ACTION PLAN

Action plan to increase the energy efficiency
of public buildings located in the Krakow Metropolis

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1. Basic Information

Project	Sustainable Metropolitan Areas and the Role of the Edge City (SmartEdge)
Organization	Krakow Metropolis Association
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1.1. Project

The SmartEdge project is carried out in two stages. Stage I of it runs from 01/11/2018 to 30/11/2020, and stage II from 01/12/2020 to 30/11/2022. The project is created by eight partners from the metropolitan areas of Akershus, Barcelona, Brandenburg, Ilfov, Krakow, Milan and Stockholm, and the Romanian Ministry of Environment.

The basic assumption of the project is to determine the potential to reduce greenhouse gas emissions, and its main goal is to improve the implemented policies at the local and regional level, which will contribute to the improvement of low-emission economy in edge cities and their metropolitan regions.

The project provides for the transfer of good practices, mutual learning and experience in the field of innovative spatial planning tools, low-emission transport, as well as increasing the energy efficiency of public buildings using the potential of renewable energy sources.

1.2. Organization

The Krakow Metropolis Association is created by the City of Krakow and 14 surrounding communes: Biskupice, Czernichów, Igołomia – Wawrzeńczyce, Kocmyrzów – Luborzyca, Liszki, Michałowice, Mogilany, Niepołomice, Skawina, Świątniki Górne, Wieliczka, Wielka Wieś, Zabierzów, Zielonki. The Association was established on June 24, 2014 and serves as the Union of Integrated Territorial Investments in the Krakow Functional Area.

The basic goals of the Association are to strengthen cooperation and to use the potential of all its units, as well as to represent and advocate common interests within the tasks performed.

1.3. Metropolitan area

The Krakow Metropolitan Area is a part of the Małopolskie Voivodeship, which is located in the southern part of Poland and covers an area of 15,183 km^2, which makes it the 5th smallest voivodeship in Poland in terms of area, and the 4th one in the country in terms of the number of inhabitants (approximately 3.4. million people). There are 19 land districts and 3 magistrate districts, as well as 182 communes within the voivodeship.

The area of the Krakow Metropolis covers 1,276 km2 with the population of slightly more than 1 million inhabitants, so it constitutes only 8% of the entire voivodeship area, where over 31% of the entire voivodeship population lives. The average population of the metropolitan area is almost twice as high as the voivodship average, which is a significant challenge in the field of spatial planning, transport and energy balance policy. At the same time, this area, and particularly the central voivodeship city, is an important tourist, scientific and business center for the entire region, which generates additional activities in the field of transport routes, housing and service infrastructure.

The Metropolis is formed by 15 communes, 3 of which, i.e. Wieliczka, Skawina and Niepołomice, are coastal cities located in the southern and south-eastern part of the area. Within the Krakow Metropolis, the visible boundaries between municipalities are blurring, which is related to the urban sprawl and the change in nature of the communes near Krakow into suburban ones. As a consequence, the challenges for the communes in the field of spatial planning are changing as well, and there is also the aspect of the importance of regional cooperation within jointly selected development directions.

1.4. Challenges for the region in terms of energy efficiency

The main environmental problem, especially noticeable in winter, is a poor air quality. In the entire voivodeship there are periods of exceeding the permissible levels for substances polluting the atmospheric air, including particular matters 10 (PM10) and 2.5 (PM2.5), as well as benzo(a)pyrene. Surface emission from residential buildings is responsible for these exceedances in over 70%. Only in the case of nitrogen oxides, surface emission has a negligible effect, up several percent.

The problem of low emissions is related to the greenhouse gases emission, insufficient energy efficiency of buildings and the lack of thermo-modernization in all of them, as well as the still

relatively low share of renewable or low-emission energy sources. Therefore, these problems should be treated jointly, and any measures that reduce energy consumption or change of the heating source of buildings in the municipal and housing sector and public institutions constitute a significant challenge contributing to the reduction of all the previously described negative environmental effects.

