021) report, published by the International Energy Agency (IEA), the commitments currently made to global efforts to meet climate targets cover less than 20% of the existing emissions gap that needs to be closed by 2030 to maintain the 1.5°C target.

Kraków as a city of green innovation

Often referred to as the heart of Poland, Krakow is a city with a rich history deeply rooted in culture, science and art. Located in southern Poland on the Vistula River, as the second largest city in Poland, Krakow is one of the oldest and most beautiful cities in Europe. Its history dates back thousands of years, making it one of the most important cultural centres in the region. It was the former capital of Poland and the seat of Polish kings for many centuries, which contributed to its rich architectural and cultural heritage.

Krakow is also a scientific and academic centre, with as many as 23 prestigious universities, such as the Jagiellonian University, one of the oldest universities in Central Europe, the AGH University of Science and Technology, the Cracow University of Technology and the Academy of Fine Arts. It is a place where art, science and culture have flourished for centuries, attracting intellectuals and artists. Today, Krakow is also a dynamically developing urban centre that strives to reconcile tradition with modernity. It is also a

city that is making efforts towards sustainable development, aiming to improve the quality of life of its inhabitants while preserving its unique cultural heritage.

Krakow is also a leader in innovative solutions related to environmental protection and climate protection. Through the consistent implementation of programmes, Krakow aims to preserve its identity and care for the future, as do many other European cities. The fight against low emissions in Krakow began many years ago, and the city was a pioneer in Poland by introducing a ban on solid fuels in 2019. However, there are still many challenges for Krakow, including reducing emissions from transport, saving energy and developing green spaces to combat climate change.

The City's ongoing transformation programmes towards zero-carbon and green public space, such as the Clean Transport Zone and energy efficiency improvements in buildings, pose a major financial challenge for the local government as well as for residents and businesses. Consequently, the search for appropriate sources of funding is now a priority. As Krakow strives to become a zero-emission city, it must also deal with social and structural challenges and structural challenges, such as fuel poverty and transport exclusion. The development of low-carbon buildings and public transport can contribute to solving not only climate problems, but also social problems.

As a dynamically developing city, Krakow demonstrates that it is possible to harmoniously combine intensive development with respect for historical heritage. The city's programmes aimed at combating smog, segregating rubbish or developing green spaces are a step towards more sustainable development.

Despite the many difficulties associated with the lack of systemic solutions at national level, Krakow has consistently made efforts to reduce air pollution and modernise public transport. As a result, the city is becoming an example to other cities on how to effectively act to protect the environment and climate while maintaining the unique character of the place.

In the face of the growing climate crisis, the need for urban transformation is inevitable. It is necessary to mobilise the efforts of many communities including: citizens, scientists, entrepreneurs, local government, urban planners and many others, in order to adapt the urban fabric to a dynamic changing reality. Changes in thinking, attitudes and behaviour are required.

Krakow in figures

Krakow is the second largest city in Poland in terms of population, with an official population of 771,069 in 2018 (the base year of the Climate Contract). Women (411,204) outnumber men (359,865) in the city. The city's area, however, is 327 km^2, which translates into a fairly high population density of 2358 persons/km^2. Due to a positive natural increase and a positive migration balance, the number of inhabitants is increasing year on year.

Kraków is also a city of prospects. The unemployment rate in 2018 was just 2.4% (2.3% in 2022). In 2018, around 140,500 companies were registered (around 168,000 in 2022) and the city has more than 4,500 commercial companies with foreign capital. Important sectors that stand out economically are tourism, university activities and cultural activities.

The largest sector generating emissions (around 93%) in the city is the provision of electricity and heat to buildings. It is worth noting at this point that less than 700 public buildings are at the disposal of the municipality (about 0.6% of all buildings in the city) and they are being successively thermo-modernised and equipped with RES installations. The remaining emissions are generated by transport (about 7%) and, to a small extent, waste management.

In order to achieve zero emissions for all buildings in the city, it is necessary to involve other actors: private property owners, entrepreneurs or housing associations that can significantly change the unfavourable balance of emissions.

Krakow's impetus for action

In 2021, Krakow's first citizen assembly, the Krakow Climate Assembly, was held to discuss climate change and the city's climate neutrality. It was attended by a group of citizens, representative of the whole city in terms of socio-demographic and spatial characteristics: gender, age group, district of residence and education level. The aim of the Climate Assembly was:

- increasing the focus of public awareness discussions around the climate crisis;
- to build a climate transition supportive community of: residents, experts, community organisations and businesses;
- gathering a pool of ideas on energy efficiency and the use of renewable energy;
- to obtain recommendations for joint action by the city and residents;
- gaining broad acceptance for the city's transformation efforts.

The Krakow Climate Assembly was a success. The result of its work was the development 32 high quality recommendations which, according to the adopted assumptions, are binding for the Mayor of the City of Krakow.

Recommendations concern many areas of city functioning. They are often interdisciplinary and cross-cutting in nature, which is why many municipal departments, teams and units are involved in their implementation. Their scope and subject matter vary, hence each requires an individual approach and planning as well as the provision of financial resources for their implementation.

The first and most important recommendation adopted by the Climate Assembly is to develop a Climate Strategy for Krakow. This objective underlines Krakow's ambition to achieve climate neutrality as soon as possible. The strategy is to be developed in a participatory manner and the work on its creation and implementation should be coordinated by a team or unit specially appointed by the Mayor. The progress of the work is to be reported annually, and the Strategy is to be regularly evaluated in order to adapt the objectives described in it and the adopted paths of action to current scientific knowledge and technological possibilities, provided that the adopted objectives are not lowered.

To this end, the City of Krakow has decided to join the Mission of 100 Neutral and Smart Cities by 2030 and to develop a Climate Contract, which is the aforementioned Climate Strategy for Krakow.

In addition, Krakow always takes into account the voices of diverse groups of citizens when preparing key documents for the development of the city. Cooperation with stakeholders, including with residents, businesses and non-governmental organisations, is an institutionalised process, regulated

by law, carried out on a continuous basis, not *ad hoc*. In the city, a number of consultations are held with various social groups during the development of strategic documents, which are acts of local law. The result of these consultations are documents co-created with the inhabitants, taking into account their ideas and their vision of Krakow's future.

The procedure for the conduct of public consultations in the Municipality of Krakow is clear and based on a number of legal regulations aimed at ensuring the participation of residents and non-governmental organisations (NGOs) in the decision-making process concerning the life of the city. The entire procedure is defined by the Resolution of the Kraków City Council, of 26 September 2018, on the principles and procedure of conducting consultations with the residents of the Municipality of Kraków and with the Kraków Council for Public Benefit Activity or non-governmental organisations and entities referred to in Article 3(3) of the Act of 24 April 2003 on public benefit activity and volunteerism on drafts of local laws in areas concerning the statutory activity of these organisations.
An abbreviated description of this procedure is as follows:

1. **Initiation of consultations**: Consultations can be initiated by the Mayor of the City of Krakow, the City Council, and various institutions, groups of residents, and NGOs.
2. **Requesting consultations**: Persons or institutions interested in carrying out consultations shall submit an appropriate request to the Mayor, including a description of the subject of the consultation, a proposal for the form, a justification and possible annexes.
3. **Publicity of the consultation**: The consultation is publicly announced and the nature of its conduct in a transparent manner takes into account the various forms of dialogue with residents and NGOs.
4. **Communicating the** consultation: Information about the consultation is widely disseminated through various communication channels such as websites, notice boards and posters.
5. **Provision of information material**: The organisational cell responsible for the consultation shall provide access to documents and factual information relating to the consultation.
6. **Duration of consultations**: Consultations shall last at least 21 days and should be carried out at times convenient for residents and NGOs (e.g. the last five days of the consultation shall not take place on public holidays).
7. **Evaluation of the consultation**: At the end of the consultation, the Mayor prepares a report containing the opinions and comments collected, which is made public and forwarded to the City Council.
8. **Introduction of changes**: The resolution introduces procedures for bylaws for the introduction of amendments resulting from public consultations with both residents and NGOs.

This brief characterisation shows that the process of public consultation in the Municipality of Krakow is based on transparency, openness to dialogue and the active involvement of residents and NGOs.

Krakow in cooperation with science and business

Kraków has been consistently working towards climate neutrality for years, implementing sectoral programmes in various areas, such as increasing the use of renewable energy, energy efficiency or transport accessibility. To participate in climate and environmental initiatives, the City of Krakow invites representatives from all walks of life, local government organisations, business, science and residents.

Krakow is implementing a joint purpose agreement between the Municipality of Krakow and the Krakow Science and Academic Centre, signed by 21 entities (GMK, members of the College of Rectors of Higher Education in Krakow, PAU). The main objective of the document is to intensify cooperation with KONA and use its potential for the sustainable and intelligent development of Krakow, in line with the in line with the provisions of the Kraków Development Strategy "Here I want to live. Kraków 2030".

The draft Krakow Cooperation Programme with KONA for 2024-2029 was prepared in accordance with the provisions of the Krakow Development Strategy "Here I want to live. Krakow 2030" and the agreement for the implementation of the joint objective concluded in 2021 between the Municipality of Krakow and representatives of the Krakow Science and Academic Centre.

Businesses making efforts to achieve this ambitious goal play a special role in Kraków's climate transformation process. The City of Krakow values and supports them and encourages long-term cooperation in this area, to create a platform for the exchange of experience between companies involved in climate action, to promote pro-climate solutions and ultimately to reduce emissions resulting from their activities.

In order to realise these assumptions, an initiative called the Pact for the Climate was created and addressed, among others, to Kraków's entrepreneurs, solemnly inaugurated at a meeting with representatives of the Kraków City Hall. During the meeting, representatives of participating companies had the opportunity to present their good practices and pro-climate and pro-environmental initiatives. This part of the meeting showed that the companies that responded positively to the city's initiative understand the urgent need to intensify their efforts to improve the quality of the environment, which is key to building a safe and healthy place to work and rest for all residents. They represent a great potential and a promise that green Krakow, through the joint efforts of the local government, business and other key Krakow communities, will soon become a reality.

The initiative aimed at Krakow's business sector is in line with the city's strategy to achieve climate neutrality as soon as possible under conditions of equitable transformation, as well as with the expectations of residents expressed during the work of the first Krakow Climate Assembly, which were recorded in 32 recommendations. In the opinion of the representative group participating in the Assembly, one of the important activities in the near future should be the creation of a space for cooperation and dialogue on Krakow's climate transformation taking into account diverse stakeholders and maintaining transparency.

To date, the following have signed up to *the Climate Pact*:

1. ASTOR.
2. AstraZeneca.
3. BP.
4. BWI Group.
5. CANAL+.
6. CH2M Poland Services.
7. Columbus Energy.
8. InPost.
9. Jacobs.
10. Lewiatan Confederation.
11. Kraków Technology Park.
12. Regional Expert Centre Southern Poland.

13. Shell.
14. SIG.
15. University of Economics.
16. University of Agriculture.

Krakow at regional level

Krakow also expresses its ambitions by cooperating with higher-level bodies to actively participate in shaping the situation at both regional and national level. This is why the city works closely with the Marshal's Office of the Małopolska Region. One of the key activities is the implementation of the Małopolskie Voivodeship Regional Climate and Energy Action Plan (RPDKiE) through various initiatives. An example of such action is the LIFE-IP EKOMAŁOPOLSKA project, which aims to comprehensively implement the RPDKiE, to support the implementation of the National Energy and Climate Plan 2021-2030 and the new EU strategy, the European Green Deal.

One of the aims of the project is to set up a network of climate and environmental advisors in 21 districts of Malopolska. The concept for the network was developed in cooperation with the districts during the technical assistance phase. The advisors are employed directly in the districts and cooperate with the Marshal's Office at regional level and with the municipalities (including the City of Kraków) at local level. The main task of the advisors is the effective implementation of the measures set out in the RPDKiE, including:

- implementation of activities in line with the LAPD;
- assisting municipalities in developing strategic energy and climate management documents and plans, and integrating these issues with other municipal plans and strategies;
- Supporting municipalities in applying for financing for RES installations, thermal modernisation of buildings, low-carbon construction, sustainable transport, energy reduction and adaptation to climate change;
- Apply for funding for climate change mitigation and adaptation measures at county level.

In addition, Krakow is implementing remedial measures indicated for implementation in the Air Protection Programme for the Małopolskie Voivodeship, adopted by the Małopolskie Voivodeship Assembly on 20 November 2023. This programme is a binding act of local law and introduces remedial measures aimed at a gradual improvement of air quality in Małopolska, which is one of the one of the key elements of climate protection.

The document provides a detailed analysis of air quality in the region and provides for long-term and short-term corrective measures. In addition, it sets out guidelines for the use of solid fuels. Corrective measures focus on three areas: reduction of low emissions, emissions from transport and industrial emissions. The Air Protection Programme imposes tasks on all levels of local government (including the City of Krakow) and selected sectors of the economy.

Krakow at national level

As at the regional level, the City of Kraków is active at the national level. An important undertaking is to participate in the implementation of the National Urban Policy 2030.

The National Urban Policy sets out directions for the development of cities to be citizen-friendly and attractive for business. Polish cities should develop in a sustainable manner, while at the same time being strong centres of development at the regional and local level. In order to achieve this, it is necessary, inter alia, to counteract spatial chaos, to involve inhabitants in the urban management process, promoting sustainable urban mobility and taking measures to reduce emissions and energy efficiency.

The National Urban Policy 2030 defines concrete actions of the government administration in the legal, financial and organisational areas to support urban development. As a result, local authorities and local communities should be equipped with the appropriate tools and opportunities for action.

The City of Krakow actively participated in the inaugural meeting of the working team of the National Urban Policy 2030, which was attended by representatives of ministries (e.g. MFiPR, MKiŚ), the Institute of Environmental Protection and local government organisations at various levels. In addition, the meeting was attended by representatives of other Polish cities participating in the European Mission of 100 Climate Neutral and Smart Cities by 2030.

Krakow's climate-smart cooperation with other actors is also implemented through the city's activities within its umbrella organisations, for example through the Union of Polish Metropolises. Topics concerning the prevention of climate change and the adaptation of cities to these changes are the subject of the Commission's work. Cooperation within the Union of Polish Metropolises allows important topics to be worked on among those dealing with them in individual cities, with the support of external experts, and the voice of the twelve cities that make up the Union is heard more clearly than that of each of the member cities individually. An example of an initiative taken by the UMP is the appeal to the Prime Minister of the Republic of Poland to amend the "Warm Housing" programme so that its provisions respond to the needs of the inhabitants and are in line with their real situation, and to enable the largest group of beneficiaries to receive financial support. Currently, following the introduction of changes to the Ciepłe Mieszkanie programme, the Municipality of Krakow is implementing the programme in the area of housing communities of three to seven flats.

Another example of national cooperation is the Climate Commission of the Association of Polish Cities - which was set up on the initiative of Krakow's Mayor Jacek Majchrowski. The cities participating in the Commission's work want to learn from each other, undertake joint initiatives and work towards legal changes to build pro-climate urban policies and promote systemic solutions.

Cooperation with Ministries

In the cooperation carried out at the national level, a special place is given to the activity undertaken with ministries, in particular the Ministry of Climate and Environment, the Ministry of Funds and Regional Policy, the Ministry of Development and Technology and the Ministry of Science and Higher Education. This collaboration is sustained through specialised platforms, such as CapaCITIES, but also through face-to-face online and live meetings, in Warsaw, among representatives of ministries, Polish City Mission cities, with the support of NetZeroCities advisors and representatives of the European Commission. The aim of this collaboration is to trigger positive legal changes, much needed in terms of legislation for the implementation of pro-climate measures, but also to mobilise public capital to support action.

In 2024, such meetings with the government side were held on average one to two times per month. Taking pro-climate measures, reducing emissions and adapting cities to climate change are actions that stem from EU commitments made at government level. In view of this, the actions that cities wish to voluntarily implement are part of government policy, enable the achievement of the indicators to which the government has committed, and are an effective tool for achieving the targets. It is therefore not surprising that ministries are involved and working together to create a climate-friendly environment. The only concern is the relatively low rate at which the commitment of the government side is increasing.

Future vision for Krakow

The vision of the city of the future - Krakow in 2050 - was developed by specialists in various fields and representatives of many stakeholder groups. Representatives of universities, district councils, local government and independent civic organisations took part in the process. Experience from the European projects EIT Climate-KIC Deep Demonstration Healthy Clean Cities, EU Mission 100 Climate-Neutral and Smart Cities by 2030 and Atelier were used. Concepts developed in European metropolises with ambitious sustainability plans were also taken into account.

In 2050, the majority of residents of Malopolska will live in large cities, primarily Krakow. As the amount of available space for new residents in Krakow is limited, many people choose to settle in the neighbouring municipalities. Although they are not formally recognised as residents of Krakow, their settlement in the area is closely linked to Krakow as they become daily users of the city. According to the "Demographic Forecast for the Kraków Urban Functional Area (MOF) for 2022-2050 by 25 municipalities, taking into account the forecast for Kraków" concerning the Kraków Metropolitan Area, approximately 1,030,000 people lived in the metropolitan area in 2018. In contrast, forecasts for 2050 indicate an increase to almost 1,200,000 inhabitants. It is therefore becoming necessary to adapt the urban structure accordingly and to meet many urban, environmental and technical challenges. Attractive spaces, streets suitable for walking and cycling and efficient public transport will ensure the free enjoyment of urban life. The city will become safe, efficient and comfortable thanks to the efforts of many communities and the consistent implementation of strategies, policies and plans for a clean environment, adaptation to climate change or the development of transport infrastructure. Defining what kind of city we want to live in in 2050 is meant to help stakeholders make strategic decisions now in order to achieve ambitious goals in the future.

Ambitious goals

The objective of the Climate Contract is to present a pathway for action to reduce emissions by 80% compared to the base year. To achieve this, it is necessary to accurately identify the reduction potentials arising from policies and strategies and complement them with local actions.

There are currently a great many plans, strategies and resolutions influencing the environment and climate in Krakow. These documents can be divided into local, created for the needs of the Municipality of Krakow, regional, addressing the whole of the Lesser Poland Voivodeship, national and EU. They also address various emission sectors. In the context of the Climate Contract, most documents focus on sectors related to energy generation and construction, which fits perfectly with the needs of the city's transformation, as these sectors account for over 90% of the city's emissions. A detailed description of the

documents that were used for the Climate Contract analyses can be found in module 'A-2 Assessment of current strategies, policies and strategic management instruments'. The projected reduction in emissions relative to the base year (2018) based on current policies and taking into account the decrease in emissions from the industrial sector between 2018 and 2022 is 59%.

This means that 21% of emissions remain to be reduced through the measures proposed in the Climate Contract. A detailed list of measures with their description, responsible entity and financial data can be found in the module "B-2 Designing the Climate Neutrality Portfolio".

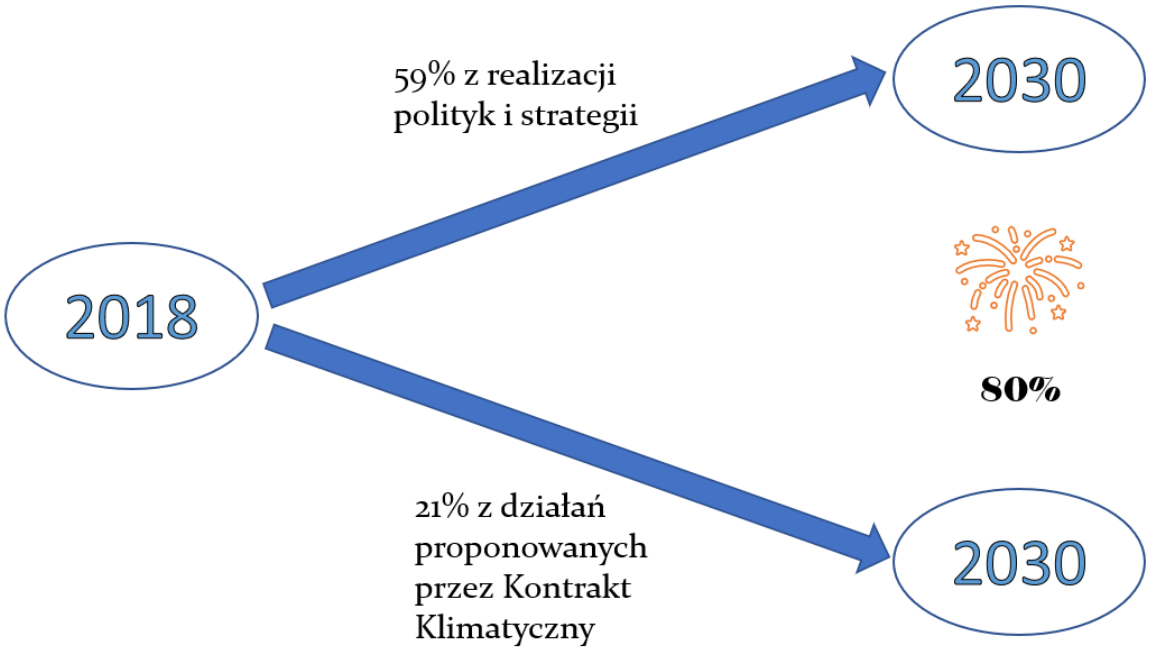


Fig. 1. Schematic of the linkage of policies and strategies from module 'A-2 Assessment of current strategic management strategies, policies and instruments' and activities from module 'B-2 Designing a climate neutrality portfolio'.

In addition to reducing greenhouse gas emissions, the energy transition brings many other benefits to residents. Job creation, lower energy bills and reduced air pollution are just some of the benefits that have a positive impact on the city. All identified non-financial benefits are described in more detail in the chapter 'Module B-1 Climate neutrality scenarios and impact pathways'.

Status of current activities

The starting year for the analysis carried out under the Climate Contract is 2018. Since then, until the contract was developed and published, the City of Krakow has made a lot of efforts in the context of combating climate change and air protection. Data from the Greenhouse Gas Emission Inventory, which is carried out annually in Krakow, shows that greenhouse gas emissions in 2022 have decreased by as much as 34% compared to 2018. If this trend of change is maintained, achieving the mission goal of reducing greenhouse gas emissions by 80% becomes realistically feasible.

However, it should be borne in mind that the base year for the Climate Contract is 2018 and the document goes on to show an 80% reduction by 2030. The above description is only intended to show the impact of the city's actions on climate protection in the last few years.

Relation to other parts of the Contract

The Climate Neutrality Action Plan to 2030, is the second part of the Climate Contract, which focuses on the actions taken to reduce greenhouse gas emissions. This part is closely linked to the Investment Plan, which describes the financing options for the actions listed in this chapter. To calculate the emission reductions, the tool of the Economic Model was used, which, for a target emission reduction of 80%, calculates the estimated costs of actions by sector and for specific investing entities. The Economic Model used in this chapter is a tool that strongly integrates the whole document with each other, linking GHG reductions to specific costs. The Climate Neutrality Mandate and the signatures of the assembled stakeholders in support of actions resulting from the from the Climate Contract, which are briefly described in this section, are further discussed in Part One - Provisions.

Climate Contract process

The unit responsible for the creation of the Climate Contract is the Department of Municipal Economy and Climate of the City of Krakow, and the authors are Grzegorz Grzybczyk and Adam Stawiarski working in the Department of Municipal Infrastructure. As part of intra-departmental cooperation, many of the data on the city's baseline were consulted with other departmental papers, in particular the Department of Energy and the Department of Waste Management. During the development of the Climate Contract, the different versions were consulted with other municipal departments and units, such as Climate - Energy - Water Management, the Air Quality Department or the Strategy, Planning and Investment Monitoring Department.

As part of expert cooperation in the climate area, a special team called the Zero Emission Krakow Portfolio Advisory Team was established. These experts were presented with a preliminary version of the Climate Contract Action Plan for consultation, to which they introduced comments and suggestions and proposed some of the emission reduction measures in the Action Plan. The team consists of:

1. Prof. Tomasz Bergier - AGH University of Science and Technology in Krakow;
2. Anita Cieślicka - Energy Forum;
3. Andrzej Guła - Krakow Smog Alarm;
4. Włodzimierz Jakubas - SIG;
5. Aleksandra Latocha - Trainer and facilitator;
6. Justyna Linke - Hyperlocal;
7. Monika Machowska - Kraków Technology Park;
8. Grzegorz Majewski - Astor;
9. Prof. Dr. Łukasz Mamica - Cracow University of Economics;
10. Prof. Elżbieta Nachlik - Cracow University of Technology;
11. Krzysztof Podgórski - MZP Lewiatan;
12. D. Eng. arch. Kinga Racoń Leja, Prof. PK - Cracow University of Technology;
13. Agnieszka Rozwadowska - Columbus Energy;
14. Katarzyna Stanislawiak - AstraZeneca;

15. Agnieszka Sznyk - INNOWO;
16. Prof. Barbara Worek - Jagiellonian University;
17. Daniel Wrzoszczyk - Kraków Metropolia Association;
18. Grzegorz Żebrowski - PGE Energia Ciepła.

The work on the Contract was also assisted by a number of other external experts. A very strong substantive contribution was made by experts employed by NetZeroCities, in particular:

1. Experts from the Technical University of Madrid, responsible for the preparation and development of the Economic Model, particularly Sean Murray and Julio Lumbreras.
2. City Advisors consulting on progress, discussing difficult issues and problems, and organising training workshops for those responsible for the development of the Contract - Justyna Wieczorkiewicz-Molendo and Anna Sokołowska.
3. Experts from the World Bank who provided numerous comments, amendments and advice affecting the readability of the Climate Contract, notably Marcel Ionescu-Heroiu, Ionut Tudor Maries, Codruta Nistor and Mariusz Krisztea.

In addition, the work on the Contract was consulted with teams (*transition teams*) of other Polish cities participating in the mission - Łódź, Rzeszów, Warsaw and Wrocław. As part of this interaction/knowledge sharing, it was possible to develop a number of solutions taking into account nationwide specificities. It has also resulted in cooperation with authorities at national level, including individual ministries.

What about after the Contract?

Submitting the Climate Contract to NetZeroCities' experts and having it assessed by specialists from the European Commission, and - we hope - getting it approved (*Mission Label*) does not end the process of working with the document. The next stage is its implementation. The Climate Contract for Krakow is a kind of climate strategy for the city, complementing and detailing the Climate Strategy. and detailing the Krakow Development Strategy. All municipal departments, units and companies will be involved in its implementation, although to varying degrees, which is due to the specific nature of their activities and scope of work.

The commitments made in the Contract do not only concern the local government. Its implementation will also involve other entities, from the business sector, academia, government administration, NGOs and representatives of other communities. Moreover, it seems reasonable to expect that the group of entities and persons involved in pro-climate actions, as well as the number of actions, will be grow significantly in the coming years. This will entail the need to develop cooperation, as well as to introduce changes and additions to the contract document itself.

The first update of the Climate Contract is planned two years after its adoption. It can be expected to introduce many changes and improvements, especially in the funding mechanisms for the measures described in the Investment Plan section. It is planned that the second iteration will take place in 2028, and in 2030 it is envisaged to verify that the objectives of the contract have been met.

Information on the progress of the Climate Contract will also be provided by the Urban Greenhouse Gas Emissions Inventory, which is updated annually, enabling the annual monitoring of the decrease in emissions compared to the base year - a key objective of the Climate Contract and the Urban Mission.

An additional element requiring modification will be the review of policies and strategies. Most of these are also subject to a two-year iteration cycle. Partial updates to the Climate Contract will result from the re-examination of these policies.

Along with the biennial review period, the activities arising from the module will also be updated. "B-2 Climate Neutrality Portfolio Design". The status of the tasks, whether they have been completed or to what extent, and any adjustments arising during the project will be determined.

Table I-1.1: Climate neutrality targets to 2030

Sector	Scope 1	Scope 2	Scope 3
Stationary energy	On	On	Partially included Emissions associated with losses in the transmission and distribution of electricity and heat.
Transport	On	On	Partially included Emissions related to losses in the transmission and distribution of electricity used in the electric motors of vehicles and emissions from the combustion of fossil fuels in the internal combustion engines of vehicles used to transport waste.
Waste management	On	-	Partially included Emissions of CH_4 and $N O_2$ emissions from the treatment of municipal waste generated within Krakow but composted at in installations outside its borders.
IPPU	Included (included in the stationary energy sector) Included raw materials and fuels used for energy generation and emissions from companies reporting emissions from activities.	-	Partially included (included in the stationary energy sector) Emissions associated with losses in the transmission and distribution of electricity and thermal energy.
AFOLU	Partially included (included in the stationary energy sector)	-	-

	Incorporated used raw materials and fuels into power generation.		
Other	-	-	-
Geographical boundaries	**Same as administrative boundaries**	**Smaller than administrative boundaries**	**Greater than administrative boundaries**
(Tick the appropriate option)	X	-	-
Description of excluded/additional areas	-	-	-
Map			

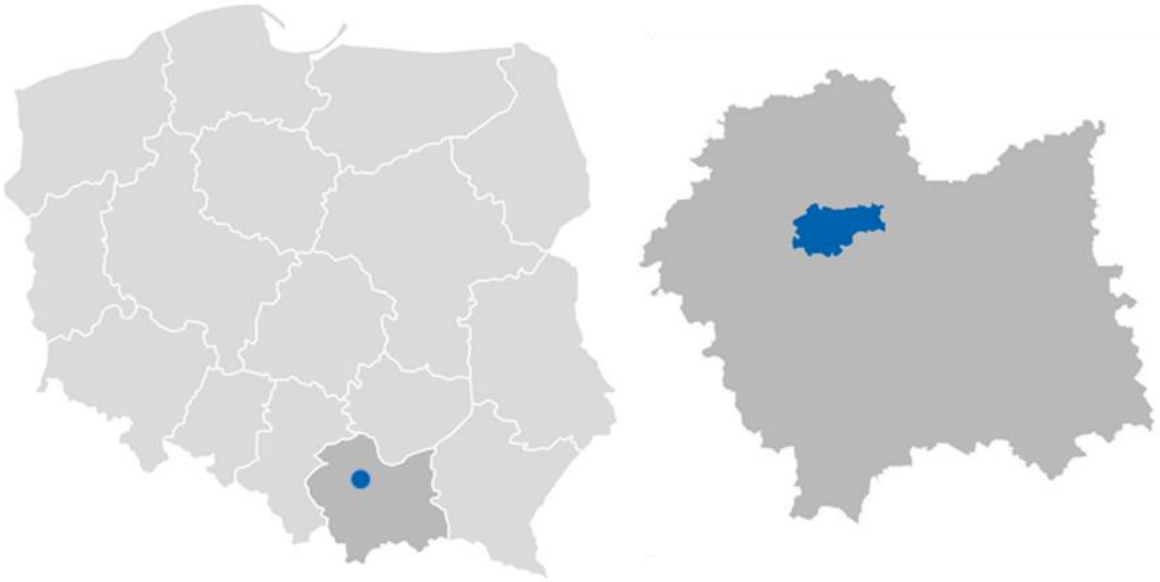


Fig. 2. Location of the city of Kraków in Poland and Malopolska.
Source: https://pdm.irmir.pl/miasta/krakow

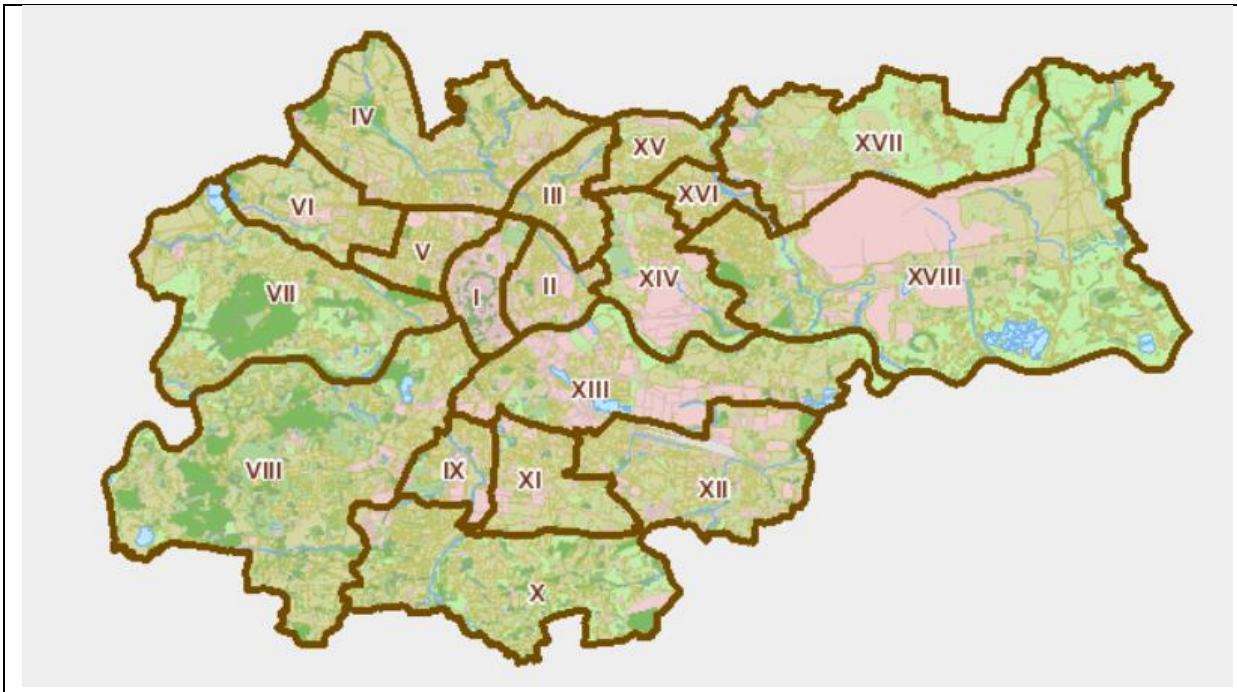


Fig. 3. Map of Krakow by districts. *Source: Urban Spatial Information System.*

2 Part A - Current status of climate action

2.1 Module A-1 Baseline greenhouse gas emissions inventory

Baseline greenhouse gas inventory

Timeframe

The base year used in the Urban Greenhouse Gas Inventory, the Economic Model, and throughout this document is 2018. Since 2018, the City of Krakow has been conducting an annual greenhouse gas emissions inventory and collecting municipal data on individual emission sectors. The year 2018 was chosen as the base year due to its high stability in terms of energy consumption and CO_2 emissions. In subsequent years, events such as the COVID-19 pandemic and the war in Ukraine significantly impacted the city's operations and urban fabric. Therefore, 2018 has been established as the base year in this document.

Urban Emission Inventory

The inventory of greenhouse gas emissions for the Municipality of Krakow (hereinafter referred to as the Urban Inventory) was carried out to identify the main sources of emissions and to determine its volume. The results obtained provide the basis for planning mitigation measures and, at the same time, in a holistic manner, allow for verification of their effect. The Urban Inventory is carried out annually, allowing emissions to be monitored in a systematic way. From 2021 onwards, the results are reported on the CDP (Carbon Disclosure Project) platform, recognised by global climate organisations and agreements (e.g. Covenant of Mayors, Cities Race to Zero).

Table A-1.1: Final energy consumption by source sector			
Base year			
Unit			
	Scope 1	Scope 2	Scope 3
Stationary energy	to be completed in the update	to be completed in the update	to be completed in the update
(Fuel type/energy consumed)	-	-	-
Transport	to be completed in the update	to be completed in the update	to be completed in the update
(Fuel type/energy consumed)	-	-	-
Waste Management	to be completed in the update	to be completed in the update	to be completed in the update
(Fuel type/energy consumed)	-	-	-

Table A-1.2a: Greenhouse gases other than CO_2 included in the Urban Inventory			
Base year	2018		
Unit	Summary of other greenhouse gases reported in the Urban Inventory (in tonnes).		
	Methane (CH_4)	Nitrous oxide (N_2O)	In terms of CO_2e
Stationary energy - energy consumption	644,4	11	20 958
Transport	-	-	-
Waste Management	467,7	18,7	18 045
Total	1 123	31,3	39 003

Greenhouse gas converter used		
CO_2	Methane (CH_4)	Nitrous oxide (N_2O)
1	28	265

Table A-1.3: Emission inventory by source sectors and subsectors (Urban inventory)				
Base year	2018			
Unit	Equivalent tCO_2/year			
	Scope 1	Scope 2	Scope 3	Total
Stationary energy - energy consumption	**3 659 939**	**3 516 736**	**234 467**	**7 411 142**
Sub-sector - households	309 091	1 232 807	107 453	1 649 351
Sub-sector - industry, trade, services and others*	3 332 725	2 283 929	127 014	5 743 668

*including energy produced and supplied to the grid	1 699 906			
Subsector - fugitive emissions	18 123	-	-	18 123
Transport	**405 253**	**82 975**	**3 620**	**491 848**
Sub-sector - Road transport (individual and collective)	350 134	338	15	**350 487**
Sub-sector - Rail transport	454	82 637	3 605	86 696
Sub-sector - Water transport	90	-	-	90
Sub-sector - Air transport	393	-	-	393
Sub-sector - "off road" transport	54 182	-	-	54 182
Waste Management	**18 035**	**-**	**10**	**18 045**
Sub-sector - composting of waste	3 710	-	10	3 720
Sub-sector - Municipal and domestic waste water	14 305	-	-	14 305
Subsector - Industrial waste water	20	-	-	20
Total for scopes	**4 083 227**	**3 599 711**	**238 097**	**-**
Total emissions from the analysed sectors of the city's operation				**7 921 035**

The urban inventory of greenhouse gas emissions in Krakow was carried out on the basis of the GHG Protocol documentation. A basic reporting level (BASIC) was selected, which takes into account emissions from fossil fuel exploitation and waste treatment processes. The area covered by the inventory was defined according to the administrative boundaries of the City of Krakow, and the inventory period is the same as the calendar year. The inventory covers three main sectors: stationary energy, transport and waste management, including municipal wastewater, household wastewater (within individual systems) and industrial wastewater (Fig. 4). The urban inventory is based on specific emissions reported to the KOBIZE, so all the emission factors and energy demand that could result from the from the inventory. Due to the lack of these data, the table "A-1.1: Final energy consumption by source sector" included in the base template (provided by NZC) has been removed. However, it is planned to complete this data in future iterations when a SECAP document is developed that calculates it. In addition to carbon dioxide, it also includes methane and nitrous oxides, whose emissions were also reported directly (Table A-1.2a).

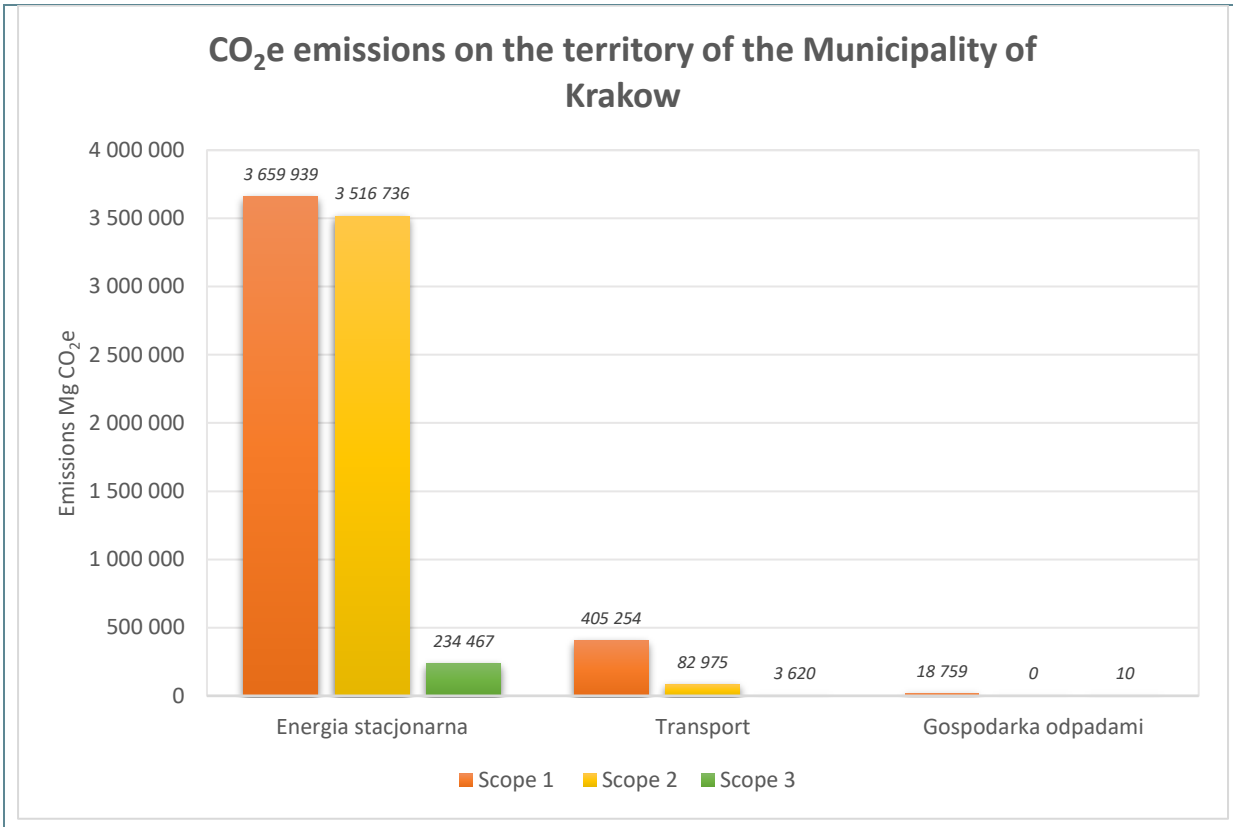
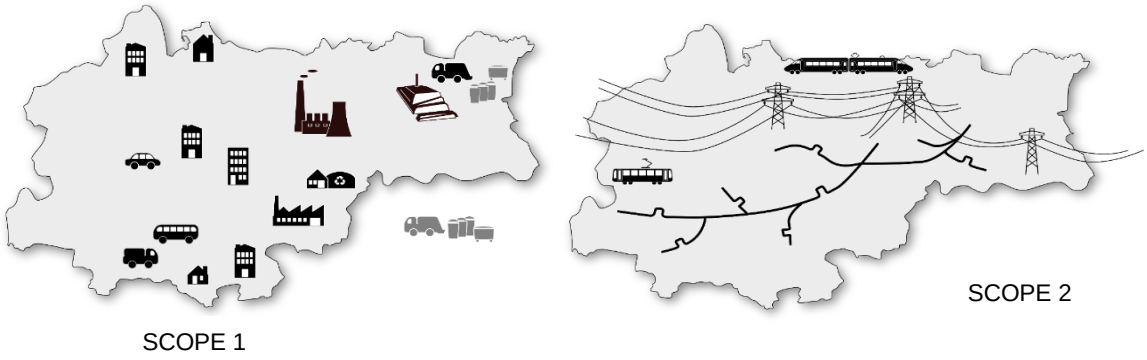


Fig. 4. CO_2e emissions in the Municipality of Krakow in 2018 according to the urban greenhouse gas inventory.
Source: own elaboration based on GHG emission inventory for Municipality of Krakow.

In the Urban Inventory, each sector is analysed in three scopes, depending on where emissions are generated (Figure 5). Scope 1 covers emissions generated at the point of use of fossil fuels or waste treatment (direct emissions) throughout the Municipality of Krakow. Scope 2 covers emissions associated with the use of electricity and heat within the city (indirect emissions), which are sourced from grid systems where the emissions occur. Scope 3 covers emissions related to the loss of energy transferred through the grid systems (indirect emissions) and emissions resulting from the city's activities but occurring outside the city boundaries, such as some travel or waste processing (direct emissions). It should be noted that this latter scope is not mandatory at the BASIC reporting level.



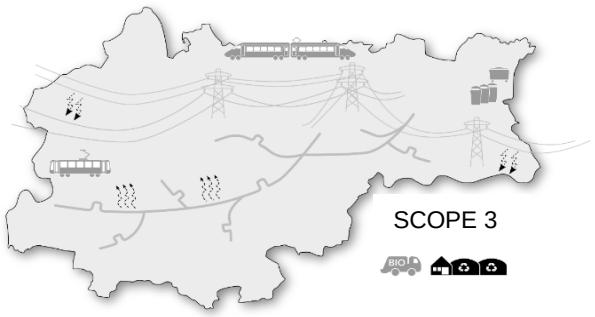


Figure 5: Method of aggregating emissions by scope.
Source: Inventory of greenhouse gas emissions for the Municipality of Krakow.

In the future, it is planned to expand the Urban Greenhouse Gas Inventory from Basic to Basic +. It is planned to expand this inventory to include separately distinguished emission sectors: Industrial Processes and Product Use (IPPU) and Agriculture, Forestry and Other Land Use (AFOLU). The IPPU sector would include greenhouse gas emissions associated with related to various industrial processes, such as cement production, chemical production, iron and steel production, insulation material production, etc., which are not directly related to the fuel combustion process. The AFOLU sector, on the other hand, would describe GHG emissions related to agricultural, forestry and other land uses, such as land use change, deforestation, conversion of forests to agriculture, land degradation, etc. The Urban Inventory at Basic + level would also take into account greenhouse gases not currently included (hydrofluorocarbons, SF_6, NF_3).

The AFOLU and IPPU sector is currently not directly included or isolated as it is not required in the protocol for cities in the basic formula. It is in the plans of the City of Krakow to supplement future inventories with these sectors, but obtaining the relevant data is a problem. Many entities do not carry out adequate monitoring, which makes it impossible to calculate emission values. Some companies are also reluctant to provide data, hiding behind corporate secrecy laws. The City of Krakow is currently analysing what materials and data sources would be needed for full monitoring under the Basic + formula and what data the office would be able to obtain. The reason for the absence of greenhouse gases not covered in the inventory, such as hydrofluorocarbons, SF6, and NF3, is the same.

Economic model

In the Climate Contract, it is essential to link the emission reduction data from various activities with the economic data presented in Part Two - the Investment Plan. In order to link these data and to have economic indicators ready under the Climate Contract, it was decided to use the Economic Model tool, which is offered by NZC to support the work on the contract.

The Economic Model was developed by experts from the University of Madrid as a support tool for cities involved in the Mission of 100 Climate Neutral and Smart Cities. It is mainly used to generate economic data and costs for the city's transformation towards zero carbon. Based on a variety of data and indicators on a number of sectors of the city's operation and future projections, the model also calculates the current and future carbon emissions of the urban area. The assumptions made about the future shape and structure of the city's functioning allow estimating the projected emission reductions and the costs that different groups of actors within the city will have to bear by 2030. The economic model allocates GHG emissions according to the breakdown of sectors other than the Urban Inventory (Fig.6).

Table A-1.3a: Emission inventory by source sector (Economic Model)				
Base year	2018			
Unit	Equivalent tCO_2 /year			
	Scope 1	Scope 2	Scope 3	Total
Transport	777 293	-	-	777 293
Buildings and heating	1 590 512	-	-	1 590 512
Electricity	-	3 622 011	-	3 622 011
Waste management and CE	-	-	150 512	150 512
Other (mainly industry)	1 579 872	-	-	1 579 872
Total	3 947 677	3 622 011	150 512	7 720 200

Table A-1.4: Activity of source sectors (Economic Model)				
Base year	2018			
Sector	Type of activity / demand	Scope 1	Scope 2	Scope 3
Transport	Passenger cars and motor vehicles (million km/year)	1992	-	-
	Buses (million km/year)	42	-	-
	Tram (million km/year)	16	-	-
	Light trucks (<3.5 tonnes) (million km/year)	115	-	-
	Heavy trucks (>3.5 tonnes) (million km/year)	906	-	-
Buildings and heating	Heat demand (central heating + hot water) (GWh/year)	5280	-	-
Electricity	Electricity demand within the city limits (GWh/year)	-	3840	-
Waste management and CE	Waste collected within the city limits (tonnes)	-	-	363993

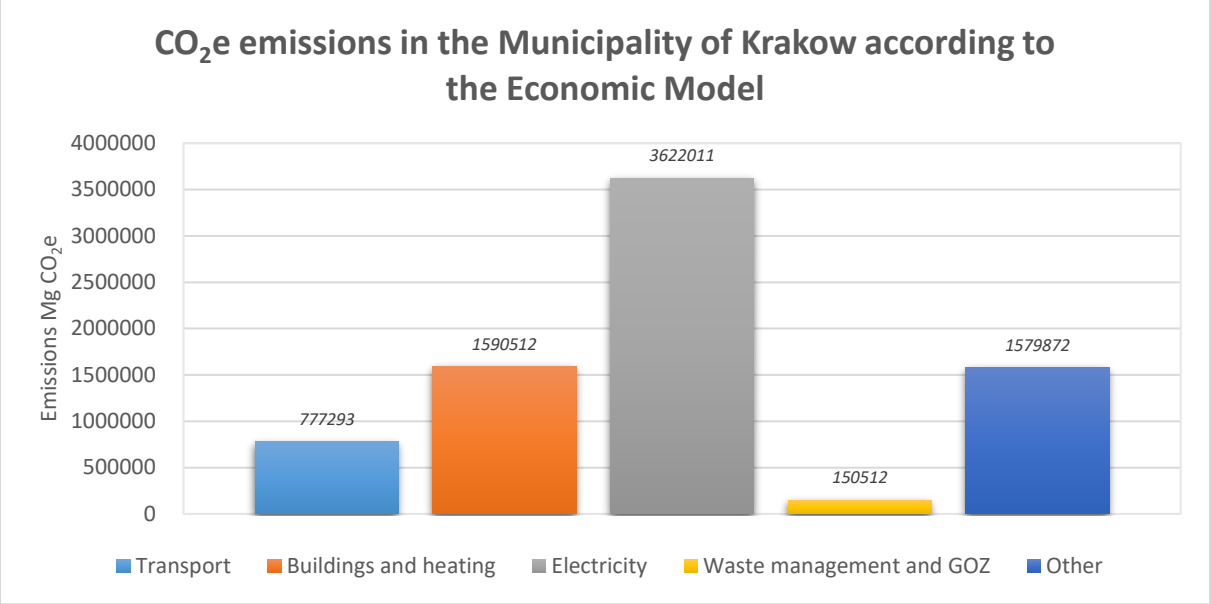


Fig. 6. CO emissions$_2$ e in the Municipality of Krakow in 2018 according to the Economic Model
Source: own elaboration

The 'Buildings and heating' sector includes heat consumption for residential, commercial and industrial purposes (excluding heat for heavy industry from „Kombinat" district). Energy in this sector is sourced from „PGE Energia Ciepła Oddział nr 1 in Kraków", „CEZ Skawina S.A", 53 ecological boiler plants belonging to MPEC located within the administrative boundaries of the city, as well as from network and local gas sources.