In the Inventory research on Metropolitan governance, from August 2018, the need to introduce the base of energy efficiency and energy consumption in the area of the entire Metropolis was indicated. This can be implemented based on the practice developed in the city of Krakow. At the same time, in the same document, a weakness was also indicated in the form of the lack of appropriate instructions and standards also in the approach to energy efficiency, as well as the lack of long-term planning and activities beyond the four-year period of office of local government units.

The challenge for the region, indicated in the Inventory research: **Renewable energy and energy systems and buildings**, from January 2020, as well as in the Low-Emission Economy Plans of the communes creating the Krakow Metropolis, is an insufficient heat insulation of buildings, most of which come from 1945-1988 and have building envelopes not meeting the current technical conditions.

The analysis of documents allows to determine that it is necessary to carry out the following types of activities in public buildings:

- Reduction of heating energy consumption through the thermo-modernization measures.
- Reduction of heating energy consumption through the modernization of systems and heat sources or the preparation of domestic hot water.
- Reduction of electricity consumption through the modernization of lighting sources, ventilation systems and equipment used in buildings.
- Reduction of primary energy consumption through the use of renewable energy sources.
- Improvement of thermal comfort and quality of buildings utilization through the use of cooling and mechanical ventilation systems.

According to the above study, it is possible to reduce the current energy consumption in a typical building by up to 60%, which will significantly contribute to the reduction of pollutant

emissions as well as the reduction of exploitation costs of the facilities. However, it should be noted that the thermo-modernization programs for public buildings implemented in recent years in the Communes have contributed to a significant improvement in their energy efficiency, therefore only some of them will require additional measures.

1.5. Purpose of the document

The main purpose of the document is to indicate within the area of energy efficiency, activities to be taken by the Communes forming the Krakow Metropolis, contributing to the improvement of thermal comfort of public buildings, reducing the costs of their utilization and reducing their impact on the environment.

Intermediate targets will be achieved within this goal in the form of:

1. Optimalization of energy costs in public buildings,
2. Reduction of energy demand through the implementation of planned investment activities and educational activities among users,
3. Creation of a plan of investment activities in public buildings of the Krakow Metropolis,
4. Cooperation of associated members on the implementation of the effects of joint experiences related to the management of public buildings,
5. Reduction of carbon dioxide emissions and pollution from public utilization facilities.

2. Context of the European Union policy

The action plan aims to influence:	Other regional development policy instrument
Name of the policy instruments concerned by the project	Air Protection Program for the Małopolskie Voivodeship - Małopolska in a healthy atmosphere

It is assumed that the activities developed under this document are supposed to contribute to the improved implementation of the Air Protection Program of the Małopolskie Voivodeship. Moreover, action undertaken in the Plan will have a wider impact, since it concerns energy policy instruments at a local, supra-local and regional level.

In the course of the project and as a result of discussions with the Regional Stakeholder Group, it was decided to change the policy instrument originally addressed in the project. The Action Plan is now addressing an instrument that was recently approved – the Air Quality Plan for Małopolska Region – Małopolska in a healthy atmosphere. The policy instrument initially addressed (Regional Operational Programme for the Małopolska Region 2014 - 2020 – Priority Axis 4. Regional Energy Policy) cannot be influenced anymore. The majority of the tasks implemented under the programme has already been completed, therefore implementing the Action Plan would not be able to cause an substantial change. However, lessons learned from the implementation of the Action Plan can be used as a basis for a recommendation to the new Operational Programme for 2021-2027 perspective. Nevertheless, for the next two years Krakow Metropolis Association will be focusing on implementing the Action Plan in order to influence the tools for implementation of a different regional policy which is the Air Protection Program for the Małopolskie Voivodeship.

At the same time, the proposed activities should be compliant with strategic documents from the EU and national levels, as well as other voivodeship documents. Ensuring the coherence of the Action Plan with the energy policy documents of the international, national and local level is the basic determinant properly define the version of development and directions of activities in the field of energy efficiency in the analyzed area. Moreover, a compliance with the documents approved and applicable in a given area is necessary to maintain investment cohesion and to correctly define the long-term vision of the analyzed area development.