The "Electricity" sector includes energy generated and supplied for residential, commercial, industrial (including heavy industry in the „Kombinat" area), public lighting in the city and transport powered by electricity. „TAURON Polska Energia" is responsible for the distribution of electricity in Kraków. Within the city, electricity is generated by „PGE Energia Ciepła Oddział nr 1 in Kraków", „CEZ Skawina", „KHK S.A." Thermal Waste Processing Plant, „TAMEH" CHP plant (operating for industrial purposes) and local renewable energy sources. The demand for electricity is not entirely met by the energy sources located within the city, so part of the energy is imported from outside its borders.

Emissions in the 'Transport' sector have been calculated on the basis of emission factors and transport data shown in local and national documents, policies etc.

The 'Waste Management and CE' sector includes emissions from the operation of the „KHK S.A." Thermal Waste Treatment Plant and the heat generation resulting from this operation, as well as emissions from solid waste generated within the city that is subjected to biological treatment.

The 'Other' sector mainly describes emissions from the industrial activities of AcerolMittal and heat generation from the „TAMEH" CHP plant. Both entities carry out their activities on the site of the Krakow „Kombinat" district. A small proportion of emissions in this sector also come from wastewater management.

The emission scopes separated by the Economic Model rigidly assign specific emission sectors to particular scopes, which does not reflect the actual situation in Krakow. For example, the model assumes that all

electricity consumed comes from sources outside the city boundaries. For this reason, the division into emission ranges resulting from the model should be treated in a subsidiary manner.

How to use the Urban Inventory and the Economic Model

Both the Urban Inventory and the Economic Model are applicable to the Climate Contract. The Urban Inventory is a better tool for determining the city's emissions because it is developed using an appropriate methodology and is updated annually, allowing for monitoring of the decrease in the city's emissions. However, it only addresses emissions that have already taken place. The Economic Model, on the other hand, looks into the future and allows the emissions data to be assigned a projected decrease from specific measures and assigns financial values to this. For this reason, in chapter "B - Pathways to achieve climate neutrality by 2030" and the Investment Plan, data will refer to emissions and sectors from the Economic Model.

Discrepancies in greenhouse gas emissions between the Urban Greenhouse Gas Inventory, and the Economic Model are minor and are due to methodological differences. Emissions in the Economic Model are calculated based on averaged emission factors and energy demand. In contrast, the inventory collects emission data from individual companies and from entities reporting to the KOBiZE. As a result of the data processing at the various stages, the aforementioned differences emerged, which ultimately settle at around 4%.

The differences between the Urban Inventory and the Economic Model are due to the different emission sectors. For example, in the Urban Greenhouse Gas Inventory, the Stationary Energy sector accounts for approximately 93% of emissions within the city. In contrast, in the Economic Model, the Buildings and Heating and Electricity together account for around 67% of emissions. However, this difference is only due to the artificial allocation of sectors. In the Economic Model, the missing emissions are under the category Other, where emissions resulting from buildings classified as industrial and from heat generation for industry are attributed.

Evaluation of urban inventories

When developing the Climate Contract, it is important to outline the city's previous strategy in the context of climate action and to assess the actual state of the city also in relation to this strategy. Such a practice enables a realistic presentation of the city's and the country's actions, takes into account the difficulties encountered in previous years, and shows the challenges of implementing actions in other necessary areas and sectors which, although necessary, may negatively affect the functioning of the city.

In 2015, the Municipality of Krakow adopted the Low Emission Management Plan for the Municipality of Krakow. It was a strategic document defining the directions of investment and non-investment activities of the Municipality of Krakow in areas related to construction, transport, energy, municipal economy and city management for the period 2014-2020 and in a longer perspective until 2040. The purpose of the plan was to present a concept of activities in the Municipality of Krakow aimed at reducing greenhouse gas emissions (CO_2 e), improving air quality, reducing low emissions by increasing the use of low-carbon energy sources, especially renewable energy sources, and reducing energy consumption and improving energy

efficiency in the city. The Low Emission Management Plan was also intended to contribute to the implementation of Kraków's smart growth strategy in line with the Smart City concept.

The document also included data on the CO_2e emissions inventory and carbon dioxide emission projection scenarios up to 2040. The base year for these scenarios was 1995 emissions.

In the real scenario, the Plan assumed CO_2e emissions in 2040 of 4 438 396 tonnes, representing a 26% reduction in CO_2 e emissions compared to 1995. In contrast, the optimal scenario assumed emissions in 2040 of 2 984 023 tonnes, representing a 51% reduction from the base year.

These scenarios show that Krakow had broad ambitions to reduce emissions long before it decided to join the Mission of 100 Climate Neutral and Smart Cities by 2030. This approach, driven by the willingness of many city stakeholder groups to act in the years to come, has been further intensified resulting in the Climate Contract, which seeks an innovative approach to achieving an 80% reduction in emissions already by 2030.

In the further development of the Climate Contract, the emission sectors will be separated according to the sectors of the Economic Model, so that the data in the Action Plan will be comparable with the data calculated by the Model in the Investment Plan.

2.2 Module A-2 Evaluation of current strategies , policies and strategic management instruments

A-2.1: Description and evaluation of current strategic management strategies, policies and instruments

The list of strategic management strategies, policies and instruments:

1. **Local:**
   - Development strategy for Krakow. This is where I want to live. Kraków 2030;
   - Assumptions to the plan for supplying the Municipality of Krakow with heat, electricity and gas fuels for the years 2023-2038;
   - Low Emission Management Plan for the Municipality of Krakow;
   - Kraków Green Deal;
   - City of Kraków Climate Change Adaptation Plan 2030;
   - Environmental Protection Programme for the City of Krakow for 2020-2030;
   - District Forestry Enhancement Programme of the City of Kraków for the period 2018 - 2040;
   - Directions for the Development and Management of Green Areas in Krakow for 2019-2030;
   - The Circular Strategy of the City of Krakow.

2. **Regional**:
   - Kraków Metropolis 2030 Strategy;

- Climate Strategy of the Krakow Metropolis 2024-2030;
- Sustainable mobility plan for Krakow Metropolis;
- Regional Climate and Energy Action Plan for the Małopolska Region;
- Air protection programme for the Małopolska voivodship.

3. **National**:
   - Poland's Energy Policy until 2040;
   - National Energy and Climate Plan 2021-2030;
   - Long-term strategy for building renovation to 2050;
   - Clean Air Programme;
   - A strategy for district heating up to 2030 with an outlook to 2040.

4. **Union**:
   - European Green Deal;
   - REPowerEU;
   - Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on establishing a framework to facilitate sustainable investment;
   - Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (RED II Renewable Energy Directive);
   - Directive of the European Parliament and of the Council on energy efficiency and amending Regulation (EU) 2023/955;
   - Directive of the European Parliament and of the Council on the energy performance of buildings EPBD (recast) (COM(2021)0802 - C9-0469/2021 - 2021/0426(COD)).

Local

Development strategy for Krakow. This is where I want to live. Kraków 2030

Territorial scope: local.
Relevance: The Krakow Development Strategy is the basic and most important document in the process of comprehensive planning of the future of the city of Krakow until 2030. The strategy was created as a result of a participatory and expert process of interaction between many groups and circles involved in the project work from the beginning: urban planners, sociologists of the city, architects, urban activists, economists, inhabitants.

Description: The city of Krakow's development strategy for 2030 envisages its transformation into a dynamic and modern metropolis that will become a leader in many fields. The vision for Krakow's future is based on six areas of development in which the city is to excel. As an intelligent and modern metropolis, Kraków plans to realise its potential by building sustainable partnerships with other European metropolises, expanding the airport and integrating various modes of transport.

In the area of modern economy and scientific potential, the city aims to create an innovative economy based on knowledge and the involvement of highly qualified human resources, through programmes supporting entrepreneurship and cooperation with academic centres. In culture and heritage, Krakow

wants to foster the creativity of its residents by providing equal access to cultural events and creative discussions.

The quality of life for residents is a priority, so the city plans to provide new public spaces, improve environmental quality standards and promote healthy lifestyles, while developing an efficient transport system. In terms of social capital, Krakow aims to strengthen the community of residents and their involvement in the life of the city through social activation programmes, especially for young people.

In the area of city management, the city plans professional management, high quality public services and rational spatial management, through the development of spatial information systems, opening up access to public information and public opinion surveys.

An update of the document is currently being developed.

Assumptions to the Plan for Supplying the Municipality of Krakow with Heat, Electricity and Gas Fuels for the years 2023-2038

Territorial scope: local.
Significance: The document sets out changes to the operation of the energy system in Kraków, describing the assumptions and options for converting it to a less carbon-intensive system.

Description: The document is based on the provisions of the Energy Law. It is drawn up for at least 15 years and is subject to updates at least once every three years. Its purpose is to analyse and evaluate the projected changes in the demand for heat, electricity and gaseous fuel, as well as to assess the level of energy security of the municipality and to propose measures to improve it. All suppliers of heat, electricity and gaseous fuels operating in the Municipality of Krakow were included in the analysis process.

As part of the creation of this document, three different development scenarios and forecasts for heat, electricity and natural gas demand were analysed. After careful consideration, Scenario 1 was considered to be the most appropriate and realistic scenario for the development of the city.

This scenario takes many assumptions from other already existing plans and strategies at national and EU level. The following changes are assumed in the planned future for Krakow:

- a slight decrease in population in the coming years, but a projected increase between 2040 and 2050;
- A gradual increase in the area of buildings complying with the highest energy standards;
- a decrease in the area of the building stock (excluding listed buildings) as a result of demolitions;
- planned thermo-modernisation of buildings in line with the Long Term Renewal Strategy (DSRB);
- Priority for thermomodernisation will be given to buildings with the highest thermal energy demand;
- new buildings within the range of the district heating network will be connected to it and those outside the range will use renewable energy sources;
- replacing light sources in street lighting with LED sources by 2048;

- The development of electromobility will include the replacement of bus fleets and an increase in the proportion of electric vehicles;
- The increase in the number of LED luminaires will depend on the rate of growth of the building stock area;
- increasing the energy efficiency of equipment and technology in line with expertise;
- by 2050, electricity for buildings will come from renewable sources;
- European Energy Certificate Scheme (EECS-GoO) certificates are envisaged for electricity from 2050;
- Consideration of the potential for electricity from photovoltaic panels requires additional elaboration.

All these assumptions translate into the following forecast of changes in demand for energy carriers in the city area:

Year	2021	2023	2028	2033	2038	2040	2050
Unit	MWh						
Heat	3 022 498	2 854 265	2 660 486	2 624 635	2 658 245	2 691 781	2 807 070
Electricity	3 458 771	3 450 347	3 433 207	3 551 035	3 661 006	3 683 258	4 077 021
Gaseous fuels	2 891 441	2 869 576	2 600 711	1 878 659	1 460 864	1 364 770	178 960

Until 2030, the plan assumes a rapid decline in energy consumption, which is linked to the thermal modernisation of the most energy-intensive buildings in the initial period. At the same time, increases in the share of RES in total energy production are projected.

Low Emission Management Plan for the Municipality of Krakow

Territorial scope: local.
Relevance: The document presents concepts for measures within the city that will serve to reduce greenhouse gas emissions, improve air quality and reduce low emissions emissions by 2040.

Description: The Low Emission Management Plan for the Municipality of Krakow sets out directions for the development of Krakow's economy for the period 2014-2020, in terms of investment and non-investment activities in areas related to energy use: public and private buildings, public and private transport, spatial management, heat and energy supply, water and sewage management, waste management.

One of the main strategic objectives is to reduce the city's greenhouse gas emissions, aiming for a reduction of 20% by 2020 and 25% by 2030 compared to 1995 levels. Specific objectives include increasing energy efficiency by 10% by 2020 and 15% by 2030, and increasing the share of renewable energy to 1.2% in 2020 and 2.0% in 2030. Some of these targets have already been achieved.

The second strategic objective is to improve air quality, with specific objectives including the reduction of surface and point source emissions, the reduction of transport emissions and low-carbon urban management.

The implementation activities comprise the sectors of the Low Carbon Economy Plan, where long-term directions of action have been identified as key strategies. The Low Emission Economy Plan for the Municipality of Krakow presents a programme of investment and non-investment activities up to 2020, estimated at around PLN 11 billion. The vast majority of these costs relate to transport investments extending beyond 2020. Funding is planned to be obtained mainly from from external funds.

Kraków Green Deal

Territorial scope: local.
Relevance: The document provides a description of the implementation of municipal programmes aimed at transitioning to a zero-carbon economy and increasing the area of green public spaces in the city. It attempts to summarise Kraków's efforts to improve the environment and achieve climate neutrality. The document additionally outlines new pathways for the city's development and innovation.

Description: The Krakow Green Deal has been developed to address the challenges of the European Green Deal, which is the European Union's key strategy to transform the EU on a path of ecological transformation and achieve net climate neutrality by 2050.

This document is the city's response to current environmental challenges. It contains a comprehensive action plan, based on relevant municipal environmental strategies and programmes, and presents financial plans. The Krakow Green Deal is closely integrated with the assumptions of two other documents of the City: "Kraków Development Strategy. This is where I want to live. Krakow 2030". and the "Study of Conditions and Directions of Spatial Development". In addition, it is based on key programmes and plans of the City concerning environmental protection and adaptation to climate change, such as the "Environmental Protection Programme for the City of Krakow for 2020-2030" and the "Adaptation Plan for the City of Krakow to Climate Change by 2030".

The Krakow Green Deal outlines actions that are supported in the city's 2022 budget and multi-year financial forecast. These actions are divided into the following areas:

1. **Buildings and Energy.**
2. **Transport and Public Transport.**
3. **Water Management.**
4. **Natural Resources.**

City of Kraków Climate Change Adaptation Plan 2030

Territorial scope: local.
Relevance: The document indicates the vision, the overarching objective and the specific objectives of the City's adaptation to climate change that should be achieved through the implementation of selected adaptation actions with a focus on the four most vulnerable sectors/areas of the City. The Adaptation Plan sets out how adaptation actions will be implemented, including responsible actors, funding framework, monitoring indicators, assumptions for evaluation and updating of the document.

Description: The Adaptation Plan provides a list of comprehensive actions to address climate change and adapt to its impacts. Its scope is not only limited to adaptation measures, but also focuses on the factors influencing climate change. An additional aim of the plan is to increase the knowledge and awareness of all actors involved, stakeholders and citizens of the city.

Adaptation measures are a key element of the plan, steering towards sustainable development. They aim to enable adaptation to climate change while not limiting development opportunities for future generations. As part of these measures, initiatives are planned to promote energy-saving behaviour, such as water conservation, efficient energy use, promotion of public transport and cycling, pedestrian zones and reduction of energy consumption through the introduction of thermal upgrading of buildings.

The plan also takes into account measures resulting from the effects of climate change already occurring. The promotion of energy-saving behaviour, the use of solar energy through the development of photovoltaics or the use of precipitation to retain clean water that can be efficiently used in various areas such as the maintenance of urban infrastructure or support for forms of small-scale retention are just some of the possibilities.

Environmental Protection Programme for the City of Krakow for 2020-2030

Territorial scope: local.
Significance: The task of the programme is to identify the necessary measures to improve the environment and bring it to a state defined by legislation and accepted by society. The document sets out objectives for the protection and improvement of a number of elements of the environment, such as the protection of ambient air, waste management and greenery and forest resources, which are necessary to reduce greenhouse gas emissions.

Description: The programme sets out overarching objectives and priorities for environmental protection measures specific to individual environmental elements. In the area of climate protection, the programme addresses the following strategic objectives:

- the rational use and restoration of green and forest resources, ensuring their sustainability;
- Increasing the proportion of green areas in developed areas and creating development plans that take environmental aspects into account;
- improving the environmental awareness of Krakow's residents through environmental education and creating a positive image of environmental protection;
- protecting the air by maintaining and improving air quality, reducing energy consumption and increasing the use of renewable energy, and reducing greenhouse gas emissions.

The document focuses on a sustainable approach to environmental protection, covering areas from greening to rational energy use, with the aim of creating an environmentally friendly and sustainable urban space in Krakow.

District Programme for Increasing the Forest Cover of the City of Krakow 2018-2040

Territorial scope: local.
Significance: The document describes plans to increase the forest cover of the city of Krakow, which is crucial in the context of absorbing some of the greenhouse gas emissions and diversifying the natural environment of the city. The programme describes the plan and pathway to achieve an 8% increase in forest cover within the municipal boundaries, which will reduce CO_2 emissions generated in Krakow.

Description: the District Programme for Increasing the Forest Cover of the City of Krakow for 2018-2040 has been prepared by the Forest Management and Geodesy Bureau in Krakow. The programme aims to increase forested areas in the Municipality of Krakow by at least 1430 ha, with an additional 200 ha as reserve areas.

The implementation of the programme is divided into four phases:

1. Period 2018-2022: In the first stage, land was selected to be included in the programme for the period 2018-2040, and from this, the land on which the implementation of the programme will take place first (2018-2022) was selected, covering more than 459 ha of land. For the land to be afforested during this period, a detailed afforestation plan has been created of approximately 117 ha.
2. Period 2023-2028: This phase is expected to lead to a significant increase in forest cover to around 6%. Afforestation work will continue on communal land and on those acquired by Krakow, including land that could not be included in the programme in period one.
3. Period 2029-2034: A further increase in afforestation areas is planned, especially on private land as well as land acquired by the Municipality of Krakow.
4. Period 2035-2040: the last phase assumes full implementation of the programme, achieving a forest cover of no less than 8%. Afforestation tasks will continue on land acquired by the Municipality of Krakow and may also include afforestation by private owners.

The programme aims to increase the woodland areas in Krakow, which will contribute to improving the city's environment.

Directions for the Development and Management of Green Areas in Krakow 2019-2030

Territorial scope: local.
Significance: The purpose of this document is to define a coherent, planned and long-term policy for the development of green areas in Krakow, taking into account, inter alia, the integration of the dispersed green structure into a continuous system of areas linked by pedestrian and bicycle routes and green routes, the preservation, development and creation of new green areas that meet social needs, the protection of historic green areas important for the quality of the cultural landscape, the protection of areas of natural value, the raising of standards for the maintenance, establishment and care of green areas, the improvement of the management of green areas in Krakow.

Description: The concept of the system of green areas of Krakow, is based on two pillars: areas of public greenery (within which also semi-natural, unmown enclaves are envisaged, with a more "wild" character) and areas of ecological and landscape greenery, partly arranged with a semi-natural

character. The system is completed by linear systems of *greenways* - publicly accessible natural or landscaped areas.

The Directions also identify spaces where there is a need to conserve or restore green spaces, and spatial planning and land resource management activities should aim to conserve, develop, restore and undertake other activities to meet social needs in this regard.

In addition, the purpose of the Directions is to enable the planning, preparation and implementation of investments (including the priority investments identified in this document) in green areas, with their appropriate functional and spatial allocation, according to social needs and natural and landscape values.

The document also takes into account the accessibility, to the existing, arranged public green areas with a recreational function, as well as municipal and state forests, and identifies areas where deficits in publicly accessible green space should be addressed.

The above issues are also written down as indicators to monitor progress in the development of publicly accessible green spaces, increasing accessibility for residents (the idea of the 15-minute city), information on increasing woodland areas and areas of natural value.

Circular strategy of the city of Krakow

Scope: local.
Significance: The main objective of the document is to create long-term, systemic changes that will ensure a sustainable future for the city. It focuses not only on recycling, but also on changing the economic system towards the idea of a circular economy.

Description: The Circular Strategy for Krakow sets out a vision of a fully circular local economy by 2050, based on four thematic areas and taking into account the characteristics of the city's various neighbourhoods. These are:

1. A city with a circular metabolism.
2. A well-connected city promoting a culture of creativity and innovation.
3. Sustainable, diverse and inclusive construction.
4. A city with a system that is friendly to humans and other species.

Within these areas, a set of 24 actions have been adopted to revitalise the circular economy in Kraków. These actions, selected on the basis of research, stakeholder engagement and identification of starting points, are the starting point for realising the vision and systemic change. The action toolkit will support the collaboration needed to shape a closed loop culture in Krakow.

The document also includes long-term goals, such as moving away from burning coal as a fossil fuel and away from landfills and waste incinerators, which require bold policies, legislation and major infrastructure projects.

Regional

Strategy of Kraków Metropolis 2030

Scope: regional.
Significance: The Krakow Metropolis 2030 Strategy is a strategy for cooperation between municipalities for sustainable supra-local development.

Description: The mission of the Krakow Metropolis is to undertake joint and concerted actions of strategic importance, responding to the challenges it faces. The consensus developed and implemented among the area's municipalities is aimed at increasing the effectiveness and efficiency of public interventions. Raising the living standards and well-being of the inhabitants is considered to be the overriding objective of all activities, and all interventions are undertaken with respect for the diversity and local specificity of the municipalities which make up the Kraków Metropolis.

Main objectives:

1. Kraków Metropolis intelligently managed, based on partnership and committed staff.
2. An environmentally friendly, climate-neutral Krakow Metropolis with a high quality of life.
4. Kraków Metropolis for active, ecological and efficient mobility.
5. Kraków Metropolis innovative and competitive, creating lasting relations in the network of Europe's leading economic centres.
6. A Krakow Metropolis that is inspiring, draws on diversity and local potentials, and builds on networks.
7. Kraków Metropolis fostering effective, inclusive education based on creative relationships.
8. A Krakow Metropolis providing modern and accessible social services to its inhabitants, valuing equality and social solidarity.

A detailed list of projects and undertakings for the 2030 horizon is set out in implementation documents called action plans, within each of the seven areas of cooperation: smart governance, environment and space, mobility, economy, leisure culture, education and social services.

One of the key elements of the Kraków Metropolis 2030 Strategy is a model of the functional and spatial structure together with recommendations for spatial policy, in accordance with the provisions of the Act on the Principles of Development Policy. The model proposes directing the development of the area towards ensuring a high standard of quality of life and availability of public services, standing out against the European background, providing a sense of security and offering opportunities for comprehensive development. The primary objective of all changes to the functional and spatial structure of the Krakow Metropolis is to achieve development in the seven areas of metropolitan cooperation. This will allow the social, economic, natural, ecological and functional-spatial aspects of the development of the 15 communes comprising the Kraków Metropolis to be dealt with in an integral manner.

Climate Strategy of the Krakow Metropolis 2024-2030

Territorial scope: regional.
Significance: SCM's roadmap for moving towards climate neutrality.

Description: The Climate Strategy for the Krakow Metropolis 2024-2030 responds to the growing challenges of climate change, emphasising the pursuit of climate neutrality, mitigation and adaptation to ongoing change, and increasing the metropolitan area's resilience to extreme meteorological conditions. Key areas of action are focused around land reclamation and retention, water and wastewater management, blue-green infrastructure, greenhouse gas reduction and energy transition. Implementation activities are divided into two categories:
A. Information - Knowledge - Collaboration: activities that meet the objectives of collecting and monitoring reliable data and stakeholder engagement.
B. Sustainable Development: activities to develop recommendations for different sectors and to analyse the possibility of implementing pro-climate principles in processes and procedures at the level of the municipalities of Krakow Metropolis and in supra-local cooperation.

Sustainable mobility plan for Krakow Metropolis

Territorial scope: regional.
Significance: The plan presents forecasts for future changes in the city of Krakow and the neighbouring municipalities that make up the Krakow Metropolis in the context of transport, while also setting out actions and targets for the transformation of the transport system.

Description: The Kraków Metropolis Sustainable Mobility Plan is a document developed to meet the growing mobility needs of urban areas and their surroundings, aiming to improve the quality of life of the inhabitants and the development of the economy. The plan builds on existing urban planning concepts and incorporates the key principles of social inclusion, active public participation and systematic evaluation.

In addition to describing and assessing the current state of the transport sector, it also presents the main problems and barriers perceived by city residents. With this knowledge, the city is able to target its activities at the most sensitive sub-sectors of the transport system. The Krakow Metropolitan Area Mobility Plan also presents scenarios for mobility development up to 2045.

Baseline scenario (BAU) - the mobility vision in this scenario is exposed to unfavourable circumstances such as rising public transport costs, reduced frequency and number of journeys, decommissioning of links, expansion of areas beyond the reach of sustainable modes of transport and lack of measures to support mobility activity or the use of public transport.

Active scenario - in this scenario, the accessibility of transport in the functional area remains stable, while mobility management measures are introduced, such as incentives to use cleaner modes of transport, improved conditions for pedestrians and cyclists, information campaigns and promotions related to public transport and personal transport modes. However, a significant effort is required to achieve this scenario, as the results of the stakeholder assessment indicate that without a significant improvement in the accessibility of public transport for residents, it will not be possible to significantly reduce the share of cars in daily travel.

Sustainable mobility scenario - this scenario is based on the fulfilment of objectives set out in the in the strategies of local authorities, which will improve the quality of life of the inhabitants and the attractiveness of the Krakow Metropolis. Achieving this goal will foster a reduction in the role of private

cars in the daily journeys of the inhabitants, through the introduction of measures reducing car traffic and increasing the space for sustainable mobility measures. At the same time initiatives will be undertaken related to the development of cycling infrastructure, increasing the accessibility of public transport (in particular rail transport) and the creation of interchanges to enable the integration of different transport systems.

The plan also outlines implementation actions by individual transport system groups that aim to achieve a positive scenario by 2045.

Regional Climate and Energy Action Plan for the Małopolska Region

Territorial scope: regional.
Relevance: The document constitutes the action plan on climate issues of the Board of the Małopolska Region and covers the tasks carried out by the Marshal's Office and its organisational units.

Description: The Regional Climate and Energy Action Plan for the Małopolska Region is a document developed by the Marshal's Office of the Małopolska Region in February 2020. Its aim is to set out actions that will contribute to: reduction of greenhouse gas emissions, improvement of air quality and low-carbon transformation of Małopolska.

The plan identifies the current level of greenhouse gas emissions and sets out priority courses of action. These are:

- reducing greenhouse gas emissions and increasing efficiency in the use of available resources;
- diversifying activities towards the promotion of low-carbon sources of energy generation;
- Increasing the share of RES installations in energy production between 2020 and 2030;
- low-carbon transformation of the region;
- exploiting synergies with other retrofit programmes to reduce energy consumption and emissions in the municipal sector and public buildings;
- improving the energy efficiency of existing buildings and developing a modern building sector that integrates technology with RES installations;
- the development of clean transport modes, including walking and cycling, electric scooters and electromobility;
- transforming the transport sector by building a modern transport system;
- reducing the production of waste and its deposition in the environment, using waste for energy purposes;
- Reducing demand for resources and energy by strengthening the circular economy;
- water efficiency, increased water retention and measures to prevent floods and droughts;
- Technological transformation in agriculture with adaptation to climate change;
- Adaptation of forests to climate change through afforestation of land and increased uptake of CO_2 by forests and protection of green spaces.

The plan is a regional response to the quantitative mitigation targets set by the European Union. It assumes:

- a reduction in greenhouse gas emissions of at least 40% (compared to 1990 levels), including for the non-ETS sectors (mainly transport, utilities and agriculture), as 30% compared to 2005 levels;

- Increasing the share of energy from renewable sources to at least 32% of gross final energy consumption;
- achieving at least a 32.5% improvement in energy efficiency.

Air protection programme for the Małopolskie Voivodeship

Territorial scope: regional.
Significance: The Air Protection Programme for the Małopolskie Voivodeship aims to achieve the permissible levels of pollutants in the air, set by Polish and EU legislation, as soon as possible. The programme sets out the most effective measures to achieve the permissible levels of PM10, PM2.5, NO_2 and benzo(a)pyrene in the air no later than by 2026.

Description: Małopolska is moving towards a low-carbon energy transition, which means reducing the use of fossil fuels and increasing the use of renewable energy sources. The Programme has analysed the possible corrective measures that will have the greatest effect in improving air quality.

The document includes an analysis of the existing air protection measures in the province, including their scope, the effects achieved and the barriers encountered. Between 2017 and 2022, 82.7 thousand boilers and furnaces using solid fuels were eliminated, of which almost one-fifth were located in Kraków. These measures have contributed to improving air quality and the health of the region's inhabitants.

This programme imposes specific corrective actions at each administrative level - province, county and municipality. The document lists corrective actions and a Short-Term Action Plan, which are implemented in situations where there is a risk of exceeding the alert, information or limit level of pollutants in the air.

In accordance with the indications of the Air Protection Programme for the Małopolska Voivodeship, an anti-smog resolution has been adopted for Krakow. As of 1 September 2019, the use of solid fuels is banned in the City of Kraków.

Achievement of today's air quality status was achieved as a result of the City's consistent policy pursued in accordance with remedial programmes such as the Air Protection Programmes developed under the Air Quality Management System. An important role was played by large-scale subsidy and resident support programmes, including, inter alia, through the implementation of the Low Emission Reduction Programme for the City of Krakow, under which the City participated in the costs of liquidating solid fuel furnaces and installing environmentally-friendly heating systems. Success would not have been possible without the participation of social organisations and the huge involvement of the city's residents in the process of replacing furnaces. Today, almost all buildings in Kraków are heated in an environmentally friendly manner.

As part of the subsidies provided by the Municipality of Krakow, more than 45,000 solid fuel fireplaces were eliminated, almost 2,000 renewable energy source installations were installed, and the total funds disbursed for this purpose amounted to almost PLN 338 million.

The resolution was preceded by several years of information and education programmes to prepare residents to change and make informed decisions about their home heating systems. Furthermore, the

regulation covers different types of heating systems, from boilers and cookers to catering installations, demonstrating a comprehensive approach to the problem.

It is also the first regulation of its kind in Poland, setting an example for other cities in the country that face similar smog problems. The anti-smog resolution for Krakow is an inspiration for other local governments, indicating the possibility of effectively combating air pollution through the introduction of appropriate regulations.

These regulations have helped to significantly reduce air pollution, which has been one of the one of the main problems of the City of Krakow. The differences in measurements over the last few years at the station in Bujaka Street (Bujaka Street is an urban background station and is representative of the whole of Krakow) for annual average concentrations are as follows:

Type of contamination	2018	2023
PM10	43 µg/m^3	23 µg/m^3
PM2.5	31 µg/m^3	15 µg/m^3
NO_2	32 µg/m^3	24 µg/m^3

National

Poland's Energy Policy until 2040

Territorial scope: national.
Significance: Poland's Energy Policy 2040 sets the framework for the country's energy transition and includes strategic decisions on the choice of technologies to support the construction of a low-carbon energy system. It is closely linked to the EU's climate policy, which sets long-term goals such as climate neutrality by 2050 and targets for 2020 and 2030.

Description: The document describes key investment decisions to realise the country's potential in the areas of energy, raw materials, technology and human resources. The plan is directed at creating conditions conducive to the development of the economy through the energy sector, while maintaining the principles of a fair transition.

Poland's energy policy until 2040 directs its efforts towards the development of smart grids. The aim of these innovative solutions is to enable more informed energy use, efficient energy management and reduced losses, while maintaining a high quality of supply. Central to this concept are information and telecommunications technologies, such as intelligent telemetry systems and systems for automatic grid monitoring, control, regulation and security. Data exchange between devices also plays an important role, which requires the spread of Internet of Things technologies. These measures also aim to empower electricity consumers, especially in the context of the planned installation of smart meters, which work closely with the construction of smart grids.

PEP2040 also identifies tools for energy planning, an example being a system for collecting data for a nationwide heat map. The provision of such databases will enable regions and entrepreneurs to estimate the potential for the development of district heating and cogeneration networks, while new investors will be provided with information on existing infrastructure. In the context of horizontal

issues, the draft PEP2040 also emphasises the importance of cyber security in the energy sector, which includes ensuring an adequate level of protection for IT systems used to provide key services.

National Energy and Climate Plan 2021-2030

Territorial scope: national.
Relevance: The document presents national assumptions and targets as well as policies and actions relating to five dimensions - decarbonisation, energy efficiency, energy security, internal energy market and research, innovation and competitiveness. The plan describes opportunities for energy transition, taking into account EU plans, targets and objectives. The National Energy and Climate Plan presents key tools and measures in the energy sector, while responding to existing EU legislation.

Description: This is a strategic document setting out the objectives and policies related to the energy union. This plan was created after taking into account expert opinion, public consultation and recommendations from the European Commission.

The main objectives of the NAPE for 2030 are:

1. GHG emission reductions of 7% in non-ETS sectors compared to 2005.
2. Achieve a share of renewable energy of 21-23% in gross final energy consumption, including a 14% share of RES in transport and an increase in the share of RES in heating and cooling.
3. A 23% increase in energy efficiency compared to PRIMES2007 projections.
4. Reduce the share of coal in electricity generation to 56-60%.

The document is currently being updated to accelerate the energy transition. Only a preliminary version is available (draft of 29.02.2024) containing only the WEM scenario, which is understood as the baseline scenario for the transformation under market-technical conditions, whose projections are realistic. In contrast, the WAM optimistic scenario remains in development. The most important changes in the context of achieving the mission objectives concern the energy system. The update of the plan assumes the use of 50.1 per cent of RES in electricity in gross final energy consumption and 32.1 per cent in heating and cooling. In addition, the update also forecasts an increase in the share of RES in the transport sector to 17.7% by 2030.

Linked to this document is the '**Development Plan for Meeting Current and Future Electricity Demand 2023-2032**', which is National Grid's plan for **meeting** these obligations.

The plan sets out forecasts for the development of power grids across the country and forecasts for changes in the diversification of electricity generation. It analyses different scenarios for the development of the electricity system to identify investments that improve the reliability of energy supply. The plan includes:

- meeting targets for the share of energy from RES in final energy consumption;
- the construction of offshore wind farms in the Baltic Sea;
- building nuclear capacity;
- connection of new generation units;
- improving supply conditions, including minimising network congestion across the system.

The most important innovation is the construction of an HVDC line connecting the north and south of Poland, enabling the efficient transmission of energy. The aim of this investment is to enable the

transmission required by the industry located in the south of Poland of energy generated from onshore and offshore wind sources gathered in the north of the country. In turn, the proposal for the construction of generation resources by the transmission system operator is intended to increase grid stability in emergency situations.

Analyses of RES production potential reach over 100 TWh per year of renewable energy by 2030, which will significantly exceed 50% of net electricity demand in Poland. This is significantly more than the levels assumed in national strategic documents (PEP2040).

Long-term building renovation strategy to 2050

Territorial scope: national.
Significance: The long-term building renovation strategy defines the actions that are necessary to ensure that private and public buildings in Poland are highly energy efficient and low-carbon by 2050.

Description: This strategy aims to make buildings in Poland more energy efficient and environmentally friendly. The strategy proposes a renovation scenario and guidance on how to support the in the process of modernising buildings.

Building renovation is a significant challenge until 2050 and is in line with the European Union's climate neutrality targets. At the same time, the strategy takes into account the urgent need to replace the most emitting heat sources in order to improve air quality and preserve the cost-effectiveness of retrofitting.

The key objective of renovation is to reduce energy consumption and CO_2 emissions, while taking care of the health and safety of building occupants. The strategy carries out a comprehensive diagnosis of the building renovation challenge and proposes a scenario for the modernisation of buildings in Poland by 2050. The document also provides public policy guidelines and indicators to monitor the implementation of the strategy.

The implementation of a building renovation plan may be facilitated by a review of energy efficiency legislation, which may require the introduction of tools to facilitate investment decisions, such as an energy class system and the implementation of solutions based on the building energy passport concept. Such a passport would contain information on thermal modernisation projects carried out and planned over several years, thus making it possible to achieve a high standard of energy efficiency already at the planning stage. The widespread use of such tools in Polish conditions could make it possible to control the thermomodernisation process, which could be carried out in stages at intervals of even several years.

In addition, the strategy is supported by other initiatives with different scopes of action, such as the "Clean Air Programme", the "Programme for the thermal modernisation of single-family buildings for the City of Kraków", "My Heat", "My Electricity", "Thermal modernisation allowance" and EU directives on the energy efficiency of new buildings.

Clean Air Programme

Territorial scope: national.
Significance: This programme focuses on reducing greenhouse gas emissions by upgrading heat sources and increasing energy efficiency in single-family buildings. By replacing outdated solid fuel cookers and boilers and thermo-modernising homes, the programme not only contributes to environmental protection, but also generates financial savings by encouraging efficient energy management.

Description: The Clean Air Programme is a comprehensive government initiative to improve air quality and reduce greenhouse gas emissions by modernising heat sources and increasing energy efficiency in single-family buildings. It focuses mainly on the replacement of outdated solid fuel-fired cookers and boilers and thermo-modernisation of homes, which contributes to environmental protection, generates financial savings through efficient energy management and increases property values. The scheme is aimed at homeowners and includes grants for replacing the heat source with a lower-emission one, thermal modernisation works and the installation of a photovoltaic micro-installation. It also increases the availability of funding for those interested in thermal upgrading or replacing heat sources with greener solutions through subsequent editions of the programme. In addition, the programme introduces changes to the funding, taking into account the different income levels of applicants and broadening the catalogue of works covered by the subsidy.

In October 2019, the Municipality of Krakow signed an agreement with the Voivodship Fund for Environmental Protection and Water Management in Krakow on cooperation in the implementation of the Priority Programme "Clean Air", thanks to which Krakow residents can also submit applications for funding and applications for payment for properties located in Krakow at the offices of the Air Quality Department of the Municipality of Krakow (the municipal consultation and information point of the Clean Air Programme run by eco-advisers from the Krakow Energy Advisory Centre). The programme meets increasing interest, and residents are increasingly taking advantage of the eco-counsellors' assistance in submitting applications. At the end of 2023, a total of almost 1,000 applications for funding and applications for payment had been submitted through the Municipality of Krakow.

A strategy for district heating up to 2030 with an outlook to 2040.

Territorial scope: national.
Relevance: The strategy describes the capabilities of the national district heating sector and the projected modernisation pathways for the sector. The document forecasts heat demand by sector and presents possible innovations and solutions for modernisation. It is also an important complement to the local heat supply plans of the city.

Description: the district heating strategy, valid until 2030, with an outlook to 2040, is a key planning document that aims to bring the energy sector in line with both national and EU requirements, particularly in the context of the New Green Deal. The document is currently in draft form, but an advanced version is now available.

As part of the development of the Strategy, a forecast was carried out as an appendix to the document and is based on a cost optimisation model for end users. The results of this analysis highlight the need

to accelerate the transformation of the sector to avoid the risk of further increases in the cost of heat due to both rising GHG allowance prices and fossil fuel imports.

The strategy for the district heating sector takes into account the need to guarantee a secure and economical heat supply to consumers and emphasises the key role of local government in organising this supply, and provides a roadmap for the energy sector. The document takes into account the current state of the sector, analysis of regulations and market conditions as a starting point for necessary changes. The document indicates the optimum directions and methods for the transformation of the heat sector in Poland to meet strategic objectives and ensure security of energy supply at acceptable prices.

EU

European Green Deal

Territorial scope: EU.
Significance: The European Green Deal aims to unite the efforts of the European Union and Member States in pursuit of sustainable development, environmental protection and the fight against climate change. It is a key initiative that reflects the EU's commitment to climate and environmental goals.

Description: the European Green Deal is a strategic initiative of the European Union that was announced in December 2019. It aims to transform the European Union into a sustainable and climate-neutral economy by 2050, in order to combat climate change, protect the environment and promote economic growth and innovation. The European Green Deal covers a wide range of actions, including:

- reducing greenhouse gas emissions: Aims to achieve climate neutrality by 2050 by significantly reducing CO_2 and other greenhouse gas emissions;
- Industrial transformation: Supports industry towards sustainable production, including through investment in low-carbon and energy-efficient technologies;
- Sustainable mobility: Promotes public transport, electromobility and cycle- and pedestrian-friendly infrastructure to reduce emissions from the transport sector;
- building renovation: By investing in the thermal upgrading and energy efficiency of buildings, it aims to reduce emissions from the building sector;
- Sustainable agriculture: Focuses on environmentally sustainable agriculture and sustainable food production, reducing negative environmental impacts;
- protecting biodiversity: Encourages the protection and restoration of natural ecosystems and combats the challenges of biodiversity loss;
- renewable energy: Supports the development of renewable energy sources such as solar, wind, geothermal and hybrid energy to increase the share of clean energy in the total energy mix.

In addition, the 'Fit for 55' legislative package was announced in July 2021 to translate the EU's climate ambitions into concrete legislation. This is a set of suggested changes to climate, energy and transport legislation. It also introduces new legislation to bring EU law in line with its climate goals.

REPowerEU

Territorial scope: EU.
Relevance: REPowerEU is an important element of the European Union's strategy to achieve net climate neutrality by 2050 and provide safe, clean and affordable access to energy for all EU citizens. This initiative is crucial for the further development of the European energy sector and the achievement of the objectives of the of the climate transition.

Description: REPowerEU is the European Commission's plan to make Europe independent from Russian fossil fuels sooner than originally planned (by 2030). The plan was announced in July 2021 as part of the European Green Deal. It aims to accelerate the green transition by promoting sustainable energy sources and integrating energy markets in the European Union. REPowerEU includes a series of measures to rapidly reduce dependence on Russian fossil fuels and increase the resilience of the EU energy system. The main objectives of REPowerEU are:

- increasing the share of renewable energy sources in the EU energy mix;
- Introduce more ambitious targets for EU member states than those resulting from 'Fit For 55';
- improving the security of energy supply by increasing the flexibility and resilience of the energy system;
- Protecting consumers by ensuring safe, affordable and sustainable access to energy;
- introduction of new standards and energy requirements for buildings;
- supporting investment in energy infrastructure, including transmission networks and energy storage;
- Integration of EU energy markets to enhance competitiveness and security of supply.

Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on establishing a framework to facilitate sustainable investment

Territorial scope: EU.
Significance: This document imposes information and reporting obligations on financial institutions and companies, seeking to increase transparency and accountability in the context of environmental and social issues. The regulation also sets CO_2 limits related to energy generation, which significantly affects the mission objectives. These rules force the modernisation of carbon-intensive thermal power plants, leading to a reduction in CO_2 emissions during energy production.

Description: Regulation (EU) 2020/852 of the European Parliament and of the Council was adopted to establish a single European policy for environmentally sustainable investments. Its main objective is to create a coherent system of environmental and social classifications that will facilitate the identification of investments in line with sustainable development objectives.

Within this regulation, sustainable investment categories have been identified, covering areas such as climate change, environmental protection, energy efficiency, circular economy, sustainable use of natural resources, biodiversity conservation, health and education.

The regulation also introduces disclosure obligations related to sustainable financial activities for investment firms, financial advisers and listed companies. Through this legislation, financial institutions will be required to report on the extent to which their investments comply with sustainability criteria.

The regulation is key to accelerating the transition towards a more sustainable economy and is part of the European Union's broader plan for financing sustainable development. It is an instrument to support the long-term goals of climate change, environmental protection and social responsibility.

Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (RED II Renewable Energy Directive).

Territorial scope: EU.
Significance: The directive at European Union level sets a binding target of 32% share of energy from renewable sources in gross final consumption by 2030 This document directly affects the district heating sector, forcing an annual increase in the share of heat from RES and waste heat supplied to consumers by at least 1.1 percentage points (y/y) by 2030 or 1.3 percentage points including waste heat.

Description: The Directive is a key piece of European Union legislation aimed at promoting and intensifying the use of energy from renewable sources. The document sets out specific targets, obligations and support mechanisms to accelerate the transformation of energy sectors.

The main elements of the directive include setting an overall target that at least 32% of the European Union's total energy consumption should come from renewable sources by 2030. In addition, the directive imposes specific targets for the share of renewable energy in the transport and heating sectors, aiming for sustainable growth and reduced greenhouse gas emissions.

Directive of the European Parliament and of the Council on energy efficiency and amending Regulation (EU) 2023/955

Territorial scope: EU.
Relevance: The directive is an implementing act in the aspect of energy and climate transformation of the and climate transformation of EU Member States resulting from the European Green Deal and the Fit for 55 package.

Description: The directive aims to reduce final energy consumption by 11.7% by 2030. Member States can make use of flexibilities in meeting this target.

The targets include a reduction in final energy consumption of at least 11.7% by 2030 compared to 2020 projections. National contributions will be set out in the integrated energy and climate plans (IEPs) and can be adjusted by the Commission if the target is not met.

Energy saving targets will gradually increase until 2030, with the public sector having specific commitments, such as an annual reduction in energy consumption of 1.9% and the renovation of at least 3% of public buildings per year.

Article 26 of the Directive also gives a very important definition of an energy-efficient system. Such a system is understood as:

- until 31 December 2027, a system using at least 50% renewable energy, or at least 50% waste heat, or at least 75% heat from from cogeneration, or at least 50% a combination of such energy and heat;
- from 1 January 2028, a system using at least 50% renewable energy or at least 50% waste heat, at least 50% renewable energy and waste heat, at least 80% heat from high-efficiency cogeneration, or at least a combination of such heat injected into the grid, in which the share of renewable energy is at least 5% and the total share of renewable energy, waste heat or heat from high-efficiency cogeneration is at least 50%.

Further changes to the definition are planned after the completion of the Mission 100 Climate Neutral and smart cities, from 1 January 2035.

Directive of the European Parliament and of the Council on the energy performance of buildings EPBD (recast) (COM(2021)0802 - C9-0469/2021 - 2021/0426(COD))

Territorial scope: EU.
Significance: The directive stipulates that from 2030 all new buildings will have to be zero-emission, and by 2050 the entire building stock in the European Union should be zero-emission.

Description: The directive is one of the key pieces of legislation in the European Green Deal and the Fit for 55 package and aims to reduce greenhouse gas emissions and eradicate energy poverty.

How Poland will achieve the goals of the directive will be decided primarily by the Polish government, on the basis of an analysis of the building renovation process contained in the National Renovation Plan.

The long-term goal of the regulation adopted by the Member States is the climate neutrality of the entire building sector in 2050. Zero carbon is to cover residential, non-residential and public buildings. Within a few years, mandatory zero-carbon standards will first cover new public buildings (from 1 January 2028) and all new buildings from 1 January 2030. The energy performance of buildings will be defined by so-called Minimum Energy Performance Standards, phased in as a mandatory requirement for non-residential buildings and optional for residential buildings. A similar function will be fulfilled by a certification system with a scale from A to G, where A stands for zero-emission buildings and G for those with the worst energy performance.

In parallel to the new EU regulations, Poland is receiving funding to improve the energy efficiency of buildings, e.g. from the National Reconstruction Plan and the European Funds for Infrastructure, Climate, Environment (over PLN 23 billion). To this must also be added the proceeds from the Social Climate Fund as well as repayable instruments from the private sector and so-called repayable financing, e.g. ESCO (Energy Saving Company) or local government green bonds. Financial support for meeting the EPBD targets is also found in the Modernisation Fund.

Evaluation of plans, policies and strategies

In the context of the fight against global warming, an analysis of the above policies, strategies and plans for Krakow shows the city's strong commitment to environmental protection and combating climate change. Kraków stands out for its advanced, integrated approach to the fight to protect the climate. The strategic approach covers the areas of green infrastructure, mobility, energy efficiency and regional cooperation. The introduction of a comprehensive sustainable development strategy has the potential to transform the city, bringing together the different areas into a unified vision.

The integration of activities enables synergistic effects, where progress in one area supports goals in others. For example, investment in green infrastructure not only improves air quality, but also affects the living comfort and health of residents. Such an approach is crucial in the complex context of climate change.

Local strategies and plans represent a clear commitment to actively involve the local community in decision-making on the fight against climate change. A participatory approach allows diverse perspectives to be taken into account, which in turn promotes effective and sustainable results. It is not only an information tool, but also a platform for social dialogue, strengthening the bond between citizens and decision-makers. In order to highlight Krakow's climate ambitions, it will also be necessary to include them in the update of the Krakow Development Strategy. This is a key strategic document of the city that integrates other relevant documents, plans and strategies. The current work on the update focuses on clearly distinguishing climate objectives, with climate, air and environmental protection as a separate strategic priority for the city.

The aforementioned plans have an important focus on cross-sectoral and regional cooperation. Krakow is not isolating itself in its climate efforts, but is engaging in partnerships with other actors in different sectors of the city's operation. Such collaboration is a key element of the global fight against climate change. It acts as a catalyst for the exchange of best practices, increasing the potential for multilateral benefits for the region.

There are also some challenges in the context of the strategies under consideration on the path of climate transformation.

- The dynamics of climate change and technological advances impose on Krakow the need to continuously adapt its strategies. Sustainable mobility planning, energy infrastructure adaptation and other long-term strategies need to be flexible and open to new challenges. This requires systematic monitoring and updating to ensure that strategies remain effective in the long term.
- Improving data availability. Limited access to comprehensive data on GHG emissions, energy consumption and other key environmental indicators makes it difficult to effectively assess progress and take appropriate action. There is a need to improve data availability and standardisation, enabling better monitoring and management of transformation processes.
- Implementation of European legislation into national law. Harmonisation of national law with European climate directives is a key element of the transition. However, this process can be complex and time-consuming, requiring the adaptation of legal systems and the introduction of relevant legislation and procedures at national level.

- Lack of implementing acts. Often, once climate legislation is adopted, there remains a lack of detailed implementing acts that clarify specific actions and targets. This lack of precise guidance can hinder the implementation of measures and the effective monitoring of progress.
- Lack of or insufficient support programmes. Successful transformation requires support from government and public institutions. However, support programmes for businesses, economic sectors and local communities to adapt to climate change, innovate and reduce greenhouse gas emissions are often missing or insufficient.
- The need for financial support to the Mission directly from the EU level. Achieving ambitious climate goals requires significant financial resources. However, national resources may not be sufficient, so it is important to provide financial support to the Mission directly from the European Union level, including through structural funds, investment programmes and other financial instruments.

The effectiveness of strategies also depends not only on their ambitious goals, but also on their effective implementation. Achieving the intended results can be hampered by limited financial resources, public resistance or technical difficulties in implementing projects. Managing projects, monitoring progress and adjusting activities accordingly are key elements of successful implementation.

Despite the financial commitment, there is also a risk of financial gaps in the implementation of ambitious plans. Finding sustainable and effective funding mechanisms is a key element of success. An appropriate balance between investment and efficient use of resources is essential to avoid interruptions to projects. It is therefore valuable not only to plan, but also to adapt flexibly to changing conditions, thus ensuring not only the sustainability of strategies, but also their effectiveness in the long term.

Impact of policies and strategic management documents on Krakow's climate ambitions

The above-mentioned documents have a significant impact on the climate ambitions of the City of Krakow. At the local level, strategies such as 'Development Strategy for Krakow. Here I want to live. Kraków 2030" or plans such as the "Low Emission Management Plan for the Municipality of Krakow" set specific targets for reducing emissions and promoting sustainable practices. In turn, the "Kraków Green Deal" and the "Adaptation Plan of the City of Kraków to Climate Change by 2030" focus on increasing green areas and preparing the city for climate change, which reinforces Kraków's commitment to environmental sustainability. In addition, the "Environmental Protection Programme" and the "District Forestry Enhancement Programme" aim to improve air quality and increase forestation, which is key to mitigating the urban heat island effect and improving the wellbeing of residents.

At the regional level, documents such as the 'Metropolia Krakowska 2030 Strategy' and the 'Sustainable Mobility Plan' support wider metropolitan cooperation in achieving common climate goals. They emphasise sustainable mobility, cleaner energy and joint climate action, which is key to increasing the impact of local initiatives. "The Regional Climate and Energy Action Plan for the Małopolska Voivodeship" fits into these activities by offering a framework for comprehensive climate and energy strategies at the provincial level.

At the national level, documents such as the "Energy Policy of Poland until 2040" and the "Clean Air Programme" provide general guidance and financial support for the transition to renewable energy sources and improved air quality. National directives help local governments align their initiatives with broader goals, ensuring consistency and strengthening efforts at the municipal level.

At the European level, the 'European Green Deal' and directives such as RED II and EPBD set ambitious targets for the use of renewable energy sources and energy efficiency. These documents create a supportive regulatory environment, encouraging local and regional authorities to take more ambitious climate action. The alignment of Krakow's local strategies with higher level policies underlines the city's commitment to achieving both national and EU climate targets, fostering a comprehensive approach to sustainable development.

The integration of local, regional, national and EU policies, strategies and strategic management instruments creates a robust framework to support Krakow's climate ambitions, leading the city to make significant reductions in greenhouse gas emissions and increase its resilience to climate change.

Selected indicator data from the documents described above were used to estimate the extent to which the commitment to achieve climate neutrality for the city by 2030 was covered. For this purpose, the Economic Model was used, which, after collecting the ambitious commitments until 2030, estimated the reduction potential at 59%. When several scenarios were included in a given document, the one that was more optimistic in terms of climate was selected.

Table A-2. Greenhouse gas emission reduction action plan.

	Baseline emissions (BAU 2030)	**Emission reductions in existing action plans, strategies, etc.**		**Remaining emissions**		**Residual emissions**		**Emission gap - Reducing emissions through the Climate Contract Action Plan to close the emissions gap**	
	Total (thousand tonnes)	Total (thousand tonnes)	(% of baseline emissions)	Total (thousand tonnes)	(% of baseline emissions)	Total (thousand tonnes)	(% of baseline emissions)	Total (thousand tonnes)	(% of baseline emissions)
Transport	595	226	38%	369	62%	234	39%	135	23%
Buildings and heating	1539	710	46%	829	54%	158	10%	671	44%
Electricity	3799	2355	62%	1444	38%	885	23%	559	15%
Waste Management and CE	94	-35	-37%	129	137%	86	91%	43	46%
Other (mainly industry)	1580	1217	77%**	363	23%	157	10%	206	13%
Total	7607	4473	59%	3134	41%	1520	20%	1614	21%

**The Economic Model calculation sheet assumes an increase in CO_2e, with the same levels of recycling selected as in the base year and population growth.*

The table above shows the estimated emissions effects of the above plans, assumptions and strategies and the changes that have occurred in Kraków's industry in the Nowa Huta area between 2018 and 2022 (blast furnace shutdown, large emission decreases) based on the Economic Model's calculation scheme. Baseline emissions are derived from the BAU 2030 scenario calculated using the Economic Model, based on the assumptions described in chapter 'Module A-1 Baseline GHG emissions inventory'. The differences between the results of the BAU 2030 scenario and the 2018 baseline inventory are small and amount to approximately 4%.

Based on the adopted plans and strategies and strategic management instruments, greenhouse gas emissions are projected to decrease by 59% by 2030 compared to the base year, which has been taken into account in the existing strategies. The main area of emission reduction is the energy sector, including both buildings, heating and electricity generation and industry. Planned changes in this sector are addressed both in national plans, such as the Energy Policy of Poland until 2040 (PEP2040) and the National Energy and Climate Plan until 2030, as well as local plans, e.g. "Assumptions to the Plan for Supplying the Municipality of Krakow with Heat, Electricity and Gas Fuels for the years 2023-2038". In spite of the current actions already included in the existing documents, there is still a 21% emissions gap to be addressed by focusing on new projects and actions in order to achieve the mission objectives.

The actions described further in Part B, will address precisely the 21% emissions gap. Closing this gap is essential to meet the goal of the Mission of 100 Climate Neutral and Smart Cities by 2030, which aims for an 80% reduction in emissions over the period in question. The 21% reduction in question translates into a direct emissions reduction target of 1,614,000 tonnes of CO_2e. This reduction is also not evenly distributed. The greatest potential for emission reductions is in the energy, buldings and industry sectors.

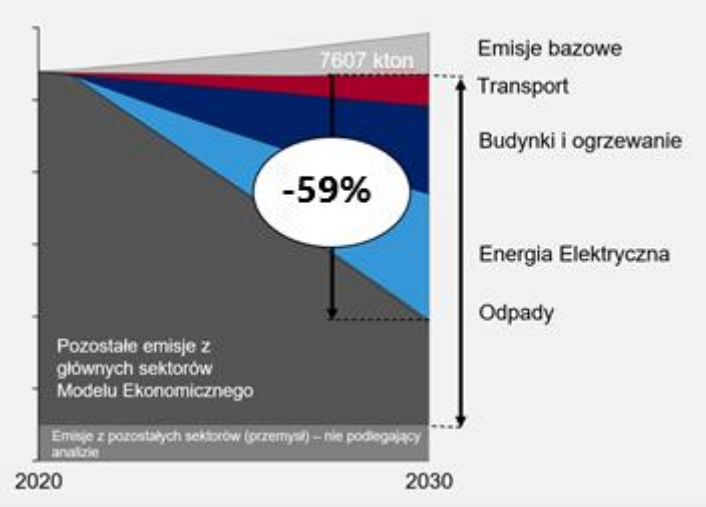


Figure 7. GHG emission reductions based on the Economic Model in existing strategies, policies and strategic management instruments.
Source: *own study*.

The Municipality of Krakow faces the challenge of limited opportunities to influence the most emitting sector - energy generation. This is a major constraint as Krakow's transformation depends mainly on domestic investment in the energy sector. The city's current level of indebtedness prevents significant direct infrastructure investments in the energy sector within the city, which could significantly burden the budget.

Therefore, Krakow should focus on measures promoting distributed energy and thermo-modernisation of buildings, which can have a significant impact on the city's energy balance. These activities will contribute to reducing emissions and improving the quality of life of the inhabitants and will reduce the costs they have to pay for energy bills. In addition, encouraging private investors to undertake similar activities by providing appropriate financial incentives and tax breaks can accelerate the process of ecological upgrading of infrastructure.

Promoting renewable energy sources is a key aspect that Krakow should undertake in order to accelerate the transition to green energy. The development of appropriate local policies and strategies to support the development of photovoltaic installations, wind power plants and district heating based on renewable energy sources can contribute to a significant reduction in emissions and increase the city's energy independence. Climate and environmental education is an equally important area for Krakow to address. Through educational initiatives, information campaigns and environmental awareness programmes, the city can raise the level of citizens' awareness of the need to take action to protect the environment and support long-term changes for sustainable community development. In this way, despite the limitations on its direct impact on the energy sector, Krakow can actively contribute to reducing emissions and promoting sustainable development, which will benefit both the environment and the city's residents.

It is worth noting that the Economic Model forecasts an increase in greenhouse gas emissions in the waste sector. This is as a result of the fact that the model assumes an increase in CO_2e emissions, with the same levels of recycling of certain types of waste as in the base year, and takes into account the generation of heat from the waste incineration plant, the continued operation of which, unchanged, is necessary to reduce the share of heat generation from carbon sources by 2030. For this reason, a significant proportion of emissions from the waste sector have been attributed to residual emissions.

Target - 80%

In order to achieve the Climate Contract's goal of an 80% reduction in emissions, it is necessary to integrate measures resulting from national policy with local measures. The following Table A-3 provides a summary of the assumptions of the Action Plan resulting from Module A-2 Assessment of current strategies, policies and strategic management instruments, actions from Module B-2 Designing a Climate Neutrality Portfolio and calculations from the Economic Model.

Table A-3. Intervention pattern of policies, strategies, strategic management instruments and actions.

Sector	Type of action	Strategies, policies and instruments for strategic management (A-2)*	Estimated emission reductions resulting from the A-2 assumptions	Actions in the Action Plan (B-2)	Estimated emission reductions resulting from B-2	Objective
Transport	Transition to public and non-mechanised transport	• Low Emission Management Plan for the Municipality of Krakow. • City of Kraków Climate Change Adaptation Plan. • Development strategy for Krakow. This is where I want to live. Kraków 2030. • Kraków Green Deal. • Kraków Metropolis 2030 Strategy. • Sustainable mobility plan for Krakow Metropolis. • Regional Climate and Energy Action Plan for the Małopolska Region. • Air protection programme for the Małopolska voivodship. • Poland's Energy Policy until 2040. • European Geen Deal.	59 thousand tonnes CO_2e	TR-2 TR-3 TR-4 TR-5 TR-7 TR-10 TR-11 TR-12 TR-13	35 thousand tonnes of CO_2e	Reduce transport needs by 1048.75 million passenger-kilometres.
	Occupancy rate of passenger cars	• Low Emission Management Plan for the Municipality of Krakow. • Sustainable mobility plan for Krakow Metropolis. • Regional Climate and Energy Action Plan for the Małopolska Region.	18 thousand tonnes of CO_2e	TR-14	28 thousand tonnes CO_2e	Increase from an average of 1.5 passengers per car to 1.9 passengers per car.
	Optimisation of freight transport logistics	• Low Emission Management Plan for the Municipality of Krakow. • Sustainable mobility plan for Krakow Metropolis.	77 thousand tonnes CO_2e	TR-15	10 thousand tonnes of CO_2e	An increase in the average loading rate of light trucks (<3.5

		• Poland's Energy Policy until 2040. • European Geen Deal.				tonnes) from an average of 23% to 30% and heavy trucks (>3.5 tonnes) from 45% to 60%.
	Electrification of trucks	• City of Kraków Climate Change Adaptation Plan. • Sustainable mobility plan for Krakow Metropolis. • Regional Climate and Energy Action Plan for the Małopolska Region. • Air protection programme for the Małopolska voivodship. • Poland's Energy Policy until 2040. • National Energy and Climate Plan 2021-2030. • European Geen Deal.	21 thousand tonnes of CO_2e			An increase in the share of electric light trucks (<3.5 tonnes) from 0% to 60% and heavy trucks (>3.5 tonnes) from 0% to 30% (2040). Approximately 35565 and 4028 new vehicles, respectively.
	Electrification of passenger cars	• City of Kraków Climate Change Adaptation Plan. • Sustainable mobility plan for Krakow Metropolis. • Regional Climate and Energy Action Plan for the Małopolska Region. • Air protection programme for the Małopolska voivodship. • Poland's Energy Policy until 2040. • National Energy and Climate Plan 2021-2030. • European Geen Deal.	38 thousand tonnes of CO_2e	TR-1 TR-16	56 thousand tonnes of CO_2e	Increase the share of electric passenger cars in the city from 0% to 34% (2040) - approximately 124,388 electric vehicles.
	Electrification of public transport	• Low Emission Management Plan for the Municipality of Krakow. • City of Kraków Climate Change Adaptation Plan. • Kraków Green Deal. • Sustainable mobility plan for Krakow Metropolis. • + for the Malopolska Region. • Air protection programme for the Małopolska voivodship. • Poland's Energy Policy until 2040. • National Energy and Climate Plan 2021-2030. • European Geen Deal.	13 thousand tonnes of CO_2e	TR-6 TR-8 TR-9	6 thousand tonnes of CO_2e	Increase in the share of electric buses in public transport from 4% to 74% (2040). Approx. 452 new electrically powered buses.

Total transport			**226 thousand tonnes of CO_2e**	-	**135 thousand tonnes of CO_2e**	-
Buildings and heating	Energy efficiency of new buildings	• Development strategy for Krakow. This is where I want to live. Kraków 2030. • Poland's Energy Policy until 2040. • Long-term strategy for building renovation to 2050. • European Geen Deal. • REPowerEU. • Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on establishing a framework to facilitate sustainable investment. • Directive of the European Parliament and of the Council on energy efficiency and amending Regulation (EU) 2023/955.	19 thousand tonnes of CO_2e	BIC-11	34 thousand tonnes of CO_2e	80% of new buildings built to better than minimum standard.
	Annual building renovation rate	• Assumptions to the plan for supplying the Municipality of Krakow with heat, electricity and gas fuels for the years 2023-2038. • Low Emission Management Plan for the Municipality of Krakow. • City of Kraków Climate Change Adaptation Plan. • Regional Climate and Energy Action Plan for the Małopolska Region. • Air protection programme for the Małopolska voivodship. • Poland's Energy Policy until 2040. • National Energy and Climate Plan 2021-2030. • Kraków Green Deal. • Long-term strategy for building renovation to 2050. • Clean Air Programme. • European Geen Deal. • REPowerEU. • Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on establishing a framework to facilitate sustainable investment. • Directive of the European Parliament and of the Council on energy efficiency and amending Regulation (EU) 2023/955.	79 thousand tonnes of CO_2e	BIC-1 BIC-2 BIC-3 BIC-4 BIC-8 BIC-9	459 thousand tonnes of CO_2e	Increase in annual building refurbishment rate from 1.1% to 4%. approx. 1270,000 m^2 more floor space.
	Increased lighting efficiency and upgrading of domestic appliances	• Assumptions to the plan for supplying the Municipality of Krakow with heat, electricity and gas fuels for the years 2023-2038. • Low Emission Management Plan for the Municipality of Krakow. • Kraków Green Deal. • Poland's Energy Policy until 2040.	103 thousand tonnes CO_2e	E-12 TR-1	*reductions from measures included in the electricity sector	Increase in annual lighting retrofit rate from 1.1% per year to 4%.

	Decarbonisation of the heating	• Assumptions to the plan for supplying the Municipality of Krakow with heat, electricity and gas fuels for the years 2023-2038. • Low Emission Management Plan for the Municipality of Krakow. • City of Kraków Climate Change Adaptation Plan. • Environmental Protection Programme for the City of Krakow for 2020-2030. • Kraków Green Deal. • Anti-smog resolution for Krakow. • Climate Strategy of the Krakow Metropolis 2024-2030. • Regional Climate and Energy Action Plan for the Małopolska Region. • Air protection programme for the Małopolska voivodship. • Poland's Energy Policy until 2040. • National Energy and Climate Plan 2021-2030. • Clean Air Programme. • A strategy for district heating up to 2030 with an outlook to 2040. • European Geen Deal. • REPowerEU. • Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on establishing a framework to facilitate sustainable investment. • Directive of the European Parliament and Council (EU) 2018/2001 of 11 December 2018 on the promotion of the use of energy from renewable sources (RED II Renewable Energy Directive).	509 thousand tonnes of CO_2e	BIC-5 BIC-6 BIC-7 BIC-10 E-1 E-2 E-3 E-7 E-10 E-14	178 thousand tonnes CO_2e	Reduction of fossil thermal generation in the urban network by 341 GWh. Reduction of individual fossil thermal energy generation by 805 GWh.
Total Buildings and heating			**710 thousand tonnes CO_2e**	-	**671 thousand tonnes of CO_2e**	-
Electricity	Electricity - switching to renewable energy sources	• Assumptions to the plan for supplying the Municipality of Krakow with heat, electricity and gas fuels for the years 2023-2038. • Low Emission Management Plan for the Municipality of Krakow. • City of Kraków Climate Change Adaptation Plan. • Environmental Protection Programme for the City of Krakow for 2020-2030. • Development strategy for Krakow. This is where I want to live. Kraków 2030. • Kraków Green Deal. • Climate Strategy of the Krakow Metropolis 2024-2030,	2355 thousand tonnes CO_2e**	BIC-4 BIC-8 BIC-11 E-1 E-2 E-3 E-4 E-5 E-6	559 thousand tonnes of CO_2e	Reduction in electricity generation from fossil fuels by 2857 GWh.

		• Regional Climate and Energy Action Plan for the Małopolska Region. • Air protection programme for the Małopolskie Voivodeship • Poland's Energy Policy until 2040. • National Energy and Climate Plan 2021-2030. • European Geen Deal. • REPowerEU. • Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on establishing a framework to facilitate sustainable investment. • Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (RED II Renewable Energy Directive).		E-7 E-9 E-10 E-11 E-12 E-13 E-14 E-15 E-16 E-17 TR-1 GOZ-1		
Total electricity			**2355 thousand tonnes CO_2e****	-	**559 thousand tonnes of CO_2e**	-
Waste management and CE	Increase in recycling rates and development of a circular economy	• Environmental Protection Programme for the City of Krakow for 2020-2030. • Development strategy for Krakow. This is where I want to live. Kraków 2030. • Kraków Green Deal. • Regional Climate and Energy Action Plan for the Małopolska Region. • Poland's Energy Policy until 2040. • European Geen Deal. • Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on establishing a framework to facilitate sustainable investment.	-35 thousand CO_2e***	BIC-10 GOZ-1 GOZ-2 GOZ-3 GOZ-4	43 thousand tonnes of CO_2e	An additional 12,138 tonnes of paper recycled. An additional 11,500 tonnes of plastic recycled. An additional 18,517 tonnes of organic waste used.
Total waste management and CE			**-35 thousand tonnes CO_2e*** **	-	**43 thousand tonnes of CO_2e**	-
Other (mainly industry)	Land reclamation, increased forest cover and blue-green infrastructure and decarbonisation of industry	• City of Kraków Climate Change Adaptation Plan. • Environmental Protection Programme for the City of Krakow for 2020-2030. • District Forestry Enhancement Programme of the City of Kraków 2018-2040. • Development strategy for Krakow. This is where I want to live. Kraków 2030. • Kraków Green Deal. • Kraków Metropolis 2030 Strategy.	1217 thousand tonnes CO_2e**	I-1 I-2 I-3 I-4 I-5 I-6 I-7	206 thousand tonnes of CO_2e	Increase in forest cover to 8% (2040).

		• Climate Strategy of the Krakow Metropolis 2024-2030. • Regional Climate and Energy Action Plan for the Małopolska Region. • European Geen Deal. • Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on establishing a framework to facilitate sustainable investment.		I-8 I-9 I-10		
Total other			**1217 thousand tonnes CO_2e****	-	**206 thousand tonnes of CO_2e**	-

* The following column is the result of only some of the indicators derived from the documents and analysed by the Economic Model. Some actions from the documents are not analysed by the Model and their implementation is described as a separate action (mainly forests and green infrastructure).
** This figure takes into account the changes that have taken place in the Kraków industry in the New Steelworks area between 2018 and 2022 (shutdown of the blast furnace, large decreases in emissions).
*** The Economic Model calculation sheet assumes an increase in CO_2e, with the same levels of recycling selected as in the base year and population growth.

2.3 Module A-3 Systemic barriers and opportunities for achieving climate neutrality in 2030

A-3.1: Description of urban systems, system barriers and development opportunities

Systemic and sectoral barriers stand in the way of Krakow's climate transformation. Identifying them, analysing them and taking action to reduce or abolish their negative impact will, together with levers for change, provide a powerful impetus for accelerating pro-climate action. The following barriers also apply to the vast majority of other Polish cities.

SYSTEMIC BARRIERS:

1. No pattern of urban climate transformation.
2. Organisational weakness.
3. Too little involvement of residents/neighbourhoods and stakeholders.
4. Difficulties in building programmes with complex organisational structure, dependence on grants.
5. Insufficient cooperation between government and local authorities.
6. Lack of long-term financial investment support schemes (stability and predictability)

1. Lack of a pattern of urban climate transformation.

There is no one ready-made universal template for the climate transformation of cities. This is because each city has different systems and requires solutions tailored to local needs. Despite the existence of pioneering cities such as Copenhagen, their experiences cannot be transferred 1:1 to Polish systemic and legislative realities.

Meanwhile, expectations of a potential role model are too high and misplaced. They often focus on finding a ready-to-implement model to guarantee success. This is not the right approach because of the diverse problems and needs of individual cities and the need to be flexible in solving them.

Those patterns of action that are already in place are inadequate in relation to the scale and urgency of the challenges. For example, there is currently a dominant tendency to focus on electricity or waste recycling, which is not right in every context.

Possible response to the barrier: The answer to the lack of a universal template for urban climate transformation is to develop flexible and contextualised strategies (e.g. City Climate Contract). Krakow should engage in local public consultations to identify specific needs and opportunities. It is also important to create platforms for the exchange of experiences between cities so that best practices can be adapted to local conditions. Investing in research and pilot projects will allow different solutions to be tested and scaled up as needed. It is also crucial to work with the private sector and NGOs to jointly develop innovative and sustainable technologies and practices.

2. Organisational weakness.

The organisational weakness of local authorities is mainly due to the siloed nature of municipal structures Horizontal knowledge sharing and cooperation between organisational units of the authority is insufficient.

The position of climate units in the structure of the offices is not strong enough. Decision makers underestimate the importance of the climate crisis, so that the transition units in the offices are often not taken fully seriously. Their tasks and decisions are not prioritised in city management and the teams built are too small. This is due, among other reasons, to the lack of tangible benefits of engaging in pro-climate activities for decision-makers.

An additional barrier related to organisational weakness is the lack of qualified clerical staff, which is mainly due to underfunded offices and low salaries. The subject of transformation itself is also new and challenging, which does not facilitate the building of strong clerical teams.

Possible response to the barrier: In order to strengthen the organisation of local authorities, it is necessary to promote horizontal cooperation between municipal organisational units through the creation of interdepartmental project teams (e.g. the Advisory Team of the Zero Emission Krakow Portfolio Council, used in the consultation of the Action Plan). The importance of climate units in the structure of offices should be increased, giving them more autonomy and influence over decisions. It is also worth investing in training and qualification of officials to increase their competence in the field of climate transformation.

3. Too little involvement of residents/neighbourhoods and stakeholders.

A pressing problem is low stakeholder engagement, which is largely due to the failure of authorities at various levels to use language based on financial and non-financial benefits. There is a lack of a message based on the reliable benefits of transformation, both material and those related to, for example, health. Currently, the message about the need for it is mainly focused on coercion.

Residents and officials also have a sense of lack of agency, ineffective action and aimlessness in pursuing transformation. This is partly related to the distant time horizon of the transformation - it is mostly mentioned in the context of 2040/2050 and there is a lack of demonstration of successes already achieved.

The enthusiasm of residents is often not properly channelled, there is also the phenomenon of 'greenwashing', which portrays measures that in reality have little impact on the climate as pro-climate.

Underlying the low level of stakeholder engagement is also an insufficient understanding of the severity of the climate crisis, which affects residents as well as officials and decision-makers. This dovetails with the lack of educational activities and information campaigns conducted on a broad scale.

In the context of our city, the lack of resources for financial incentives or promotional and information campaigns is also a problem.

Possible response to a barrier: To increase the involvement of residents and stakeholders, the local government should use the language of benefits, highlighting both the material and health benefits of the climate transition. It is important to run information campaigns that showcase the successes already

achieved and present the concrete, local benefits that the transition will bring in the shorter term. It is also important to involve the community in the decision-making process to increase the sense of agency and influence over change. Organising educational initiatives and promoting transparency of activities can help build greater understanding and involvement among residents.

4. Difficulties in building programmes with complex organisational structure, dependence on grants.

Energy transformation is a huge challenge, large-scale tasks involving stakeholders belonging to many groups: local government, business, private owners, academia are needed. Implementing multi-scale projects that most cities have not yet implemented and are not prepared for.

Meanwhile, the frequent lack of internal cooperation and adequate governance makes it difficult to build comprehensive and effective programmes to foster transformation. In addition, the lack of appropriate legal instruments, legislative inconsistencies and shortcomings, and the thematic complexity of transformation itself further inhibit the construction of good support programmes.

A low sense of responsibility among stakeholders is also a barrier. When building programmes and looking for financial instruments, the lack of ownership among stakeholders, especially business, is also a problem. They often 'shift' this responsibility to local authorities, government and consumers, whose competences are often limited.

A possible answer to the barrier: To overcome the difficulties in building complex energy transition programmes, it is necessary to strengthen internal cooperation and effective project management, involving all stakeholders, including business, local governments and academic institutions. Legislation also needs to be simplified and clarified (Module C-1 - Organisation and Management Innovation) and clear legislative instruments need to be put in place to support the transition. It is also crucial to increase ownership among all stakeholders, promoting public-private partnerships and collective action to build effective support programmes and find appropriate sources of funding.

5. Insufficient cooperation between government and local authorities.
The lack of a government climate neutrality strategy and the low ambition of existing policy documents is one of the most important barriers, which translates into the lack of a coherent and shared vision for transformation. Programmes also often have ill-defined targets and indicators, which do not translate into tangible environmental benefits.

Progress is blocked by conflicts of competence and regulatory contradictions. Lack of sufficient cooperation with the government stems, among other things, from the unclear division of competences between different ministries, as well as between central government and local authorities. The problem is compounded by a lack of consistency and legislative uncertainty, which translates into a lack of trust and strategic decisions. Regulations for support programmes at national, local and intra-governmental levels are complex. They are characterised by complex language and a "thicket" of rules and criteria, which makes them difficult to implement and difficult for stakeholders to understand.

There is a lack of an effective platform for cooperation between government and local governments, which is not conducive to urban climate transformation. Central authorities often underestimate the potential of local governments to shape change and fail to share knowledge and decision-making with them. Climate policy is also often lost to the current political agenda, the primacy of current issues over climate action is evident.

Possible response to the barrier: In order to improve cooperation between the government and local governments on climate transformation, it is necessary to create a clear and ambitious government climate neutrality strategy that addresses and coordinates actions at all levels of government. It is also crucial to simplify regulations and set clear targets and indicators to monitor progress and achieve measurable environmental benefits. Introducing an effective collaborative platform that enables knowledge sharing and decision-making between government and local governments, will help build trust and a shared vision for transformation. These topics are being addressed in meetings set up as part of the collaboration with ministries in agreeing the vision of the Mission Cities Climate Contracts.

6. Lack of long-term financial investment support schemes (stability and predictability).

A very important barrier in the context of energy transition and RES investments is the lack of long-term financing and investment support schemes. In the context of RES investments, stability and predictability are crucial for investors, as these projects require significant financial resources and are long-term in nature. Lack of certainty about the continuation of support or its changes in the short term may discourage investors from engaging in such projects.

Achieving climate neutrality for energy companies requires huge investments. Most such investments are capital-intensive projects, with significant capital expenditure needs and a lead time of several years. In the long term, however, they bring significant benefits that outweigh the investment costs over time. However, such activities and projects need stability and predictability, especially in the context of national laws and strategies at the national level. Consistency in regulation, funding mechanisms and adequate legislative support is necessary for investor security.

Long-term financial support schemes, such as the feed-in tariff scheme, allow investors to plan their investments for the long term, as they offer stability and certainty about prices, income levels and returns. However, if such long-term support is lacking, investors may be concerned about the risk of changes in policy or the legal environment, which may affect the viability of their projects.

As a result, the lack of stable and predictable financial support schemes is a significant barrier to the development of RES investments, as it can lead to reduced investments and delays in project implementation, which in turn can have a negative impact on the development of the sector and the achievement of climate neutrality targets.

Possible response to the barrier: Introducing stable and predictable regulatory and financial frameworks, which are essential to increase investor confidence and accelerate the transition to sustainable energy. Such support schemes allow investors to effectively manage risks and minimise uncertainties associated with investments in the renewable energy sector.

Key findings from the identification of system barriers:

1. Systemic barriers to climate transformation fall into several key categories - organisational, financial, legislative-political and social.
2. Governance at the local government level is an extremely important action. They need to undergo significant systemic change, including breaking down siloed internal structures and giving greater prominence to the units responsible for climate transformation.
3. The widest possible awareness of the transformation needs to be built among decision-makers, residents

and business, which will require changes in communication and more investment in education and information campaigns.

4. A key role in breaking down barriers must be played by central government, which should work effectively with local authorities, define a coherent vision of transformation and be characterised by high ambition in action. In the current situation, however, the initiative must come mainly from the cities.

SECTORAL BARRIERS:

1. Buildings and construction.
2. Renewable energy sources.
3. Transport.
4. Finance.

1. Buildings and construction.

The energy transformation of the city, especially in the context of the buildings sector, faces a number of challenges that require a comprehensive approach and sustainable solutions.

One of the most significant constraints is that only a small percentage of buildings are owned by the city, while the rest are owned by private entities. The complexity of building ownership raises administrative and organisational challenges. The introduction of uniform energy efficiency standards becomes more difficult when the diversity of private owners with varying financial resources has to be taken into account. Private owners may be less willing to invest in modern technologies given the rising cost of living, which in turn makes a coordinated approach to improving energy efficiency on a wider scale more difficult.

Another major challenge is the high cost of construction and building materials, which has a direct impact on the feasibility of carrying out thermal modernisation of buildings. Rising material prices are influencing resistance to carrying out retrofitting work, especially for older buildings that require complex repair work. The inability to meet the financial challenges of thermomodernisation translates into low energy efficiency, which in the long term is the cause of the generation of additional costs associated with high energy bills.

An additional complication for the city's energy transition is the fact that much of the energy is produced in plants that are not under the control of the municipal authorities. This limits the city's influence on the energy source structure, making it difficult to implement a sustainable energy policy. By not being able to decide on the type of fuel or technology used to produce energy, the city can become dependent on traditional sources, such as coal, instead of using greener solutions.

In the case of dynamically developing cities such as Krakow, the increase in the number of buildings and inhabitants introduces additional challenges. This requires adapting infrastructure to new needs, which in turn generates logistical and financial costs. Demand for energy grows as the city expands, raising the question of whether the city can provide enough energy resources while reducing greenhouse gas emissions.

In the context of the buildings sector, additional challenges encountered by the City of Kraków include the lack of focus of national programmes to support the decarbonisation of buildings. Current initiatives are mainly focused on improving air quality, often neglecting aspects related to energy efficiency or the use of renewable energy sources in the building sector. The lack of a clear national strategy targeting the decarbonisation of buildings can make it difficult for municipal authorities to access the necessary funding and support required to implement ambitious retrofit projects.

Another major challenge is the lack of consistent building data, measurements and analyses carried out on a large scale. Insufficient data hinders an accurate understanding of the current energy situation of buildings in the city. The lack of precise information prevents fully effective planning and decision-making regarding energy efficiency investments and building retrofits. Expanding the level of available knowledge, as well as carrying out comprehensive analyses and measurements, is key to effectively assessing the effects and costs of energy transformation measures for buildings.

In the buildings sector, the fragmentation of decisions on thermal modernisation also poses a considerable challenge. The lack of large-scale integrated planning for building energy efficiency prevents the full potential of the land around buildings and economies of scale from being realised. This acts as a constraint on the ability to develop coherent strategies and effectively manage urban resources, making it difficult to plan multiple thermal upgrading projects simultaneously.

Last, but not least, are historic buildings. Due to their unique character and cultural value, thermomodernisation often faces legal obstacles and resistance from the public. In spite of the benefits that energy efficiency improvements would bring, there is a concern that the changes may damage the original character of these historic buildings.

In summary, energy transformation of the city's building sector requires a holistic approach, taking into account the diversity of owners, financial, cultural and infrastructural aspects. Successful action requires collaboration between the public and private sectors, innovative financing models, and sustainable long-term plans. It is also worth remaining flexible and open to new technologies in order to effectively address today's urban energy transition challenges.

Possible response to the barrier: The energy transformation of Krakow's building sector can be strengthened by expanding existing and introducing new financial incentives for private building owners to invest in energy efficiency, which could offset differences in financial resources, and promoting thermo-modernisation through the ESCO formula. An educational campaign that speaks the language of benefits and facilitates access to technical solutions that have been developed and are ready to be implemented is also key. In addition, cooperation with the private sector should be developed to increase the share of renewable energy sources and the integration of data and analysis should be promoted to enable better planning and efficient management of thermo-modernisation projects.

2. Renewable energy sources.

Renewable energy sources (RES) are one of several sectors where the city's energy transition faces numerous barriers. In Kraków, the key aspects that hinder the successful implementation of RES are likely to be the same as in other large cities in the region.

A major constraint is the lack of available land for the location of photovoltaic farms. In cities such as Krakow, where space is limited, finding suitable areas to install solar panels becomes a challenge. Urban

building structures limit the availability of land, and the prices of vacant land available on the market far outweigh the financial benefits investors can achieve from PV farms.

An additional problem is the location restrictions for some forms of RES, such as windmills. Windmills require specific atmospheric conditions. The Małopolska region is a place with one of the worst conditions for the location of such investments in Poland. The area is not distinguished by high wind speeds compared to other provinces. Furthermore, the presence of numerous protected areas and the varied morphology of the terrain are not conducive to the development of wind energy on an industrial scale. This is a major obstacle to the efficient use of wind energy, which in turn limits the city's potential for green energy.

The location in the basin also contributes to poor weather conditions, especially in winter. During periods of heavy fog or smog, the efficiency of photovoltaic installations can drop significantly, negatively affecting the overall performance of renewable energy sources. Atmospheric conditions are a key factor in determining the efficiency of different RES technologies, and their instability poses a challenge for a city aiming to use green energy sources.

Significant investment costs are another barrier to the development of RES in the city. The introduction of new technologies, especially on a large scale, involves high costs that can be a burden on the budget of residents and private investors. Despite the potential savings in the long term, the initial investment can be a barrier to rapid and massive RES development.

In the context of RES, the lack of a developed energy storage structure is also a significant challenge. RES, such as solar and wind power, generate energy in an unstable manner, dependent on weather conditions. Without effective energy storage systems, it is difficult to store surplus energy generated during periods of good weather, to be used at times when weather conditions are less favourable. The lack of adequate storage infrastructure therefore poses a challenge to the stability of energy supply in cities that want to augment their energy mix with renewable energy sources.

However, it should be emphasised that some barriers can be overcome by the benefits of RES especially for individual consumers. A current problem is the rising price of energy, which is largely generated from fossil fuels. As civilisation progresses, our need for electricity to power a variety of devices is increasing. In addition, the transformation of the passenger car sector from internal combustion engines to electric cars is also leading to an increased demand for energy. Renewable energy sources could be the solution to this problem. Thanks to renewable energy sources, we are able to become partially independent of suppliers and can cover our energy needs with our own installation. These types of installations do not additionally require the supply of raw materials, so that the large investment contribution is offset over time by lower bills.

In conclusion, despite the potential benefits of renewable energy sources, cities such as Krakow face a number of difficulties related to location, weather conditions, investment costs and the lack of a developed storage infrastructure.

Possible answer to the barrier: The energy transformation of the city of Krakow in the context of renewable energy sources (RES) can be supported by investing in modern energy storage technologies, enabling the efficient use of energy generated during periods of good weather. In addition, promoting legislative and financial initiatives to reduce the costs of RES investments can increase the attractiveness of such solutions for private investors and city residents. Educational activities talking

about the financial and environmental benefits of RES technologies should contribute to a significant increase in the dynamics of the energy transition.

3. Transport.

The transport sector is emerging as a key barrier and a significant challenge in the context of the city's climate neutrality. By analysing various aspects, we can identify factors that hinder a successful transition.

The first major problem is the lack of access to precise data in Krakow's inventory of greenhouse gas emissions from the transport sector. The lack of precise information on actual CO_2 emissions makes it difficult to take action. Real emissions are undoubtedly higher than assumed, highlighting the urgent need to provide more precise data and to correct strategies related to reducing the environmental impact of transport. This is particularly evident when comparing CO_2 with other Polish cities, where emissions from the transport sector are significantly higher, despite a smaller population.

In the Urban Inventory, emissions from the transport sector are calculated in an indirect way and compared to other emission calculation methods, as well as other cities with similar characteristics to Krakow, this sector appears to be underestimated. For example, the "Google Environmental Insights Explorer" tool, which also uses the GPC methodology, estimates emissions from the transport sector in 2018 at 1,230,000 thousand tonnes of CO_2 e, when according to the Urban Inventory emissions are estimated at around 500,000 thousand tonnes of CO_2 e. Another reference could be the city of Wrocław, which is similar to Krakow in many respects. According to the data, 1,245,368 tonnes of CO_2e were emitted from road transport in the Wrocław area in 2021. Therefore, real emissions in Kraków from the transport sector may be higher and may require more measures aimed at reducing them.

In the winter season (mainly) the lack of alternatives to the car becomes a clear limitation. In spite of reasonably well-functioning public transport in the city centre, there are transport barriers to commuting to Krakow from neighbouring municipalities without access to the fast agglomeration railway. Public transport to such locations is often insufficiently well developed, forcing commuters to travel to the city centre by car. In addition, an insufficient number of Park&Ride sites contributes to infrequent transfers from car to public transport during a single trip. These barriers make giving up individual means of transport an unattractive option for those living outside the city centre.

An additional challenge is the reluctance of the public to give up combustion vehicles. The introduction of restrictions on the use of traditional cars is being met with resistance from parts of society, which is hindering the effective implementation of measures to improve air quality and reduce emissions. One reason for this is certainly the price. New electric cars from the showroom are more expensive on average by PLN 100 000 compared to their conventionally driven counterparts. In addition, the price of electric cars is increasing faster than that of combustion cars. According to the Research and Automotive Institute Samar, the weighted average price of a new passenger car in 2022 (as of August) was PLN 151 541 (13.6% more than in 2021), while that of an electric car was PLN 245 034 (23.8% more than in 2021). In addition to this, the aftermarket for electric cars is only just developing and is incomparably smaller than for combustion cars, a situation that will take time to improve.

There is also the problem of a lack of infrastructure to meet the demand for chargers for electric vehicles. The insufficient number of charging stations, as well as the difficulty in connecting new chargers to existing infrastructure, means that the growing demand for electric vehicles is not sufficiently supported.

In summary, the transport sector appears as an area where the transformation of the city faces a number of difficulties. Lack of access to accurate data, lack of alternatives in the winter period, public resistance and insufficient infrastructure for electric vehicles are significant barriers requiring comprehensive strategies and actions to successfully re-model the way transport operates in Krakow. In the context of implementing the most crucial measures towards achieving a zero-carbon city, a priority for Krakow should be to focus on the development of rail infrastructure, increasing the share of efficient travel by public transport and developing a network of chargers for electric cars.

Possible response to the barrier: The transformation of Kraków's transport sector can be supported by improving the data collection system for CO_2, allowing a more precise strategy to be developed to reduce the environmental impact of transport. The development of alternative forms of urban transport, such as agglomeration high-speed rail and the expansion of the Park&Ride network, can reduce reliance on individual cars, particularly from neighbouring municipalities. Educational and financial campaigns to encourage a switch to electric vehicles can reduce CO_2, despite high initial costs and public resistance to new technologies. It is also crucial to invest in the expansion of electric vehicle charging infrastructure to meet the growing demand for green solutions in urban transport.

4. Finance.

Kraków's finances represent a significant barrier and challenge to the energy transition process. By analysing key financial aspects, we can identify factors that hinder the effective implementation of climate investments.

The first important element is the indebtedness of cities, including Krakow. Debt limits the flexibility to decide on new investments, including in the area of energy transition activities. Debt forces the need to control spending and reduce investment activity in many sectors of activity.

In view of future financial commitments including loans, the city may face with limited financial resources available for new investments. In the context of the energy transition, where innovative projects and infrastructure are needed, limited resources can be a significant brake on ambitious climate action.

According to the Economic Model, an important part of the city's climate transformation should be financed indirectly by residents and private investors. The city has limited influence over these processes, which makes it even more difficult to implement sustainability plans. Without the right tools and financial support for residents and private investors, the city may face difficulties in encouraging capital investment in pro-climate measures.

In the face of these challenges, Krakow needs to develop innovative financing strategies, seeking new sources of capital and partnerships to accelerate the energy transition. Increased awareness among residents and collaboration with the private sector could be the key to overcoming financial barriers while enabling the city's sustainable development.

Possible response to the barrier: Krakow's energy transition in the face of financial barriers can be supported by restructuring the city's debt and controlling spending to free up resources for climate investments. It is also crucial to seek new sources of funding, such as public-private partnerships and investment from residents, to increase the availability of capital for sustainable development projects.

Education and social mobilisation are essential to increase awareness and commitment to the energy transition process, contributing to overcoming the city's financial challenges.

Action lines

In the context of the city's climate neutrality, the lines of action presented cover a wide range of areas to effectively address climate change and create sustainable, energy-efficient communities. They address the aforementioned barriers that the city needs to overcome in order to achieve the Mission's goal. Below is a brief description of each of the directions listed:

- Cooperation of local governments with the government on support programmes:
  - Strengthen the partnership between local governments and the government in developing support programmes that ensure effective responses to the real needs and opportunities of local communities.

- Emission reduction management and visualisation model:
  - Creating an intuitive management model that allows key information and data on GHG reductions to be presented in an accessible way.

- Availability of exemplary technical solutions:
  - Provide wide access to exemplary technical solutions and promote good practices so that stakeholders can use them freely and free of charge.

- Financial and business models for building retrofits:
  - Develop financial and business models that enable massive retrofitting of buildings, taking into account the scale and urgency of action and ensuring financial benefits for stakeholders.

- The concept of a low- or zero-carbon energy system:
  - Develop the concept of an energy system with low or zero emissions, with the aim of reducing the negative impact on the environment.

- The concept of an energy-positive district:
  - Introducing the concept of an energy district generating surplus energy, which contributes to sustainable and efficient use of resources.

- An organisational and economic model for energy communities:
  - Develop an organisational and economic model for energy communities to ensure energy stability and community self-sufficiency.

- A space management model for changing transport habits:
  - Implementation of a spatial management model to change transport habits, improve living comfort and better organise urban space.

- Social innovation to strengthen participation in democratic decision-making:

- The introduction of social innovation in democratic decision-making aims to create a more participatory society, where citizens feel involved, responsible and actively co-shape their environment and local politics.

- Social innovations that build awareness and change behaviour:
  - Implementing data-driven social innovation to build awareness and change behaviour, increasing resident engagement.

- A platform for cooperation and knowledge sharing with other cities:
  - Creating a platform for cooperation on the basis of the experience and knowledge gained by the pilot cities, allowing for easy replication of proven solutions in cities where these solutions will be relevant and beneficial.

- Procedure for managing a multisectoral portfolio of programmes:
  - Establish a management procedure that involves multiple stakeholders in the implementation of programmes, projects and tasks based on data analysis.

Levers of Change

Levers of Change are those places in a complex system where a small adjustment leads to a big change in the whole system. These can be technology, regulation and governance, financial and business models, social innovation, organisational capacity. In terms of barriers, both systemic and sectoral, the following levers of change were identified from NetZeroCities' 'Theory Of Change':

- Technology/Infrastructure:
  In the area of technology and infrastructure, levers for change include the introduction of modern environmentally friendly technologies such as renewable energy sources, efficient energy technologies and innovative transport solutions. The city's infrastructure must be brought up to sustainable standards, which includes a wide range of solutions from buildings to transport systems.

- Governance and Policy:
  Levers for change in the area of governance and policy refer to effective strategies and regulations that support the goals of sustainable development and reduction of greenhouse gas emissions. This includes the implementation of urban plans, transport policies, and energy efficiency regulations.

- Social Innovation:
  Social innovation as a lever for change encompasses innovative approaches by local communities and NGOs in addressing climate-related issues. These can be community engagement projects, local government initiatives or educational programmes that promote environmental awareness and pro-climate behaviour.

- Democracy and Social Participation:
  In the context of the levers of democratic change and public participation, it is crucial to involve residents in the decision-making processes of the city's climate transformation. This includes public consultations, public debates and participation in the urban planning process.

- Finance:
  Levers for change in the area of finance include developed financing models for climate transition projects. These can include public and private investment, financial instruments to support green projects and the creation of appropriate financing mechanisms for sustainable initiatives.

- Education and Skills:
  Education and skills development are key to successful urban climate transformation. Levers for change in this area include education programmes, vocational training and information campaigns that raise environmental awareness and develop the skills needed to take pro-climate action.

The interaction of these levers of change is key to successful urban climate transformation and enables a comprehensive approach to creating sustainable and green urban communities.