2.1. Linkage with strategic documents of the European Union

Europe 2020 A strategy for smart, sustainable and inclusive development

Planned measures to increase the energy efficiency of buildings are in line with the priority indicated in the above Strategy – sustainable development of cities – in terms of reducing emissions of greenhouse gases and other pollutants, using renewable energy sources and reducing final energy consumption.

Directive on energy consumption

The directive includes a plan to reduce energy consumption. On the basis of its provisions, the Regulation of the Minister of Infrastructure of April 12, 2002 on technical conditions to be met by buildings and their location was introduced (currently Journal of Laws 2019, item 1065 and the Regulation of the Minister of Development of September 16, 2020 – Journal of Laws 2020, item 1608), in which specific requirements for newly built and modernized public buildings were determined. Currently, for buildings in the public resource, the requirements of WT standard must be met, where the primary energy ratio for public buildings serving as healthcare is below 190 kWh/(m^2*year), and for other public buildings – 45 kWh/(m^2*year) and the maximum heat transfer coefficients for building envelopes have been introduced.

2.2. Linkage with national documents

National Development Strategy 2020

This Action Plan is consistent with the basic goal of the Strategy, which is the development of cities as places that are friendlier to live in, with a lower impact on the environment, and their development, in accordance with the requirements of environmental protection.

Polish energy policy until 2030

The policy presents a strategy in the field of energy technology, in accordance with the adopted provisions of the climate and energy package of the European Union, and forecasts the direction of improving energy efficiency through the modernization of outdated heating systems, industry and distribution networks, implementation of thermo-modernization works, and construction of highly-efficient generative units.

National Strategy for Regional Development 2030

The National Strategy indicates a new model of regional development of Poland as a socially and territorially balanced country, and also indicated the Goal. 3 – Increasing the quality of management and implementation of territorially oriented policies, under which it is necessary to strengthen the administration potential for the development management

and to strengthen the cooperation on the local, regional and supra-regional levels. The ideals indicated in this Action Plan contribute to the improvement of cooperation and transfer of experience between the Communes forming the Association.

National Spatial Development Concept 2030

An important element of the function of urban areas is an appropriate spatial development policy, as well as directing the transformations in a way that has the least impact on the natural environment. The activities planned in this document are consistent with the Goal number 5 of the National Spatial Development Concept – Increasing the resilience of the spatial structure to natural threats and loss of energy security, shaping special structures supporting the national defense capabilities.

2.3. Linkage with regional documents

Strategy for Voivodeship Development „Małopolska 2030" - Project

This document is consistent with the Environment Area, which provides for activities focused on improving air quality, renewable energy and energy efficiency of Małopolska, as well as with the Sustainable territorial development Area, which presents activities aimed at properly planned spatial development and intraregional cohesion.

Plan to decommission coal-fired boilers in the Krakow Metropolis by 2022

The document adopted by the Communes of the Metropolitan Association, which is to contribute to the improvement of air quality in the region, and also indirectly to the improvement of the heat generation efficiency in all buildings previously heated with solid fuel. The activities planned under this document will contribute to obtaining the rules and procedures for proper verification of the energy class of public buildings, they can be also transferred to the lands of residential buildings or enterprises.

Anti-smog resolution for Małopolska

The resolution introduces restrictions and prohibitions in the area of the exploitation of installations in which fuel is combusted in order to prevent negative impact on human health and the environment. As part of the resolution, provisions were introduced to support the decommissioning of solid fuel boilers, as well as the implementation of activities contributing to the reduction of energy consumption in buildings, and thus improvement of energy efficiency, which is also reflected in this Action Plan.

2.3.1. Air Protection Program for the Małopolskie Voivodeship

The document was adopted by the Resolution of Małopolska Voivodeship Assembly no. XXV/373/20 of September 28, 2020, it was developed in connection with exceeding the air quality standards in the Małopolskie Voivodeship in 2018. Its integral part is the short-term action Plan.

The aim of the Program is to identify/ the reasons for exceeding the permissible and target levels of particular matter, nitrogen dioxide and benzo(a)pyrene, and to designate corrective actions by 2023. The document covers three air quality zones: the Krakow agglomeration zone, the Tarnów city zone and the Małopolska zone.