Table A-3.2: Systems and stakeholder mapping

System	Stakeholder	Stakeholder impact on the city's climate neutrality ambitions	Interest in the city's climate neutrality ambition.
Public sector	**City Council**	City Council - large	**City Council:** The Council is the strategic decision-making body for the city's climate policy. By adopting relevant plans and programmes, it can promote investments in renewable energy, energy efficiency and sustainable transport.
	District councils	Neighbourhood councils - moderate	**District councils**: The scope of the District Councils activities includes selecting, planning and evaluating the implementation of tasks that directly concern the neighbourhood area and serve the needs of its inhabitants in specific areas. Acting for the development of community self-governance. Proposing to the City Council, the Mayor and the municipal organisational units on matters of importance to the district's residents. Giving an opinion, upon request or on its own initiative, on matters of importance to neighbourhood residents. Funding for the implementation of district tasks is determined annually by the City Council of Krakow in the budget. The councils can act at the local level, involving residents and undertaking specific environmental activities in their districts, such as establishing urban greenery or organising local educational campaigns. District councillors are elected in elections every five years**.**
	Departaments of the Municipality of Krakow • Department of Strategy Planning and Investment Monitoring • Department of Air Quality • Department of Environmental Management • Department of Housing • Departament of Public Relations • Departament of Municipal Traffic Engineer • Department of City Treasury	UMK departments - moderate (depending on the competence of the specific department)	**UMK departments:** **Department of Strategy Planning and Investment Monitoring**: Responsible for developing the city's development strategies taking into account climate objectives. It can also monitor the progress of the plans and identify areas for further action. **Department of Air Quality:** Co-ordinates the implementation of the tasks of the Air Protection

	Municipal units • Climate-Energy-Water Management • Urban Greenery Board • Public Transport Authority • Krakow City Roads Board • Municipal Investment Board • Municipal Buildings Administration **Municipal companies** • Municipal Heating Company • Krakow Municipal Holding • Waterworks of the City of Krakow • Kraków City Development Agency • Municipal Public Transport Company • Municipal Cleaning Company in Krakow **Scientific institutions** • Krakow University of Technology - Faculty of Environmental Engineering and Power Engineering • AGH University of Science and Technology - Faculty of Energy and Fuels • University of Agriculture - Faculty of Production Engineering and Energy • Jagiellonian University - Faculty of Geography and Geology • Pedagogical University of the Commission of National Education in Krakow - Faculty of Science and Natural Sciences • University of Economics - College of Management and Quality Sciences of Management and Quality Sciences	Municipal entities - moderate (depending on the competence of the specific department) Municipal companies - large (formally their task is to implement the city's strategy and policy city's strategy and policy, but in practice they themselves incorporate measures in the city's climate neutrality policy) Scientific institutions - moderate	Programme carried out by individual UMK Departments and municipal organisational units subordinate to the Mayor of the City of Krakow and develops strategies and programmes aimed at reducing emissions and improving the quality of life of the inhabitants. **Department of Environmental Management**: Deals with urban planning, ensuring the sustainability of the city, including the protection of green spaces and the provision of access to public spaces. **Department of Housing**: Can promote green and energy-efficient construction and the development of environmentally friendly housing estates, which contributes to reducing greenhouse gas emissions from the construction sector. **Department of Social Communication**: Carries out information and education campaigns, raising residents' awareness of climate issues and promoting pro-environmental behaviour. **Department of Municipal Traffic Engineer**: Responsible for transport infrastructure planning, including the development of public transport and alternative modes of transport, which contributes to reducing emissions. **Department of City Treasury**: can allocate funds to emission reduction projects, e.g. subsidising investments in renewable energy or upgrading urban infrastructure to improve energy efficiency. **Urban units:** **Climate-Energy-Water Management**: Responsible for climate and energy issues in the city and the promotion of energy efficiency. Coordinates activities on the use of renewable energy sources and water conservation. **Urban Greening Authority**: By developing green spaces, it contributes to the absorption of carbon dioxide, improves air quality and provides natural places for residents to recreate and relax. **Public Transport Authority**: Promotes sustainable transport by developing a public transport network based on low-carbon energy, which reduces emissions and improves the accessibility of public transport. **Krakow City Roads Authority**: Through the development of cycling infrastructure, pavements, as well as other forms of non-car modes of transport, encourages the use of alternative means of transport, which contributes to reducing traffic and emissions. **Municipal Investment Board**: implements urban infrastructure modernisation projects aimed at increasing the energy efficiency of buildings and improving the use of renewable energy sources. **Municipal Buildings Management**: carries out investments to improve the energy efficiency of municipal buildings, which contributes to reducing energy consumption and greenhouse gas emissions. **City companies:** **Municipal Heating Company**: Works on the modernisation and ecological expansion of the district heating network, promotes the efficient use of energy and the development of renewable energy systems. **Krakow Municipal Holding**: implements waste management projects, including promoting recycling, composting and the development of waste segregation infrastructure, which contributes to the reduction of

	• Institute of Mineral and Energy Economy, Polish Academy of Sciences • Institute of Geography and Spatial Planning, Polish Academy of Sciences • AGH Energy Centre **Associations of municipalities and towns** • Krakow Metropolis Association **Regional government** • Voivodship Fund for Environmental Protection and Water Management • Marshal's Office of the Małopolska Region **The Polish Government** • Ministry of Climate and Environment • Ministry of Development and Technology • Ministry of Funds and Regional Policy • National Fund for Environmental Protection and Water Management • Bank Gospodarstwa Krajowego **European Commission**	Associations of municipalities and towns - large Regional government - large Polish government - large European Commission - large	greenhouse gas emissions associated with waste management. **Waterworks of the City of Krakow**: seeks to improve the efficiency and sustainable management of the city's water resources, reducing water losses and promoting economical and environmentally friendly technologies in water supply and wastewater disposal. **Kraków City Development Agency**: Coordinates projects aimed at the sustainable development of the city, including investment in environmental infrastructure, environmental education and the promotion of innovative environmental solutions. **Municipal Public Transport Company**: promotes the development of public transport based on clean and low-emission energy, modernises rolling stock and transport infrastructure to reduce transport-related emissions. **Municipal Cleaning Company**: makes investments in the development of waste segregation infrastructure, promotes recycling and processing of organic waste, which contributes to the reduction of greenhouse gas emissions associated with wastewater treatment and waste management. **Scientific institutions:** Kraków's scientific institutions play a key role in researching, developing and promoting innovative solutions related to climate neutrality. Through inter-university cooperation and interdisciplinary research projects, these institutions have the potential to develop comprehensive strategies for the sustainable development of Krakow. Their contributions include the development of new technologies related to renewable energy sources, energy efficiency, natural resource management and the promotion of environmental awareness in society. **Associations of municipalities and towns:** The Krakow Metropolis Association, through its initiatives and projects, supports climate neutrality measures, integrating various actors in the region to promote sustainable development and implement joint strategies to reduce greenhouse gas emissions. **Regional government:** The local government supports environmental projects and works to protect the environment and reduce greenhouse gas emissions at a regional level, through funding, developing sustainable development plans and promoting innovative solutions. **Government of Poland:** The Polish government, through its ministries and financial institutions, shapes policy on environmental protection, the development of green technologies, the allocation of funds for sustainable development projects and the management of national environmental resources, thus supporting the goals of reducing emissions and creating a greener economy. **European Commission:** The European Commission, through its regulatory activities, financial programmes and cooperation with Member States, promotes climate policy and works to reduce greenhouse gas emissions by supporting eco-innovation and the development of a sustainable economy within the European Union.

Private sector	**Energy producers and suppliers** • Tauron Dystrybucja • PGE • PSG • CEZ Polska **Industry** • ArcelorMittal Poland • Tameh Poland • Columbus Energy • ASTOR • Kraków Technology Park • BWI Group • SIG • Globeco **Transport of persons and goods** • Inpost • BP • Shell • Mobilis Sp. z o.o. • Malopolska Railway Ltd. Z o.o. **Media and others** • AstraZeneca • CANAL + • Leviathan Confederation • Radio Kraków	Energy producers and suppliers - large Industry - large Passenger and freight transport - moderate Media and other - moderate	**Energy producers and suppliers:** Energy producers and suppliers such as Tauron Dystrybucja, PGE, PSG and CEZ Polska influence the shaping of the energy market and the achievement of emission reduction targets by investing in renewable energy sources, modernising infrastructure and promoting energy efficiency. They also exert a strong influence through the use of the best, most cost-effective technologies, reducing energy consumption and providing good operating models, financial montages and support with knowledge, experience and local, governmental and European funds. **Industry:** Industry plays a key role in the country's economy, contributing to production growth, employment and technological development. These companies operate in various sectors, including steel, energy, technology and manufacturing, influencing the dynamism and innovation of Polish industry. They exert a strong influence on the city's climate neutrality through the technological, design and management innovations they offer and in their own pursuit of zero carbon. **Passenger and freight transport:** Transport companies and businesses play a key role in the city's climate transformation. Investment in a fleet of renewable energy vehicles, the development of infrastructure for public transport and the promotion of alternative modes of transport, such as electric bicycles or carsharing systems, contribute to reducing CO_2 emissions and improving air quality. In addition, transport companies can work with local authorities to develop an urban mobility strategy that aims to make the city sustainable by reducing car traffic and promoting public transport and clean modes of transport. **Media and others:** The media plays an important role in promoting the city's climate neutrality by informing the public about the risks of climate change and presenting environmentally friendly solutions. Through educational campaigns, articles, TV and radio programmes and social media activity, the media can raise public awareness of green practices, encourage environmental action and mobilise the community to support initiatives to reduce greenhouse gas emissions. In addition, by scrutinising the actions of municipal authorities and businesses, the media can influence transparency of actions and accountability for the goals of climate neutrality goals.
Non-governmental sector	**Pro-climate NGOs** • Krakow Smog Alert • Carbon Footprint Foundation • Aeris Futuro **Pro-social NGOs** • Krakow for Residents Association • Rescue Action Association for Krakow	NGO proclimate - moderate	**Pro-climate and pro-social NGOs:** Non-governmental organisations (NGOs) have an important impact on promoting the climate neutrality of the city and building a society committed to environmental protection. By conducting educational campaigns, organising community events and campaigns, and supporting innovative environmental projects, NGOs can raise public awareness of climate change and mobilise the local community to take pro-environmental action. In addition, by lobbying for the introduction of relevant climate policies and by cooperating with municipal authorities and businesses, NGOs can have a significant impact on shaping the city's sustainable development strategy and the implementation of specific environmental projects. Through their commitment and social activism, NGOs can play an important role in

		Pro-social NGOs - moderate	building a greener and more sustainable future for the city.

A-3.3: Description or visualisation of the participatory model of climate neutrality of the city

Achieving climate neutrality for Krakow requires the involvement of all groups of residents and stakeholders. This means real cooperation, i.e. moving up the ladder of participation (Sherry Arnstein, 1969). In the case of Krakow, this means moving from what was considered apparent cooperation (informing residents, consulting on solutions and easing tensions only when they arise) to realising cooperation properly (partnership, delegation and citizen control).

Krakow engages with residents and stakeholders on the subject of pro-climate action through:

- direct meetings with representatives of Krakow's NGOs;
- implementation of citizens' assemblys;
- activities involving Kraków's businesses and universities;
- advisory and co-decision-making activities at the strategic level.

1. Cooperation with Kraków's NGOs:

Direct cooperation was established during the Climate-KIC project 'Kraków: Deep Demonstration of Healthy, Clean Cities'. Krakow's NGOs were crucial in helping to co-create the 'Krakow Position Paper Towards a Healthy Clean Krakow' in 2020, which provided the foundation for the City's further carbon reduction efforts. They also set out their expectations for collaboration during a series of pro-climate meetings with officials in 2021. In 2021 and 2022, they participated in both of Krakow's citizens' assemblys, taking on important roles: providing expertise during educational meetings, as well as a monitoring function during the deliberation process and forging the assembly's recommendations.

2. Krakow Citizen Assembly of Climate

A citizen assembly is a way of making important decisions by a randomly selected group of male and female citizens, whose role is to decide on an issue, taking into account the common good. This group is intended to represent the general population of the city.

Kraków's first citizen assembly took place in 2021 and was dedicated to climate change and the city's climate neutrality. Its participants worked on recommendations on the topic: "How can the City of Krakow and citizens reduce energy consumption and increase the use of renewable energy?".

A total of 589 Krakow residents applied to take part in the Assembly, to whom one of 20,000 invitations was sent. The youngest candidate was 16 years old, the oldest - 87. A group of 60 panellists was selected from among them, representative for the entire Kraków community, who started their participation in the Assembly with three educational meetings. The educational meetings included 39 speeches by representatives of the magistrate's office, municipal units, experts, scientists and representatives of non-governmental organisations. They were open to all willing listeners (online).

This was followed by deliberative meetings, in small groups under the guidance of a facilitation team. These were not televised. As a result, more than 100 proposals for recommendations were developed in areas such as: Krakow's climate strategy, renewable energy sources, education and participation,

energy saving, municipal lighting, thermo-modernisation or spatial planning. The partial proposals were then refined, combined into larger ones and put to a vote. The Mayor of Krakow was presented with 32 final recommendations, which received at least 80% support among the panellists during the vote. All voted recommendations were considered binding by the Mayor.

3. Kraków Transport Assembly

Following the success of the climate assembly, Krakow 2022 organised a citizens' assembly on transport, the Krakow Transport Citizen Assembly (KTCA). It sought answers to the question "How can the City of Kraków and residents influence the further development of sustainable transport measures?". Participants tackled the development of recommendations on this topic based on the areas of: optimising transport in the city, how to provide parking spaces, reducing emissions from transport, managing vehicle traffic within the city.

In a two-stage draw, a group of 80 people was selected to attend Assembly meetings.

The three educational meetings were followed by two deliberative meetings, the second of which was also a wrap-up meeting where voting took place. As many as 43 recommendations received a minimum of 80 per cent support from the voters and were also positively endorsed by the monitoring panel. In accordance with the panel, proposals with such support were considered binding by the president and are being successively implemented.

4. Climate Pact

The Pact was established in 2022 to increase the involvement of businesses, public institutions, community organisations and academia operating in Kraków in the pursuit of climate neutrality and climate change mitigation. The Pact included eleven entities, nine from the business sector - large Krakow businesses and business organisations - and two Krakow universities. The result was a platform for cooperation between the individual signatories and the City and other participants.

The partners agree to take action to reduce global warming, to create climate strategies and to regularly inform the city of actions taken in line with the principles of the Pact. Assumptions of the Pact:

- **Limiting global warming**: A joint declaration of action to limit temperature increase below 2°C and preferably to 1.5°C;
- **company climate strategies**: Adhering companies commit to developing climate strategies within two years of joining the Pact;
- **Annual reporting**: the entities undertake to report annually on the status of implementation of their strategies to the Department of Municipal Affairs and Climate of the City of Krakow.

The Climate Pact is an expression of support for the City's efforts and active involvement in activities leading to climate neutrality. The initiative is also a platform for the exchange of experience between partners involved in pro-climate activities, the promotion of climate-friendly solutions and, ultimately, the reduction of greenhouse gas emissions. The inclusion of more partners shows that Krakow's climate transformation can and should be discussed and acted upon together.

5. The "Zero Emission Krakow" Portfolio Advisory Team

In order to increasingly respond to contemporary developmental challenges, including systemic barriers to achieving climate neutrality, Krakow is introducing changes to the budget task management

system, implementing them in project methodologies, more recently also as project portfolios. The portfolio is intended to aggregate pro-climate initiatives (tasks, projects, programmes) implemented by the City of Krakow and to manage them efficiently in order to achieve the climate-related strategic goals indicated in the "Development Strategy of Krakow. This is where I want to live. Kraków 2030." The implementation of the Portfolio will make Krakow a city developing in a sustainable way, striving for economic prosperity and the health of its inhabitants in harmony with the environment and taking into account the needs of future generations, resilient to extreme climate phenomena, coping with the effects of these phenomena, economical and friendly to inhabitants and visitors.

The Portfolio Advisory Panel is an opinion-giving body, influential in shaping the City's policy, advisory to the Portfolio Council, composed of prominent representatives from the world of science, politics, business, local government, NGOs. It provides opinions and advice on projects and programmes. Submits projects and programmes whose objectives and scope may fit into the Portfolio Strategy. It is composed of permanent and appointed members to discuss specific projects, topics for Council meetings. The work of the Advisory Team does not have a rigid timetable, as the individual members of the Team have different amounts of time and different levels of ability or even willingness to get involved. Nonetheless, the Team is a strong group of people representing business, academia, local government and non-governmental organisations that have a significant influence on the City's climate policy.

3 Part B - Pathways to achieve climate neutrality by 2030

3.1 Module B-1 Climate neutrality scenarios and impact pathways

Table B-1.1: Impact paths

Sector and system leverage	Early changes (1-2 years)	Late results (3-4 years)	Direct effects (emission reductions)	Indirect effects (co-benefits)
Sector: Buildings and heating. **System leverage:** Technology/Infrastructure.	Measures to decarbonise the district heating system (heat pumps, biogas, etc.).	Continued and stable growth of RES in the city's energy mix.	671 thousand tonnes of CO_2e	Increase in the number of jobs in the RES sector.
	Promoting the modernisation of technology and infrastructure used in buildings (e.g. lighting, replacement of valves).	Reducing energy consumption in buildings by replacing appliances with more efficient ones.		Lower energy charges for residents.
	Thermo-modernisation of buildings to improve energy efficiency.	Raising the energy efficiency standard of buildings.		Lower energy bills for residents. Job creation. Reducing the urban heat island.
	Investment in energy storage technologies.	The popularisation of energy storage equipment will increase the efficiency of RES systems and their popularity.		Job growth in the RES sector.
Sector: Buildings and heating. **System leverage:** Governance and Policy.	There is strong support for a change in the structure of energy generation due to EU commitments,	The high level of commitment should remain high because of the irreversible		Increase in capital invested in climate projects and activities.

	the rising costs of exploiting coal from Polish mines and cutting off gas imports from Russia.	actions taken earlier.		
	Generation of system solutions for building thermo-modernisation schemes at local, regional and national level.	Implementation of building retrofit schemes involving multiple stakeholder groups (local authorities, businesses, cooperatives, residents, etc.).		Decline in fuel poverty. Engaging citizens in co-creating climate neutrality measures.
	Work to implement energy standards for new buildings.	Construction of new buildings with a baseline high energy standard.		Job creation. Reducing the urban heat island.
	Developing recommendations and recommendations to the national level to invest in energy companies due to the need to meet EU obligations and ensure national energy security.	Thanks to the increasing share of new technologies, energy generation should become increasingly cheaper, allowing energy companies to allocate more of their own capital to investment.		Increase in capital invested in climate projects and activities.
Sector: Buildings and heating. **System leverage:** Education and Skills.	Educational campaigns targeting different social groups to raise awareness of energy savings.	Reducing energy demand in buildings.		Lower energy charges for residents.
	Develop schemes and models for thermal modernisation with the participation of multiple stakeholder groups.	Scaling up and replicating the solutions developed.		Development of public participation processes.

Sector: Buildings and heating. **System leverage:** Finance.	Support for investment in thermal modernisation and RES programmes.	Reducing energy demand in buildings and decreasing the share of supplied energy generated by coal sources.		Job creation. Lower energy charges for residents. Reducing the urban heat island.
	Development of schemes and financing models for thermal modernisation with the participation of multiple stakeholder groups.	Scaling up and replicating the solutions developed.		Development of public participation processes. Engaging citizens in co-creating climate neutrality measures.
Sector: Buildings and heating. **System leverage:** Democracy and Participation	Continue to support citizens with energy advice.	Increasing interest in RES solutions among citizens.		Job creation.
Sector: Buildings and heating. **System leverage:** Social innovation.	Developing district and community energy model solutions with significant citizen involvement.	Developing sustainable urbanism.		Development of public participation processes. Engaging citizens in co-creating climate neutrality measures.
Sector: Transport. **System leverage:** Technology/Infrastructure.	Development of a network of electric car chargers.	The growing popularity of electric cars.	135 thousand tonnes of CO_2e	Less air pollution. Reducing the urban heat island.
	Expansion of the public transport fleet towards zero-emission.	Decrease in emissions from the public transport sector.		Less air pollution. Reducing the urban heat island.

	Expansion of public transport infrastructure.	The creation of new tram depots in previously inaccessible locations (e.g. Mistrzejowice) and the popularisation of public transport.		Less air pollution. Less noise pollution. Reducing the urban heat island. Increased road safety.
	Extension of pedestrian and cycle infrastructure.	Increase in proportion of walking and cycling trips.		Improving the fitness and health of residents. Less air pollution. Less noise pollution.
	Energy storage acquisition and cost-effective distribution programmes.	Reduced aggregate energy consumption in transport.		Decrease in the cost of maintaining public transport.
Sector: Transport. **System leverage:** Governance and Policy.	Creation of a Clean Transport Zone.	Displacement of old and carbon-intensive modes of transport and optimisation of freight logistics.		Less air pollution. Less noise pollution. Increased road safety. Reducing the urban heat island. Increase in improved well-being.
	Development of the functioning of the public transport system.	A greater proportion of people using public transport.		
	Popularisation of "car-pooling" and alternative modes of transport through regulation.	Increasing popularity of alternative modes of transport.		Less air pollution. Less noise pollution.
	Change of use of public spaces e.g. fewer parking spaces, pedestrian streets.	Reduce car transport to the city centre.		Less air pollution. Less noise pollution.

				Reducing the urban heat island. Development of green spaces.
	Regulation of freight transport requirements.	Increasing the loading of lorries.		Less air pollution. Less noise pollution.
Sector: Transport. **System leverage:** Education and Skills.	Popularise alternative means of transport (e.g. scooters).	Reduce the need for private cars for city centre residents.		Less air pollution. Improving the fitness and health of residents. Less noise pollution.
Sector: Transport. **System leverage:** Democracy and Social Participation.	The popularisation of hybrid and remote working reduces the need to commute to workplaces.	Remote working will become increasingly desirable for employees and more companies will start to switch to it for competitive reasons.		Less air pollution. Less noise pollution. Increase in improved wellbeing.
Sector: Electricity. **System leverage:** Technology/Infrastructure.	Development of RES-based solutions (photovoltaics, etc.).	Increase of RES in the energy mix of the city.	559 thousand tonnes of CO_2e	Lower energy charges for residents. Job creation.
	Design of new photovoltaic farms.	Increase of RES in the energy mix of the city.		Job creation.
Sector: Electricity. **System leverage:** Governance and Policy.	There is strong support for a change in the structure of electricity generation at plants in the city due to EU commitments, the	The high level of commitment should remain high because of the irreversible actions taken earlier.		Increase in capital invested in climate projects and activities.

	rising costs of exploiting coal from Polish mines and cutting off gas imports from Russia.			
	Developing recommendations and recommendations to the national level to invest in energy companies due to the need to meet EU obligations and ensure national energy security.	Thanks to the increasing share of new technologies, power generation should become increasingly cheaper, allowing energy companies to allocate more of their own capital to investment.		Increase in capital invested in climate projects and activities.
	Purchasing green energy.	This measure will reduce the carbon footprint generated by the city and allow the development of energy companies.		Increase in capital invested in climate projects and activities.
Sector: Electricity. **System leverage:** Education and Skills.	Educational campaigns targeting different social groups to raise awareness of energy savings.	Reducing energy demand in buildings.		Lower energy charges for residents.
Sector: Electricity. **System leverage:** Finance.	Financial support for those interested in investing in RES.	Increase of RES in the energy mix of the city.		Lower energy charges for residents.
Sector: Electricity. **System leverage:** Democracy and Social Participation.	Continue to support citizens with energy advice.	Increasing interest in RES solutions among citizens.		Job creation.
Sector: Electricity. **System leverage:** Social Innovation.	Developing district and community energy model solutions with strong citizen involvement.	Developing sustainable urbanism.		Engaging citizens in co-creating climate neutrality measures. Development of public participation processes

Sector: Waste management and CE. **System leverage:** Technology/Infrastructure.	Continuation of the "Circular Strategy for Krakow" programme	Increase in recycling rates.	43 thousand tonnes of CO_2e	Development of a circular economy. Job creation. Increased citizen satisfaction with a cleaner environment. Increase in recycling rates.
	Continuation of the city-wide system the use of materials reusable.			
	Systems for producing energy from waste sources.	Increase in RES sources in total energy consumption.		
	Infrastructure investment for recycling and waste treatment.	Establishment of new recycling and recovery facilities.		
Sector: Waste management and CE. **System leverage:** Social innovation.	Local initiatives to implement recycling and ecology innitiatives.	Increase in recycling rates.		Increased citizen satisfaction with a cleaner environment. Increase in improved well-being. Increase in recycling rates.
Sector: Waste management and CE. **System leverage:** Education and Skills.	Informing people about the benefits recycling and how to recycle waste.	Increase in recycling rates.		
Sector: Other (mainly industry). **System leverage:** Technology/Infrastructure.	Development of green infrastructure and creation of urban parks.	Increase the proportion of green spaces in the city.	206 thousand tonnes of CO_2e	Improving the fitness and health of residents. Increase in improved wellbeing. Environmental restoration and green space development. New structural links of green spaces. Job creation. Increasing citizens' qualifications and skills.
	Displacement of carbon-intensive emission and pollution sources.	Environmental restoration.		
Sector: Other (mainly industry). **System leverage:** Governance and Policy.	Increase in forest cover and urban greenery within the city.	Continued growth of greenery in Krakow contributing to greater		
	Replacing heavy, carbon-intensive			

	industry with activities based on new technologies.	absorption of carbon dioxide from the atmosphere.		Development of public participation processes. Engaging citizens in co-creating climate neutrality measures.
Sector: Other (mainly industry). **System leverage:** Education and Skills.	Introduce educational activities in schools on environmental responsibility and the role of urban greenery.			
Sector: Other (mainly industry). **System leverage:** Democracy and Social Participation.	Holding consultations with residents to obtain their views and ideas on the development of green space.			

B-1.2: Description of the impact pathways

In order to ensure comparability of the emission sectors with the data contained in the Investment Plan, the impact pathways are described by the sectors resulting from the Economic Model described in chapter "Module A-1 Baseline Greenhouse Gas Emission Inventory".

The impact pathways indicated above, focusing on five key sectors, simultaneously cover six main system levers. It is noteworthy how a large number of actions are assigned to the Building and Heating and Electricity sectors. These sectors are the main source of emissions in Krakow and also the main factor responsible for the emissions gap. In this context, the levers for change focus primarily on technological investments to increase energy efficiency and a sustainable transformation of the energy system.

Even with state-of-the-art energy efficiency technologies for buildings in the municipal area, achieving climate neutrality on the scale of a large city like Krakow will require significant investment in upgrading the region's energy system, which operates independently of Krakow. Intergovernmental and local government cooperation therefore appears to be a key aspect.

Defining a common pathway for climate and energy transformation at different territorial levels becomes an extremely key element in achieving the mission's goals. With the co-creation of a common pathway of change between the City of Krakow and government authorities, a much stronger message can be developed. By working together, each party can then focus on implementing the actions over which it has real influence, making the effectiveness of such cooperation invaluable.

With this approach, Krakow can focus on taking action within its territorial scope, such as educational initiatives within the city, promoting and supporting the use of renewable energy sources, engaging in work related to the modernisation and energy efficiency of buildings, developing the public transport system and actively supporting technological innovation in the field of energy within the city. Governmental and local government becomes a key factor for the successful implementation of such a complex transformation process.

Contemporary cities are increasingly making efforts to achieve climate neutrality, aiming to reduce greenhouse gas emissions and adapt to climate change. However, these efforts do not only benefit the environment, but also local communities. The climate neutrality action pathways identified above also demonstrate the range of indirect benefits that result from climate transformation. The list of *co-benefits* that result from these efforts and describe the wide range of positive effects they can have on the city's residents and its socio-economic and environmental development is as follows:

- **Job creation**: job creation in renewable energy, high-tech construction or high-tech industries means increased employment opportunities for local residents, which can lead to reduced unemployment and economic growth.

- **Lower energy** bills **for residents:** by investing in renewable energy and energy efficiency, residents will be able to enjoy lower energy bills, which brings real savings to their household budgets.

- **Reducing the urban heat island:** measures to reduce the urban heat island, such as green roofs, urban parks and tree canopies, can help reduce the effects of hot weather by improving the thermal comfort of residents and reducing the need for home air conditioning, reducing energy demand.

- **Increase in capital invested in climate projects and activities:** investment in climate neutrality projects attracts external capital to the city, which can support economic development and new initiatives for environmental development or new technologies.

- **Reducing fuel poverty:** improving energy efficiency and access to cheap energy can help to reduce fuel poverty by providing residents with stable and affordable energy prices.

- **Involving citizens in the co-creation of climate neutrality measures:** active involvement of citizens in the creation and implementation of climate neutrality measures can lead to greater public awareness and support for such initiatives.

- **Development of public participation processes:** climate neutrality initiatives can foster the development of public participation processes, enabling residents to actively participate in decisions affecting their environment.

- **Reduced air pollution:** the reduction of pollutant emissions associated with traditional energy production and transport can contribute to improved air quality, which benefits residents' health and the environment.

- **Less noise pollution:** the development of public transport, including electric means of transport and the reduction of car traffic, can lead to a reduction in noise levels in the city, with benefits for the mental health of residents.

- **Increased road safety:** investment in infrastructure for public transport, cycling and pedestrians, as well as a reduction in car traffic, can improve road safety, reducing accidents.

- **Improving residents fitness and health:** clean air, a safe environment and an active lifestyle, e.g. through cycling or walking, can contribute to improving the physical and mental health of residents.

- **Increase in improved wellbeing:** including improved health, cleaner air and more green spaces can contribute to an overall increase in residents' satisfaction and sense of happiness.

- **Development of green spaces:** investment in city parks, community gardens and green spaces not only improves the aesthetics of the city, but also offers places for recreation, relaxation and social gatherings for residents.

- **Developing a circular economy:** working towards a circular economy promotes the sustainable use of resources and the minimisation of waste, which can create new jobs and accelerate the development of the local economy.

- **Increase recycling rates:** promoting recycling and waste separation can lead to a reduction in landfill waste, which benefits the environment and reduces negative impacts on public health.

- **New structural linkages of green spaces:** the development of green spaces can foster the creation of new urban ecosystems, increasing biodiversity and creating new ecological links between urban areas.

- **Increased qualifications and skills of citizens:** training and education programmes related to climate neutrality can increase the qualifications and skills of **citizens**, which in turn can lead to greater competitiveness in the labour market and increased personal development.

These co-benefits not only contribute to the quality of life of residents, but also support the sustainability of the city and its communities. The above-mentioned co-benefits have a well-defined calculation method presented in the document provided by NetZeroCities for cities "Comprehensive Indicator Framework". The City of Krakow plans to use the described methodology to calculate the co-benefits in future iterations of the document.

3.2. Module B-2 Designing a climate neutral portfolio

Table B-2.1: Description of portfolios of activities - textual or visual		
Areas of activity	Portfolio description	
	List of actions	Descriptions
Buildings and heating	BIC-1 - Programme of thermal modernisation of single-family buildings for the City of Kraków. BIC-2 - Thermomodernisation of educational buildings of the Municipality of Krakow. BIC-3 - ZIT. Thermomodernisation of municipal buildings, public buildings	BIC-1, BIC-2, BIC-3, BIC-4, BIC-9: These activities focus on improving the energy efficiency of buildings to reduce their emissions. Particular emphasis is placed on programmes to encourage and support private housing capital investment in thermal upgrading, as the municipality's

	and the Municipal Social Welfare Centre in Kraków. BIC-4 - Actions entitled 'Renewable energy system for residential heating and energy generation' and 'Modernisation of buildings and premises owned by ZBK'. BIC-5 - Use of waste heat at the Plaszow Treatment Plant. BIC-6 - Construction heat pump fed by municipal wastewater. BIC-7 - Implementation of a local energy programme based on heat pumps with a capacity of approximately 1 MW. BIC-8 - Project NEEST - NetZero Emission and Environmentally Sustainable Territories. BIC-9 - Large-scale programme of deep thermo-modernisation of buildings in Kraków. BIC-10 - Decarbonisation of the district heating system with the development of the district heating network. BIC-11 - Campaign for zero-emission buildings construction and emissions reduction in the building sector. E-1 - Programme for the development of RES in the Municipality of Krakow. E-2 - Programme for the development of renewable energy sources in the Municipality of Krakow. E-3 - Modernisation of the biogas tanks at the Płaszów Sewage Treatment Plant. E-7 - Construction of new CHP systems. E-10 - Installation of two cogeneration units at the Płaszów Treatment Plant.	stock covers only a few percent of the buildings in the city. BIC-8: The NEEST project aims to create smart, environmentally friendly cities through innovative urban planning and urban resource management approaches. It focuses on activities related to large-scale thermal retrofit projects in urban quarters and the creation of local energy communities. BIC-11: This action consists of promoting technologies that go beyond those commonly used in building refurbishment, including the inclusion of intelligent building systems, control automation, prefabricated methods for building insulation and also including mechanical ventilation with heat recovery. BIC-5, BIC-6, BIC-7, BIC-10, E-3, E-7, E-10: These projects focus on increasing the share of RES in the total energy produced in the city. The activities of municipal companies in line with the CE concept focus on the efficient use of raw materials generated in Krakow. To this end, projects are being carried out to use energy from municipal wastewater, biogas and waste. In this way, waste can be used to increase the city's energy potential and reduce CO_2 . E-1, E-2, E-14: These actions consist of increasing the share and popularisation of individual RES sources among private stakeholders, residents, etc.

	E-14 - Development of distributed renewable energy generation.	
Electricity	BIC-4 - Actions entitled 'Renewable energy system for residential heating and energy generation' and 'Modernisation of buildings and premises owned by ZBK'. BIC-8 - Project NEEST - NetZero Emission and Environmentally Sustainable Territories. BIC-11 - Campaign for zero-emission construction and reducing emissions in the building sector. E-1 - Programme for the development of RES in the Municipality of Krakow. E-2 - Programme for the development of renewable energy sources in the Municipality of Krakow. E-3 - Modernisation of the biogas tanks at the Płaszów Sewage Treatment Plant. E-4 - Construction of a photovoltaic installation at the Barycz landfill site. E-5 - Construction of photovoltaic farms by Krakow Municipal Holding. E-6 - Construction of a photovoltaic farm at the Raba Water Treatment Plant. E-7 - Construction of new CHP systems. E-8 - Construction of photovoltaic farms and local installations by MPEC. E-9 - ZIT. Construction of an energy storages. E-10 - Installation of two cogeneration units at the Płaszów Treatment Plant. E-11 - Project entitled Modernisation of road lighting in Krakow.	BIC-4, BIC-11, E-1, E-2, E-3, E-4, E-5, E-6, E-7, E-8, E-9, E-10, E-14, E-15, GOZ-1: These projects focus on increasing the share of RES in the overall share of energy produced in the city. Due to Krakow's geographical conditions, these measures focus on photovoltaic activities. Other energy sources, such as wind, hydro and geothermal energy, have a weak potential in Krakow and such infrastructure should be better exploited in other regions. In Krakow, however, there is significant potential for the location of photovoltaic devices on rooftops. Google's Environmental Insights Explorer estimates that the potential of these devices is capable of offsetting more than 800,000 tonnes of carbon dioxide equivalent. In addition, major energy companies are planning significant investments to put photovoltaic farms beyond the rooftop, which could further increase the potential of this sector. The storage of energy generated by RES is also important, so there is a need to analyse the feasibility of different ways of storing it, e.g. with hydrogen. E-11, TR-1: The City of Krakow is committed to finding measures and projects that can have a noticeable impact on the city's energy balance. To this end, measures are being implemented to modernise the city's lighting system. In addition to the mere replacement of the infrastructure with newer ones, intelligent and automated urban lighting management systems are also being designed to save energy consumption while maintaining the comfort of the inhabitants. BIC-8, E-12, E-13: In addition, the ATELIER, NEEST and COMANAGE projects aim to create smart, environmentally friendly cities through innovative urban planning and urban resource management approaches. They focus on activities related to large-scale thermal retrofit projects in urban quarters and the creation of local energy communities.

	E-12 - ATELIER project - AmsTErdam and BiLbao cItizen drivEn smaRt cities. E-13 - COMANAGE project. E-14 - Development of distributed renewable energy generation. E-15 - Creation of new photovoltaic farms to power the city. E-16 - Development of energy communities and energy awareness. E-17 - Green energy purchase. TR-1 - Participation in the SmartEPC project. GOZ-1 - Construction of a recycling system for biodegradable waste and in the process of composting and fermentation - electricity and biogas production.	E-16: The task aims to develop prosumer photovoltaic installations in the city (installations from 50 kW) by 2030. E-17: The scope of the measure includes the purchase of green electricity under the city's group purchasing formula.
Transport	TR-1 - Participation in the SmartEPC project. TR-2 - Project for fast, collision-free rail transport in Krakow (Premetro). TR-3 - ZIT. Construction of the SKA "Kraków Prądnik Czerwony" railway stop together with the construction of a Park & Ride car park and the construction of an integrated transfer node together with the P&R Bronowice car park and a bus terminal. TR-4 - ZIT. Construction of cycling routes along the streets : Al. Pokoju, Walerego Sławka, Brożka, Nawojki and Jancarza. TR-5 - ZIT. Construction of KST tram line (Krowodrza Górka - Azory district). TR-6 - ZIT. Development of a tramway fleet to serve the Krakow City Transport system and the development of intelligent transport systems (ITS) to improve transport accessibility within the city of Krakow.	TR-2, TR-3, TR-5, TR-6, TR-7, TR-10: Actions in the mobility sector and transport mainly focus on the development of public transport infrastructure. The city bus network is being electrified more and more every year, and the % of new electric buses in relation to the total fleet is one of the highest in Europe. In addition, new transport links and tram lines are being created, increasing transport accessibility from border and often densely populated areas. TR-12, TR-13, TR-15: The City of Krakow is involved in quite a number of analysis

	TR-7 - ZIT. Reconstruction of tram tracks together with turnout nodes and associated infrastructure at : - Straszewskiego and Karmelicka Street - Starowislna Street TR-8 - Creation of new charging stations for electric buses. TR-9 - Tram Energy Storage in District XII of the City of Krakow and Tram Energy Storage in District XI of the City of Krakow. TR-10 - Construction of new tram lines with associated infrastructure. TR-11 - Projects and activities related to the development of cycling infrastructure and implementation of the Cycling Policy of the City of Krakow. TR-12 - Project SUM - Smooth Shared Urban Mobility. TR-13 - Clean Transport Zone. TR-14 - Programme to support modern forms of local transport and organisation of the transport system. TR-15 - Development of sustainable logistics. TR-16 – Long-term programme to popularise and develop electric mobility infrastructure (new charging stations).	and legislative projects. Such activities are aimed at creating intelligent strategic and management solutions for car and truck transport with a view to its greater integration with other modes of transport, e.g. by building Park & Ride sites. TR-1, TR-8, TR16: These actions focus on the expansion of the electric vehicle fleet in public and private transport and the development of the infrastructure necessary for its operation. TR-4, TR-11, TR-14: These projects focus on the promotion of alternative means of transport such as scooters, bicycles, etc. and the development of the transport infrastructure necessary for their use.
Waste management and CE	BIC-10 - Decarbonisation of the district heating system with the development of the district heating network. GOZ-1 - Construction of a recycling system for biodegradable waste and in the process of composting and fermentation - electricity and biogas production. GOZ-2 - MINEV project. GOZ-3 - Smart Circuit Project.	BIC-10, GOZ-1, GOZ-2, GOZ-3, GOZ-4: Activities in the sector focus on the expansion of recycling and waste treatment facilities and treatment of waste in combination with the development of RES through the treatment of biodegradable waste. Many of the activities carried out by waste companies, due to the concentration of activities on energy generation, are assigned in the energy systems sector. In addition, an increase in recycling levels and a decrease in the amount of waste produced is planned. Created numerous information and education activities to

	GOZ-4 - Development of Krakow's Circural Economy.	this end, involving more residents into the process.
Other (mainly industry)	I-1 - Creation of new green spaces. I-2 - Increasing the area of urban forests. I-3 - Maintain a high ratio of biologically active area in the city. I-4 - Introduce smaller forms of green infrastructure in heavily build-up parts of the city. I-5 - Planting of trees, shrubs and protection of existing trees. I-6 - CoFarm4Cities project. I-7 - Life Pact Project - The human factor: Adapting the City for Tomorrow. I-8 - Greene 4.0 project. I-9 – Usage of CSS, CCU technology and carbon capture. I-10 - Reclamation of post-industrial areas in Nowa Huta district.	I-1, I-2, I-3, I-4, I-5, I-6, I-7: A steady increase in greenery is forecast in the Municipality of Krakow, which will contribute to a greater uptake of carbon dioxide from the atmosphere. Projects connected with related to urban greenery are implemented both by the City (planned activities, civic budget) and by private entities, residents, companies. Nowadays, a great deal of action is initiated by citizens themselves in the civic budget. Residents are very keen to come up with ideas for developing green areas in their neighbourhood, which makes the process of increasing green spaces go smoothly. I-8, I-9, I-10: These activities focus on supporting industry based on new and innovative technologies.

B-2.2: Outline of individual activities - BIC-1		
Description of operation	Name of the action	Programme of thermal modernisation of single-family buildings for the City of Kraków.
	Type of action	Technical and infrastructural action.
	Description of operation	Since 2018, the city has been running the Programme for thermal modernisation of single-family buildings for the City of Kraków, under which residents have the opportunity to obtain subsidies for tasks including: — insulation of external walls (max. PLN 150/m^2); — insulation of the roof/ceiling, the ceiling over the top floor or the last heated storey (max. PLN 150/m^2); — insulation of the floor on the ground/ceiling above an unheated basement (max. PLN 150/m^2);

		— replacement of windows (max. PLN 700/m^2 woodwork surface); — replacement of external doors (max. PLN 1,800/m^2 woodwork surface); — replacement of garage doors (max. PLN 850/m^2 carpentry area). The maximum total subsidy for the aforementioned elements may not exceed 50% of the eligible costs incurred and no more than PLN 25,000. It is required to achieve an environmental effect, which is to be understood as a minimum 25% reduction in the heating demand in the building as a result of the implementation of the recommendations indicated in the energy audit or energy assessment without taking into account the efficiency of the heating system.
Reference to impact pathways	Impact sector	Buildings and heating.
	System lever	Technology/Infrastructure. Finance.
	Impact (with reference to module B-1.1)	Thermo-modernisation of buildings to improve energy efficiency. Support for investment in thermal modernisation and RES programmes.
Implementation	Units/persons responsible for implementation	City of Krakow – Department of Air Quality.
	Scale of action and entities covered	Local action within the administrative boundaries of the city of Krakow.
	Stakeholders involved	City residents, construction companies, contractors, energy auditors.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeframe for the task runs from 2018 to 2030.
Receipts & costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Buildings and heating sector - 1 255 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Costs incurred for 2018-2024 - approx. PLN 17 000 000 (sum of costs incurred in 2018 - 2023 and costs planned for 2024).

		Estimated costs for 2025 - 2030 - approx. PLN 25 000 000 (approx. EUR 7 555 000). Total estimated costs approx. PLN 42 000 000 (EUR 9 333 000).

B-2.2: Outline of individual activities - BIC-2		
Description of operation	Name of the action	Thermomodernisation of educational buildings of the Municipality of Krakow.
	Type of action	Technical and infrastructural action.
	Description of operation	Selected buildings intended for educational tasks will undergo comprehensive energy modernisation. Depending on the needs indicated in the energy audits, energy modernisation will include in particular such measures as insulation of the external envelope, replacement of windows and doors and replacement or modernisation of the internal central heating system.
Reference to impact pathways	Impact sector	Buildings and heating.
	System lever	Technology/Infrastructure.
	Impact (with reference to module B-1.1)	Thermo-modernisation of buildings to improve energy efficiency.
Implementation	Units/persons responsible for implementation	Municipal Education Service Centre.
	Scale of action and entities covered	Local action within the administrative boundaries of the city of Krakow.
	Stakeholders involved	School administrators, construction companies.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeframe for the task is 2021 - 2023. Measures targeting the thermo-modernisation of educational buildings will also be implemented by the Municipality in later years.
Receipts & costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Buildings and heating sector - 554 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Estimated costs - PLN 4 430 505 (approx. EUR 984 000).

B-2.2: Outline of individual activities - BIC-3		
Description of operation	Name of the action	ZIT - Thermomodernisation of municipal buildings, public buildings and the Municipal Social Welfare Centre in Krakow.
	Type of action	Technical and infrastructural action.
	Description of operation	The project plans to carry out thermo-modernisation of various types of buildings in the Municipality of Krakow, including public buildings, residential buildings, residential-utility buildings and historic buildings. Project implementation will be based on energy audits. The project is part of the Integrated Territorial Investment Facility, covering the area of the Krakow Metropolis, and focuses on solving common development problems concerning energy efficiency of public buildings, reduction of air and CO_2 pollution , and improvement of the comfort of use of public facilities. The implementation of the project results from both the diagnosis and the objectives of the municipal strategies. The project fits in with the Strategy's objectives for energy efficiency and air quality and is linked to other projects aiming to reduce air pollution and energy demand.
Reference to impact pathways	Impact sector	Buildings and heating.
	System lever	Technology/Infrastructure.
	Impact (with reference to module B-1.1)	Thermo-modernisation of buildings to improve energy efficiency.
Implementation	Units/persons responsible for implementation	Krakow Metropolis Association together with the Municipality of Krakow, which is a member of the association.
	Scale of action and entities covered	Action within municipal and public building stock.
	Stakeholders involved	Residents, poor and homeless people, property managers.
	Comments on implementation - resources needed, timetable and milestones	Action only in the design phase, currently no timetable or milestones.
Receipts & costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Buildings and heating sector – 1 038 tCO_2e.

	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	The measure will be co-financed with funds from the European Fund for Małopolska for 2021-2027. Estimated investment costs - approx. PLN 45 000 000 (approx. EUR 10 000 000).

B-2.2: Outline of individual activities - BIC-4		
Description of operation	Name of the action	Actions entitled „Renewable energy system for residential heating and energy generation" and „Modernisation of buildings and premises owned by ZBK".
	Type of action	Technical and infrastructural action.
	Description of operation	The measure, Renewable Energy Systems for Residential Heating and Power Generation, focuses on the implementation of renewable energy solutions for the efficient heating of residential buildings and the generation of energy from renewable sources. The action entitled Modernisation of buildings and premises in ZBK's stock focuses on the modernisation of existing buildings and premises in ZBK's stock. These activities include a variety of modernisation works aimed at improving the energy efficiency, aesthetics and overall quality of these facilities, contributing to higher housing and utility standards for residents.
Reference to impact pathways	Impact sector	Buildings and heating. Electricity.
	System lever	Technology/Infrastructure.
	Impact (with reference to module B-1.1)	Thermo-modernisation of buildings to improve energy efficiency. Development of RES-based solutions.
Implementation	Units/persons responsible for implementation	Municipal Buildings Administration (ZBK).
	Scale of action and entities covered	Local action within the administrative boundaries of the city of Krakow.
	Stakeholders involved	Housing associations, residents.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeframe for the task is 2021 - 2024.

Receipts & costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Buildings and heating sector - 363 tCO_2e. Estimated reduction in the Electricity sector - 91 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	The costs of the measure entitled Modernisation of buildings and premises owned by ZBK are difficult to determine due to the difficulty of classifying which stages of technical modernisation are to be considered pro-climatic. Total estimated budget of the measure - PLN 12 533 229 (approx. EUR 2 785 000).

B-2.2: Outline of individual activities - BIC-5		
Description of operation	Name of the action	Use of waste heat at the Płaszów Sewage Treatment Plant.
	Type of action	Technical and infrastructural action.
	Description of operation	Use of waste heat from the combustion of sludge at the Sludge Thermal Treatment Station to heat process facilities.
Reference to impact pathways	Impact sector	Buildings and heating.
	System lever	Technology/Infrastructure.
	Impact (with reference to module B-1.1)	Action to decarbonise the district heating system.
Implementation	Units/persons responsible for implementation	Waterworks of the City of Krakow S.A.
	Scale of action and entities covered	Local energy system.
	Stakeholders involved	Enterprises.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. Planned completion date for the task - 2024.
Receipts & costs	Renewable energy generated (if applicable)	Thermal power - 300 kW.
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Buildings and heating sector - 932 tCO_2e.

	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Estimated investment costs - PLN 550 000 (approx. EUR 122 000).

B-2.2: Outline of individual activities - BIC-6		
Description of operation	Name of the action	Construction of heat pump fed by municipal wastewater.
	Type of action	Technical and infrastructural action.
	Description of operation	Implementation of a bottom-up heat pump project fed by municipal wastewater to improve the city's district heating system.
Reference to impact pathways	Impact sector	Buildings and heating.
	System lever	Technology/Infrastructure. Governance and policy.
	Impact (with reference to module B-1.1)	Action to decarbonise the district heating system. Support for changing the structure of energy generation. Systems for producing energy from waste sources.
Implementation	Units/persons responsible for implementation	Municipal Heating Company S.A. (MPEC).
	Scale of action and entities covered	Action to supply the energy system of the City of Krakow.
	Stakeholders involved	Businesses, residents.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeframe for the task is 2024 - 2028. A broader description of the measure will be presented in future iterations of the document as the as the project develops.
Receipts & costs	Renewable energy generated (if applicable)	Capacity - approx. 30 MW.
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Buildings and Heating sector - 88 540 tCO_2e. Estimated reduction in the Waste Management and CE sector – 4 660 tCO_2e.

	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Estimated investment costs - PLN 258 000 000 (approx. EUR 57 333 000).

B-2.2: Outline of individual activities - BIC-7		
Description of operation	Name of the action	Implementation of a local energy programme based on heat pumps with a capacity of approximately 1 MW.
	Type of action	Technical and infrastructure measure.
	Description of operation	Implementation of a local energy programme based on heat pumps to improve the city's district heating system.
Reference to impact pathways	Impact sector	Buildings and heating.
	System lever	Technology/Infrastructure. Governance and policy.
	Impact (with reference to module B-1.1)	Action to decarbonise the district heating system. Strong support for changing the structure of energy generation.
Implementation	Units/persons responsible for implementation	Municipal Heating Company (MPEC).
	Scale of action and entities covered	Action to supply the energy system of the City of Krakow.
	Stakeholders involved	Businesses, residents.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeframe for the task runs from 2024 to 2028. A broader description of the measure will be provided in future iterations of the document as the project develops.
Receipts & costs	Renewable energy generated (if applicable)	Power - approx. 1 MW.
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Buildings and Heating sector - 3 107 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Estimated investment outlay - PLN 7 000 000 (approx. EUR 1 555 000).

B-2.2: Outline of individual activities - BIC-8		
Description of operation	Name of the action	Project NEEST - NetZero Emission and Environmentally Sustainable Territories
	Type of action	Innovation and technology action.
	Description of operation	The anticipated outcome of the project will be schemes of practical solutions on how to improve the energy efficiency of buildings, which can be replicated throughout Poland. Through well-planned thermo-modernisation measures and organisational changes, the amount of electricity and heat supplied to buildings will be reduced. Lower energy demand will in turn translate into lower greenhouse gas emissions. The NEEST project will also produce guidelines on how to thermally upgrade different types of urban quarters to reduce emissions to almost zero and guidance on how to finance their implementation. More on the NEEST project can be found in Module A-2 Evaluation of current strategies, policies and strategic management instruments.
Reference to impact pathways	Impact sector	Buildings and heating and Electricity.
	System lever	Social innovation. Governance and policy. Finance. Education and skills.
	Impact (with reference to module B-1.1)	Develop schemes and models for financing thermal modernisation with the participation of multiple stakeholder groups. Developing district and community energy model solutions with strong citizen involvement. Generation of system solutions for building thermo-modernisation schemes at local, regional and national level. Developing recommendations and recommendations to the national level to invest in energy companies.
Implementation	Units/persons responsible for implementation	Project partners. On the Krakow side – Department of Municipal Economy and Climate.
	Scale of action and entities covered	National action based on the dissemination of knowledge and ready-made practices.

	Stakeholders involved	Project partners - Łódź, Rzeszów, Warsaw, Wrocław and the National Centre for Research and Development. Residents, local and national authorities, businesses.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeframe for the task is between 2023 and 2025.
Receipts and costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Buildings and heating sector - 192 tCO_2e. Estimated reduction in the Electricity sector - 48 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	The project is funded by the European Union under the Horizon 2020 programme. The funds allocated to the project - PLN 6 500 000 (approx. EUR 1 440 000), with PLN 1 295 181 (approx. EUR 287 000) for Kraków.

B-2.2: Outline of individual activities - BIC-9		
Description of operation	Name of the action	Large-scale programme of deep thermo-modernisation of buildings in Kraków.
	Type of action	Financial and technical action.
	Description of operation	The measure consists of large-scale thermal modernisation of buildings, which are the main source of emissions in Krakow. In order to achieve the objectives of the measure, thermomodernisation should be taking into account different investment financing schemes. Krakow plans to develop existing subsidy programmes for the thermal modernisation of buildings and create new ones. A key milestone for the development of the entire strategy and plan for thermomodernisation will be the results of the NEEST - NetZero Emission and Environmentally Sustainable Territories project. This project will bring ready-made technological solutions, prepared for immediate scaling and implementation in other urban quarters. It will also be necessary to attract new

		non-municipal funding to support thermo-modernisation programmes - for which it will be necessary to use funds allocated from the National Reconstruction Plan for thermomodernisation. In order to expand the various forms of support for thermal modernisation, the Municipality of Krakow is implementing two government programmes: Stop Smog Programme and Warm Housing Programme. Obtaining subsidies under these programmes requires the participation of the Municipality, which applies for funding and implements the programmes. On 14.06.2024, the Municipality of Krakow concluded an agreement with the WFOŚiGW for co-financing within the framework of the Priority Programme "Warm Housing". The subject of this Agreement is the granting to the Municipality by the WFOŚiGW of a subsidy in the amount of PLN 3 million from the funds made available to the WFOŚiGW by the National Fund for Environmental Protection and Water Management for the implementation of undertakings under the above-mentioned programme. At present, the Municipality of Krakow is implementing the Warm Hausing Programme for housing communities of three to seven flats. The Stop Smog programme, adopted by a resolution of the Krakow City Council, supports the replacement of heat sources that do not meet low-emission standards and thermo-modernisation in single-family buildings of the least affluent. The programme aims to reduce emissions and improve air quality. In addition, based on the recommendation of the Krakow Climate Assembly, a draft Programme for the thermomodenisation of multi-family buildings has been developed and is awaiting funding for further implementation. On the other hand, the measure assumes a significant increase in the share of thermal modernisation with private funds through the ESCO (*Energy Service Company*) formula. The company interested in ESCO-type financing commits its financial resources to carrying out the modernisation project at the customer's site, and recovers its investment (including remuneration) through staggered payments obtained through the savings generated by the

		completed project. The payback period depends on the individual agreement between the parties. Another method of encouraging building thermo-modernisation will be to promote comprehensive One Stop Shop (OSS) building retrofit services to speed up and facilitate the retrofit process. The One Stop Shop formula involves a service that provides the most comprehensive possible service to the owner (investor) of the building that is to undergo energy retrofitting. The aim of this formula is to facilitate, encourage, simplify and accelerate the process and, as a result, to increase the rate of building refurbishment. Historic buildings have an important role in the large-scale process of thermal modernisation in Krakow. The FuturHist project, implemented by European cities of great historical value (including Krakow), will provide technical solutions for their modernisation. The aim of the project is to develop efficient and cost-effective solutions which will allow historic buildings to reduce their energy demand by at least 60% while maintaining their historical and cultural values. The solutions developed as part of the project are intended to be replicable and applicable on a wider scale. Four demonstration buildings have been selected as part of the task, in which construction work will be carried out according to project assumptions. One of these buildings is located in Krakow. The aim is to develop solutions that can be applied to the widest possible range of historic buildings found in Europe.
Reference to impact pathways	Impact sector	Buildings and heating.
	System lever	Technology/Infrastructure. Finance. Social innovation.
	Impact (with reference to module B-1.1)	Thermo-modernisation of buildings to improve energy efficiency. Support for investment in thermal modernisation and RES programmes. Develop schemes and models for financing thermal modernisation with the participation of multiple stakeholder groups. Developing district and community energy model solutions with strong citizen involvement.

Implementation	Units/persons responsible for implementation	Municipality of Krakow (as monitoring entity).
	Scale of action and entities covered	City-wide action.
	Stakeholders involved	Municipal companies, private companies, energy companies, building managers, housing associations, residents, investors, developers, banks and investment funds.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeframe for the task is 2024-2030.
Receipts & costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	843 057 MWh per year in 2030 from single and multi-family buildings. 476 079 MWh per year in 2030 from historic buildings.
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Buildings and Heating sector – 456 168 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Estimated costs - PLN 13 300 000 000 (approx. EUR 2 955 555 000).

B-2.2: Outline of individual activities - BIC-10		
Description of operation	Name of the action	Decarbonisation of the district heating system with the development of a district heating network.
	Type of action	Technical action.
	Description of operation	The focus of the action is the development of waste heat and RES sources cooperating with the district heating system in order to achieve a low emission factor for district heating while maintaining the competitiveness of the district heating system. The scope of the project consists in the construction of an Energy Recovery Plant (ZOE) - 3 Line Thermal Waste Conversion Plant (ZTPO) together with with the necessary infrastructure using part of the infrastructure of the existing plant. In Line 3 of the ZTPO (ZOE), electricity and heat will be generated in cogeneration as a result of combustion of combustible waste fractions (approximately 100,000 Mg per year). The

		actual nominal capacity of the installation will be approximately 12.1 Mg/h. With an assumed maximum plant operation time of 8,300 h/year. According to KHK, the construction of the Energy Recovery Plant (ZOE) envisages the construction of a line for the thermal conversion of municipal waste and non-hazardous waste, including pre-dried sewage sludge in furnace technology with a combustion grate, together with auxiliary installations and necessary infrastructure. The planned environmental effect of the Project according to KHK is to reduce the mass of landfilled waste by 99,000 Mg/year. The reduction of carbon dioxide emissions as a result of the Project will be approximately 12,600 $MgCO_2$ /year. Electricity production: 60 thousand MWh/year, thermal energy about 330 thousand GJ/year. Energy from thermal waste conversion is considered "green" energy. Energy parameters of the project: — 6.6 MWe/20.24 MWt plant; — flue gas heat recovery plant 6.5 MWt. In addition, the measure assumes the modernisation and expansion of the existing district heating network, as well as the expansion of generation capacity. It is necessary to supply district heating to the more peripheral districts of Krakow.
Reference to impact pathways	Impact sector	Buildings and heating. Waste management and CE.
	System lever	Technology/Infrastructure. Governance and policy.
	Impact (with reference to module B-1.1)	Action to decarbonise the district heating system. Systems for producing energy from waste sources. Investment in energy storage technologies. There is strong support for a change in the structure of energy generation due to EU commitments, the rising costs of exploiting coal from Polish mines and cutting off gas imports from Russia. Developing recommendations and recommendations to the national level to invest in energy companies.
Implementation	Units/persons responsible for implementation	Municipality of Krakow (as monitoring entity).
	Scale of action and entities covered	City-wide action.
	Stakeholders involved	Municipal companies, private companies, energy companies.

	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeframe for the task is 2024-2030.
Receipts and costs	Renewable energy generated (if applicable)	183,300 MWh per year in 2030 from the waste incineration plant expansion.
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Buildings and Heating sector – 30 708 tCO_2e. Estimated reduction in the Waste Management and CE sector – 13 100 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Estimated costs - PLN 915 500 000 (EUR 203 444 000).

B-2.2: Outline of individual activities - BIC-11		
Description of operation	Name of the action	Campaign for zero-emission buildings construction and emissions reduction in the building sector.
	Type of action	Management-innovation activity.
	Description of operation	The action consists of promoting technologies that go beyond those commonly used in building refurbishment, including the inclusion of intelligent building systems, control automation, prefabricated methods for insulating buildings and including mechanical ventilation with heat recovery. As part of the campaign, detailed transformation proposals are being developed, which include definitions of baseline conditions for the renovation of private and public buildings in line with NZEB (near-zero energy buildings) principles. Other local priorities such as access to utilities, consideration of energy storage or occupant comfort are also taken into account. A set of urban planning principles for climate-neutral quarters based on the energy community model will be defined. Local regulations and land-use plans will be updated to support and facilitate the formation of energy communities and investment in climate-neutral technologies.

		The campaign intends to introduce new governance models for housing communities and their integration into the local climate neutrality ecosystem. Through these measures, the local authority will contribute to the creation of a more sustainable, greener urban environment, which contributes to the overall reduction of emissions in the building sector and the promotion of zero-emission construction.
Reference to impact pathways	Impact sector	Buildings and heating.
	System lever	Technology/Infrastructure. Governance and policy. Education and skills. Social innovation.
	Impact (with reference to module B-1.1)	Promoting the modernisation of the technology and infrastructure used in buildings. Work to implement energy standards for new buildings. Educational campaigns targeting different social groups to raise awareness of energy savings. Developing district and community energy model solutions with strong citizen involvement.
Implementation	Units/persons responsible for implementation	Municipality of Krakow (as monitoring entity)
	Scale of action and entities covered	City-wide action.
	Stakeholders involved	Municipal companies, private companies, developers, residents, construction companies, scientific institutes, ngo.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeframe for the task is between 2024 and 2030.
Receipts and costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Buildings and heating sector - 42 472 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Estimated costs - PLN 30 000 000 (approx. EUR 6 666 000).

B-2.2: Outline of individual activities - E-1		
Description of operation	Name of the action	Programme for the development of RES in the Municipality of Krakow.
	Type of action	Technical and infrastructural action.
	Description of operation	As part of the budget task entitled: Programme for the development of RES in the Municipality of Krakow, the city is implementing a project related to: 1) the construction of renewable energy installations (photovoltaic installations of various capacities) on municipal buildings, facilities and properties that meet formal and technical conditions; 2) installation of reactive power compensation systems; 3) implementation of a system to manage utility consumption and energy production from photovoltaic installations. The task is scheduled for completion in 2030. The aim of the project is to: increase the level of energy production from renewable sources, reduce the demand for grid electricity, improve the efficiency of the electricity grid, improve the environment by improving air quality, including the reduction of CO_2 and other particulate and gaseous pollutants.
Reference to impact pathways	Impact sector	Buildings and heating. Electricity.
	System lever	Technology/Infrastructure. Finance.
	Impact (with reference to module B-1.1)	Support for investment in thermal modernisation and RES programmes. Development of RES-based solutions.
Implementation	Units/persons responsible for implementation	Climate - Energy - Water Management (KEGW).
	Scale of action and entities covered	The measure covers buildings belonging to the Municipality of Krakow.
	Stakeholders involved	Residents, businesses, property managers.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeframe for the task is between 2020 and 2030.
Receipts and costs	Renewable energy generated (if applicable)	Currently, the KEGW unit has made 13 installations with a total capacity of 546.6 kW. The average annual electricity production from these installations is 533 827 MWh.

		Assumed electricity production in 2030 - 854 MWh.
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Buildings and Heating sector - 126 tCO_2e. Estimated reduction in the Electricity sector - 502 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Estimated costs up to 2030 - PLN 30 000 000 (EUR 6 666 000).

B-2.2: Outline of individual activities - E-2		
Description of operation	Name of the action	Programme for the development of renewable energy sources in the Municipality of Krakow.
	Type of action	Technical and infrastructural action.
	Description of operation	Since 2020, the city has been running the Programme for the Development of Renewable Energy Sources in the Municipality of Krakow (PROZE), under which residents have the opportunity to obtain targeted subsidies for the implementation of environmental protection related task to supporting the use of local renewable energy sources and the introduction of more environmentally friendly energy carriers, consisting of the purchase and installation: — air source heat pumps; — ground source heat pumps; — solar collector installations; — photovoltaic installations. In addition, due to the amendment of the resolution, from 2022 it is possible to obtain co-financing for the purchase and installation of energy storages and electric vehicle charging stations in the event of having or simultaneously applying for a grant for a photovoltaic installation. In addition, Kraków's residents can apply for subsidies for the purchase and installation of energy management systems if they have a photovoltaic installation and an energy storage facility at the same time or if they simultaneously apply for a subsidy for this scope. The maximum grant amount is up to 60% of the eligible costs incurred, but no more than:

		- PLN 18,000 for the purchase and installation of an air source heat pump; - PLN 33,000 for the purchase and installation of a ground source heat pump; - PLN 7,500 for the purchase and installation of solar thermal collectors; - PLN 15,000 for the purchase and installation of a photovoltaic system; - PLN 7,500 for the purchase and installation of electricity storage; - PLN 1,500 for the purchase and installation of an energy management system; - PLN 6,000 for the purchase and installation of vehicle charging stations. In 2022, the programme has been extended to allow housing associations and housing cooperatives to apply for a grant. The grant can be obtained for the purchase and installation: — photovoltaic installations; — energy storage; — energy management systems; — electric vehicle charging stations. The maximum grant amount is up to 60% of the eligible costs incurred, but no more than: — PLN 48 000 gross for the purchase and installation of a photovoltaic micro-installation ; — PLN 7,500 gross for the purchase and installation of electricity storage; — PLN 1,500 gross for the purchase and installation of an energy management system; — PLN 6,000 gross for the purchase and installation of vehicle charging stations. The call for applications has not yet taken place due to a lack of adequate funding.
Reference to impact pathways	Impact sector	Buildings and heating. Electricity.
	System lever	Technology/Infrastructure. Finance.
	Impact (with reference to module B-1.1)	Support for investment in thermal modernisation and RES programmes. Investment in energy storage technologies. Development of RES-based solutions.
Implementation	Units/persons responsible for implementation	Municipality of Krakow – Department of Air Quality
	Scale of action and entities covered	Supplying the city's energy system.
	Stakeholders involved	Residents, housing associations, housing communities, contractors.

	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeframe for the task is between 2020 and 2030.
Receipts and costs	Renewable energy generated (if applicable)	The exact amount of renewable energy generated depends on the types of stakeholder applications seeking funding and will be completed in future iterations.
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Buildings and Heating sector - 483 tCO_2e. Estimated reduction in the Electricity sector – 1 931 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Costs for 2020-2024 - approx. PLN 33 000 000 (sum of costs incurred in 2020-2023 and costs planned for 2024) Estimated costs for 2025 - 2030 – approx. PLN 55 000 000. Total estimated costs: PLN 88 000 000 (approx. EUR 19 555 000). Attention: The indicated amount of estimated costs for the period 2025 - 2030 refers to subsidies for individuals, cooperatives and housing communities combined.

B-2.2: Outline of individual activities - E-3		
Description of operation	Name of the action	Modernisation of the biogas tanks at the Płaszów Sewage Treatment Plant.
	Type of action	Technical and infrastructural action.
	Description of operation	Replacement of 2 biogas tanks with new ones of increased capacity allowing operation from 100% to 20% full, which will enable the full potential of the biogas produced to be exploited and green energy generation to be increased.
Reference to impact pathways	Impact sector	Buildings and heating.
	System lever	Technology/Infrastructure.
	Impact (with reference to module B-1.1)	Action to decarbonise the district heating system.
Implementation	Units/persons responsible for implementation	Waterworks of the City of Krakow

	Scale of action and entities covered	Local energy system.
	Stakeholders involved	Enterprises.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. Planned completion date for the task - 2024.
Receipts and costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	Tank capacities of up to approx. 3200 m^3 .
	Estimated greenhouse gas emission reductions for each emission source sector	The estimated reduction in the Buildings and Heating sector is hard to estimate and will be completed in a future update.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Estimated investment costs - PLN 1 800 000 (approx. EUR 400 000).

B-2.2: Outline of individual activities - E-4		
Description of operation	Name of the action	Construction of a photovoltaic installation at the Barycz landfill site.
	Type of action	Technical and infrastructural action.
	Description of operation	A photovoltaic installation is planned for the reclaimed part of the Barycz municipal landfill (between 2024 and 2025. The energy produced is expected to provide power for all waste treatment facilities at the Barycz Environmental Centre, with surplus energy being fed back into the grid.
Reference to impact pathways	Impact sector	Electricity.
	System lever	Technology/Infrastructure. Governance and policy.
	Impact (with reference to module B-1.1)	Supporting a change in the structure of electricity generation at plants within the city. Design of new photovoltaic farms.
Implementation	Units/persons responsible for implementation	Municipal Cleaning Company
	Scale of action and entities covered	Supply to the local energy system.
	Stakeholders involved	Enterprises.
	Comments on implementation - resources	This action addresses the emissions gap. The planned timeframe for the task is 2024-2025.

	needed, timetable and milestones	
Receipts and costs	Renewable energy generated (if applicable)	Approx. 957 MWh/year.
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Electricity sector - 657 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Estimated costs - PLN 6 000 000 (approx. EUR 1 333 000).

B-2.2: Outline of individual activities - E-5		
Description of operation	Name of the action	Construction of photovoltaic farms by Krakow Municipal Holding.
	Type of action	Technical and infrastructural action.
	Description of operation	Construction of a photovoltaic farm with energy storage to increase stabilisation and self-consumption of green energy. The land for the larger farm will be newly acquired by Krakow Municipal Holding.
Reference to impact pathways	Impact sector	Electricity.
	System lever	Technology/Infrastructure. Governance and policy.
	Impact (with reference to module B-1.1)	Supporting a change in the structure of electricity generation at plants within the city. Design of new photovoltaic farms.
Implementation	Units/persons responsible for implementation	Krakow Municipal Holding
	Scale of action and entities covered	Supply to the city's energy system.
	Stakeholders involved	Enterprises.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The task is in the preliminary planning phase, with no set completion dates yet.
Receipts and costs	Renewable energy generated (if applicable)	2 farms with an installed capacity of approximately 2 MWp and 300 kWp.
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Electricity sector – 1 352 tCO_2e.

	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	The estimated cost of implementation is included in the total allocation of the Krakow Municipal Holding for photovoltaic investments discussed in the outlines of the individual measures, at an amount of approximately PLN 10 - 20 million (approx. EUR 2 million - 4.5 million).

B-2.2: Outline of individual activities - E-6		
Description of operation	Name of the action	Construction of a photovoltaic farm at the Raba Water Treatment Plant.
	Type of action	Technical and infrastructure measure.
	Description of operation	A photovoltaic farm is under construction at the Raba Water Treatment Plant with a completion date of 2024.
Reference to impact pathways	Impact sector	Electricity.
	System lever	Technology/Infrastructure. Governance and policy.
	Impact (with reference to module B-1.1)	Supporting a change in the structure of electricity generation at plants within the city. Design of new photovoltaic farms.
Implementation	Units/persons responsible for implementation	Waterworks of the City of Krakow S.A.
	Scale of action and entities covered	Supply to the city's energy system.
	Stakeholders involved	Enterprises.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. Planned completion date for the task - 2024.
Receipts and costs	Renewable energy generated (if applicable)	Photovoltaic farm capacity - 950 kW.
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Electricity sector - 698 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Estimated investment costs - PLN 8 200 000 (approx. EUR 1 822 000).

B-2.2: Outline of individual activities - E-7		
Description of operation	Name of the action	Construction of new CHP systems.
	Type of action	Technical and infrastructural action.
	Description of operation	Construction of H2Ready cogeneration systems (hydrogen), with the aim of transforming the city's energy system to a less carbon-intensive one.
Reference to impact pathways	Impact sector	Buildings and heating and Electricity.
	System lever	Technology/Infrastructure. Governance and policy.
	Impact (with reference to module B-1.1)	Action to decarbonise the district heating system. Development of RES-based solutions. Support for changing the structure of energy generation. Investment in energy storage technologies.
Implementation	Units/persons responsible for implementation	Municipal Heating Company S.A.
	Scale of action and entities covered	Action to supply the energy system of the City of Krakow.
	Stakeholders involved	Enterprises.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeframe for the task is 2025 - 2028. A broader description of the measure will be provided in future iterations of the document as the project develops.
Receipts and costs	Renewable energy generated (if applicable)	Capacity - approx. 13 MW.
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Buildings and heating sector - 6 803 tCO_2e. Estimated reduction in the Electricity sector – 27 212 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Estimated investment costs - PLN 92 000 000 (approx. EUR 20 444 000).

B-2.2: Outline of individual activities - E-8		
Description of operation	Name of the action	Construction of photovoltaic farms and local installations by MPEC.
	Type of action	Technical and infrastructural action.

	Description of operation	Construction of farms and local photovoltaic installations to transform the city's energy system to a less carbon-intensive one.
Reference to impact pathways	Impact sector	Electricity.
	System lever	Technology/Infrastructure. Governance and policy.
	Impact (with reference to module B-1.1)	Supporting a change in the structure of electricity generation at plants within the city. Design of new photovoltaic farms.
Implementation	Units/persons responsible for implementation	Municipal Heating Company S.A.
	Scale of action and entities covered	Action to supply the energy system of the City of Krakow.
	Stakeholders involved	Enterprises.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeframe for the task is 2025 - 2028. A broader description of the measure will be provided in future iterations of the document as the project develops.
Receipts and costs	Renewable energy generated (if applicable)	Capacity - approx. 32 MW.
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Electricity sector - 23 520 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Estimated investment costs - PLN 134 000 000 (approx. EUR 29 777 000).

B-2.2: Outline of individual actions - E-9		
Description of operation	Name of the action	ZIT - Construction of energy storages.
	Type of action	Technical and infrastructural action.
	Description of operation	Construction of a scalable energy storage facility at the site of the Thermal Waste Conversion Plant. The project fits in with the development objectives of the area covered by the ZIT instrument, solving common development problems in the Krakow Metropolitan area. Its implementation, resulting from the diagnosis and goals of the urban strategy, focuses on the use of renewable energy sources, reduction of air pollution and

		CO_2 , and improvement of energy efficiency and comfort of use of public buildings. The project is linked with other undertakings within this strategy, which will contribute to a reduction in air pollution and an increase in the share of renewable energy.
Reference to impact pathways	Impact sector	Electricity.
	System lever	Technology/Infrastructure.
	Impact (with reference to module B-1.1)	Development of RES-based solutions.
Implementation	Units/persons responsible for implementation	The Krakow Metropolia Association together with the Municipality of Krakow, which is a member of the association, and Krakow Municipal Holding S.A.
	Scale of action and entities covered	Operation within the Thermal Waste Conversion Plant.
	Stakeholders involved	Enterprises.
	Comments on implementation - resources needed, timetable and milestones	Action only in the design phase, currently no timetable or milestones.
Receipts and costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	The estimated reduction in the Electricity sector is hard to estimate and will be completed in a future update.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	The measure has secured funding from the European Fund for Małopolska 2021-2027. Estimated investment costs - PLN 2 000 000 (approx. EUR 444 000).

B-2.2: Outline of individual activities - E-10		
Description of operation	Name of the action	Installation of two cogeneration units at the Płaszów Treatment Plant.
	Type of action	Technical and infrastructural action.
	Description of operation	Installation of two cogeneration units with an electrical output of 800 kW and thermal output 790 kW each, together with the construction of a transformer station, equipped with with transformers and a low- and medium-

		voltage switchgear. The task is in the final phase of implementation with a completion date of 2024.
Reference to impact pathways	Impact sector	Buildings and heating and electricity.
	System lever	Technology/Infrastructure. Governance and policy.
	Impact (with reference to module B-1.1)	Action to decarbonise the district heating system. Development of RES-based solutions. Support for changing the structure of energy generation. Investment in energy storage technologies.
Implementation	Units/persons responsible for implementation	Waterworks of the City of Krakow S.A.
	Scale of action and entities covered	Local energy system.
	Stakeholders involved	Enterprises.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. Planned completion date for the task - 2024.
Receipts and costs	Renewable energy generated (if applicable)	Two CHP units with an electrical output of 800 kW and a thermal output of 790 kW each.
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Buildings and heating- 592 tCO_2e. Estimated reduction in the Electricity sector – 2 366 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Estimated investment costs - PLN 8 000 000 (approx. EUR 1 777 000).

B-2.2: Outline of individual activities - E-11		
Description of operation	Name of the action	Modernisation of road lighting in Krakow.
	Type of action	Technical and infrastructural action.
	Description of operation	The aim of the project is reducing electricity consumption through the use of modern LED luminaires and a lighting management system. The material scope of the Project at the investment stage includes, among other things, the following tasks: — Replacement of lamps, extension arms and installation of telecommunication

		controllers to enable communication with the Superior Lighting Management System under the terms of the EPC Contract; — design of the reactive power reduction subsystem and installation of the corresponding reducers for 746 control cabinets; — the provision and implementation of a master lighting management system software package (compliant with the previous specification) in accordance with the previous specification), which will be an open system for the remote management of LED luminaires allowing dynamic control of lighting intensity depending on the actual traffic conditions on public roads, as well as external light levels (including dynamic control of existing LED luminaires within the City of Krakow that are not being replaced); — adaptation of non-replaced existing power supply and control cabinets to the operation of energy-efficient LED luminaires (including possible retrofitting of equipment for their remote control and monitoring).
Reference to impact pathways	Impact sector	Electricity.
	System lever	Technology/Infrastructure.
	Impact (with reference to module B-1.1)	Reducing electricity consumption through technological upgrades.
Implementation	Units/persons responsible for implementation	Krakow City Roads Board.
	Scale of action and entities covered	Operation within the administrative boundaries of the City of Kraków.
	Stakeholders involved	Residents, businesses.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeframe for the task is 2024-2028.
Receipts and costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Electricity sector – 4 408 tCO_2e.

	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Estimated investment costs - PLN 85 712 361 (approx. EUR 19 047 000).

B-2.2: Outline of individual activities - E-12		
Description of operation	Name of the action	ATELIER project - AmsTErdam and BiLbao cItizen drivEn smaRt cities.
	Type of action	Innovation and technology action.
	Description of operation	The ATELIER project aims to create Positive Energy Districts in Amsterdam and Bilbao. The main objectives are to reduce CO_2 emissions through the implementation of local smart city solutions, to support sustainable, safe and accessible energy systems for residents and to promote cooperation and knowledge sharing between the partner cities. The project also aims to prove that the solutions applied in Amsterdam and Bilbao can be replicated in other partner cities. As part of the ATELIER programme, Krakow has the following objectives: — gain knowledge and skills in the development of integrated energy districts (PEDs); — organise a local "Innovation Atelier" as a meeting place for different types of stakeholders; — integration of renewable energy into the district heating and cooling system; — developing a plan to replicate the PED concept in selected areas; — increasing the involvement of residents and stakeholders; — Developing a 'City Vision 2050' as a pathway to achieving climate neutrality.
Reference to impact pathways	Impact sector	Electricity.
	System lever	Social innovation. Education and skills.
	Impact (with reference to module B-1.1)	Developing district and community energy model solutions with strong citizen involvement.

		Educational campaigns targeting different social groups to raise awareness of energy savings.
Implementation	Units/persons responsible for implementation	Project partners. On the Krakow side - the Department of Municipal Economy and Climate.
	Scale of action and entities covered	International action based on the spread of knowledge and ready-made practices.
	Stakeholders involved	Project partner cities - Amsterdam, Bilbao, Bratislava, Budapest, Copenhagen, Matosinhos and Riga.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeline for the project is 2019-2024.
Receipts and costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Electricity sector - 48 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	The project is funded by the European Union under the Horizon 2020 programme. Estimated budget on the Kraków side - PLN 1 259 765 (approx. EUR 279 000) .

B-2.2: Outline of individual activities - E-13		
Description of operation	Name of the action	COMANAGE project.
	Type of action	Innovative and social action.
	Description of operation	The project will develop a toolkit for the creation and management of energy communities. This will entail the creation of a methodological and operational framework for the management of energy communities and equipping public authorities involved in energy community projects with a set of integrated support services, mechanisms and tools to facilitate the leadership and management of energy communities and other forms of citizens' energy initiatives, ensuring their growth and sustainability in the medium and long-term. The ultimate goal of the project will be twofold: to

		ensure that energy community projects that have already been established can operate and grow in the medium to long term; to encourage and stimulate the creation of new energy projects implemented by energy communities. To this end, the project will operationalise a transnational network of knowledge and competence providers and mobilise and engage key stakeholders around three Operational Integrated Service Centres. These will be established in three pilot areas, represented in the consortium by the Metropolis of Barcelona in Spain, the Association of Krakow Metropolis in Poland, the National Association of Lazio Italian Municipalities in Italy. Objectives and outcomes: development of an energy community management toolkit; piloting within the HUB; creation of an e-learning toolkit; holistic energy community framework and collaborative methodology; energy community needs and best practice analysis; energy community management toolkit - prototype and update; HUB stakeholder engagement and mobilisation plan; pilot implementation plans for HUB; e-learning platform with training materials; testing and implementation of energy community management toolkit; development, maintenance and mapping plan communication and dissemination plan.
Reference to impact pathways	Impact sector	Electricity.
	System lever	Social innovation. Governance and policy. Education and skills.
	Impact (with reference to module B-1.1)	Developing district and community energy model solutions with strong citizen involvement. Developing recommendations and recommendations to the national level to invest in energy companies. Educational campaigns targeting different social groups to raise awareness of energy savings.
Implementation	Units/persons responsible for implementation	Krakow Metropolis Association.
	Scale of action and entities covered	Action based on the development of ready-to-implement solutions.
	Stakeholders involved	Project consortium, SMK municipalities.

	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeframe for the task is 2022-2025.
Receipts and costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Electricity sector - 269 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Estimated total project budget - PLN 7 300 000 (approx. EUR 1 622 000).

B-2.2: Outline of individual activities - E-14		
Description of operation	Name of the action	Development of distributed renewable energy generation.
	Type of action	Financial and technical action.
	Description of operation	The measure aims to develop individual electricity generation using private photovoltaic panels on the roofs of buildings and thermal energy through heat pumps. The assumed result is the use of more than 32% of the roof area of buildings in the city for the installation of PV systems and the exploitation of opportunities for RES installations on industrial buildings and brownfield sites. The Urban Planning Department of the City of Krakow is currently working on changes to the current local plan for the 'Nowa Huta Przyszłości - Igołomska Południe' area. The new version of the plan will facilitate the installation of PV on buildings by private entrepreneurs and will allow the establishment of photovoltaic farms on post-industrial agricultural land. For the smooth implementation of PV installations, cooperation at local and regional level will be necessary with conservationists. Under this measure, the City of Krakow plans to launch a support programme for the preparation of comprehensive project documentation for the installation of RES on historic buildings. Currently such a project is already being implemented by the municipal unit KEGW in the area of the Cultural Park - Nowa Huta. The Municipality of Krakow is actively involved in in the dissemination of distributed energy generation by

		supporting prosumer initiatives, providing subsidies and advisory support. As a result, the growth rate of new PV installations is accelerating year on year. Between 2020 and 2021, more than 19% of newly connected installations were with municipal PROZE programme financial support. A significant opportunity for the intensification of existing programmes and the creation of new ones is provided by the acquisition of significant municipal funding from the National Reconstruction Plan. The first funds from the plan have already been granted to the municipality for the implementation of pilot and innovative RES projects in the city.  Figure 8: Growth rate of the number of PV micro-installations connected in the GMK area. In 2020, only one in 16 residential buildings in Kraków had PV installed. In 2021, it was already one in eight residential buildingsMore than 90% of the current PV micro-installations in Kraków (as of 2023) were connected between 2020 and 2023. In addition, due to the amendment of the Acts on renewable energy sources and other legislative changes proposed by the Municipality of Krakow, the number of photovoltaic micro-installations will grow faster every year. The project also includes the use of heat pumps for the production of heat energy in buildings, with a predominance of air source heat pumps and some ground source heat pumps where warranted.
Reference to impact pathways	Impact sector	Buildings and heating. Electricity.
	System lever	Technology/Infrastructure. Finance.
	Impact (with reference to module B-1.1)	Support for investment in thermal modernisation and RES programmes. Development of RES-based solutions.
Implementation	Units/persons responsible for implementation	Municipality of Krakow (as monitoring entity).
	Scale of action and entities covered	City-wide action.

	Stakeholders involved	Municipal companies, private companies, residents.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeframe for the task is between 2024 and 2030.
Receipts and costs	Renewable energy generated (if applicable)	345 564 MWh per year in 2030 from PV installations on residential and commercial rooftops. 129 865 MWh per year in 2030 from RES installations on industrial sites.
	Energy removed/replaced, amount or type of fuel	103 270 MWh per year in 2030 from heat pump installations.
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Buildings and Heating sector – 46 553 tCO_2e. Estimated reduction in the Electricity sector 330 004 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Estimated costs - PLN 5 186 553 899 (approx. EUR 1 152 567 000).

B-2.2: Outline of individual activities - E-15		
Description of operation	Name of the action	Creation of new photovoltaic farms to power the city.
	Type of action	Technical action.
	Description of operation	The aim of the measure is to increase the share of RES in the structure of electricity generation for the area of the City of Kraków. A number of energy companies and enterprises are currently implementing their PV farm projects. These include Krakow Municipal Holding, PGE EC S.A., MPEC, Tauron, PSE and other smaller companies. However, more needs to be done. The biggest barrier in the case of Krakow is the fact that the

		city is densely built-up, which makes it a problem to find a suitable area for the construction of farms. Within the administrative borders of the city, post-industrial areas - ash and slag dumps - have great potential. The Municipality of Krakow is looking for new sites with the possibility to develop PV farms in neighbouring municipalities. This provides new business opportunities in the metropolitan area of the municipality. In the neighbouring municipalities, companies are developing to lease land specifically for PV installations and to resell green energy. Such investments are also profitable due to the fact that there are very good and favourable conditions for obtaining solar energy in the foothills above the city.
Reference to impact pathways	Impact sector	Electricity.
	System lever	Technology/Infrastructure.
	Impact (with reference to module B-1.1)	Development of RES-based solutions.
Implementation	Units/persons responsible for implementation	Municipality of Krakow (as monitoring entity).
	Scale of action and entities covered	Action throughout the city and in neighbouring municipalities in the Krakow Metropolitan Area.
	Stakeholders involved	Municipal companies, private companies, energy companies.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeframe for the task is 2024-2030.
Receipts and costs	Renewable energy generated (if applicable)	54 978 MWh per year in 2030 from PV farm installations.
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Electricity sector - 36 597 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Estimated cost of action - PLN 290 400 000 (approx. EUR 64 533 000).

B-2.2: Outline of individual activities - E-16

Description of operation	Name of the action	Development of energy communities and energy awareness.
	Type of action	Innovation and technology action.
	Description of operation	The measure aims to develop prosumer photovoltaic installations within the city (installations from 50 kW) by 2030. The long-term objective of the task is to significantly reduce the carbon footprint of electricity used within the city in the 2030 timeframe by developing local electricity generation and increasing its consumption within the city. The direction of action is the development of renewable electricity sources within the city in a prosumer formula and system sources. The scope of the project includes the further development of photovoltaic installations within the city in a prosumer formula with an intensity of 23 MW/year as in recent years between 2025 and 2030. Legal changes, such as the introduction of the term virtual prosumer, as well as educational and informational activities for interested residents will be necessary for the assumed development of activities.
Reference to impact pathways	Impact sector	Electricity.
	System lever	Social innovation. Democracy and social participation Education and skills.
	Impact (with reference to module B-1.1)	Developing district and community energy model solutions with strong citizen involvement. Continue to support citizens with energy advice. Educational campaigns targeting different social groups to raise awareness of energy savings.
Implementation	Units/persons responsible for implementation	Municipality of Krakow (as monitoring entity).
	Scale of action and entities covered	City-wide action.
	Stakeholders involved	Residents, energy companies, housing associations, property managers, energy communities, banks, local investors.

	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeframe for the project is 2024-2030.
Receipts and costs	Renewable energy generated (if applicable)	80 500 MWh in 2030.
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Electricity sector - 53 500 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Estimated costs - PLN 480 000 000 (approx. EUR 106 666 000).

B-2.2: Outline of individual activities - E-17		
Description of operation	Name of the action	Green energy purchase.
	Type of action	Management action.
	Description of operation	The scope of the measure includes the purchase of green electricity under the city's group purchasing formula from 2025 to 2030 with a volume of 100 GWh/year. Krakow has taken such initiatives before. On 1 July 2021, the Municipality of Krakow concluded a 2-year agreement for the purchase of green energy in volume - as much as 424,000 MWh delivered to 3258 consumption points. This reduced emissions from the city by 325,000 tonnes of CO_2 .
Reference to impact pathways	Impact sector	Electricity.
	System lever	Governance and Policy.
	Impact (with reference to module B-1.1)	Purchasing green energy.
Implementation	Units/persons responsible for implementation	Municipality of Krakow.
	Scale of action and entities covered	City-wide action.
	Stakeholders involved	Municipal companies, energy companies.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeframe for the action is 2024-2030.

Receipts and costs	Renewable energy generated (if applicable)	100 000 MWh in 2030.
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Electricity sector - 66 500 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Action currently very difficult to estimate due to the variability of costs over long time scales.

B-2.2: Outline of individual activities - TR-1		
Description of operation	Name of the action	Participation in the SmartEPC project.
	Type of action	Innovation and technology action.
	Description of operation	SmartEPC is a project co-funded by the HORIZON 2020 programme, a collaboration between several European cities. Its coordinator is Croatia and its partners are: Spain, France, Poland and Belgium. Krakow is a partner in the project and at the same time acts as a pilot, as a city that has committed to replacing street lighting with energy-efficient lighting based on the standards developed within the project. By participating in this project, Krakow will test the implementation of Smart City elements using its street lighting infrastructure. As part of the Smart EPC project, Krakow is also testing the use of LED lanterns for vehicle charging.
Reference to impact pathways	Impact sector	Electricity
	System lever	Technology/Infrastructure.
	Impact (with reference to module B-1.1)	Reducing electricity consumption through technological upgrades.
Implementation	Units/persons responsible for implementation	Krakow City Roads Board.
	Scale of action and entities covered	Operating within the administrative boundaries of the city of Krakow.
	Stakeholders involved	Residents, businesses.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeframe for the task is 2022-2024.

Receipts and costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Electricity sector - 49 tCO_2e. Estimated reduction in the Transport sector - 3 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Estimated costs - PLN 1 232 977 (approx. EUR 273 000).

B-2.2: Outline of individual activities - TR-2		
Description of operation	Name of the action	Project for fast, collision-free rail transport in Krakow (Premetro).
	Type of action	Technical and infrastructural action.
	Description of operation	The Action consists of implementing one of the Krakow pre-metro variants analysed in the "Feasibility study for the construction of fast, collision-free rail transport in Krakow". Seven variants are currently being analysed, with each of them routed parallel to the north side of Krakow in relation to the Vistula River. The projected routes are: - beginning - Jasnogórska Street (Bronowice), - end - Mogiła housing estate (Nowa Huta) or Kocmyrzowska street (Wzgórza Krzesławickie). Depending on which option is chosen, the length of the route is about 25 km and about 20 interchange stops.
Reference to impact pathways	Impact sector	Transport.
	System lever	Technology/Infrastructure. Governance and policy.
	Impact (with reference to module B-1.1)	Expansion of public transport infrastructure. Expansion of the public transport fleet towards zero-emission. Development of the functioning of the public transport system.
Implementation	Units/persons responsible for implementation	Municipality of Krakow.
	Scale of action and entities covered	City-wide action to increase transport accessibility.
	Stakeholders involved	Residents, businesses.
	Comments on implementation - resources	Action only in the design phase, currently no timetable or milestones.

	needed, timetable and milestones	
Receipts & costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Transport sector – 6 230 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Preliminary investment costs vary depending on the variant. The cost of one of the likely versions of the project is approximately PLN 4 753 050 000 (approx. EUR 1 056 233 000).

B-2.2: Outline of individual activities - TR-3		
Description of operation	Name of the action	ZIT - Construction of the SKA "Kraków Prądnik Czerwony" railway stop together with the construction of a Park & Ride car park and the construction of an integrated transfer node together with the P&R Bronowice car park and a bus terminal.
	Type of action	Technical and infrastructural action.
	Description of operation	Construction of a railway stop and P&R car park and construction of an interchange, bus terminal and P&R car park (outside the city centre). The project integrates the development objectives of the area covered by the ZIT instrument, focusing on the development of public transport infrastructure and sustainable mobility. The implementation of the project results from the diagnosis and objectives of the urban strategy, aiming to create interchanges and P+R car parks around train and tram stations and stops. The project cooperates with other initiatives in the framework, which contributes to increasing the share of public transport and reducing pollutant emissions.
Reference to impact pathways	Impact sector	Transport.
	System lever	Technology/Infrastructure. Governance and policy. Education and skills.
	Impact (with reference to module B-1.1)	Expansion of public transport infrastructure. Development of the functioning of the public transport system. Popularise 'car-pooling' and alternative modes of transport through regulation.

		Popularise alternative means of transport (e.g. scooters).
Implementation	Units/persons responsible for implementation	Krakow Metropolis Association together with the Municipality of Krakow, which is a member of the association.
	Scale of action and entities covered	Action within less well connected areas and away from the city centre.
	Stakeholders involved	Residents of neighbouring municipalities, city residents, transport companies.
	Comments on implementation - resources needed, timetable and milestones	Action only in the design phase, currently no timetable or milestones.
Receipts and costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Transport sector - 2 687 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	As part of the implementation of the project, funding was obtained from the European Fund for Małopolska for 2021-2027. Estimated investment costs - PLN 110 000 000 (approx. EUR 24 444 000).

B-2.2: Outline of individual activities - TR-4		
Description of operation	Name of the action	ZIT - Construction of cycle routes along the streets: — Al. Pokoju; — Walerego Sławka; — Brożka; — Nawojki; — Jancarza.
	Type of action	Technical and infrastructural action.
	Description of operation	Various investments are planned in cycling infrastructure in Krakow, including the construction of cycle paths along Al. Pokoju, Walery Sławek Street, the north side of Brożka Street and cycle tracks along Nawojki and Jancarza Streets. These projects will be implemented in accordance with the Sustainable Mobility Plan for the Krakow

		Metropolis. The project integrates the development objectives of the area covered by the ZIT instrument, focusing on the creation of a coherent pedestrian and cycling infrastructure in the Krakow Metropolis. The implementation of the project results from the diagnosis and objectives of the urban strategy, aiming to increase the importance of active mobility and high availability of sustainable mobility infrastructure. Linked to other projects, it contributes to increasing the share of zero-emission individual travel and reducing pollutant emissions.
Reference to impact pathways	Impact sector	Transport.
	System lever	Technology/Infrastructure. Governance and policy. Education and skills.
	Impact (with reference to module B-1.1)	Extension of pedestrian and cycle infrastructure. Popularise alternative means of transport (e.g. scooters). Change of use of public spaces e.g. fewer parking spaces, pedestrian streets.
Implementation	Units/persons responsible for implementation	Krakow Metropolis Association together with the Municipality of Krakow, which is a member of the association.
	Scale of action and entities covered	Action along the traffic routes described in the project. Effects of the measure scaled for the entire city and Krakow Metropolis area.
	Stakeholders involved	Residents of neighbouring municipalities, city residents, transport companies, cycling associations.
	Comments on implementation - resources needed, timetable and milestones	Action only in the design phase, currently no timetable or milestones.
Receipts and costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Transport sector – 1 393 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	As part of the implementation of the measure, funding was obtained from the European Fund for Małopolska for the period 2021-2027. Estimated investment costs approx. PLN 15 000 000 (approx. EUR 3 333 000).

B-2.2: Outline of individual activities - TR-5		
Description of operation	Name of the action	ZIT - Construction of KST tram line (Krowodrza Górka - Azory district).
	Type of action	Technical and infrastructural action.
	Description of operation	As part of the construction of the KST tram line, 2.5 km of track from the Krowodrza Górka terminus to the Azory bus terminus will be built, together with infrastructure. The Azory loop will be roofed and equipped with a terminal building. Four bus stops with information boards, reconstruction of streets and intersections, pavements and cycle paths are planned. Noise barriers and a pedestrian/bicycle bridge over Weissa Street next to the P+R car park will be added. The line will be controlled by the Area Traffic Control System. The existing footbridge over Opolska Street will be adapted, adding lifts for better access to tram stops. A three-level P+R car park for 200 cars will be built next to the Azory terminus, with a covered Bike&Ride area for 50 bicycles.
Reference to impact pathways	Impact sector	Transport.
	System lever	Technology/Infrastructure. Governance and policy. Education and skills.
	Impact (with reference to module B-1.1)	Expansion of public transport infrastructure. Development of the functioning of the public transport system. Popularise 'car-pooling' and alternative modes of transport through regulation. Popularise alternative means of transport (e.g. scooters).
Implementation	Units/persons responsible for implementation	Krakow Metropolis Association together with the Municipality of Krakow, which is a member of the association.
	Scale of action and entities covered	Action along the traffic routes described in the project. Effects of the measure scaled for the entire city and Krakow Metropolis area.
	Stakeholders involved	Residents of neighbouring municipalities, city residents, transport companies.
	Comments on implementation - resources needed, timetable and milestones	Action only in the design phase, currently no timetable or milestones.
Receipts and costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-

	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Transport sector – 4 213 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	The measure has attracted funding from the European Infrastructure, Climate and Environment Fund for 2021-2027. Estimated investment costs - PLN 249 997 500 (approx. EUR 55 555 000).

B-2.2: Outline of individual activities - TR-6		
Description of operation	Name of the action	ZIT - Development of the tramway fleet to serve the Krakow City Transport system and development of intelligent transport systems (ITS) to improve transport accessibility within the city of Krakow.
	Type of action	Technical and infrastructural action.
	Description of operation	The project will see the purchase of 30 new low-floor tram cars, including 10 two-way 32-34m tram cars, 10 one-way 32-34m tram cars and 10 one-way 42-45m tram cars, equipped with an overhead powerless running system and overrun platforms for the disabled, air conditioning, a monitoring system, and other amenities. The development of Intelligent Transport Systems (ITS) in Krakow includes the installation of Dynamic Passenger Information (DIP) boards at bus and tram stops, purchase and installation of auto-computers for vehicles, installation of Variable Message Signs (VMS) at entrances to the city and detectors, expansion of the transport network, access control in designated areas, installation of number plate recognition devices, and informative parking signs in the inner city. These initiatives will have a positive impact on the area of urban transport through better passenger information, smoother traffic, punctuality, shorter travel times, and better connections to neighbouring municipalities, which will encourage the use of public transport and alternative means of transport.
Reference to impact pathways	Impact sector	Transport.
	System lever	Technology/Infrastructure. Governance and policy. Education and skills.

	Impact (with reference to module B-1.1)	Expansion of the public transport fleet towards zero-emission. Expansion of public transport infrastructure. Development of the functioning of the public transport system. Popularise 'car-pooling' and alternative modes of transport through regulation. Popularise alternative means of transport (e.g. scooters).
Implementation	Units/persons responsible for implementation	Krakow Metropolis Association together with the Municipality of Krakow, which is a member of the association, and Municipal Public Transport Company S.A.
	Scale of action and entities covered	City-wide impact measure.
	Stakeholders involved	Residents of neighbouring municipalities, city residents, transport companies.
	Comments on implementation - resources needed, timetable and milestones	Action only in the design phase, currently no timetable or milestones.
Receipts and costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Transport sector – 2 372 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	The measure has attracted funding from the European Infrastructure, Climate and Environment Fund for 2021-2027. Estimated investment costs - PLN 521 967 488 (approx. EUR 115 992 000).

B-2.2: Outline of individual activities - TR-7		
Description of operation	Name of the action	ZIT - Reconstruction of tram tracks together with turnouts and associated infrastructure at: — Straszewskiego; — Karmelicka Street; — Starowislna Street.
	Type of action	Technical and infrastructural action.
	Description of operation	The measure includes the reconstruction of the tram tracks in Straszewskiego and Karmelicka Streets, as well as the junctions of switches and associated infrastructure. In Karmelicka Street,

		the works planned include those related to the overhead line, lighting and drainage, as well as the reconstruction of the road system. In Straszewskiego Street, on the other hand, modernisation of the Piłsudskiego junction at the Jagiellonian University, the overhead line, lighting and drainage are planned. The entire project is located in the city centre, where there is a restricted traffic zone and traffic organisation. The measure also includes work on the track and road system in the section from the junction with Dietla Street to Powstańców Śląskich Bridge, with the replacement of tram tracks and modernisation of the overhead catenary network, as well as the construction of pavements and cycle paths.
Reference to impact pathways	Impact sector	Transport.
	System lever	Technology/Infrastructure. Governance and policy. Education and skills.
	Impact (with reference to module B-1.1)	Expansion of public transport infrastructure. Development of the functioning of the public transport system. Popularise 'car-pooling' and alternative modes of transport through regulation. Popularise alternative means of transport (e.g. scooters).
Implementation	Units/persons responsible for implementation	Krakow Metropolis Association together with the Municipality of Krakow, which is a member of the association.
	Scale of action and entities covered	City-wide impact measure.
	Stakeholders involved	Residents of neighbouring municipalities, city residents, transport companies.
	Comments on implementation - resources needed, timetable and milestones	Action only in the design phase, currently no timetable or milestones.
Receipts and costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Transport sector – 2 807 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	The measure has attracted funding from the European Infrastructure, Climate and

		Environment Fund for 2021-2027. Estimated investment costs - PLN 162 754 934 (approx. EUR 36 167 000).

B-2.2: Outline of individual activities - TR-8		
Description of operation	Name of the action	Creation of new charging stations for electric buses.
	Type of action	Technical and infrastructural action.
	Description of operation	Creation of 2 pantograph stations for charging electric buses on Łużycka Street and 2 pantograph stations on Stojałowskiego Street. It is also planned to build 1 pantograph station for charging electric buses on Rydygiera Street.
Reference to impact pathways	Impact sector	Transport
	System lever	Technology/Infrastructure.
	Impact (with reference to module B-1.1)	Expansion of the public transport fleet towards zero-emission. Expansion of public transport infrastructure. Energy harvesting, storage and cost-effective distribution programmes.
Implementation	Units/persons responsible for implementation	Municipal Public Transport Company in Krakow.
	Scale of action and entities covered	Local transport system.
	Stakeholders involved	Transport companies.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. Planned completion date for the task - 2024.
Receipts and costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	This action is an integral part of the various measures to promote and convert towards electric transport.
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Transport sector - 2 074 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Estimated costs - PLN 6 500 000 (EUR 1 444 000).

B-2.2: Outline of individual activities - TR-9		
Description of operation	Name of the action	Tram Energy Storage in District XII of the City of Krakow and Tram Energy Storage in District XI of the City of Krakow.
	Type of action	Technical and infrastructure measure.
	Description of operation	Storing energy that is returned to the grid by recuperating it from running trams and supporting the traction substation by returning the stored energy to the grid to reduce voltage drops.
Reference to impact pathways	Impact sector	Transport.
	System lever	Technology/Infrastructure.
	Impact (with reference to module B-1.1)	Expansion of public transport infrastructure. Energy generation, storage and economical energy distribution.
Implementation	Units/persons responsible for implementation	Krakow City Roads Board.
	Scale of action and entities covered	Operation within the administrative boundaries of the City of Kraków.
	Stakeholders involved	Transport companies.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeframe for the task is 2024-2025.
Receipts and costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	The specific value will be given in further design proceedings and supplemented in future iterations.
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Transport sector – 1 258 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Estimated investment costs - PLN 14 000 000 (approx. EUR 3 111 000).

B-2.2: Outline of individual activities - TR-10		
Description of operation	Name of the action	Construction of new tram lines with associated infrastructure.
	Type of action	Technical and infrastructural action.
	Description of operation	Modernisation of tram tracks together with associated infrastructure and creation of new

		tram lines: Cichy Kącik - Azory, Osiedle Krowodrza Górka - Azory, part of the KST line (Meissnera Street - Mistrzejowice) and Krowodrza Górka - Górka Narodowa Settlement.
Reference to impact pathways	Impact sector	Transport.
	System lever	Technology/Infrastructure. Governance and policy.
	Impact (with reference to module B-1.1)	Expansion of the public transport fleet towards zero-emission. Expansion of public transport infrastructure. Development of the functioning of the public transport system.
Implementation	Units/persons responsible for implementation	Municipal Investment Board (lines Azory - Cichy Kącik, Osiedle Krowodrza Górka - Azory and Krowodrza Górka - Górka Narodowa), Department of City Treasury (section of the KST line Meissnera Street - Mistrzejowice), Krakow City Roads Board (infrastructure modernisation)
	Scale of action and entities covered	Operation within the administrative boundaries of the city.
	Stakeholders involved	Residents, construction and industrial companies.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. Planned completion dates for the task depend on the specific section of infrastructure.
Receipts and costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Transport sector - 11 107 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Actions financed by different actors on different time scales. Current costs heavy to estimate, approx. PLN 615 000 000 by 2030 (approx. EUR 136 666 000).

B-2.2: Outline of individual actions - TR-11

Description of operation	Name of the action	Projects and activities related to the development of cycling infrastructure and implementation of the Cycling Policy of the City of Krakow.
	Type of action	Organisational and infrastructural action.
	Description of operation	The city of Krakow carries out a wide range of activities in the context of the development of pedestrian and cycling transport. In this connection the postulates of the Cycling Policy of the city and many projects aiming at the development of infrastructure or promotion of cycling as a means of transport are implemented. An example of such activities is the project "Bike to School - Stars" aimed at promoting cycling to school among pupils, parents and teachers.
Reference to impact pathways	Impact sector	Transport.
	System lever	Technology/Infrastructure. Governance and policy. Education and skills.
	Impact (with reference to module B-1.1)	Extension of pedestrian and cycle infrastructure. Popularise 'car-pooling' and alternative modes of transport through regulation. Popularise alternative means of transport (e.g. scooters).
Implementation	Units/persons responsible for implementation	Depending on specific activities / projects: Krakow City Council - Department of Municipal Economy and Climate, Krakow City Roads Board, Public Transport Board.
	Scale of action and entities covered	Operation within the administrative boundaries of the city.
	Stakeholders involved	Residents.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timing of the task depends on the specific project. A broader description of the measure will be provided in future iterations of the document as the project develops.
Receipts and costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Transport sector - 2 446 tCO_2e.

	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Activities funded by different actors on different time scales. Estimated costs hard to determine, due to the frequent lack of separation of costs for development and maintenance. Estimated cost - PLN 23 000 000 (approx. EUR 5 111 000).

B-2.2: Outline of individual activities - TR-12		
Description of operation	Name of the action	SUM project - Smooth Shared Urban Mobility.
	Type of action	Organisational action.
	Description of operation	The SUM project primarily aims to create more sustainable and efficient urban transport solutions. The project aims to reduce transport emissions, reduce traffic congestion and make the city of Krakow friendlier for all its inhabitants. The project aims to introduce innovative and novel shared mobility systems in 15 European cities by 2026, with plans to cover 30 cities in Europe by 2030. Krakow, as a city participating in the SUM project, intends to pilot the new shared mobility system in selected areas of the city.
Reference to impact pathways	Impact sector	Transport.
	System lever	Governance and policy. Education and skills.
	Impact (with reference to module B-1.1)	Popularise 'car-pooling' and alternative modes of transport through regulation. Popularise alternative means of transport (e.g. scooters).
Implementation	Units/persons responsible for implementation	Public Transport Board.
	Scale of action and entities covered	Action based on the development of ready-to-implement solutions.
	Stakeholders involved	Project partner cities.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeframe for the task is 2023-2026.
Receipts and costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-

	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Transport sector - 29 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Estimated total costs - PLN 1 592 697 (approx. EUR 353 000).

B-2.2: Outline of individual activities - TR-13		
Description of operation	Name of the action	Clean Transport Zone.
	Type of action	Organisational action.
	Description of operation	The Krakow Clean Transport Zone is an area where the most polluting cars - that is, old vehicles, even more than 30 years old - will not be allowed to drive. The SCT area will roughly coincide with the borders of Krakow. However, it will not include motorways and motorways running through the city.
Reference to impact pathways	Impact sector	Transport.
	System lever	Governance and policy.
	Impact (with reference to module B-1.1)	Creation of a Clean Transport Zone. Change of use of public spaces e.g. fewer parking spaces, pedestrian streets.
Implementation	Units/persons responsible for implementation	Public Transport Board.
	Scale of action and entities covered	Operating within the administrative boundaries of the city of Krakow.
	Stakeholders involved	Residents, car companies.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeframe for the task is 2023-2025.
Receipts and costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Transport sector - 3 677 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Estimated costs - PLN 685 000 (approx. EUR 152 000).

B-2.2: Outline of individual activities - TR-14		
Description of operation	Name of the action	Programme to support modern forms of local transport and organisation of the transport system.
	Type of action	Financial and organisational action.
	Description of operation	This programme consists of supporting alternative modes of transport and developing dedicated infrastructure for them. In order to achieve climate neutrality, it is necessary to make modes of transport other than the car - more comfortable for residents, so that they choose, for example, to travel by bicycle or public transport not out of compulsion, but out of economic viability, time efficiency and travel comfort. As part of the task, the following measures are planned: **1. Development of pedestrian and cycle infrastructure:** — Construction of new cycle lanes: Creation of dedicated cycle lanes and pedestrian/cycle paths, separated from car traffic. — Modernisation of existing routes: Widening and renewing current cycle paths, installing better lighting and safety features. — Creating safe crossings: Safe crossings for pedestrians and cyclists should be provided at intersections and high traffic areas. **2. Promote alternative modes of transport through regulation:** — Financial incentives: Discounts for people using 'car-pooling' and for companies supporting this form of transport. — Introduction of car sharing zones: Creation of dedicated parking areas for 'car-pooling' and carsharing. — Educational campaigns: Promoting the environmental and economic benefits of car-pooling. **3. Developing the functioning of the public transport system:** — Increasing the frequency of services: Improving timetables to make public transport more accessible and attractive.

		— Introducing smart solutions: developing solutions to make using transport easier, such as a monitoring system and locating city buses for residents. — Infrastructure modifications: introducing solutions to improve the speed of public transport, e.g. adapting urban roads for buses. **4. Change of use of public spaces:** — Reducing the number of parking spaces: Gradual reduction in the number of parking spaces in the town centre to discourage car use. — Creation of pedestrian zones: Introducing streets excluded from car traffic, which will be accessible only to pedestrians and cyclists. — Green spaces: Increasing the number of parks, squares and green spaces in cities, which will encourage residents to walk and be active outdoors. **5. Promote alternative modes of transport:** — Scooter and bicycle rental stations: Creation of points where scooters or electric bicycles can be easily rented. — Regulation: Introduce clear regulations for the use of scooters and bicycles on public roads, including speed limits and safety rules. — Promotions and discounts: Encourage the use of scooters and bicycles by offering discounts on first rides or subscriptions. **6. Popularise hybrid and remote working:** — Support for companies: Encouraging companies to implement the hybrid working model through tax breaks and support programmes. — Awareness campaigns: Promoting the benefits of remote working, such as reducing traffic congestion and improving air quality. — Digital infrastructure: Investing in the development of high-speed internet and modern communication tools to make remote working more efficient and accessible.
Reference to impact pathways	Impact sector	Transport.
	System lever	Technology/Infrastructure. Governance and Policy.

		Education and Skills. Democracy and Social Participation.
	Impact (with reference to module B-1.1)	Extension of pedestrian and cycle infrastructure. Popularise 'car-pooling' and alternative modes of transport through regulation. Development of the functioning of the public transport system. Change of use of public spaces e.g. fewer parking spaces, pedestrian streets. Popularise alternative means of transport (e.g. scooters). The popularisation of hybrid and remote working reduces the need to commute to workplaces.
Implementation	Units/persons responsible for implementation	Municipality of Krakow (as monitoring entity)
	Scale of action and entities covered	Operating within the administrative boundaries of the city of Krakow.
	Stakeholders involved	Residents, motor businesses, cyclists, ngo, business.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeframe for the task is between 2024 and 2030.
Receipts and costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Transport sector - 28 090 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Estimated costs - PLN 90 000 000 (approx. EUR 20 000 000).

B-2.2: Outline of individual activities - TR-15		
Description of operation	Name of the action	Development of sustainable logistics.
	Type of action	Organisational action.
	Description of operation	In order to achieve sustainable logistics and increase the loading of freight transport in the city, the Municipality of Krakow plans to implement the following measures:

		1. Support for the establishment of logistics centres and freight consolidation points — Logistics centres: Support the construction of logistics centres on the outskirts of the city, where goods can be consolidated before further transport to the city centre. — Consolidation points: Create local consolidation points where different suppliers can combine their loads to optimise routes and increase delivery efficiency. **2. Introduction of intelligent logistics management systems** — Digital platform: Creation of an online platform that will enable logistics companies and hauliers to share information about available loads and free space in vehicles. — Tracking and route optimisation systems: Support investment in GPS technology and fleet management systems to monitor and optimise delivery routes. **3. Promoting cooperation between companies** — Logistics co-operatives: Encourage companies to form logistics co-operatives to share transport resources and jointly plan deliveries. — Partnership agreements: Initiating partnership agreements between large and small companies for the joint use of transport vehicles. **4. Investing in clean modes of transport** — Electric and hybrid fleets: Encourage companies to invest in electric and hybrid vehicles through tax breaks and subsidies. — Rail transport: Promote the use of rail transport for heavy loads, thus reducing the number of trucks on urban roads. **5. Setting low emission zones and banning the entry of empty vehicles** — Low emission zones: Introduce low-emission zones where only vehicles meeting certain environmental standards and those with full loads can enter. — Ban on the entry of empty vehicles: Restriction of entry into the city centre for unloaded or underloaded transport vehicles. **6. Optimisation of delivery times**

		— Night deliveries: Encourage night-time deliveries when traffic is less, allowing vehicles to move more quickly and efficiently. — Delivery time windows: Introduce regulated time windows for deliveries in the city centre to better manage traffic and reduce congestion. **7. Education and information campaigns** — Training and workshops: Organise training and workshops for logistics companies on sustainable transport practices. — Promotional campaigns: Running campaigns to promote the benefits of optimised loading and sustainable logistics, both for companies and the environment. **8. Regulatory support** — Regulation: Introduce legislation to support sustainable logistics, such as mandatory reporting of vehicle load levels.
Reference to impact pathways	Impact sector	Transport.
	System lever	Governance and Policy.
	Impact (with reference to module B-1.1)	Regulation of freight transport requirements.
Implementation	Units/persons responsible for implementation	Municipality of Krakow (as monitoring entity)
	Scale of action and entities covered	Operating within the administrative boundaries of the city of Krakow.
	Stakeholders involved	Residents, transport companies, logistics hubs, retail businesses, shopkeepers and wholesalers.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeframe for the task is between 2024 and 2030.
Receipts and costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Transport sector - 10 000 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Currently, costs are very hard to estimate due to the innovative nature of the measure and will be completed in future updates.

B-2.2: Outline of individual activities - TR-16		
Description of operation	Name of the action	Long-term programme to popularise and develop electric mobility infrastructure (new charging stations).
	Type of action	Finance and technology action.
	Description of operation	In order to effectively increase the share of electric cars (both public and private) and expand the network of charging stations so that it is sufficient for the increasing number of electric cars, the Municipality of Krakow plans to implement the following solutions: **1. Expansion of charging infrastructure** (a) Public charging stations: — Location planning: Carry out analysis and location planning for new charging stations, with a focus on high-traffic locations such as shopping centres, municipal car parks, P & R and sites at tourist attractions. — Construction of new stations: Installation of at least 150 new public charging stations in the first five years of the programme. — Cooperation with the private sector: Public-private partnerships (PPPs) to increase the number of charging stations, e.g. in supermarket chains or on business premises. b) Private charging stations: — Urban regulations: Making it mandatory to install charging stations in new residential and commercial buildings and in large parking complexes. — Grants and concessions: Offer grants and tax relief to private property owners who install charging stations. **2. Financial and regulatory incentives** — Tax credits and grants: Grant tax concessions and subsidies to residents buying electric vehicles. Subsidies can come from both municipal and national budgets. — Parking discounts: Introduction of parking discounts and dedicated parking spaces for EVs at key locations in the city. — Preferential loans: Work with local banks and financial institutions to offer preferential credit terms for the purchase of electric vehicles.

		3. Educational and promotional programmes — Information campaigns: Conduct information and education campaigns on the benefits of electric vehicles, both in terms of environmental and and economic. — Test drives: Organising open days and events where residents can test drive electric vehicles. — Education in schools: Introduction of educational programmes on electromobility in schools and universities. **4. Investment in technology and research** — Smart charging systems: Investing in the development of smart charging systems that can optimise energy consumption and reduce the load on the power grid. — Research and development: Supporting local universities and research institutes in the development of new technologies in the field of electromobility, including the development of batteries and efficient energy management systems. **5. Partnerships and cooperation** — Working with businesses: Encourage local businesses to invest in electric vehicles by offering subsidies and tax breaks. — International partnerships: Establish partnerships with other cities and regions to share best practices and technologies in electromobility. **6. Monitoring and evaluation** — Monitoring systems: Implement systems to monitor the use of charging stations and the number of electric vehicles, so that the effectiveness of the programme can be assessed on an ongoing basis. — Regular reports: Publish regular reports on the progress of the programme and propose any adjustments based on the data collected. By implementing the above measures, the city can significantly increase the share of electric vehicles in urban traffic, while improving air quality and contributing to the fight against climate change.
Reference to impact pathways	Impact sector	Transport.
	System lever	Technology / Infrastructure.

		Governance and Policy.
	Impact (with reference to module B-1.1)	Development of a network of electric car chargers. Expansion of the public transport fleet towards zero-emission. Energy storage acquisition and cost-effective distribution programmes. Popularise 'car-pooling' and alternative modes of transport through regulation.
Implementation	Units/persons responsible for implementation	Municipality of Krakow (as monitoring entity).
	Scale of action and entities covered	Operating within the administrative boundaries of the city of Krakow.
	Stakeholders involved	Residents, car companies.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeframe for the task is 2024-2030.
Receipts and costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Transport sector - 56 180 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Estimated costs - PLN 180 000 000 (approx. EUR 40 000 000).

B-2.2: Outline of individual measures - GOZ-1		
Description of operation	Name of the action	Construction of a recycling system for biodegradable waste and in the process composting and fermentation - electricity and biogas production.
	Type of action	Technical and infrastructural action.
	Description of operation	It is a multi-task project, implemented in phases. As part of the investment, it is planned to build: — plastics recycling plant; — municipal waste recovery facility; — bulky waste recovery plant; — a selective municipal waste collection point for the collection of municipal waste brought by the owners of properties located in the Municipality of Krakow;

		— a municipal waste storage facility for treated waste, waste generated and products obtained from the recycling process, together with the installation of a photovoltaic installation on the roofs of the buildings, which is part of a wide-ranging programme to produce electricity from renewable sources and will reduce the operating costs of the installation.
Reference to impact pathways	Impact sector	Waste Management and CE and Electricity.
	System lever	Technology/Infrastructure.
	Impact (with reference to module B-1.1)	Systems for producing energy from waste sources. Infrastructure investment for recycling and waste treatment. Development of RES-based solutions.
Implementation	Units/persons responsible for implementation	Municipal Cleaning Company.
	Scale of action and entities covered	-
	Stakeholders involved	Residents, businesses.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeframe for the task is 2024-2027.
Receipts and costs	Renewable energy generated (if applicable)	The specific value will be given in further design proceedings and completed in future iterations.
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Electricity sector - 839 tCO_2e. Estimated reduction in the Waste Management and CE sector – 15 940 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Estimated costs - PLN 70 000 000 (approx. EUR 15 555 000).

B-2.2: Outline of individual measures - GOZ-2		
Description of operation	Name of the action	MINEV project.
	Type of action	Organisational and innovative action.
	Description of operation	The MINEV project - Waste MINimisation in Large EVents - is being carried out by staff from the UMK Department of Municipal Affairs and

		Climate Change as part of the INTERREG EUROPE Programme. The main objective of the project is to explore the possibilities for cities and implement measures to prevent/minimise waste generation when organising events, making them more sustainable and environmentally friendly. Identification of good practices will take place for different types of events, including closed/open, sports, business, cultural, scientific, religious, etc.
Reference to impact pathways	Impact sector	Waste management and CE.
	System lever	Social innovation. Education and skills.
	Impact (with reference to module B-1.1)	Local initiatives to implement recycling and ecology innitiatives. Informing people about the benefits of recycling and how to recycle.
Implementation	Units/persons responsible for implementation	Municipality of Krakow - Department of Municipal Economy and Climate.
	Scale of action and entities covered	City-wide action.
	Stakeholders involved	Numerous stakeholders linked to the project theme, residents.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeframe for the task is 2023-2027.
Receipts and costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Waste Management and CE sector – 1 872 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Estimated total costs - PLN 754 440 (approx. EUR 167 000).

B-2.2: Outline of individual activities - GOZ-3		
Description of operation	Name of the action	Smart Circuit project.
	Type of action	Innovation and organisational action.

	Description of operation	An international project implemented by a consortium of 12 companies and institutions from nine European countries. The project aims to strengthen and develop the role of digital innovation hubs (DIHs) and the application of new technologies in the implementation of the circular economy (CEE). At a supra-regional level, we are involved in the creation of a CE Academy - a platform for sharing knowledge, good practices and establishing business relationships for companies planning to implement CE principles, as well as for circular technology providers and others. The project will include support for activities related to the transformation of the manufacturing industry towards smarter growth and implementation of green technologies in the areas of textiles, construction and ICT/electronics, cross sectoral. The project plans a pilot implementation in each region. The strategic partner of the Kraków Technology Park is the Małopolskie Voivodeship and the technology partner is Ergo Design.
Reference to impact pathways	Impact sector	Waste management and CE.
	System lever	Education and Skills.
	Impact (with reference to module B-1.1)	Informing people about the benefits of recycling and how to recycle.
Implementation	Units/persons responsible for implementation	Kraków Technology Park.
	Scale of action and entities covered	Manufacturing companies from the Małopolska region.
	Stakeholders involved	Manufacturing companies from the Małopolska region.
	Comments on implementation - resources needed, timetable and milestones	Planned completion date: 2023-2026. Project activities: — creation of a publication containing 122 examples of successful implementation of circular economy mechanisms (including 10 from the Małopolska area); — launching a training platform, the Circular Innovation Academy (CE Academy), as a source of knowledge on the principles of the circular economy, with a focus on sectors such as construction, electronics and textiles;

		— implementation of a series of interviews and strategic meetings with representatives of local, regional and national administration, on instruments and support mechanisms that successfully use modern technologies when implementing the principles of the circular economy - pilot implementation of CE in an industrial plant. KPT's strategic partner is the Malopolska Voivodeship and the technology partner is Ergo Design. The project builds Kraków's position as one of the of the most important centres for pro-climate activities, characterised by a strong business, innovation and academic base.
Receipts and costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Waste Management and CE sector - 252 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Total financial costs - EUR 240 000 (approx. PLN 1 050 000).

B-2.2: Outline of individual activities - GOZ-4		
Description of operation	Name of the action	Development of Krakow's Circular Economy.
	Type of action	Management-innovation activity.
	Description of operation	The measure plans to develop a closed-loop economy within the city of Krakow. It assumes the automation of sorting processes at both sorting plants in operation, as well as the modernisation of the composting plant and adaptation of the Dismantling Plant to the growing stream of bulky waste. In addition, Circular Economy Action Plan for the City of Krakow until 2030 is being prepared. Implementation will take place in the following stages:

		— Stage I - analysis of the state of CE in the City of Krakow - SWOT analysis for the areas developed in the diagnosis; — Phase II - development and adoption of a CE Action Plan for the City of Krakow. The study is part of a project co-financed by the National Centre for Research and Development under the 1st call for open projects within the Strategic Programme for Scientific Research and Development Works "Social and Economic Development of Poland under the Conditions of Globalizing markets' GOSPOSTRATEG 2.
Reference to impact pathways	Impact sector	Waste Management and CE.
	System lever	Technology/Infrastructure. Education and skills.
	Impact (with reference to module B-1.1)	Continuation of the "Circular Strategy for Krakow" programme. Continuation of the city-wide system the use of materials reusable. Infrastructure investment for recycling and waste treatment. Informing people about the benefits of recycling and how to recycle.
Implementation	Units/persons responsible for implementation	Municipality of Krakow (as monitoring entity)
	Scale of action and entities covered	City-wide action.
	Stakeholders involved	Municipal companies, businesses, developers, residents, construction companies, material manufacturers.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeframe for the task is between 2024 and 2030.
Receipts & costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Waste Management and CE sector – 6 742 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Estimated cost of action - PLN 30 000 000 (approx. EUR 6 666 000).

B-2.2: Outline of individual activities - I-1		
Description of operation	Name of the action	Creation of new green spaces.
	Type of action	Organisational and technical action.
	Description of operation	The action concerns the establishment of new public green areas, including city parks, river parks, city meadows, forest parks, ecological parks, fortress green areas. The action includes the implementation of the assumptions set out in the "Directions of development and management of green areas in Krakow for 2019-2030", adopted by Order No. 2282/2019 of the Mayor of the City of Krakow of 09.09.2019. A number of further public green areas are planned to be implemented as part of the following projects, among others: XXL Park (Witkowicki Forest with the Prądnik Valley), park on the Ulga Canal, continuation of the Podgórze Green Ring project, creation of further river parks as part of the continuation of the Wisła Łączy project, White Sea Park. The measure also includes appropriate management of green areas so that they can absorb even more carbon dioxide, e.g. by giving up abandoning part of the lawns in favour of flower meadows, introducing biocenotic zones in the parks, maintaining part of the green areas in a semi-natural form, maintaining a high coefficient of biologically active surface.
Reference to impact pathways	Impact sector	Other.
	System lever	Technology/Infrastructure. Governance and Policy. Democracy and Social Participation.
	Impact (with reference to module B-1.1)	Development of green infrastructure and creation of urban parks. Increase in forest cover and urban greenery within the city. Consult residents for their views and ideas on green space development.
Implementation	Units/persons responsible for implementation	Krakow Municipal Greenery Board.
	Scale of action and entities covered	City-wide action in different parts of Krakow.
	Stakeholders involved	Residents.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timing of the task depends on the specific project.

Receipts and costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Other sector - 180 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	180 tCO_2e.
	Total and unit (per unit CO_2 e) costs	Estimated costs - PLN 410 000 000 (approx. EUR 91 111 000).

B-2.2: Outline of individual activities - I-2		
Description of operation	Name of the action	Increasing the area of urban forests.
	Type of action	Organisational and technical action.
	Description of operation	Implementation of the District Programme for Increasing the Forest Cover of the City of Kraków 2018-2040, so that forests ultimately constitute a minimum of 8% of the municipality's area, including the purchase of property for new forests and afforestation of land. The measure also includes forest planting campaigns together with residents.
Reference to impact pathways	Impact sector	Other.
	System lever	Technology/Infrastructure. Governance and Policy. Democracy and Social Participation.
	Impact (with reference to module B-1.1)	Development of green infrastructure and creation of urban parks. Increase in forest cover and urban green space within the city. Consult residents for their views and ideas on green space development.
Implementation	Units/persons responsible for implementation	Krakow Municipal Greenery Board.
	Scale of action and entities covered	City-wide action in different parts of Krakow.
	Stakeholders involved	Residents.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timing of the task depends on the specific project.
Receipts & costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-

	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Other sector - 15 259 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	15 259 tCO_2e.
	Total and unit (per unit CO_2 e) costs	Estimated costs of action - PLN 37 000 000 (approx. EUR 8 222 000).

B-2.2: Outline of individual activities - I-3		
Description of operation	Name of the action	Maintain a high ratio of biologically active area in the city.
	Type of action	Organisational and technical action.
	Description of operation	Activity consisting in appropriate creation of spatial management by, inter alia, introducing appropriate provisions in local spatial development plans and in the planned General Plan of the City of Krakow, acquiring land for the benefit of the Municipality of Krakow in order to create green areas, covering areas of high natural value, including wetlands, with forms of nature protection. On a smaller scale, the action consists of. Unsealing impermeable surfaces in road lanes, squares, car parks by replacing hardened surfaces with biologically active areas, e.g. creating new green belts, lawns in squares and along existing roads, and in the absence of space - individual "windows" for trees.
Reference to impact pathways	Impact sector	Other.
	System lever	Technology/Infrastructure. Governance and Policy.
	Impact (with reference to module B-1.1)	Development of green infrastructure and creation of urban parks. Increase in forest cover and urban green space within the city.
Implementation	Units/persons responsible for implementation	Municipality of Krakow - Department of Spatial Planning, Department of City Treasury, Department of Environmental Management, Krakow City Roads Board, Krakow Municipal Greenery Board
	Scale of action and entities covered	City-wide action in different parts of Krakow.
	Stakeholders involved	Residents.
	Comments on implementation - resources	This action addresses the emissions gap. The planned timing of the task depends on the specific project.

	needed, timetable and milestones	
Receipts and costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Other sector - 142 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	142 tCO_2e.
	Total and unit (per unit CO_2 e) costs	Estimated costs - PLN 325 000 000 (approx. EUR 72 222 000).

B-2.2: Outline of individual activities - I-4		
Description of operation	Name of the action	Introduce smaller forms of green infrastructure in heavily build-up parts of the city.
	Type of action	Organisational and technical action.
	Description of operation	The measure includes the introduction of green roofs and green walls (climbing plants and vertical gardens), creating pocket parks and community gardens, transforming lawns into flower meadows, planting trees in city squares and road lanes, establishing "Urban Groves", i.e. introducing dense canopies of native species in small areas where there is not enough space to plant a regular forest. The measure may also include the introduction of an incentive scheme aimed at individuals and external bodies to establish green roofs and walls.
Reference to impact pathways	Impact sector	Other.
	System lever	Technology/Infrastructure. Governance and Policy. Democracy and Social Participation.
	Impact (with reference to module B-1.1)	Development of green infrastructure and creation of urban parks. Increase in forest cover and urban greenery within the city. Consult residents for their views and ideas on green space development.
Implementation	Units/persons responsible for implementation	Krakow Municipal Greenery Board, Krakow City Roads Board, Climate-Energy-Water Management and other cells the municipal organisational units and municipal companies running the investments or managing buildings.

	Scale of action and entities covered	City-wide action in different parts of Krakow.
	Stakeholders involved	Residents.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timing of the task depends on the specific project.
Receipts and costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Other sector - 12 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	12 tCO_2e.
	Total and unit (per unit CO_2 e) costs	Estimated costs of action - PLN 28 000 000 (approx. EUR 6 222 000).

B-2.2: Outline of individual activities - I-5		
Description of operation	Name of the action	Planting of trees, shrubs and protection of existing trees.
	Type of action	Organisational and technical action.
	Description of operation	The action includes the planting of trees and shrubs on land belonging to the Municipality of Krakow, but also indicating appropriately high natural compensation in the form of tree planting, in decisions authorising the removal of greenery issued to external entities and the implementation of Ordinance No. 591/2024 of the Mayor of the City of Krakow of 26 February 2024 on the introduction of detailed principles for the protection of trees in investments in the Municipality of Krakow and to introduce rules for calculating the minimum number of replacement plantings in exchange for trees removed due to collision with investments carried out by property managers on behalf of the Municipality of Krakow.
Reference to impact pathways	Impact sector	Other.
	System lever	Technology/Infrastructure. Governance and Policy. Democracy and Social Participation.
	Impact (with reference to module B-1.1)	Development of green infrastructure and creation of urban parks.

		Increase in forest cover and urban greenery within the city. Consult residents for their views and ideas on green space development.
Implementation	Units/persons responsible for implementation	Department of Environmental Management, the Municipal Conservator of Monuments and entities managing real estate on behalf of the Municipality of Krakow, including the municipal organisational units, municipal organisational units and municipal companies.
	Scale of action and entities covered	City-wide action in different parts of Krakow.
	Stakeholders involved	Residents.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timing of the task depends on the specific project.
Receipts and costs	Renewable energy generated (if applicable)	
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Other sector - 28 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	28 tCO_2e.
	Total and unit (per unit CO_2 e) costs	Estimated costs of action - PLN 64 000 000 (approx. EUR 14 222 000).

B-2.2: Outline of individual activities - I-6		
Description of operation	Name of the action	The CoFarm4Cities project.
	Type of action	Innovative and social action.
	Description of operation	An international project in a partnership of 9 actors working together to find an environmentally friendly solution to urban sprawl. The premise is to identify and sustainable use of peri-urban agricultural, mixed or abandoned areas and the development of a stakeholder engagement model (UFSLU) to transform them into urban farms. The overall objectives of the project include: — development and promotion of urban agriculture;

		— protecting biodiversity; — an increase in the use of undeveloped land in urban areas; — development of nature-based solutions. The long-term objectives of the project are: — sustainable urban development; — climate change adaptation.
Reference to impact pathways	Impact sector	Other.
	System lever	Democracy and social participation. Education and Skills. Social innovation.
	Impact (with reference to module B-1.1)	Consult residents for their views and ideas on green space development. Introduce educational activities on environmental responsibility and the role of urban greenery. Local initiatives to implement recycling and ecology innitiatives.
Implementation	Units/persons responsible for implementation	Krakow Municipal Greenery Board.
	Scale of action and entities covered	Action based on the development of ready-to-implement solutions.
	Stakeholders involved	Project partner cities. City residents, non-governmental institutions, schools and kindergartens, universities, other cities wishing to multiply this type of solution.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeframe for the task runs from 2023 to 2026.
Receipts and costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	The estimated reduction in the Other sector will be completed once the results of the project are known.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Estimated total costs - PLN 1 300 935 (approx. EUR 289 000).

B-2.2: Outline of individual activities - I-7

Description of operation	Name of the action	Life Pact Project - The human factor: Adapting the City for Tomorrow.
	Type of action	Socio-infrastructural action.
	Description of operation	LIFE PACT is an initiative that aims to develop and test an integrated approach to climate change adaptation in cities by implementing nature-based solutions. The project is carried out by partners from Belgium, Spain and Poland, and the main pilot city and coordinating entity is Leuven in Belgium. In terms of infrastructure measures, the project focuses on the creation of two rain gardens and three green public spaces that will reduce the urban heat island effect.
Reference to impact pathways	Impact sector	Other.
	System lever	Technology/Infrastructure. Education and Skills Democracy and social participation.
	Impact (with reference to module B-1.1)	Development of green infrastructure and creation of urban parks. Consult residents for their views and ideas on green space development. Introduce educational activities on environmental responsibility and the role of urban greenery.
Implementation	Units/persons responsible for implementation	Climate - Energy - Water Management.
	Scale of action and entities covered	Local activities within the city of Krakow.
	Stakeholders involved	Project partner cities Madrid, Leuven. Residents.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeframe for the task is 2022-2025.
Receipts & costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	The estimated reduction in the Other sector will be completed in a future project update.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	-
	Total and unit (per unit CO_2 e) costs	Estimated total costs - approx. PLN 3 709 123 (approx. EUR 824 000).

B-2.2: Outline of individual activities - I-8		
Description of operation	Name of the action	Greene 4.0 project.
	Type of action	Innovation and organisational action.
	Description of operation	An international project implemented by a consortium of 9 companies and institutions from 7 European countries. The core objective of the project is to support small and medium-sized manufacturing companies in implementing green and digital innovations and creating new supply chains. The application of green production practices will minimise the negative environmental impact of manufacturing companies and save energy and natural resources.
Reference to impact pathways	Impact sector	Other (mainly industry).
	System lever	Governance and Policy.
	Impact (with reference to module B-1.1)	Replacing heavy, carbon-intensive industry with activities based on new technologies.
Implementation	Units/persons responsible for implementation	Kraków Technology Park.
	Scale of action and entities covered	Manufacturing companies from the Małopolska region.
	Stakeholders involved	Manufacturing companies from the Małopolska region.
	Comments on implementation - resources needed, timetable and milestones	Planned completion date: 2023-2026. Project objectives include: — conducting a survey among manufacturing companies in the Małopolska area (questions about the production methods used, the use of green and digital technologies, the legal, financial, organisational barriers encountered, attitudes towards green and digital transformation); — the production of a report summarising the results of the survey; — holding workshops for company representatives interested in the topic of green business transformation; — improving users' perceptions, attitudes and acceptance of digital transformation; — Increasing access to cross-border markets and creating instruments for cooperation between innovative actors, including companies and start-ups; — the creation of a set of tools to support manufacturing companies in the green

		transformation process (including a knowledge exchange platform); — the launch of a platform bringing together manufacturing companies with start-ups and companies offering innovative green and digital solutions; — supporting digital transformation through smart and green innovation; — accelerating and supporting start-ups — creating and disseminating knowledge on digital transformation through smart and green innovation; — improving users' perceptions, attitudes and acceptance of digital transformation; — increasing access to cross-border markets (new markets) and creating instruments for cooperation between innovative actors, including companies and start-ups; — creating connections, synergies and complementarities between regional innovation ecosystem services; — building innovation capacity for start-ups and companies and supporting the product development, testing and market validation process for smart and green products/services; — integrate green pilots/products as a resource to support the implementation of the smart specialisation strategy; — creating and disseminating knowledge on digital transformation through smart and green innovation.
Receipts and costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	-
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	The estimated reduction in the Other sector will be completed once the results of the project are known.
	Total and unit (per unit CO_2 e) costs	Total funding - approx. EUR 270 000 (approx. PLN 1 210 000).

B-2.2: Outline of individual activities - I-9

Description of operation	Name of the action	Usage of CCS, CCU technology and carbon capture
	Type of action	Technical action.
	Description of operation	As part of the measure, a CCS plant is planned to capture carbon dioxide from the atmosphere. Due to the lack of widespread uptake of CCS technology, Krakow Municipal Holding has entered into a strategic partnership with the Norwegian companies Vinco Innovation and CO_2 Management to gain knowledge on how to implement this technology. As part of the cooperation, a partnership project was created project entitled "Acquisition of knowledge and know-how from Norway concerning CCS and CCU technologies for the needs of the Thermal Waste Conversion Plant in Kraków". These companies specialise in implementing innovative technologies and already have experience with the CCS and SCU method. As part of the project two reports were prepared for Krakow Municipal Holding. Vinco prepared a business report describing the economic, organisational, legal and environmental issues for CSS solutions for an eco-combustion plant. The report also describes potential challenges and difficulties that may occur in the implementation of the new technology. The second report, produced by CO_2 Management, in turn describes a technical analysis of the CCSU technology, taking into account carbon capture capabilities, transboundary transport and geological sequestration. Possible storage sites were also analysed. The report notes that in the Krakow area there are prospects for storing CO_2 locally, but in terms of the short to medium term goal of implementing the technology, transport and storage of CO_2 in the North Sea is more likely. The report highlights that the comprehensive operation of such technology could start as early as 2030.
Reference to impact pathways	Impact sector	Other.
	System lever	Technology/Infrastructure. Governance and Policy.
	Impact (with reference to module B-1.1)	Displacement of carbon-intensive emission and pollution sources. Replacing heavy, carbon-intensive industry with activities based on new technologies.
Implementation	Units/persons responsible for implementation	Municipality of Krakow (as monitoring entity)

	Scale of action and entities covered	City-wide action.
	Stakeholders involved	Municipal companies, enterprises, technical universities, scientific institutes, ngo.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeframe for the task is between 2024 and 2030.
Receipts and costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Other sector - 180 000 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	180 000 tCO_2e.
	Total and unit (per unit CO_2 e) costs	The estimated cost is currently very difficult to determine due to the lack of widespread dissemination of CCS technology. The cost will be completed in future iterations as the measure develops.

B-2.2: Outline of individual activities - I-10		
Description of operation	Name of the action	Reclamation of post-industrial areas in Nowa Huta district.
	Type of action	Organisational and technical action.
	Description of operation	This action consists in the reclamation of the post-industrial areas of Nowa Huta and opening up this space for residents. It is planned that the Municipality of Krakow will acquire 300 hectares of industrial land, which will then be recultivated with complementary activities leading to an improvement in the quality of life of the area's residents, including the fight against social exclusion and regaining the ability of vulnerable groups to reintegrate into the labour market. **1. Supporting industry based on new technologies** Investment in new technologies includes the creation of technology parks and business incubators to support the development of new technology companies such as IT, biotechnology, nanotechnology and green energy. Collaboration with universities

		and research institutes to establish research and development (R&D) centres will allow work on new green technologies. Incentives for new businesses include offering subsidies and tax breaks from new technology industries that choose to operate in Nowa Huta. In addition, the establishment of special economic zones with preferential conditions for companies investing in low-carbon technologies. **2. Consult with residents to obtain their views and ideas on the development of the brownfield space** Public consultation will involve holding regular workshops and meetings with residents to give their views and ideas on greenfield development. Surveys and questionnaires will also be carried out among residents to gather their suggestions on brownfield redevelopment. Cooperation with the local community will be implemented through the creation of working groups involving local residents, representatives of local organisations and experts, who will collaborate on the planning and implementation of rehabilitation projects. In addition, education and information programmes will be conducted on the benefits of reclaiming brownfield sites and developing green spaces. **3. Development of green spaces** Creation of recreational areas will include the establishment of new parks, gardens and squares on brownfield sites that will be accessible to residents. The construction of cycle routes and walking paths will connect the new green spaces to the rest of the city. Green infrastructure will be promoted through the installation of green roofs and walls on buildings, both new and existing. In addition, the creation of protected areas and nature reserves on brownfield sites will aim to protect local flora and fauna.
Reference to impact pathways	Impact sector	Other.
	System lever	Technology/Infrastructure. Governance and Policy. Democracy and Social Participation.

	Impact (with reference to module B-1.1)	Displacement of carbon-intensive emission and pollution sources. Replacing heavy, carbon-intensive industry with activities based on new technologies. Consult residents for their views and ideas on green space development.
Implementation	Units/persons responsible for implementation	Municipality of Krakow (as monitoring entity).
	Scale of action and entities covered	City-wide action.
	Stakeholders involved	Municipal companies, enterprises, technical universities, scientific institutes, ngo.
	Comments on implementation - resources needed, timetable and milestones	This action addresses the emissions gap. The planned timeframe for the task is 2024-2030.
Receipts and costs	Renewable energy generated (if applicable)	-
	Energy removed/replaced, amount or type of fuel	-
	Estimated greenhouse gas emission reductions for each emission source sector	Estimated reduction in the Other sector - 10 000 tCO_2e.
	Compensated greenhouse gas emissions (carbon dioxide absorbed)	
	Total and unit (per unit CO_2 e) costs	The estimated cost of the measure is currently difficult to determine due to the dynamic changes that are taking place among industrial enterprises in the New Steelworks area and will be completed in future updates.

B-2.3: Summary of residual emissions strategy

Residual emissions strategy

Residual emissions refer to the remaining GHG emissions that cannot be reduced through existing plans, strategies and policies. These emissions come from various sources such as buildings, heating, electricity, industry, transport, waste management and other areas of urban life. The residual emissions strategy addresses a 20% reduction in the city's overall emissions.

In order to develop an effective residual emissions strategy, it is crucial to first identify where these emissions are coming from and assess the feasibility of implementing emission reduction measures. Once options for further emission reductions have been ruled out for technical, economic or practical reasons, the focus is on offsetting residual emissions.

The strategy prioritises options that permanently capture and absorb carbon captured from the atmosphere, providing long-term emission reduction benefits. This includes measures such as increasing natural sinks such as forests and wetlands, implementing permanent sequestration methods such as carbon capture and storage (CCS) technologies, and using offsets by investing in projects that remove or reduce emissions elsewhere.

The main objective of the City of Kraków is to focus on increasing the forested area within its borders as part of a residual emissions strategy. "The district programme for increasing the forest cover of the City of Kraków 2018-2040" aims to significantly increase the city's forested area from 4% in 2018 to 8% by 2040. This emphasis on developing the city's forests dovetails with the goal of increasing natural carbon sinks and contributes to the overall reduction of residual emissions.

The vision for afforestation in the City of Krakow is based on a detailed field analysis and land classification. Much of the land already has existing tree and shrub cover, which will be assessed for its suitability for further afforestation. The land has been divided into different categories, depending on the existing vegetation cover and natural value. The plan envisages both afforestation of land without prerequisites and artificial restoration with an appropriate selection of tree species. Particular attention is paid to the preservation of valuable plant communities and to the exclusion of afforestation on areas of high nature value.

By prioritising the development of urban forests, the city aims to harness the carbon sequestration potential of trees and vegetation. Urban forestry initiatives will involve planting more trees in parks, green spaces and along streets, as well as preserving existing woodlands within the city limits. Implementing the plan to increase greenery will not only help offset residual emissions, but will also bring additional benefits such as improved air quality, increased biodiversity and improved urban aesthetics.

In addition, the Environmental Management Department of the Municipality of Krakow has prepared a document entitled "Directions of development and management of green areas in Krakow for 2017-2030." Annex II "Nature protection" proposes the creation of new 32 ecological uses. The possibility of creating new nature and landscape complexes (e.g. Zakrzówek and Góra Księża or Bodzów and Góra Św. Anny) was also given. As part of the work on the document, a comprehensive valorisation of existing and potential green areas was also developed to meet the needs of increasing the proportion of urban greenery.

In addition, any initiative to create new green spaces or increase the city's forest cover underlines Krakow's commitment to sustainable urban development and increasing resilience to climate change. Proactive measures to develop green spaces demonstrate the city's recognition of the important role that natural ecosystems play in mitigating climate change and creating a healthier environment for its residents.

In addition to nature-based measures, Krakow is also committed to implementing technical solutions to reduce greenhouse gas emissions from municipal installations, including municipal waste incineration plants in particular. In 2024, Krakow Municipal Holding plans to participate in the third call of the Interreg Central Europe Project. One of the three planned projects is aimed at implementing technical solutions to reduce greenhouse gas emissions from municipal installations, including municipal waste incinerators in particular. Particular emphasis will be placed on projects in the field of carbon capture, utilisation and storage - CCU and CCS.

In summary, the residual emissions strategy aims to achieve further reductions in the city's emissions, while taking into account the importance of long-term carbon storage and the need for sustainable solutions to tackle climate change.

3.2 Module B-3 Monitoring, evaluation and learning indicators

Table B-3.1: Set of indicators and metrics for monitoring and evaluating progress in selected impact pathways.

Addressed effects and impacts	Activities and projects	**Indicator or meter number**	Indicator name	Target values		
				2026	2028	2030
Reduction of CO_2 emissions in relation to base year	all	W54_U	Greenhouse gas emissions in GMK - city operations [Mg CO_2 -eq/year]	5 259 thousand Mg, (35% reduction BAU2030	4 118 thousand Mg, (50% reduction BAU2030)	1 521 thousand Mg, (80% reduction BAU2030)
Decrease in energy demand in buildings	BIC-1 BIC-2 BIC-3 BIC-4 BIC-8 BIC-9 BIC-11	M19_151	Total surface area of insulation carried out in public buildings	Increasing trend	Increasing trend	Increasing trend
Reducing energy consumption within the city limits	BIC-1 BIC-2 BIC-3 BIC-4 BIC-8 BIC-9 BIC-10 BIC-11 E-9 E-12 E-13	W25_O	Reduction in non-renewable primary energy demand of single-family buildings MWh	Increasing trend	Increasing trend	Increasing trend
Reducing emissions in electricity generation	BIC-5 BIC-6 BIC-7 BIC-8 BIC-10 E-1 E-2 E-3 E-4 E-5 E-6 E-7 E-8 E-9 E-10 E-11 E-12 E-13 E-14 E-15 E-16 E-17 TR-1 GOZ-1	W20_U	Share of electricity produced from renewable energy sources in total electricity consumption %	Increasing trend	Increasing trend	Increasing trend

Decrease in emissions from the transport sector	TR-2 TR-3 TR-5 TR-6 TR-7 TR-8 TR-9 TR-10 TR-14	W2_T	Share of public transport in the distribution of transport tasks		Increasing trend	Increasing trend	Increasing trend
Decrease in emissions from the passenger transport sector	TR-12 TR-13 TR-15 TR-16	W16_T	Implementation rate of the number of parking spaces in the P+R system		Increasing trend	Increasing trend	Increasing trend
Development of transport infrastructure	TR-1 TR-8 TR-16	W43_O	Number of electric vehicle charging stations installed under the grant from Municipality of Krakow		Increasing trend	Increasing trend	Increasing trend
Development of cycling infrastructure	TR-4 TR-11 TR-12 TR-14	W45_T	Increase in the length of cycling routes		Increasing trend	Increasing trend	Increasing trend
Development of rail infrastructure	TR-5 TR-7 TR-10	W4_T	Share of tracks requiring modernisation [%]		Downward trend	Downward trend	Downward trend
Development of rail infrastructure	TR-6	W44_T	Share of tram fleet over 15 years old [%]		Downward trend	Downward trend	Downward trend
Decrease in energy demand in buildings	BIC-1 BIC-2 BIC-3 BIC-4 BIC-8 BIC-9 BIC-11	W24_O	Number of single-family buildings thermo-modernised with grants from Municipality of Krakow		Increasing trend	Increasing trend	Increasing trend
Increase in green spaces and CO_2 absorption	I-1 I-2 I-3 I-4 I-5 I-6 I-7 I-8 I-10	W27_O	Number of "pocket" parks		Increasing trend	Increasing trend	Increasing trend
Increase in forest area and CO_2 absorption	I-1 I-2 I-3 I-5 I-10	W26_O	Share of forest in total city area		4%	5%	6%
Satisfaction with being able to influence the city government	effect of all activities	W23_D	Satisfaction with ability to influence city government [%]		Increasing trend	Increasing trend	Increasing trend

B-3.2: Metadata of indicators - W54_U	
Indicator name	Greenhouse gas emissions in GMK - city operations
Indicator unit	Mg CO_2 -eq/year.

Definition	Indicator defining the annual greenhouse gas emissions in the Municipality of Krakow related to the activities of the city ("City-induced framework"), determined in accordance with the Global Protocol for Community-Scale Greenhouse Gas Inventories (GPC) methodology, unit - Mg CO_2 -eq/year.
Method of calculation	W54_U = (M62_U) + (M63_U) + (M64_U) + (M66_U) + (M67_U) + (M68_U) + (M69_U) + (M70_U) Where: M62_U - GMK GHG emissions from the Stationary Energy (energy consumption) sector - Scope 1 (Mg CO_2 -eq/year), M63_U - GHG emissions in GMK from the Stationary Energy sector (energy consumption) - range 2 (Mg CO_2 -eq/year), M64_U - GHG emissions in GMK from the Stationary Energy sector (energy consumption) - range 3 (Mg CO_2 -eq/year), M66_U - GHG emissions in GMK from the Transport sector - Scope 1 (Mg CO_2 -eq/year), M67_U - GMK GHG emissions from the Transport sector - Scope 2 (Mg CO_2 -eq/year), M68_U - GHG emissions in GMK from the Transport sector - Scope 3 (Mg CO_2 -eq/year), M69_U - GHG emissions in GMK from the Waste sector (generated on GMK premises) - Scope 1 (Mg CO_2 -eq/year), M70_U - GHG emissions in GMK from the Waste sector (generated on GMK premises) - range 3 (Mg CO_2 -eq/year).
Context of the indicator	
Does the indicator measure direct impacts (reduction of greenhouse gas emissions)?	Yes
If so, which emission source sectors does it measure?	Buildings and heating, electricity, transport, waste management and CE, other.
Does the indicator measure indirect impacts (e.g. co-benefits)?	Not
If so, what co-benefits does this indicator measure?	-
Is the indicator useful for monitoring the results/impact of activities?	Yes
If so, for which activities and impact pathways is it useful?	All
Is the indicator taken into account by existing methodologies - CDP/SCIS/Covenant of Mayors?	Yes
Data required	
Data source	A value derived from the annual *Greenhouse Gas Emission Inventory of the Municipality of Krakow*. The inventory is prepared by the Department of Municipal Economy and Climateon the basis of the methodology described in the *Global Protocol for Community-Scale Greenhouse Gas Inventories* (GPC) guidebook.
Is the data source local or national?	Local
Expected availability	Easy - a document produced annually by the Municipality.

Suggested data collection interval	Year
References	
Documents describing the indicator	*Global Protocol for Community-Scale Greenhouse Gas Inventories* (GPC) Guide
Other systems using this indicator	-

B-3.2: Metadata of indicators - M19_151	
Indicator name	Total surface area of insulation carried out in public buildings
Indicator unit	m^2
Definition	This is a domain-specific measure of the total area of all external walls and other elements of the building structure of public buildings that have been thermally insulated over a specified period. This measure is expressed in square metres (m^2) and is used to assess the extent of thermal upgrading works to improve the energy efficiency of public buildings.
Method of calculation	The yardstick is determined by the reporting in the Stradom system of thermal modernisation measures by municipal units.
Context of the indicator	
Does the indicator measure direct impacts (reduction of greenhouse gas emissions)?	Not
If so, which emission source sectors does it measure?	-
Does the indicator measure indirect impacts (e.g. co-benefits)?	Not
If so, what co-benefits does this indicator measure?	-
Is the indicator useful for monitoring the results/impact of activities?	Yes
If so, for which activities and impact pathways is it useful?	Technology/Infrastructure, Governance and Policy, Education and Skills
Is the indicator taken into account by existing methodologies - CDP/SCIS/Covenant of Mayors?	-
Data required	
Data source	Urban data collected from individual units.
Is the data source local or national?	Local
Expected availability	Easy
Suggested data collection interval	2 years
References	
Documents describing the indicator	-
Other systems using this indicator	-

B-3.2: Metadata of indicators - W25_O	
Indicator name	Reduction in non-renewable primary energy demand of single-family buildings

Indicator unit	MWh
Definition	By reduction of the heating demand without taking into account the efficiency of the heating system in single-family buildings which underwent thermo-modernisation works within the framework of subsidies from Municipality of Krakow, we mean the difference of reduction of the heating demand without taking into account the efficiency of the heating system before and after thermo-modernisation on the basis of data included in energy assessment, energy audit expressed in MWh.
Method of calculation	W25_O = M22_O - M23_O Where: M22_O - Value of heating demand without taking into account the efficiency of the heating system before thermomodernisation in single-family buildings in which thermomodernisation works will be carried out under a grant from Municipality of Krakow. M23_O - Value of heating demand without taking into account heating system efficiency after thermomodernisation in single-family buildings where thermomodernisation was carried out under a grant from Municipality of Krakow.
Context of the indicator	
Does the indicator measure direct impacts (reduction of greenhouse gas emissions)?	Not
If so, which emission source sectors does it measure?	Buildings and heating, electricity
Does the indicator measure indirect impacts (e.g. co-benefits)?	Yes
If so, what co-benefits does this indicator measure?	Reduction in energy expenditure by residents.
Is the indicator useful for monitoring the results/impact of activities?	Yes
If so, for which activities and impact pathways is it useful?	Technology/Infrastructure
Is the indicator taken into account by existing methodologies - CDP/SCIS/Covenant of Mayors?	Not
Data required	
Data source	Database of the Division for Air Quality Department.
Is the data source local or national?	Local
Expected availability	Easy
Suggested data collection interval	Year
References	
Documents describing the indicator	-
Other systems using this indicator	-

B-3.2: Metadata of indicators - W20_U	
Indicator name	Share of electricity produced from renewable energy sources in total electricity consumption
Indicator unit	%

Definition	Indicator indicating the % share of energy produced from renewable energy sources in the total amount of energy consumed in a given year in Kraków. Allows monitoring of the share of renewable energy sources in overall energy consumption in Kraków.
Method of calculation	W20_U = (M33_U)/(M34_U) Where: M33_U - amount of energy produced in a given year using renewable energy sources in Krakow M34_U - total amount of energy consumed in Krakow by all consumers excluding Mittal Steel Poland SA
Context of the indicator	
Does the indicator measure direct impacts (reduction of greenhouse gas emissions)?	Not
If so, which emission source sectors does it measure?	Buildings and heating, electricity
Does the indicator measure indirect impacts (e.g. co-benefits)?	Not
If so, what co-benefits does this indicator measure?	-
Is the indicator useful for monitoring the results/impact of activities?	Yes
If so, for which activities and impact pathways is it useful?	all
Is the indicator taken into account by existing methodologies - CDP/SCIS/Covenant of Mayors?	Yes
Data required	
Data source	Report on the study of the compatibility of the development plans of energy companies operating in the municipality.
Is the data source local or national?	Local
Expected availability	Average
Suggested data collection interval	Year
References	
Documents describing the indicator	-
Other systems using this indicator	Cities: Wrocław, Łódź, Warsaw, Poznań, Tricity

B-3.2: Metadata of indicators - W2_T	
Indicator name	Share of public transport in the distribution of transport tasks.
Indicator unit	%
Definition	The indicator shows changes in the distribution of transport tasks. The share of public transport in the overall modal split should be about 60% of all trips. This figure should be systematically surveyed (short- and long-term studies) so that the city can react to changes, especially unfavourable ones. The city should strive to develop the transport system in accordance with the principles of sustainable development and thus make every effort to increase the share of public transport in the overall division of transport tasks.

	This will result in a reduction of congestion in the city, traffic pollution as well as noise.
Method of calculation	W2_T = (M2_T)/((M2_T)+ (M3_T)+(M4_T)+(M5_T)) Where: M2_T - number of persons using public transport M3_T - number of persons using a private car M4_T - number of people using bicycles M5_T - number of people using walking trips
Context of the indicator	
Does the indicator measure direct impacts (reduction of greenhouse gas emissions)?	Not
If so, which emission source sectors does it measure?	Transport
Does the indicator measure indirect impacts (e.g. co-benefits)?	Not
If so, which co-benefits does this indicator measure?	-
Is the indicator useful for monitoring the results/impact of activities?	Yes
If so, for which activities and impact pathways is it useful?	Technology/Infrastructure, Governance and Policy, Social Innovation
Is the indicator taken into account by existing methodologies - CDP/SCIS/Covenant of Mayors?	Yes
Data required	
Data source	ZIKiT/GK/KHK - on the basis of the results of studies conducted by KHK periodically (every 3-10 years)
Is the data source local or national?	Local
Expected availability	Easy
Suggested data collection interval	3 years
References	
Documents describing the indicator	-
Other systems using this indicator	Cities: Wrocław, Łódź, Warsaw, Poznań.

B-3.2: Metadata of indicators - W16_T	
Indicator name	Implementation rate of the number of parking spaces in the P+R system
Indicator unit	%
Definition	The indicator shows changes in the number of available parking spaces operating in the P&R system. This number should be systematically increased through investment measures, in order to reduce the number of journeys made by car. The direct effect will be a reduction in congestion in the city and thus a reduction in air and noise pollution from mainly individual transport.
Method of calculation	W16_T = (M25_T)/(M26_T) Where:

	M25_T - number of P&R parking spaces M26_T - number of parking spaces planned for the P&R system
Context of the indicator	
Does the indicator measure direct impacts (reduction of greenhouse gas emissions)?	Not
If so, which emission source sectors does it measure?	Transport
Does the indicator measure indirect impacts (e.g. co-benefits)?	Not
If so, which co-benefits does this indicator measure?	-
Is the indicator useful for monitoring the results/impact of activities?	Yes
If so, for which activities and impact pathways is it useful?	Technology/Infrastructure, Governance and Policy, Social Innovation
Is the indicator taken into account by existing methodologies - CDP/SCIS/Covenant of Mayors?	-
Data required	
Data source	ZDMK/ZTP - on the basis of the number of parking spaces available in newly opened P&R car parks
Is the data source local or national?	Local
Expected availability	Easy
Suggested data collection interval	2 years
References	
Documents describing the indicator	-
Other systems using this indicator	Cities: Wrocław, Łódź, Warsaw, Poznań.

B-3.2: Metadata of indicators - W43_O	
Indicator name	Number of electric vehicle charging stations installed under the grant from Municipality of Krakow
Indicator unit	unit
Definition	This is an indicator of the number of newly created electric vehicle charging stations .
Method of calculation	Identify the number of new electric vehicle charging stations within the administrative boundaries of the city.
Context of the indicator	
Does the indicator measure direct impacts (reduction of greenhouse gas emissions)?	Not
If so, which emission source sectors does it measure?	-
Does the indicator measure indirect impacts (e.g. co-benefits)?	Not
If so, what co-benefits does this indicator measure?	-
Is the indicator useful for monitoring the results/impact of activities?	Yes
If so, for which activities and impact pathways is it useful?	Technology/Infrastructure

Is the indicator taken into account by existing methodologies - CDP/SCIS/Covenant of Mayors?	-
Data required	
Data source	GMK
Is the data source local or national?	Local
Expected availability	Average
Suggested data collection interval	2 years
References	
Documents describing the indicator	-
Other systems using this indicator	-

B-3.2: Metadata of indicators - W45_T	
Indicator name	Increase in the length of cycling routes
Indicator unit	metre
Definition	The indicator illustrates changes in cycling infrastructure. The length of cycling routes should be systematically increased through investment measures, in order to reduce the number of journeys made by car. The direct effect will be a reduction in congestion in the city and thus shaping sustainable mobility patterns among inhabitants.
Method of calculation	W45_T = (M32_T) - (M31_T) Where: M31_T - length of cycling routes in year n M32_T - length of cycling routes in year n+1
Context of the indicator	
Does the indicator measure direct impacts (reduction of greenhouse gas emissions)?	Not
If so, which emission source sectors does it measure?	-
Does the indicator measure indirect impacts (e.g. co-benefits)?	Not
If so, what co-benefits does this indicator measure?	-
Is the indicator useful for monitoring the results/impact of activities?	Yes
If so, for which activities and impact pathways is it useful?	Technology/Infrastructure, Governance and Policy
Is the indicator taken into account by existing methodologies - CDP/SCIS/Covenant of Mayors?	-
Data required	
Data source	ZIKiT - on the basis of the number of completed new sections of cycling routes
Is the data source local or national?	Local
Expected availability	Easy
Suggested data collection interval	Year
References	
Documents describing the indicator	-

Other systems using this indicator	Cities: Wrocław, Łódź, Warsaw, Poznań.

B-3.2: Metadata of indicators - W4_T	
Indicator name	Share of tracks requiring modernisation
Indicator unit	%
Definition	The indicator shows the number of tracks in need of modernisation. This length should be systematically reduced so that the indicators depicting the quality of the tracks gradually improve as investment measures are taken.
Method of calculation	W4_T = (M10_T)/((M9_T)+ (M10_T)) Where: M9_T - length of track - good condition M10_T - length of track - poor condition
Context of the indicator	
Does the indicator measure direct impacts (reduction of greenhouse gas emissions)?	Not
If so, which emission source sectors does it measure?	-
Does the indicator measure indirect impacts (e.g. co-benefits)?	Not
If so, what co-benefits does this indicator measure?	-
Is the indicator useful for monitoring the results/impact of activities?	Yes
If so, for which activities and impact pathways is it useful?	Technology/Infrastructure, Governance and Policy, Education and Skills
Is the indicator taken into account by existing methodologies - CDP/SCIS/Covenant of Mayors?	-
Data required	
Data source	ZIKiT - based on ongoing monitoring of track condition, data obtained on an annual basis.
Is the data source local or national?	Local
Expected availability	Easy
Suggested data collection interval	Year
References	
Documents describing the indicator	-
Other systems using this indicator	-

B-3.2: Metadata of indicators - W44_T	
Indicator name	Share of tram fleet over 15 years old
Indicator unit	%
Definition	The indicator shows the change in the number of new tram rolling stock used for public transport services. Tram rolling stock should be systematically replaced in

	order to eliminate old trams characterised by a high level of exploitation. This should be facilitated by the tram fleet renewal policy pursued by the operator and the Municipality of Krakow. The key effect will be a reduction in the environmental impact of transport and air and noise pollution from transport.
Method of calculation	W44_T = (M29_T)/(M30_T) Where: M29_T - number of tramway rolling stock over 15 years old M30_T - total number of tramway rolling stock
Context of the indicator	
Does the indicator measure direct impacts (reduction of greenhouse gas emissions)?	Not
If so, which emission source sectors does it measure?	-
Does the indicator measure indirect impacts (e.g. co-benefits)?	Not
If so, what co-benefits does this indicator measure?	-
Is the indicator useful for monitoring the results/impact of activities?	Yes
If so, for which activities and impact pathways is it useful?	Technology/Infrastructure, Governance and Policy, Education and Skills
Is the indicator taken into account by existing methodologies - CDP/SCIS/Covenant of Mayors?	-
Data required	
Data source	MPK S.A. - based on data on the number of tramway rolling stock used for the provision of public transport services within Krakow Public Transport.
Is the data source local or national?	Local
Expected availability	Easy
Suggested data collection interval	2 years
References	
Documents describing the indicator	-
Other systems using this indicator	-

B-3.2: Metadata of indicators - W24_O	
Indicator name	Number of single-family buildings thermo-modernised with grants from Municipality of Krakow
Indicator unit	Number of buildings.
Definition	The number of single-family buildings in which thermal modernisation works were carried out under the subsidy from the Municipality of Krakow should be understood as single-family buildings whose owners obtained a subsidy under the Programme for thermal modernisation of single-family buildings for the City of Krakow and carried out the required thermal modernisation works.

Method of calculation	W24_O = M21_O Where: M21_O - Number of single-family buildings, in which thermomodernisation was performed within the framework of subsidies from Municipality of Krakow
Context of the indicator	
Does the indicator measure direct impacts (reduction of greenhouse gas emissions)?	Not
If so, which emission source sectors does it measure?	-
Does the indicator measure indirect impacts (e.g. co-benefits)?	Not
If so, what co-benefits does this indicator measure?	-
Is the indicator useful for monitoring the results/impact of activities?	Yes
If so, for which activities and impact pathways is it useful?	Technology/Infrastructure, Governance and Policy, Education and Skills
Is the indicator taken into account by existing methodologies - CDP/SCIS/Covenant of Mayors?	-
Data required	
Data source	Database of the Environmental Management Department of the City of Krakow
Is the data source local or national?	Local
Expected availability	Easy
Suggested data collection interval	2 years
References	
Documents describing the indicator	-
Other systems using this indicator	-

B-3.2: Metadata of indicators - W27_O	
Indicator name	Number of 'pocket' parks.
Indicator unit	Number of parks
Definition	Pocket parks, also known as mini-parks (tut. Gardens of the Krakowians) are urban open spaces of relatively small size. They are usually located on a single or several small plots of land in the city, where they are dispersed throughout the city enabling different groups of people to enjoy them when there are no other attractive green spaces nearby. Pocket parks not infrequently aim to fulfil the functions of standard sized parks in an attempt to meet the different types of demands made by their users. The requirements for larger green spaces can be met by creating multi-functional and/or themed pocket parks. The creation of pocket parks not only promotes the identification of residents with smaller green spaces located in the immediate vicinity, but also the building of local identity and the integration of its users.

Method of calculation	W27_O = (M24_O) Where: M24_O - number of completed pocket parks
Context of the indicator	
Does the indicator measure direct impacts (reduction of greenhouse gas emissions)?	Not
If so, which emission source sectors does it measure?	-
Does the indicator measure indirect impacts (e.g. co-benefits)?	Not
If so, what co-benefits does this indicator measure?	-
Is the indicator useful for monitoring the results/impact of activities?	Yes
If so, for which activities and impact pathways is it useful?	Technology/Infrastructure, Governance and Policy, Education and Skills, Democracy and Social Participation.
Is the indicator taken into account by existing methodologies - CDP/SCIS/Covenant of Mayors?	-
Data required	
Data source	Information collected by the Krakow City Greenery Management Board, updated on a regular basis with the start/finish of construction on the unit's website or Facebook page.
Is the data source local or national?	Local
Expected availability	Average
Suggested data collection interval	2 years
References	
Documents describing the indicator	-
Other systems using this indicator	-

B-3.2: Metadata of indicators - W26_O	
Indicator name	*Share of forest in total city area*
Indicator unit	%
Definition	Forest cover: Ratio of the total area of forest land ('Ls') to the total area of all land within the administrative boundaries of Krakow, expressed as a percentage [%].
Method of calculation	W26_O = (M25_O)/(M2_P) Where: M25_O - area of forests in the City of Krakow M2_P - total area of Krakow
Context of the indicator	
Does the indicator measure direct impacts (reduction of greenhouse gas emissions)?	Not
If so, which emission source sectors does it measure?	-
Does the indicator measure indirect impacts (e.g. co-benefits)?	Not
If so, which co-benefits does this indicator measure?	-

Is the indicator useful for monitoring the results/impact of activities?	Yes
If so, for which activities and impact pathways is it useful?	Technology/Infrastructure, Governance and Policy, Education and Skills, Democracy and Social Participation.
Is the indicator taken into account by existing methodologies - CDP/SCIS/Covenant of Mayors?	-
Data required	
Data source	Land and Building Register - as at 31 December each year
Is the data source local or national?	Local
Expected availability	Average
Suggested data collection interval	2 years
References	
Documents describing the indicator	-
Other systems using this indicator	-

B-3.2: Metadata of indicators - W23_D	
Indicator name	Satisfaction with ability to influence city government
Indicator unit	%
Definition	Indicator based on responses from a questionnaire question (or questions) with the following identifiers: Q19P The content of the question (or questions): I will now read out a list of different aspects of living in Kraków. I would like you to rate how important these are to you and how satisfied you are with them. Please rate these aspects with reference to the last 12 months. Your ability to influence the Kraków authorities.
Method of calculation	percentage of positive responses ('strongly satisfied' and 'fairly satisfied')
Context of the indicator	
Does the indicator measure direct impacts (reduction of greenhouse gas emissions)?	Not
If so, which emission source sectors does it measure?	-
Does the indicator measure indirect impacts (e.g. co-benefits)?	Not
If so, what co-benefits does this indicator measure?	-
Is the indicator useful for monitoring the results/impact of activities?	Yes
If so, for which activities and impact pathways is it useful?	all
Is the indicator taken into account by existing methodologies - CDP/SCIS/Covenant of Mayors?	Not
Data required	

Data source	Quality of Life and Quality of Public Services Survey from 2020 Krakow Barometer (BK)
Is the data source local or national?	Local
Expected availability	Average
Suggested data collection interval	2 years
References	
Documents describing the indicator	Kraków Barometer
Other systems using this indicator	-

4 Part C - Enabling climate neutrality by 2030

4.1 Module C-1 Innovation interventions in organisation and management

Table C.1.1 Innovative management interventions

Name of the action	Description	Addressed system barriers / development opportunities	Authorities and stakeholders involved	Possible impact
Project portfolios Zero Emission Krakow Project Portfolio; Smart City Project Portfolio.	Tasks, projects and programmes implemented in a coherent, cumulative manner, producing synergy effects.	**Barrier:** Lack of a pattern of urban climate transformation. Fragmentation of pro-climate measures, duplication of actions taken, repetition of mistakes, inconsistent tasks.	Local government (departments, units, companies).	Acceleration of the transformation process, possible implementation of larger projects, consistency of actions taken, strategic evaluation of projects.
Portfolio Advisory Team.	Introduce an official mechanism to allow external professionals to co-govern the city.	**Barrier** : Organisational weakness. Restriction of action planning to a few people from the local government; no direct influence of residents (professionals) on pro-climate measures.	Local government (City Council), professionals representing universities, business, ngo).	Basing strategic decisions for transformation on the knowledge of top experts, a broad multi-faceted view of the city's challenges.

Citizens' assemblys Krakow Climate Assembly. Kraków Transport Assembly.	The Mayor of Krakow accepts for implementation the recommendations prepared by the randomly selected panellists.	**Barrier**: Too little involvement of residents. Lack of citizens' sense of empowerment and participation in city management and pro-climate measures.	Local government (City of Kraków) and a randomly selected cross-section of residents.	Genuine participation in the management of the city, increasing the sense of responsibility, involvement, agency.
Strong support of the Civic Budget.	Residents prepare projects which, if voted on, are implemented by the City.	**Barrier**: Too little involvement of residents. Lack of pro-climate initiatives among residents, lack of sense of agency, responsibility.	Local government (departments, units, companies) Residents (including minors!).	Growing commitment to ongoing pro-climate activities, creativity and awareness.
Eliminating the siloed approach to managing the City.	Creating extensive but transparent urban structures ready for large-scale climate projects .	**Barrier** : Organisational weakness. Fragmented governance by area, siloed, insufficient proclimatic measures.	Local government (departments, units, companies).	Increased capacity, better and faster management, greater decision-making, modern management tools.
Recommendation to implement the change of climate zones for energy design for Krakow and increase the temperature from -20 to -16 deg C.	This measure will allow the energy demand of buildings within the administrative boundaries of the city to be made more realistic.	**Barrier** : Organisational weakness. Legislative provisions that are outdated to modern standards, making it difficult to introduce innovative solutions.	Local government, municipal entities and companies, private entrepreneurs, private energy companies.	Facilitate the modelling process of the city's energy system and increase the potential to introduce low-carbon solutions.
Recommendations for legislative changes to facilitate low-carbon solutions.	The implementation of the recommended 23 legislative changes will facilitate the implementation of the measures proposed to achieve the city's zero carbon footprint (for a description of the proposed legislative	**Barrier :** Insufficient cooperation between government and local authorities. Some legislative provisions have not changed with the with the progressive implementation of new technologies and are a hindrance	Local government, municipal entities and companies, private entrepreneurs, private energy companies, residents, national administration.	Dependent on enrolment - facilitating the implementation of climate, water, waste and energy. Facilitate the introduction of new technologies into the city's operating system.

	changes, see the narrative section below).	to their implementation.		

C-1.2: Description of innovative management interventions to achieve climate neutrality

New tasks for the City, resulting from the ambition to achieve climate neutrality, have resulted in a change in the management system. The changes concern:

- the introduction of a new project management instrument, the project portfolio;
- a mechanism to increase stakeholder collaboration and influence on the city's activities - the portfolio advisory team,
- the creation of functioning public participation mechanisms - two successful citizens' assemblys;
- the development of a budget for municipal tasks that citizens decide on directly - the civic budget;
- creating urban structures better equipped to implement measures - eliminating silos.

Project portfolios

Krakow implements a task-based budget: the city's individual activities are divided into specific, detailed tasks. Some of the tasks are implemented as projects, in accordance with the Prince 2 methodology, which makes it easier to achieve the objectives. However, in the case of pro-climate measures, practice has shown that the project methodology is not sufficient. Measures to reduce emissions
and adaptation of the city to climate change are large, cross-cutting and implemented by many units. They are not a separate area of city management, but rather another way of implementing existing activities. They relate to education, municipal management, transport, housing, culture, sports, office functioning, ICT, tourism, business, civil society. In view of this, it is not enough to implement many separate projects, each on its own. They must be made to work together to achieve even better results through synergy.

To better respond to the challenge, Krakow has introduced a new element into the project management system: project portfolios. Project portfolios are an innovation in the management system, both in the managerial/organisational aspect - due to the streamlining of decision-making and implementation processes - and in the social aspect - due to the inclusion in the work of the portfolio of representatives from various backgrounds: science, business, NGOs.

There are currently two project portfolios in operation: "Zero Emission Krakow" and "Smart City". The "Zero Emission Krakow" portfolio aggregates pro-climate initiatives (tasks, projects, programmes) implemented by the City of Krakow and allows for their efficient management. The implementation of the Portfolio will make Krakow a city developing in a sustainable way, striving for economic prosperity and the health of its inhabitants in harmony with the environment and taking into account the needs of

future generations, resilient to extreme climate phenomena, coping with their effects, economical and friendly to inhabitants and visitors.

Zero Emission Krakow Project Portfolio Advisory Team

The Portfolio Advisory Panel is an opinion-giving body, influential in shaping the City's policy, advisory to the Portfolio Council, composed of prominent representatives from the world of science, politics, business, local government, NGOs. It provides opinions and advice on projects and programmes. Submits projects and programmes whose objectives and scope may fit into the Portfolio Strategy. It is composed of
made up of permanent members and members appointed to discuss specific projects, topics for Council meetings. The work of the Advisory Team does not have a rigid timetable, as the individual members of the Team have different amounts of time and different levels of ability or even willingness to get involved. Nonetheless, the Team is a strong group of people representing the business community, universities, local government and NGOs who have a significant influence on the shaping of the City's climate policy. The introduction of the institution of the Advisory Team has programmatically implemented the use of external specialists' knowledge and output into the project management system.

Citizens' assemblys

Krakow has so far conducted two citizen assemblys. These assemblys do not produce solutions that are implemented in legislation, but rather identify the city's voluntary willingness to implement solutions. Nevertheless, the city mayor pledged to accept the recommendations with at least 80% support from the panellists for implementation - and he has kept his word. The Krakow assemblys consisted of an educational part, where participants listened to experts: employees of Krakow's universities, representatives of ngo's, business, officials, and a deliberative part, where they discussed their ideas on how to improve the functioning of the city. The assembly's recommendations have a strong social mandate, as they come from a very representative, randomly selected group of residents - and not just from those who usually participate in the city's activities anyway, due to their membership of an NGO or a group with particular interests. A assembly is therefore similar to a referendum, while being less costly and - because of the educational sessions for the panellists - producing better, more substantive solutions.

These assemblys took a structured approach to the methodology of selecting an appropriate group of participants, also including marginalised groups in the process. As part of the work on the Krakow Climate Assembly, an appropriate methodology for selecting panellists was developed so that the composition of the Assembly reflected the general population of Krakow in terms of specific socio-demographic and spatial characteristics, which included:

1. gender (k, m);
2. age group:
    a. 18-24 years;
    b. 25-39 years;

c. 40-64 years;
d. 65+ years;

3. district of residence;
4. level of education:
   a. none/basic;
   b. secondary/professional;
   c. higher.

The Krakow Climate Assembly included 70 panellists: 60 persons constituting the core line-up and 10 persons in the reserve line-up. The participants were a reflection of the general population of Krakow.

The first stage of recruiting panellists consisted in reaching out with information, encouraging and inviting the widest possible group of Krakow residents to participate in the Assembly and, consequently, registering potential participants in the process, which was carried out by printing and distributing invitations to male and female residents of Krakow in order to achieve an appropriate sample of panellists. 20,000 unique invitations were sent to randomly selected addresses in all districts of Krakow and extensive communication activities were carried out, whose reach exceeded 1.5 million people (media, local media, posters, city lights, illuminated buildings, radio programmes and podcasts, involvement of dozens of local opinion leaders, others).

There was also extensive public consultation in which all residents of Krakow could participate. The consultation was carried out over 26 days, five expert stands, eight consultation meetings, an art competition for children and two consultation forms were created. 168 organisational comments and 252 factual comments were received.

As part of the second stage, an appropriate electronic tool for registering candidates for panellists was prepared and a random draw was made using the database of registered persons and a 60-person group of panellists was selected, together with a 10-person reserve group, in a manner ensuring transparency of the process, randomness of the selection and representativeness of the Assembly, i.e. taking into account socio-demographic and spatial characteristics in relation to the entire population of Krakow.

Residents of Krakow were also able to watch three of the Assembly's educational meetings live and access educational materials in the online Knowledge Zone.

Opportunities were also provided for stakeholders to participate in the Panel: representatives of NGOs, informal movements, businesses, or housing cooperatives. Information about the call for sites was published, among others, on the Operator's website, in social media and in professional services, including through paid advertisements.

The parties were given the opportunity to:

- presenting your position and proposed recommendations at an educational assembly meeting (live or recorded speech) or submitting your position in writing;
- to review the proposed recommendations and provide the panellists with their comments on them;
- participation in one deliberative meeting on an observer basis, on the same basis as officials and civil servants of the City of Krakow (participation in group work, with no possibility of participation in sub-groups);
- participation in the last meeting of the Assembly, during which final discussions were held and voting on recommendations.

The involvement of the parties was therefore considerable and, it seems, above standard. Particularly as more than a dozen parties qualified for the Assembly.

Krakow Climate Assembly pages (alphabetical order):

1. AGH University of Science and Technology (Prof. Piotr Kleczkowski);
2. Business Centre Club Małopolska Lodge;
3. European Clean Air Centre;
4. Extinction Rebellion;
5. Krakow City of Startups Foundation;
6. Open Plan Foundation;
7. Scientific Circle of the Challenges of the Green Deal (Cracow University of Economics);
8. Left Together;
9. Youth Climate Strike;
10. Polish Zero Waste Association;
11. Cooperative "Krakow Social Power Plant";
12. Housing Cooperative "Na Kozłówce";
13. Better City Association;
14. Poland 2050 Association;
15. Faculty of Biology, Jagiellonian University (Dr Joanna Kajzer-Bonk);
16. Earth Is Us (informal group);
17. Union of Associations Polish Green Network.

Despite the challenges of COVID-19, the Krakow Climate Assembly managed to run smoothly, including maintaining the correct structure of the Assembly. During the final vote on the recommendations, a group of not only 60 people from the core membership was present, but also several people from the from the reserve group.

Citizens' budget

Part of the city's budget is earmarked for projects submitted by residents, and it is the residents who decide which projects will be implemented by the municipality. The opportunity to take part is open to a wide range of people (children, young people, adults, seniors), as is the use of the results of completed projects. The civic budget thus perfectly demonstrates the level of knowledge, involvement and sympathy of the residents. A positive trend can be seen over the last few years - the number of project applications submitted by young people is increasing, as is the number of applications for projects related to the environment, including the climate. This gives confidence in the effectiveness of the climate education provided by the City, as well as unlocking creativity and increasing the involvement of residents.

The Civic Budget has been in place in Krakow since 2014, and the creation of a civic budget is mandatory in municipalities that are cities with county rights from 2019. These cities have to allocate at least 0.5 per cent of the municipality's expenditure included in the last budget execution report. The civic budget operates on a city-wide basis as well as in individual neighbourhoods. The projects that receive the most support from residents in the vote are included in Krakow's budget and are implemented in the next financial year.

Improving internal management processes (silos)

The organisational weakness of local government is mainly due to siloed departments in municipal offices. There is insufficient horizontal knowledge sharing and cooperation between office units. The position of climate units in the structure of offices is not strong enough. Decision makers underestimate the importance of the climate crisis, so that the transition units in the offices are often not taken fully seriously. Their tasks and decisions are not prioritised in city management, and the teams built are too small.
Proper hierarchy, collaboration, implementation of horizontal processes - such project processes, going across the siloed structure, have been implemented by the project management system adopted at Krakow City Hall.

Krakow's climate-neutrality activities are implemented in a coordinated manner by municipal departments, units and companies, in particular: Department of Municipal Economy and Climate, Climate-Energy-Water Management unit, Department of Air Quality, Department of Strategy and Investment Monitoring, Department of Entrepreneurship and Innovation, Board of Urban Greenery, Board of Public Transport, Board of Municipal Buildings, Municipal Thermal Power Company SA, Municipal Transport Company SA.

Currently, in accordance with the project management system, each project included in the Zero Emission Krakow portfolio has a project manager and a project team, most often appointed by an official order from the Magistrate Director, and project documentation is maintained in accordance with procedures in an internal system and is accessible to other project managers. The portfolio is managed by a Portfolio Board, consisting of the directors of the departments and units most involved in pro-climate measures. An advisory body is the Portfolio Advisory Panel, formed from prominent representatives of science, politics, business, local government, NGOs.

Recommendations for legislative changes

The Office of the City of Krakow, in cooperation with stakeholders, has developed proposals for 23 legislative changes to facilitate the implementation of tasks in the energy, climate, water management, transport and waste management sectors. These amendments were presented by the Mayor of the City of Krakow during a meeting with new members of the Sejm coming from Krakow with a request to implement them in the 10th term of the Sejm. Representatives of the City of Krakow will strive for these changes to be introduced, which will facilitate the implementation of activities and assumptions included in the Action Plan. An important chance for the introduction of these changes is also provided by the cooperation established during the work on the Climate Contract at the national level.

Table C.1.1a: Proposed legislative changes.

Lp.	Name and title of the act	Provision to be deleted/amended/added	Comment
1	**ACT of 17 August 2023 amending the Act on renewable energy sources and certain other acts**	Article 38e. Paragraph 1. **Current wording**: An energy cooperative meets all of the following conditions: (1) it operates in the area of a rural or urban-rural municipality within the meaning of the provisions on public statistics or in the area of	Proposal for an amendment to give municipalities the option of using a form of energy cooperative within the city

		no more than 3 such municipalities immediately adjacent to each other; **Proposal for change:** An energy cooperative meets all of the following conditions: (1) it operates in the area of a rural municipality, an urban-rural municipality or an urban municipality within the meaning of the provisions on public statistics or in the area of no more than 3 such municipalities immediately adjacent to each other;	
2	**Act of 24 April 2009 on investments in the field of liquefied natural gas regasification terminal in Świnoujście**	Art. 6 par. 3 item 11 *Before submitting the application for a decision to determine the location of an investment project within the scope of the terminal, the investor shall request opinions from the locally competent board of the province, the board of the poviat and the head of the commune (mayor, town president)* - requires adding a provision as in the commentary	There is no reference in the provision **to what scope the opinion is to be issued**. Specific departments of the Office of the City of Krakow and municipal organisational units (under the authority of the President of the City of Krakow) already issue opinions to: 1. Article 6(3)(4) 2. Article 6(3)(5) 3. Article 6(3)(7a) 4. Article 6(3)(9)
3	**Law of 20 February 2015 on renewable energy sources**	Article 105a - add provisions (or introduce an additional article) to the article regarding the allocation of funds from the RES levy account for the transformation needs of municipalities as a goal to achieve climate neutrality.	The provision will help to intensify energy transition efforts and the move towards climate neutrality. The introduction of this provision will require adjustment of the other provisions of the Act.
4	**Water Law Act (Journal of Laws of 2023, item 1478 as amended)**	Article 16 (Definitions)	It is necessary to introduce a definition of an area not covered by open or closed sewerage systems. The lack of a definition raises the problem of defining an area not included in open or closed sewerage systems. This is reflected in the judgment of the Voivodship Administrative Court in Krakow of 28.03.2019 ref. SA/Kr 1574/18, which accepted that there is no legal basis for the authority's failure to recognise that a single property or a group of several properties constitutes an area, and that equipping a property or a group of several properties with sewerage facilities constitutes a property located in an area covered by a sewerage system.
5	**Water Act (Journal of Laws 2023, item 1478, as amended).**	Article 269(1)(1) **Current wording**: (1) A water service charge shall also be paid for: 1) the reduction of natural terrain retention as a result of the execution on a property with an area of more than 3,500 m^2 of works or constructions permanently connected to the	It is requested that the word 'exercise' be changed to 'performance'. The current use of the wording "execution" raises the problem of determining the period for which the fee is due, as reflected in the judgment of the

		ground which have the effect of reducing this retention by excluding more than 70% of the area of the property from the biologically active area in areas not covered by open or closed sewerage systems; **Proposal for change**: (1) A water service charge shall also be paid for: 1) the reduction of natural field retention as a result of the execution on a property with an area of more than 3,500 m^2 of works or structures permanently connected to the ground which have the effect of reducing this retention by excluding more than 70% of the area of the property from the biologically active area in areas not covered by open or closed sewerage systems; Article 270(7) **Current wording**: The amount of the water service charge for a reduction in natural field retention as a result of carrying out on a property with an area of more than 3,500 m^2 works or buildings permanently connected to the ground which have the effect of reducing this retention by excluding more than 70% of the area of the property from the biologically active area in areas not covered by open or closed sewerage systems depends respectively on the size of the sealed area, understood as the built-up area excluded from the biologically active area, and the application of retention compensation. **Change proposal**: The amount of the water service charge for the reduction of natural field retention as a result of the execution on a property with a surface area of more than 3,500 m^2 of works or constructions permanently connected to the ground which have the effect of reducing this retention by excluding more than 70% of the surface area of the property from the biologically active area in areas not covered by open or closed sewage systems depends respectively on the size of the sealed area, understood as the built-up area excluded from the biologically active area, and the application of retention compensation.	Voivodship Administrative Court Krakow of 28.03.2019 ref. SA/Kr 1574/18, which assumed that this provision would apply to events that took place after 1.01.2018, i.e. after the date of entry into force of the Water Law Act.
6	**Water Act (Journal of Laws 2023, item 1478, as amended).**	Article 272 Adding after paragraph 8, paragraph 8a which reads: 8a. If the property is developed with multi-unit buildings in which separate ownership of premises has been established, the obligations of the owner of the common property shall be borne by the housing association or housing cooperative.	Designation of property management entities (e.g. housing communities and housing cooperatives) as entities obliged to pay the water service charge where the property is developed with a multi-unit building in which separate ownership of premises has been established. At present, the charges are imposed on the individual co-owners of the property,

			according to their shares. This often results in the cost of enforcing the charge in question, particularly where administrative proceedings have to be initiated, being greater than the proceeds received.
7	**Water Act (Journal of Laws 2023, item 1478, as amended).**	Article 272(10) **Current wording**: (10) In determining the amount of the fees referred to in paragraphs 1 to 9, a billing period of one quarter shall be taken into account. **Proposal for change**: 10. setting the amount: (1) the charges referred to in paragraphs 1 to 7 and 9 shall have a billing period of a quarter; (2) the fee referred to in paragraph 8 shall take into account a reference period of one year. Article 272(23) **Current wording**: (23) The entity obliged to pay the fee for water services referred to in paragraph (8) shall pay the fee to the bank account of the competent municipal (city) office within 14 days from the date on which it has been served with the information, referred to in paragraph 22. **Proposal for change**: (23) The entity obliged to pay the fee for water services referred to in paragraph (8) shall pay the fee to the bank account of the competent municipal (city) office in 4 equal quarterly instalments no later than by the end of the month following the end of each quarter.	Simplification of the system of levying water service charges for the reduction of natural land retention, by sending a single annual notice (rather than 4 times a year) of the amount of the charge in question, which would be paid by the entity in 4 equal quarterly instalments. The variability of the sealed area on a property occurs extremely infrequently during the year, and it therefore seems unreasonable to include a quarterly billing period in the determination of this fee. This provision results in the need to send four, mostly identical, notices to the property owner during the year. The amendment would reduce the cost of mailing and the time required to prepare the information threefold, thereby reducing staff costs.
8	**Water Act (Journal of Laws 2023, item 1478, as amended).**	Article 299(5) **Current wording**: (5) The proceeds of water service charges for the reduction of natural field retention referred to in Article 269(1)(1) shall constitute 90% of the revenue of the Polish Water Authorities and 10% of the revenue of the budget of the relevant municipality. **Proposal for change**: (5) The proceeds of water service charges for the reduction of natural field retention referred to in Article 269(1)(1) shall constitute 40% of the revenue of the Polish Water Authority and 60% of the revenue of the budget of the relevant municipality	The costs incurred by the municipality/city for the implementation of the task, i.e. for the handling of correspondence and staff costs, are several times higher than 10% of the income from this fee, which constitutes, the income of the city budget. In order to make the reimbursement of the costs incurred by local government units more realistic, it is necessary to increase their percentage share in the income from this fee.
9	**Water Act (Journal of Laws 2023, item 1478, as amended).**	Article 552(2a) para. 2: **Current wording**: 2) the statements of the entities obliged to pay charges for water services, for the respective quarters. **Proposal for change**: 2) the statements of the entities liable to pay water service charges, for the individual	Simplification of the system of submitting declarations of entities obliged to pay the water service charge for the reduction of natural field retention, by sending one annual declaration (rather than 4 times a year). The variability

		quarters and, in the case of the water service charge referred to in Article 272(8), for the individual years. Article 552(2b): **Current wording**: 2b. Entities obliged to pay charges for water services shall be obliged to submit the declarations referred to in paragraph 2a(2) in accordance with the templates published in the in the Public Information Bulletin on the website of Wód Polski: 1) Polish Water for the purpose of establishing the amount of the charges referred to in Article 272(1-l) and (9) and Article 275(8)(6), 2) to the mayor, mayor or president of the city, for the purpose of determining the amount of the fee, referred to in Article 272(8) - within 30 days of the day falling at the end of each quarter, except that the declarations for Q4 2026 shall be submitted by water users by 14 January 2027. **Proposal for change**: 2b. Entities obliged to pay charges for water services shall be obliged to submit the statements referred to in paragraph 2a(2) in accordance with the templates published in the Public Information Bulletin on the website of the Polish Water Authority: 1) to the Polish Water Authority for the purpose of establishing the amount of charges referred to in Article 272(1-l) and (9) and Article 275(8)(6) within 30 days of the day falling at the end of each quarter, except that statements for the fourth quarter of 2026 shall be submitted by water service users by 14 January 2027. 2) to the mayor, mayor or town mayor for the purpose of determining the amount of the charge referred to in Article 272(8) by 31 January of the year following the year to which it relates, except that the statements for 2026 shall be submitted by water service users by 14 January 2027.	of the sealed area on a property occurs extremely infrequently during the course of a year, and therefore sending quarterly statements seems unjustified. This provision results in the need for the property owner to send four, mostly identical, statements during the year.
10	**Act of 10 April 2003 on special principles of preparation and execution of investments in the scope of public roads**	Article 1(1) Proposed amendment: "The Act sets out the principles and conditions for the preparation of investments in the field of public roads within the meaning of the provisions of the Act of 21 March 1985 on public roads (Journal of Laws of 2022, item 1693, 1768, 1783 and 2185), hereinafter referred to as 'roads', **including roads for bicycles and tramway tracks located outside the road strip and car parks**, as well as the authorities competent in these matters."	The proposed amendment consists in the possibility to realise the construction of cycle paths and pavements (pedestrian accesses) on the basis of a decision on permission for the realisation of a road investment, by specifying in the provision that the provisions of the Act also apply to cycle paths and pavements. At present, this is only possible if the cycle path or footpath is located directly next to a public road, while there are no legal regulations allowing the construction of cycle paths and footpaths (pedestrian accesses) in other

			locations. The amendment would be consistent with the reference to the Act on public roads in Article 1(1) of the Road Specust Law, which in turn uses both the notions of a bicycle path and a pavement. Extending the scope of the Act to include the possibility of building tram tracks (without parallel carriageways) - a provision that is particularly important in large cities, where efforts are being made to reduce car traffic and the introduction of ecological forms of transport. This provision would facilitate investments aimed at providing residents with the fastest possible connections between different areas of the city. On the other hand, the extension of the scope of the Act to include the possibility of building car parks will contribute to facilitating the implementation of parking policies in cities, particularly with regard to the construction of Park&Ride car parks. Their creation may have an impact on reducing congestion in city centres and also on reducing transport emissions.
11	**Law of 11 January 2018 on electromobility and alternative fuels**	Article 36(1) (effective from 1 January 2025. New wording: Local government unit, excluding municipalities and districts whose population does not exceed 50 000, provides or contracts the provision of public transport services within the meaning of the Act of 16 December 2010. on public collective transport (Dz. U. of 2022, item 1343 and 2666) to entities which, in total, ensure a share of zero-emission buses or buses fuelled by biomethane **or natural gas** in the fleet of vehicles in use on the territory of this local government unit of at least 30% Article 68(4) New wording: The local authority referred to in Article 36(1), ensure that the share of zero-emission buses or buses running on biomethane **or natural gas** in the fleet in use is at least: 1) 5% - from 1 January 2021; 2) 10% - from 1 January 2023; 3) 20% - from 1 January 2025.	It is proposed to include in the statutory limits for public transport buses also natural gas vehicles. The emission characteristics of this type of vehicle are virtually no different from those of biomethane-powered vehicles. Many Polish cities, in order to improve air quality, have already purchased and are using this type of vehicle.
12	**Law of 11 January 2018 on electromobility and alternative fuels**	Removal of Article 76(2), viz: Contracts concluded by local and regional authorities for the performance of public	It is proposed to delete this provision. This provision may result in discontinuation of the

		tasks referred to in Article 35(2)(1), excluding public transport, shall expire on 31 December 2025 if they do not ensure the use of electric vehicles or natural gas vehicles at the level specified in Article 35(2).	continuity of public services and claims for damages against local government units. At the same time, due to the still underdeveloped market of specialist electric vehicles, used e.g. for the implementation of investments (including road investments), the expiry of contracts may result in the loss of funds obtained from the European Funds.
13	**Act of 13 September 1996 on maintenance of cleanliness and order in municipalities (Journal of Laws 2023, item 1469, as amended).**	Addition of paragraph 5 to Article 9o to read: The minister responsible for the climate may determine, by means of a regulation, a model report, including annexes, for entrepreneurs emptying septic tanks or settling tanks in installations of domestic sewage treatment plants	The introduction of reporting templates and appendices for entrepreneurs and municipalities, or a reporting database (a solution like BDO - Waste Data Base) will standardise the information provided and improve the control of reports provided by entrepreneurs to municipalities and provided by municipalities to the competent provincial environmental protection inspector and the competent director of the regional water management board of the State Water Management Authority Wody Polskie.
14	**Act of 13 September 1996 on maintenance of cleanliness and order in municipalities (Journal of Laws 2023, item 1469, as amended).**	Addition of provisions in Article 3(3) on what should be included and how records of septic tanks and domestic wastewater treatment plants should be kept.	The introduction of provisions on what records of septic tanks and domestic sewage treatment plants should contain will unify and standardise the state of the above-mentioned records kept in municipalities.
15	**Act of 13 September 1996 on maintenance of cleanliness and order in municipalities (Journal of Laws 2023, item 1469, as amended).**	Amendment of Article 3(5) para. 2) of the records on the number of registered persons to be reported in the annual report of the mayor/mayor/president. in the annual report of the Mayor/Registrar on liquid waste management, i.e. From the record: *The mayor, mayor or town mayor shall draw up a report on liquid waste management for the previous calendar year containing information on: the number of property owners from whom liquid waste has been collected and* ***the number of persons registered at the address of the property*** *on which the respective septic tank or the respective domestic sewage treatment plant is located;* For the record: *The mayor, mayor or town mayor shall draw up a report on liquid waste management for the previous calendar year containing information on: the number of property owners from whom liquid waste has been collected and* ***the number of persons living at the address of the property*** *on which the*	Showing the number of residents instead of registered persons will provide a more appropriate and actual number of persons using septic tanks and domestic wastewater treatment plants.

		respective septic tank or the respective domestic sewage treatment plant is located;	
16	**Act of 13 September 1996 on maintaining cleanliness and order in communes and order in communes (Journal of Laws of 2023, item 1469, as amended).**	Addition of para. 5) in Article 7(1) of the provision for the rental and operation of portable toilets and sanitary containers (portable waste receptacles).	The identification of a new group of entrepreneurs will improve the verification process of the reports submitted by entrepreneurs as well as those submitted by the municipality. The standardisation (positioning) in the legislation of "mobile non-drainage reservoirs", once they have been separated from "stationary reservoirs", will lead to more transparent measures that will facilitate the preparation of reports, their verification and the control of reports at each administrative level.
17	**Act of 13 September 1996 on maintaining cleanliness and order in communes and order in communes (Journal of Laws of 2023, item 1469, as amended).**	Addition of a provision in Article 9o(3)(6) concerning the date of collection, the amount of liquid waste collected from the property and the septic tank to which the liquid waste from the property has been transferred.	Detailing the report with data on the date of collection, the amount of liquid waste collected from the property and the septic tank to which the liquid waste from the property has been transferred will make it possible to check and verify the reports. It will allow irregularities to be detected and prevented in good time.
18	**Act of 13 September 1996 on maintaining cleanliness and order in municipalities (Journal of Laws 2023, item 1469, as amended).**	Addition of a provision in Article 9o(3) on the need for the entity to submit zero reports.	The obligation on entrepreneurs carrying out the activity of emptying containers without waste and transport of liquid waste to submit zero reports in the event that, while holding a permit, they did not empty any waste receptacles in the municipality in the reporting period, i.e. a provision analogous to Article 9n(6) of the Act concerning the obligation to submit zero reports by entrepreneurs who did not collect municipal waste from property owners in the municipality in a given year.
19	**Act of 13 September 1996 on maintaining cleanliness and order in municipalities (Journal of Laws 2023, item 1469, as amended).**	Addition of a provision in Article 5(2) and (7) concerning the technical possibilities of connecting a property to the sanitary sewerage network and the procedure in the event that a domestic sewage treatment plant does not meet the separate regulations.	The introduction of the provisions will enable the smooth conduct of administrative proceedings under the Act.
20	**Act of 13 September 1996 on maintenance of cleanliness and order in municipalities (Journal of Laws 2023, item 1469, as amended).**	Addition of provisions in Article 5(7) concerning the determination in the prescriptive decision of the deadline for fulfilling the obligation laid down in Article	Currently, the provisions of the Act prevent the authorities from setting a deadline in the decision ordering the connection to the sewerage network, with the

		5(1)(2), i.e. connecting the property to an existing sewage network.	result that property owners are obliged to connect the property on the date of finality of the ordering decision, and this is clearly unrealistic.
21	**Act of 13 September 1996 on maintaining cleanliness and order in communes and order in communes (Journal of Laws of 2023, item 1469, as amended).**	Adding provisions in Article 9d(1) concerning the possession of equipment compatible with the profile of activity, e.g. by adding in Article 9d(1)(1) u.c.p.g. 'appropriate to the type of municipal waste collected'.	According to the current legislation, an entity collecting municipal waste from property owners is obliged to meet all conditions and be fully equipped regardless of the type of municipal waste collected (e.g. an entity collecting only waste electronic equipment or bulky waste must meet the requirements for collectors of all types of municipal waste).
22	**Act of 13 September 1996 on maintaining cleanliness and order in communes and order in communes (Journal of Laws of 2023, item 1469, as amended).**	Addition of provisions in Article 4(2a) concerning the requirements for separate collection of municipal waste and composting of biodegradable waste in home composting facilities.	Defining the requirements for for carrying out selective collection of municipal waste and composting of biodegradable waste in home composters is necessary in order to unify the above-mentioned rules in Poland and for the Ministry of the Environment to carry out consistent educational activities in the field of correct municipal waste management.
23	**Act of 13 September 1996 on maintaining cleanliness and order in municipalities (Journal of Laws 2023, item 1469 as amended).**	Addition of provisions in Article 9x(1) on the possibility of penalising the entrepreneur for not submitting the municipal waste management report.	Currently, the provisions of the Act allow a penalty to be imposed on an entrepreneur who has filed a report after the deadline. However, an entrepreneur who has not submitted the report at all cannot be penalised. In view of the above, an appropriate provision should be introduced to address the above issue.

4.2 Module C-2 Social innovation interventions

Table C.2.1 Social innovation interventions				
Name of the action	**Description**	**Addressed system barriers / development opportunities**	**Authorities and stakeholders involved**	**Possible impact**

Citizens' assemblys	Mayor of Krakow accepts for implementation recommendations prepared by randomly selected panellists	Lack of participation in city management and pro-climate measures	Local government (City of Kraków) and randomly selected cross-section of residents	Genuine participation in urban governance
Climate Education Centre	Access to knowledge on climate change climate change and environmental protection to a diverse audience	Lack of sound knowledge, reliance on false narratives	Local government (specialised department), external specialists, cross-sectional groups of residents	Reliable transition message, benefit language
Pro-climate events	Access to climate change and environmental knowledge for a diverse audience	A lack of commitment, a sense that climate issues are important and urgent	Local government (departments, units and companies), cross-sectional groups of residents	Increasing residents' involvement, awareness and understanding of empowerment, getting the word out to a wide range of residents
Portfolio Advisory Team	Portfolio Board advisory body influencing policy	Lack of direct influence of residents (professionals) on pro-climate measures	Local government (City authorities), specialists representing universities, business, NGOs)	Basing strategic decisions in terms of transformation with the knowledge of the best specialists
Pact for Climate	Voluntary stakeholder commitment to climate action and reporting	Low involvement stakeholders other than the City in climate action	Local government, business, universities, ngo	Taking action by major Krakow's major players, raising their profile and encouraging by example, good practice

C-2.2: Description of innovative social measures

Krakow realises how important broad public participation is for pro-climate measures. In order for it to develop, it is necessary, on the one hand, to increase the awareness and knowledge of residents and, on the other, to create mechanisms through which they have a real, rather than theoretical, influence on decisions made in the city. Krakow is taking measures that are innovative from the point of view of the previous approach, typical of Polish cities:

- residents decide and recommend actions - citizen assemblys;
- residents gain knowledge - Climate Education Centre opened in 2023;
- the city reaches out to residents with climate themes - numerous outdoor events;
- stakeholders collaborate and co-create the city's policy - the Portfolio Advisory Team.

Citizens' Assembly

Krakow is one of the few cities in Poland to have held two citizens' assembly. They allow all selected citizens, representing a cross-section of society, to have their say - and not just those who usually participate in the city's activities anyway because they belong to an NGO or a group with particular interests. Their vote matters - the recommendations with the highest support are accepted by the mayor for implementation.

Very important in the context of the city's zero-carbon agenda was the **Krakow Climate Citizen Assembly**. This assembly involved many community groups in the city of Krakow to develop common goals for the city of Krakow to achieve. It took place in 2021 and was dedicated to climate change and the city's climate neutrality. Its participants analysed how authorities and citizens can reduce energy consumption and increase the use of renewable energy.

As a result of its work, 32 high-quality recommendations were developed and submitted to the city authorities, which, according to the adopted assumptions, are binding for the Mayor of Krakow.

The recommendations cover many areas of city functioning. They are often interdisciplinary and cross-cutting in nature, which is why many municipal departments, teams and units are involved in their implementation. Their scope and subject matter are diverse, hence each requires an individual approach and planning, as well as the provision of financial resources for their implementation.

One of the main recommendations is that the city should move towards climate neutrality as soon as possible. Given the challenges of a just transition and tackling energy exclusion, participants concluded that the city should have a plan to achieve climate neutrality, with at least a 30 per cent reduction in greenhouse gas emissions by 2030 relative to 2018, and at least an 80 per cent reduction by 2040, and achieve climate neutrality by no later than 2050.

Other points mainly focus on:

- educational activities aimed at citizens on topics related to climate change and energy efficiency;
- opportunities to implement RES in various sectors of the city's operation;
- thermo-modernisation of buildings and how to financially support it;
- implementation of urban green development programmes and investments in green infrastructure;
- organisational and legislative changes.

Climate Education Centre

Currently, the message of the need for climate transformation is mainly focused on coercion or fear. Local governments do not use language based on financial or non-financial benefits and non-financial benefits. There is a lack of a message based on the reliable benefits of the transition, both material and those related to, for example, health. Well-planned, regular climate education activities targeting different groups of citizens (children, adults, seniors) strengthen stakeholder engagement.

Pro-climate events

Underlying the low level of stakeholder engagement is also an insufficient understanding of the severity of the climate crisis, which affects residents as well as officials and decision-makers. This dovetails with the lack of educational activities and information campaigns by cities. The widest possible awareness about the transition needs to be built among decision-makers, residents and business, which requires communication changes and more investment in education and information campaigns.

Zero Emission Krakow Portfolio Advisory Team

The enthusiasm of residents is often not properly channelled, there is a phenomenon of 'greenwashing', which portrays as pro-climate actions that in reality have little impact on the climate. Participation in the Portfolio Advisory Panel gives you a real say in the decisions taken by the most important body working in the city for climate transformation. People who have proven themselves to be committed and competent have been invited to join the Panel. In addition, they represent different communities (business, NGOs, universities) and are ambassadors for climate action in their communities.

Pact for Climate

In order to achieve climate neutrality, it is necessary to involve other stakeholders. Climate pacts mobilise Kraków's businesses and institutions for climate action and cooperation, while supporting the City. As part of these pacts, members commit to implementing climate-neutral actions and to reporting progress annually to the city government.

The Pact was established in 2022 to increase the involvement of businesses, public institutions, social organisations and academia operating in Kraków in the pursuit of climate neutrality and the fight against climate change. The partners undertake to take action to reduce global warming, create climate strategies and regularly inform the city of actions taken in line with the principles of the pact.

This initiative supports the city's efforts to achieve climate neutrality. In order to meet this challenge, Krakow is opening its doors to external partners, encouraging them to work together. The Pact for the Climate is also a platform for the exchange of experience between partners involved in climate action, the promotion of climate-friendly solutions and, ultimately, the reduction of greenhouse gas emissions.

The partners undertake to take action to limit global warming, to develop climate strategies and to regularly inform the city about actions taken in line with the principles of the Pact. The Pact increases the involvement of businesses, public institutions, social organisations and the scientific community operating in Kraków in the pursuit of climate neutrality and combating climate change. It removes the barrier of low involvement of actors other than the City.

5 Prospects and next steps

Planned activities for the next iterations of the Climate Contract Action Plan

Growing climate awareness

Krakow has undertaken a huge challenge and effort to write down its climate ambitions, current and planned commitment to climate transformation in the form of a Municipal Climate Contract, trying to present the most up-to-date data and the most advanced plans.
On the one hand, therefore, it can be said that at the moment it is difficult to pinpoint the actions planned to be developed during the iteration. However, experience teaches us that progress in the field of climate change is extremely rapid. Solutions that were introduced only one to two years ago as innovative experiments now function as a normal part of the city's reality and do not cause surprise or concern. These rapid changes in action and, above all, in thinking about the climate transition affect the entire frame of reference - at local, regional and governmental levels. They can be seen in the changing narrative in the media, in the growing knowledge and awareness of the Polish and awareness of Poles, particularly the people of Krakow.

Future iterations of the Climate Contract

The first iteration of the Climate Contract is planned for two years after its adoption. It can be expected to introduce many changes and improvements, especially in the funding mechanisms for the measures described in the Investment Plan section. It is planned that the second iteration will take place in 2028, and it is foreseen to check in 2030 whether the objectives of the contract have been met.

During the next iterations, cooperation will be established with the entities that participated in the creation of the Zero Emission Krakow Portfolio Advisory Team - representatives of business, universities and non-governmental organisations (NGOs). The document will also be consulted within the framework of the Climate Pact, which regularly expands to include new participants. A decision on the adoption of the document through a resolution of the Krakow City Council will be taken at a later stage. In case of a positive decision, the document will be widely consulted and will go through a formal public consultation procedure. It will be presented to various stakeholder groups and their comments will be collected as required by the Act. The conclusions resulting from this process will be reflected and reflected in subsequent versions of the document.

Verifiability of progress towards the Climate Contract targets will be ensured by the City's Greenhouse Gas Inventory, which monitors emissions in Krakow on an annual basis. On its basis it will be possible to assess at which stage of transition the city is currently at and how much remains to be done. In addition, there are plans to expand the Municipal Greenhouse Gas Inventory from the Basic to the Basic + level in the future. It is planned to expand this inventory to include the separately identified emission sectors Industrial Processes and Product Use (IPPU for short) and Agriculture, Forestry and Other Land Use (AFOLU for short) as well as additional greenhouse gases.

Essential information on relevant monitoring data will be provided by the city's STRADOM system. This system contains the key projects implemented in the city. Each of these projects, in turn, is assigned evaluation indicators to assess the degree of implementation of the key projects.

During the iteration, the 'Module A-2 Assessment of current strategic management strategies, policies and instruments' will be updated. Most of the documents described in this chapter are also subject to a two-year iteration cycle. Updates to the Climate Contract and progress within the implementation of the documents themselves will emerge from the review of the documents again.

Along with the two-year update period, the activities resulting from the module "B-2 Climate Neutrality Portfolio Design" will also be updated. The status of the tasks, whether they have been completed or to what extent, and any adjustments arising during the project will be determined.

Another important element in terms of the plan for future iterations is the information contained in the in reporting to the CDP (named after the Climate Disclosure Project). CDP is a not-for-profit organisation that runs a global system for collecting and publishing data on the environmental impact of investors, companies, cities and regions. CDP is recognised as one of the world's most credible ranking organisations on this topic. As a result of its participation in the Cities Race to Zero campaign and the Covenant of Mayors on Climate and Energy, Krakow has been reporting on its climate change adaptation and mitigation activities through the CDP since 2022. The monitoring of the score awarded each year will provide external confirmation of the ongoing tasks towards climate neutrality.

6 Annexes

Kraków

CLIMATE CITY CONTRACT OF KRAKOW

NET ZERO CITIES

EU MISSION PLATFORM | CLIMATE NEUTRAL AND SMART CITIES

Climate City Contract of Krakow

Commitments to climate neutrality by 2030

Kraków

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On initiative:

- Aleksander Miszalski, Mayor of the City of Krakow.

Manager of the Climate Contract development process:

- Andrzej Łazęcki (Director, Department of Municipal Economy and Climate),
- Małgorzata Starnowska (Deputy Director, Department of Municipal Economy and Climate).

Author Team:

- Grzegorz Grzybczyk (Department of Municipal Economy and Climate),
- Adam Stawiarski (Department of Municipal Economy and Climate).

Expert support:

On the NetZeroCities side:
- Justyna Wieczorkiewicz-Molendo (City Advisor),
- Anna Sokolowska (City Advisor).

World Bank experts.

On the part of the City of Kraków:
- Department of Utilities and Climate,
- Department of Strategy, Planning and Investment Monitoring,
- Air Quality Division,
- Urban Greening Authority,
- Representatives of the Zero Emission Krakow Portfolio Council,
- Representatives of the Advisory Panel of the “Zero Emission Krakow” Portfolio Board,
- Other representatives of Krakow City Hall departments, municipal organisational units and municipal companies of the Municipality of Krakow.

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1 Introduction

Vision for Krakow's future

Kraków of the future is an intelligent, environmentally friendly and sustainable city. By 2050, the city aims to develop as a dynamic metropolis that successfully combines modern technology with its historical and cultural heritage. Krakow will be a city that responds effectively to climate, social and economic challenges through active civic participation and widespread public awareness. Kraków's residents will co-create the city, nurturing its sustainability and social well-being while adapting to rapidly changing global realities. The city will benefit from the spread of artificial intelligence, allowing the development of innovative solutions in the field of computerisation and robotisation, while maintaining a high quality of life and respecting cultural heritage.

Mission of Krakow

The current "Kraków Development Strategy. This is where I want to live. Kraków 2030" defines Kraków's mission as one of the two most important cities in Poland. As the "locomotive" of Małopolska's development, Kraków makes important contributions in areas such as science, research, modern technology and regional innovation. As a strong European metropolis, Kraków focuses on building cooperation with other cities, which strengthens its international position.

Krakow also aspires to be a smart city in a wide range of aspects of city functioning, including:

- **Environment**: Krakow optimises energy consumption, protects the climate, reduces emissions and manages resources sustainably using modern technologies.
- **Governance**: smart governance is about competence, public participation, transparency and high quality public services. It also includes integrated governance with the participation of all residents and cooperation between the public and private sectors.
- **Quality of life**: The city provides residents with a welcoming living environment, access to public services (including online), education, health care, care for seniors, modern infrastructure, safety, a rich cultural offer and urban greenery.
- **Mobility**: the city has an integrated and safe transport system, using information and communication technologies to create an efficient network of connections.
- **Economy**: The smart economy is based on modern services, industry and R&D sectors, supports creative industries, demonstrates innovation, labour market flexibility and effective cooperation between science and business.

Kraków's vision and mission are focused on creating a sustainable, innovative and resident-friendly city, ready for the challenges of the future and able to adapt to change.

Climate crisis

The climate crisis is the greatest contemporary challenge, the negative effects of which affect millions of people around the world every year. In recent years, we have increasingly witnessed the effects of progressive climate change, often compounded by the consequences of the inevitable development of

vulnerable urban areas, such as an increase in development, population density and vehicle numbers, and, on the other hand, a decrease in the proportion of biologically active areas and disposable water resources. Both sudden, violent weather phenomena such as storms, flooding and waterlogging, as well as prolonged periods with high temperatures and droughts, will cause increasing material and economic losses and, above all, increasing risks to human life and health.

The results of scientific research and analysis indicate that these phenomena will worsen, posing a threat not only to the quality of life, but also to the social and economic development opportunities of many cities, regions and countries around the world. This research is reflected in the positions of governments and international organisations. In order to prevent the effects of climate change, each country should take long-term action to significantly reduce its greenhouse gas emissions as early as 2030.

The main climate threats facing Krakow are related to extreme temperatures (high maximum temperatures, heat waves amplified by urban heat islands), uneven distribution of precipitation (long periods without rain causing drought, torrential rain and floods), and poor air quality. Krakow, like other Polish cities, is consistently implementing a long-term strategy to adapt the city to climate change. By identifying the greatest threats and adopting long-term goals and commitments, Krakow is pursuing a systemic approach to climate transformation.

However, the city's action must not only focus on adaptation. It is also necessary to join in the fight against global warming. To this end, the Municipality of Krakow has expressed the ambition to achieve climate neutrality as soon as possible. It was therefore in the vital interest of the City of Krakow to join the European "*Mission of 100 Climate Neutral and Smart Cities by 2030*" in order to make the most of the opportunities it brings. Participation in the Mission is both a challenge and an opportunity for the city to maximise our efforts to achieve climate neutrality. The City of Krakow has the ambition to create a more sustainable urban environment and attractive, friendly urban areas to live, work and relax in harmony and harmony with the environment.

Strategic objectives

The current "Kraków Development Strategy. I want to live here. Kraków 2030" sets an important course of action in the context of environmental and climate protection - "Kraków 2030 is a liveable city". Specific goals include:

- **Universally accessible, high quality public space**: Create universally accessible spaces combining tradition and modernity, where squares, streets and parks will be attractive places for residents to meet and be active. Provision of high quality green spaces evenly distributed throughout the city.
- **Revitalised urban areas**: With the active participation of residents, reducing inequalities in living conditions, improving quality of life, revitalising local spaces, increasing economic activity and stimulating social and civic participation.
- **Environmental sustainability**: Care for a high quality environment, with a particular focus on improving air quality, reducing noise levels and reducing electromagnetic field emissions.
- **A citizen-friendly, efficient and environmentally friendly transport system**: Improve public transport, increase the share of environmentally **friendly** forms of mobility such as public

transport, walking and cycling. Reducing car traffic, especially transit traffic in the centre, and improving street safety.

- A **high level of security in Krakow**: Increasing the level and feeling of security through cooperation between services and institutions, involvement of citizens in prevention activities and securing the city against natural disasters, technical catastrophes and the effects of adverse climate change.
- **Universal implementation of healthy and active living**: Creating conditions for a healthy and active lifestyle, education on preventive health care and motivating residents to participate in sports and recreational activities. Promoting healthy ageing as a valuable development resource.

In the Municipality of Krakow an Integrated Management System STRADOM is in place and under development, covering the activities of the City Hall and large Municipal Organisational Units at the strategic and operational level. The aforementioned Krakow Development Strategy is the document superior to other Strategic Management Instruments (SMI) such as projects, project portfolios, programmes and policies. The Climate Contract for Krakow is prepared as one of the SMIs, at the policy level.

European Mission of 100 climate-neutral and smart cities by 2030

In February 2022, Krakow prepared an application to join a new EU initiative called *Mission 100 of Climate Neutral and Smart Cities by 2030.* Its aim is to support and promote 100 European cities in a systemic transformation towards climate neutrality and transform them into centres of experimentation and innovation.

On 28 April 2022, the European Commission announced the list of cities selected to participate in the mission. These are 100 cities from all 27 EU Member States, plus 12 cities from countries associated or potentially associated with Horizon Europe (2021-2027) for research and innovation. Krakow was among such metropolises as Paris, Lisbon, Munich, Dublin and Milan. 377 cities from across Europe applied to participate in the programme.

The selected cities are home to 12% of Europe's population. This included both larger and smaller centres - currently at different stages on the road to climate neutrality.

The aim of *the 'Mission of 100 Climate Neutral and Smart Cities'* is to implement transformational and innovative plans that will lead to climate neutrality by 2030. Mission Cities will act as hubs of experimentation and innovation to enable all European cities to follow suit by 2050. Mission Cities will involve local authorities, citizens, entrepreneurs, investors as well as regional and national authorities. For Mission Cities that want to become climate-neutral by 2030, a key point is the preparation of Climate Contracts, i.e. documents showing the pathway to achieving climate neutrality for the city.

The whole process will require several iterations of the Climate Contract between now and 2030, as outlined in the Mission (Figure 1). The document includes a number of actions, including establishing cities as EU leaders in large-scale research and innovation, establishing innovative urban governance models, involving citizens in the process and creating an investment plan. Such an approach, however, requires a great deal of flexibility, as much progress is currently taking place in the fields of climate and energy and more and more new solutions are available. It is therefore important for Krakow to be an

active participant in this process and to modify the actions included in the Contract on the basis of the based on the best available technical and organisational solutions.

Figure 1: Climate transformation map.
Source: NetZeroCities.

The Climate Transformation Map is a diagram that shows the seven most relevant stages of the Just Transition process. These are:

- gaining strong support (city authorities, local ecosystem, other levels of government),
- mapping and understanding of the system (data, dependencies and connections, future scenarios),
- portfolio building (synergy of activities, analysis of possible climate neutrality pathways),
- implementation of actions (tracking progress, implementation, common portfolio of actions),
- learning and reflection (taking the right direction, adapting, building a shared consciousness),
- new normality (replication, scaling, consolidation, formalisation),
- building an inclusive environment conducive to change.

The first six elements follow one another, stemming from one another, as it were. The seventh element brings them together and embeds them in a new reality. The climate contract describes an iterative process; it is not enough to go down this path once. Each of the elements described above must be repeated in successive cycles, bringing the city closer to climate neutrality.

The road to climate neutrality is yet to be pioneered by the cities involved in the Mission for 100 Climate Neutral and Smart Cities by 2030. In this context, learning is crucial to accelerate progress towards achieving climate neutrality in every city. Co-creation and testing to incrementally improve strategies and plans is the only way to discover the way forward when it is not clear. Achieving climate neutrality will require both rapid successes (readily available technologies and rapid implementation) and experimentation (in new areas) to refine and evolve strategies leading to full decarbonisation.

2 Goal: Climate neutrality by 2030

Goals of the Climate Contract

The ongoing climate crisis is manifested in the increasingly frequent observation of extreme weather events, which have a negative impact on the wellbeing of residents and can have long-term health effects. Krakow's ambitious goal of achieving climate neutrality is to make the city a cleaner and friendlier place to live in every aspect: living, working and relaxing. The city wants to offer everyone: residents and visitors alike more greenery, clean air and water and more efficient transport. Krakow is continuously working to accelerate a systemic transformation aimed at achieving climate neutrality, which will manifest itself in reducing greenhouse gas emissions to a minimum and implementing solutions for a clean and liveable environment. and resident-friendly environment.

As part of the First Krakow Climate Panel, organised in 2021, 32 recommendations were developed and submitted to the City authorities to tackle climate change in the coming decades. Climate neutrality is fully supported by the Krakow authorities and numerous social, scientific and business communities. The city authorities have announced that they will take all measures leading to the implementation of the recommendations and the achievement of climate neutrality.

The objective of the Climate Contract is to present a pathway for action to reduce greenhouse gas emissions by 80% relative to the base year (2018) by 2030**.** To achieve this the following parts of the Climate Contract take into account emission reduction options resulting from policies and strategies already in place at local, regional, national and EU level, and the remaining emissions gap was filled with local actions. All this is under the assumption that the barriers and risks described in the later parts of the document (Action Plan and Investment Plan) can be overcome.

The plan is prepared for emissions within the boundaries of the Municipality of Krakow and does not contain any territorial exclusions. Data for the base year comes from the Urban Greenhouse Gas Inventory developed in accordance with the GHG Protocol for Cities methodology at the BASIC level. The action pathways described in the following sections, on the other hand, refer to the sectors described in the Economic Model developed by the experts. A detailed description of the use of the individual data can be found in Part Two of the document - Action Plan, in the chapter 'Module A-1 GHG Baseline Inventory'.

Climate Contract for Krakow

The Krakow Contract is a document that demonstrates an approach to the gap between the projects already underway and planned for implementation, as well as the actions that result from national trends and developments, and the actions needed to achieve climate neutrality. It consists of three parts:

1 Commitments.

2 Action Plan.

3 Investment Plan.

The Contract comprehensively describes the city's pathway to climate neutrality. It is a document that shows what needs to be done to achieve the city's climate neutrality, while recognising the scale and complexity of the challenge and the difficulties that implementation may encounter. The Contract is a declaration of cooperation and action. The commitment is political and image. Contrary to its name, the contract is not a legally binding agreement.

The target adopted in the Climate Contract for Krakow is to reduce greenhouse gas emissions emissions by 80% by 2030 compared to 2018. A large part of the emission reduction (4,473 thousand tCO_2 e) (carbon dioxide equivalent) will result from actions implemented after 2018 or planned in strategic documents of the City and the Polish government. The contract contains a detailed description of 58 actions that should be taken to achieve additional emission reductions of 1,614 thousand tCO_2 e. The cost of these actions was estimated at 28,769 million PLN. However, the calculations of the Economic Model indicate that the total financial benefits, direct and indirect (reduced energy expenditure, health care, additional jobs, etc.) outweigh the costs of the transformation. Emission reductions will overwhelmingly result from from the implementation of national strategies, carried out by private actors: energy companies, businesses and building owners and managers.

Non-financial benefits of climate transformation

Contemporary cities are increasingly making efforts to achieve climate neutrality, aiming to reduce greenhouse gas emissions and adapt to climate change. However, these efforts do not only benefit the environment, but also local communities. The actions listed in the Action Plan to realise the provisions of the 100 Cities Mission have a range of non-financial benefits, which are as follows:

- The creation of new, well-paid jobs in the renewable energy, high-tech construction and high-tech industry sectors contributes to increasing employment opportunities for local communities. Such dynamics can result in a reduction in unemployment and stimulate the city's economic development, leading to an improved quality of life for residents in the long term. New jobs in innovative sectors offer not only better employment conditions, but also career opportunities in areas of the future that are key to the global economy. This makes the city more attractive to young people and professionals, which further fuels the local economy and innovation. Investment in renewable energy and energy efficiency directly benefits residents in the form of lower energy bills. This relieves household budgets, resulting in greater financial stability for people. In the long term, lower energy costs can also increase residents' savings, which can be allocated to other needs, improving the overall quality of life.

- Adaptation actions to reduce the urban heat island, such as the introduction of green roofs, the creation of urban parks and the planting of trees, contribute to reducing the effects of the heat. This not only improves the thermal comfort of residents, but also reduces the need for air conditioning, resulting in lower energy consumption. In addition, green roofs and urban parks contribute to the aesthetics of the city, creating a more pleasant and welcoming environment.

- Climate projects trigger an influx of external funding, which further supports the city's economic development. Investments stimulate new environmental initiatives

and the development of new technologies, strengthening the city's position as a leader in sustainable development. Attracting external capital not only supports local projects, but also creates the conditions for long-term cooperation with other cities and institutions around the world, which can lead to the exchange of knowledge and technology.

- Improved energy efficiency and access to cheaper energy contribute to the reduction of energy poverty, meaning that more residents have stable access to affordable energy. The lower cost of energy allows the poorest residents to improve their living conditions by eliminating situations where they have to choose between paying their energy bills and other basic needs. This increases the overall sense of social security in the city.

- Involving citizens in the co-creation of climate neutrality actions increases environmental awareness and builds public support for such initiatives. The development of public participation processes allows residents to actively participate in decisions concerning their environment, which strengthens the sense of community and responsibility for the environment. These initiatives can also lead to an increase in residents' trust in local authorities, which is crucial for the effective implementation of pro-environmental policies.

- Reducing emissions from traditional energy production and transport translates into improved air quality, which has a direct impact on residents' health. Cleaner air means a lower risk of respiratory and cardiovascular diseases, which contributes to an overall improvement in public health. In cities with high levels of pollution, emission reductions can lead to significant savings in the healthcare system through reduced hospitalisations and medical visits related to air pollution-related illnesses.

- Noise reduction through developed public transport and electric means of transport benefits the mental health of residents, creating a calmer and more comfortable urban environment. Less noise also promotes better sleep quality, which is crucial for health and well-being.

- Investments in infrastructure for public transport, bicycles and pedestrians result in reduced car traffic improving road safety. Fewer road accidents translate into the safety of residents, as well as reduced social and economic costs associated with treating victims and repairing infrastructure.

- An active lifestyle promoted by cycling and walking improves the physical and mental condition of residents, leading to an overall improvement in health. Regular physical activity is one of the key factors in the prevention of many chronic diseases such as obesity, diabetes and heart disease. Improving the health of residents can lead to a reduced burden on the healthcare system, benefiting the city as a whole.

- The development of green spaces, such as city parks and community gardens, not only improves the aesthetics of the city, but also offers places for recreation, relaxation and community gatherings. This increases residents' satisfaction and happiness. Green spaces also provide important places for physical activities such as jogging, walking or team games, which promotes a healthy lifestyle. In addition, such places foster social integration, strengthening interpersonal bonds and building a stronger local community.

- Green space development promotes the creation of new urban ecosystems, increasing biodiversity and creating new ecological links between areas. New structural linkages of green spaces can support the development of ecological corridors that allow the migration and survival of different species, contributing to the protection of biodiversity.

- The circular economy promotes the sustainable reuse of resources and the minimisation of waste, leading to the creation of new jobs and accelerating the development of the local economy. These transformations can increase the innovation of local businesses, which will have to adapt to new standards and requirements. These actions also promote environmental protection by reducing waste and increasing the efficiency of resource use.

- Promoting recycling and waste separation reduces the amount of waste sent to landfill, benefiting the environment and public health. An increase in recycling levels can also lead to the development of a local recycling industry, creating additional jobs and supporting the local economy. Education and awareness of the importance of recycling can also increase social responsibility
and green attitudes among residents.

- Training and education programmes related to climate neutrality contribute to an increase in the skills and qualifications of residents, which in turn leads to greater competitiveness in the labour market and increased personal development. Through these programmes, residents not only gain new professional skills, but also a better understanding of environmental problems and how to solve them. This in turn can inspire their own initiatives and projects that contribute to the further development of the city.

These changes make the city more friendly, healthy and sustainable, resulting in better lives for its residents. Climate transformation not only contributes to environmental protection, but also builds stronger, more integrated and happier communities. Each of these co-benefits forms part of a larger jigsaw puzzle aimed at creating the city of the future - a place where innovation, ecology and quality of life go hand in hand, creating a harmonious and sustainable space for all inhabitants.

3 Key strategic priorities and interventions

Priority 1 - Buildings

One of the priority goals of the City of Krakow in terms of achieving climate neutrality is to introduce thermal modernisation of buildings on a massive scale. This action aims to reduce emissions and improve the energy efficiency of buildings, which are one of the main sources of emissions in the city. In this context, the city is betting on the implementation of the Green Neighbourhood Model, a strategic experiment to implement a business model for deep thermo-modernisation of buildings.

To date, programmes offering grants and loans for home renovation have met with limited interest from both individual and institutional building owners, yielding only partial improvements in energy efficiency. To change this, Krakow intends to create a comprehensive thermo-modernisation programme that not only improves energy efficiency, but also unlocks additional benefits such as supply chain innovation, rapid data-driven learning, business development, job creation, health benefits and fuel poverty reduction.

The programme envisages a significant increase in the share of privately financed thermal modernisation, including through the ESCO (Energy Service Company) formula. In this formula, the ESCO finances the modernisation project and then recovers its outlay through staggered payments generated by the energy savings resulting from the project. Krakow is also promoting a comprehensive One Stop Shop (OSS) building retrofit service to speed up and facilitate the retrofit process by offering building owners a full service investment. The process is to be carried out at no cost to property owners, regardless of the type of ownership and use of the buildings. Large-scale actions also enable additional projects such as building climate resilience, creating co-working spaces and developing green and blue-green infrastructure in shared spaces. In this way, it will be possible to develop entire local communities, ensuring greater impact and citizen involvement, transforming the retrofit programme into a neighbourhood greening programme.

Large-scale thermal modernisation of buildings in Krakow, however, requires a complex approach and a variety of investment financing schemes. The city also plans to develop existing subsidy schemes and create new ones, including schemes using funds from the National Recovery Plan. A key element of the strategy is the *NEEST - NetZero Emission and Environmentally Sustainable Territories* project, which will bring ready-made technological solutions ready for immediate scaling and implementation in other urban quarters.

Historic buildings, which require special technical solutions, are of particular importance in the process of thermal modernisation. To this end, projects are being prepared to develop efficient and cost-effective methods of modernising these buildings.

Through such a comprehensive approach, Krakow can not only significantly reduce emissions, but also improve the quality of life of its residents by supporting the local economy, public health and social cohesion. Massive thermo-modernisation, as a key element of the zero carbon strategy, is a fundamental step towards creating a sustainable, friendly and modern city of the future.

Priority 2 - Renewable energy

The second priority objective for the City of Krakow in terms of achieving climate neutrality is to significantly increase the share of renewable energy sources (RES) in the city's energy mix. To achieve this, Krakow plans to develop individual electricity generation using private photovoltaic (PV) panels on the roofs of buildings and heat pumps for heat production.

Krakow should use more than 32% of the roof area of buildings in the city for the installation of PV installations, which includes industrial buildings and brownfield sites. For efficient implementation of PV installations, cooperation with conservationists will be necessary. The city plans to launch a support programme that will enable the preparation of comprehensive project documentation for the installation of RES on historic buildings. Currently, such a project is already being implemented by the municipal unit KEGW in the Nowa Huta Cultural Park.

The Municipality of Krakow actively promotes distributed energy generation by supporting prosumer initiatives, providing subsidies and advisory support. As a result, the growth rate of new PV installations is accelerating year on year. Between 2020 and 2021, more than 19% of newly connected installations had financial support from the Programme for the Development of Renewable Energy Sources in the Municipality of Krakow (PROZE). Significant funding for the intensification of existing programmes and the creation of new ones will come from the National Reconstruction Plan, allowing pilot and innovative RES projects to be implemented in the city. In 2020, only one in sixteen residential buildings in Kraków had PV installed, while in 2021 it will be one in eight. More than 90% of the current PV micro-installations in Kraków (as of 2023) were connected between 2020 and 2023.

Actions to increase the share of RES also include the use of heat pumps for heat production in buildings, with air source heat pumps predominating and some ground source heat pumps.

Many energy companies and enterprises, such as Krakow Municipal Holding, PGE EC S.A., MPEC, Tauron and PSE, are implementing their PV farm projects. However, due to the dense urban development of the city, it is necessary to intensify activities and to search for suitable areas for PV farms. Post-industrial areas such as ash and slag dumps have great potential. The Municipality of Krakow is also looking for new sites for PV farms in neighbouring municipalities, which creates new business opportunities in the metropolitan area. Companies will be established in the surrounding municipalities to lease land for PV installations and resell green energy. These investments are profitable thanks to the favourable conditions for solar energy in the foothills around Krakow.

Krakow is also participating in the ATELIER project, which aims to create Energy Positive Districts. This project aims to reduce CO_2 emissions by implementing local smart urban solutions, supporting sustainable, safe and accessible energy systems and promoting cooperation between partner cities. As part of the ATELIER project, Krakow aims to increase knowledge and skills in the development of integrated energy districts, organise a local "Innovation Atelier" and integrate renewable energy into the city's heating and cooling system.

The city will develop a plan to replicate the concept of Energy Positive Districts in selected areas, increasing resident and stakeholder involvement as a pathway to climate neutrality. Increasing the

share of RES in the city's energy mix is a key element of this strategy, contributing to the sustainable development of Krakow and improving the quality of life of its residents.

Priority 3 - Rail transport

The third priority objective for the city of Krakow in terms of achieving climate neutrality is the development of rail transport. A key element of this strategy is the development of a network of collision-free trams that allow rapid and reliable travel around the city without disruption from traffic. The construction of a metro is also planned, which could provide an alternative to the busiest routes and significantly relieve the burden on surface traffic. The increased accessibility of the tram network aims to reduce the need for car transport, which will contribute to reducing emissions and improving air quality. The new tram lines are to be fully integrated into the existing public transport infrastructure, providing convenient transfers and shorter journey times. By investing in modern tram rolling stock, Kraków is betting on ecological and energy-efficient solutions. Collision-free tram routes will allow increased speed and punctuality of journeys, encouraging residents to give up their cars in favour of public transport. The expansion of the tram infrastructure also provides for the development of green tracks, which will further reduce noise and improve urban aesthetics. In addition, the increased availability of trams and the planned metro will contribute to the sustainable development of the city by supporting emission-free mobility. As a result, Kraków is aiming to create a modern transport system that is friendly to both the environment and residents.

Priority 4 - The need for cooperation

The above priorities require cooperation and commitment, but they are also an opportunity to keep Krakow attractive to investors and make it a comfortable place to live. To attract highly skilled professionals, we need to offer development opportunities, a high standard of living and participation in the management and planning of the city's development. One of the biggest challenges of the transformation is to mobilise private capital and develop business models that combine public and private capital. The second key challenge is to ensure broad support and activity of different social groups: residents, entrepreneurs and researchers. That is why we are improving the tools of participation and dialogue: citizen panel, civic budget, financing of social initiatives, workshops with residents, consultation of solutions, education and consultancy.

The most numerous group needed to bring about accelerated change are citizens. Developing solutions with civil society to the challenges of achieving climate neutrality for the city is key. The Climate Contract between the City of Krakow and the European Commission requires the involvement of key stakeholders in the city, such as business and industry, the science and technology community, NGOs. Including their perspective on the city's achievement of climate neutrality early in the policy and decision-making processes will provide the city with valuable guidance and identify their role as partners in developing long-term, broad-based support for the *Mission of 100 Climate Neutral and Smart Cities by 2030*. In order to implement the Mission, it is also very important to develop a collaborative dialogue with the Polish government so that the actions taken are stronger and can gain wider public recognition and support.

4 Principles and process

Values and Principles

The implementation of the Climate Contract for Krakow will be transparent, accountable, open to new approaches, innovative and carried out with the involvement of many actors and citizens, in the form of participation and co-partnership.

The above approach results from the principles set out in the Krakow Development Strategy "Here I want to live. Kraków 2030", the principles of implementation of the Strategy and the strategic management documents subordinate to it.

The Contract shall be implemented in accordance with the standards of governance and public co-management specified in the Strategy, which in the context of achieving the city's development goals represent a set of overriding values shaping the way in which not only the Local Government of the City of Krakow, but also its social, economic and public partners act. The standards in question relate to: the responsibility of the city government to provide high quality services; the responsiveness of public officials to residents' problems; multi-lateral partnerships; adaptive management.

As a local government community, we are united in the need to refer to a set of norms to guide us in the management of the city, the implementation of public policies or in our daily dealings with citizens. By appealing to civic attitudes, the values and principles reinforce our sense of community.

Responsibility. Responsibility for actions, words. Respect for commitments and reliability. Responsibility also includes solidarity with others. It is also the efficiency of local government structures, understood as efficiency of action, responsibility for a high quality of life and public space.

Openness. Willingness to accept the new or the different - a person, an idea, an idea. Willingness to compromise on the vision and priorities for Krakow's development. Openness to new proposals for solving social issues. Openness towards visitors to Krakow; also openness towards the surrounding municipalities.

Social dialogue. Understood as encouragement and inspiration directed at residents to engage in and co-determine the development of the City. It takes into account the interests of different groups and builds effective communication mechanisms.

Building competitiveness. The entire development policy of the City should be directed towards the sustainable strengthening of its competitiveness, based on its own development resources. In the conditions of global competitiveness and mobility of capital, this means first and foremost investing in human and social capital, also the active involvement of entrepreneurs and investors, as it is on them that economic growth and investment depend the greatest extent of economic growth and investment.

Flexible response. A way of acting by the local government that makes it open and inviting to residents to undertake new activities and find solutions together. It is a guarantee of surviving crises and responding appropriately to emerging challenges and problems and problems.

Equal opportunities. This means equal access for residents, social groups and communities to the opportunities and opportunities provided by the City's development resources and potential.

Krakow Climate Citizen Assembly

Krakow is one of the few cities in Poland to have held two citizens' assemblies. These assemblies allow all selected citizens, representing a cross-section of society, to have their say - and not just those who usually participate in the city's activities anyway, due to their membership of an NGO or a group with particular interests. Their vote matters - the recommendations with the highest support are accepted by the mayor for implementation.

Very important in the context of the city's zero-carbon **agenda** was the **Krakow Climate Citizen Assembly**. This assembly involved many of Krakow's community groups to develop common goals for the city to achieve. It took place in 2021 and was dedicated to climate change and the city's climate neutrality. Its participants explored how authorities and residents could reduce energy consumption and increase the use of renewable energy.

As a result of its work, 32 high-quality recommendations were developed and submitted to the city authorities, which, according to the adopted assumptions, are binding for the Mayor of Krakow.

Recommendations concern many areas of city functioning. They are often interdisciplinary and cross-cutting in nature, which is why many municipal departments, teams and units are involved in their implementation. Their scope and subject matter vary, so each requires an individual approach and planning as well as the provision of financial resources for their implementation. One of the main recommendations is to develop a climate strategy for the city, which is this Climate Contract for the City of Krakow.

Krakow in cooperation with science and business

For years, Krakow has been consistently implementing actions to achieve climate neutrality by implementing sectoral programmes in various areas, such as increasing the use of renewable energy, energy efficiency or transport accessibility. The City of Kraków invites representatives from all walks of life, local government organisations, business, science and residents to participate in climate and environmental initiatives.

Krakow is implementing the Joint Purpose Agreement between the City of Krakow and the Krakow Science and Academic Centre signed by 21 entities (the Municipality of Krakow, members of the College of Rectors of Higher Education in Krakow, the Polish Academy of Arts and Sciences). The main objective of the document is to intensify cooperation with the Krakow Scientific and Academic Centre (KONA) and use its potential for the sustainable and smart development of Krakow, in line with the in line with the provisions of the Kraków Development Strategy "Here I want to live. Kraków 2030".

A draft Krakow Cooperation Programme with KONA for 2024-2029 has been prepared in accordance with the provisions of the Krakow Development Strategy "Here I want to live. Krakow 2030" and the

agreement for the implementation of a common goal concluded in 2021 between the Municipality of Krakow and representatives of the Krakow Science and Academic Centre.

Entrepreneurs, making efforts to achieve this ambitious goal, play a special role in Krakow's climate transformation process. The City of Krakow values and supports them, and encourages long-term cooperation in this area in the form of creating a platform for the exchange of experience between companies involved in climate action, the promotion of pro-climate solutions, promoting pro-climate solutions and ultimately reducing emissions from their operations.

In order to realise these assumptions, an initiative called *the Pact for the Climate* was created and addressed, among others, to Kraków's entrepreneurs, solemnly inaugurated at a meeting with representatives of the Kraków City Hall. During the meeting, representatives of participating companies had the opportunity to present good practices and the pro-climate and pro-environmental initiatives they undertake. This part of the meeting showed that the companies that responded positively to the city's initiative understand the urgent need to intensify their efforts to improve the quality of the environment, which is key to building a safe and healthy place to work and rest for all residents. They represent a great potential and a promise that green Krakow, through the joint efforts of the local government, business and other key Krakow communities, will soon become a reality.

Climate Contract process

The unit responsible for the creation of the Climate Contract is the Department of Municipal Economy and Climate of the City of Cracow, Municipal Infrastructure Department. Within the framework of intra-departmental cooperation, many of the data on the city's baseline were consulted with other departments of the Division, in particular the Department of Energy and the Department of Waste Management. During the development of the Climate Contract, the different versions were consulted with other municipal departments and units, such as Climate - Energy - Water Management, the Air Quality Department or the Strategy, Planning and Investment Monitoring Department.

As part of expert collaboration on climate change, a special team called the Zero Emission Krakow Portfolio Advisory Team has been established. This team consists of 18 experts from various sectors, including universities, NGOs, technology companies, energy institutions and the health and innovation sectors. The team also includes professors from technical and economic universities and representatives from energy organisations. A preliminary version of the Climate Contract Action Plan was presented to these experts for consultation, to which they introduced comments and suggestions and proposed some of the emission reduction actions in the Action Plan.

The work on the Contract was also assisted by a number of other external experts. A very strong substantive contribution was made by experts employed by NetZeroCities, in particular:

1. Experts from the University of Madrid, responsible for the preparation and development of the Economic Model, particularly Sean Murray and Julio Lumbreras.
2. NetZeroCities advisors, consulting on progress, discussing difficult issues and problems and organising training workshops for those responsible for the creation of the Contract - Justyna Wieczorkiewicz-Molendo and Anna Sokołowska.

3. Experts from the World Bank who provided numerous comments, amendments and advice affecting the readability of the Climate Contract, notably Marcel Ionescu-Heroiu, Ionut Tudor Maries, Codruta Nistor and Mariusz Krisztea.

In addition, work on the Contract was consulted with teams (*transition teams*) from other Polish cities participating in the 100 Cities Mission - Łódź, Rzeszów, Warsaw and Wrocław. As part of this cooperation, it was possible to work out a number of solutions taking into account national specificities. It has also resulted in cooperation with authorities at national level, including individual Polish ministries.

In the cooperation implemented at national level, a special place is given to the cooperation undertaken with ministries, in particular the Ministry of Climate and Environment, the Ministry of Funds and Regional Policy, the Ministry of Development and Technology and the Ministry of Science and Higher Education. This collaboration is sustained through specialised platforms, such as CapaCITIES, but also through face-to-face online and live meetings, in Warsaw, among representatives of ministries, Polish City Mission cities, with the support of NetZeroCities advisors and representatives of the European Commission. The aim of this collaboration is to trigger positive legal changes, much needed in terms of legislation for the implementation of pro-climate actions, but also to mobilise public capital to support action.

Future iterations of the Climate Contract

The first iteration of the Climate Contract is planned for two years after its adoption. It can be expected to introduce many changes and improvements, especially in the financing mechanisms for the actions described in the Investment Plan section. It is planned that the second iteration will take place in 2028, and in 2030 it is foreseen to check how far the objectives of the contract have been met.

Verifiability of progress towards the Climate Contract targets will be ensured by the City's Greenhouse Gas Inventory, which monitors the decrease in emissions in Krakow on an annual basis. On its basis it will be possible to assess at which stage of the transformation the city is currently at and how much remains to be done. In addition, there are plans to expand the Municipal Greenhouse Gas Inventory from the Basic to the Basic + level in the future. It is planned to expand this inventory to include separately distinguished emission sectors: Industrial Processes and Product Use (abbreviated IPPU) and Agriculture, Forestry and Other Land Use (abbreviated AFOLU), as well as additional greenhouse gases.

Essential information on relevant monitoring data will be provided by the city's STRADOM system. This system contains the key projects implemented in the city. Each of these projects, in turn, is assigned evaluation indicators to assess the degree of project implementation.

During the iteration, the 'Module A-2 Assessment of current strategic management strategies, policies and instruments' will be updated. Most of the documents described in this chapter are also subject to a two-year iteration cycle. Updates to the Climate Contract and progress within the implementation of the documents themselves will emerge from the re-review of policies and strategies.

Along with the two-year update period, the activities resulting from the from the module "B-2 Climate Neutrality Portfolio Design". The status of the tasks, whether they have been completed or to what extent, and any adjustments arising during project implementation will be determined.

Another important element in terms of the plan for future iterations is the information contained in the in reporting to the CDP (Climate Disclosure Project). CDP is a not-for-profit organisation that runs a global system for collecting and publishing data on the environmental impact of investors, companies, cities and regions. CDP is recognised as one of the world's most credible ranking organisations on this topic. In connection with our city's participation in the *Cities Race to Zero* campaign and *the Covenant of Mayors on Climate and Energy*, Krakow has been reporting on *climate* change adaptation and mitigation activities through the CDP since 2022. The monitoring of the score awarded to the city of Krakow each year will allow for external confirmation of the tasks implemented towards climate neutrality.

5 Contract signatures

To articulate a common commitment/agreement for all stakeholders who sign this Commitment to Climate Neutrality 2030 document.

Date of signature Name Signature

_____

Aleksander Miszalski - Mayor of the City of Krakow

6 Annex: Individual commitments of signatories

Detailed agreements , which set out the details of climate action between the municipality and other stakeholders (individuals, groups and institutions).