Basic directions assumed in the Air Protection Program are actions in the field of reducing low emissions and improving energy efficiency, reducing emissions in the transport sector and economic activity. From the point of view of this Action Plan, the first area is the most important, i.e. reducing low emissions and improving energy efficiency, in which individual tasks are listed by entities:

- Public Institutions – lack of financing of carbon sources in terms of subsidies for residents and ensuring adequate levels of covering the demand for electricity through renewable energy sources.
- Commune heads, mayors and presidents – maintenance of the Clear Air Program service point and employment, as well as maintenance, of the Eco-consultant; conducting information campaigns, heat sources inventories and controls of observing air protection regulations along with carrying out activities to support residents suffering from energy poverty and updating planning documents.
- Poviat starosts – employment and maintenance of the Eco-consultant, conducting information campaigns and allocating part of own income to support activities related to air protection.
- The Board of the Małopolskie Voivodeship and the Małopolska Voivodeship Assembly – co-financing of pro-ecological investments in the voivodeship, preparing and adopting anti-smog resolutions, coordinating and monitoring the implementation of the Air Protection Program, as well as cooperating with other entities, or information activities.

The Action Plan also directly influences the goal of the Air Protection Program, which is to cover all energy used in public buildings by renewable energy sources by 2025. Meeting this goal will require a proper inventory of currently installed capacities, as well as determining the demand, potential and costs of this investment.

Planned actions contributing to the improvement of the policy instrument

In the planned remedial and long-term actions of the Air Protection Program for the Małopolskie Voivodeship, many points have been introduced to improve the energy efficiency of public buildings, both through the modernization of heating sources, the use of renewable energy sources, and the implementation of thermo-modernization measures.

However, in order to properly implement these actions, it is necessary to prepare an inventory of public buildings owned and to determine the level of energy consumption in each of them every year, as well as to keep the record of these data on a multiannual basis. The steady analysis of the energy carriers consumption in each building in the public resource, the designated procedure for collecting these data, as well as monitoring levels, will enable the determination of simplified energy balances and will be the basis for qualifying a given building for appropriate modernization activities.

At the regional level, this data can be used in the case of subsidy or loan programs that will reward activities in buildings with a low energy efficiency class, as the objects having the greatest negative impact on the quality of the atmospheric air.

3. Envisaged actions

The analysis of the area, connections and functions, as well as the determined challenges in the field of energy efficiency, made it possible to define actions, the implementation of which will result in obtaining the results specified in this document. These activities will also enable the full use of the possibilities of cooperation between the units forming the Krakow Metropolis, as well as they will become recommendations for the entire Małopolskie Voivodeship, allowing the region to go towards a low-emission economy, in which public buildings have a high energy standard.

The aim of the action is **to improve the thermal comfort of public buildings, reduce the costs of their use and reduce their environmental impact.**

As part of this goal, intermediate targets will be achieved in the form of:

1. Optimization of energy costs in public buildings,
2. Reducing the demand for energy by implementing planned investment activities and educational activities among users,
3. Creating a plan of investment activities in public buildings of the Krakow Metropolis,
4. Cooperation of associated members on the implementation of the effects of common experiences related to the management of public buildings,
5. Reducing carbon dioxide emissions and pollution from public facilities.

Action name:

Energy Management System of the Krakow Metropolis

Compliance with the project

The action is fully consistent with the designated goal of the SmartEdge project, i.e. determining the potential for reducing greenhouse gas emissions, including reducing heat and electricity consumption. Moreover, it is expected that the action may be a recommendation for the improvement of the regional policy instruments in the field of air protection.

At the same time, it is inspired by the good practice of the Energy Observatory of the Metropolitan Area of Barcelona project, as well as the meetings of employees responsible for energy management in individual communes developed within the Krakow Metropolis.

Moreover, the action is also based on the system implemented within the public buildings of the City of Krakow.

Context and description of the action

The task of the system is to collect data on the consumption of electricity, fuel gases and solid fuels, as well as heat in public buildings, along with their cyclical assessment in terms of capturing anomalies and implementing improvement actions. The collected data will be recalculated in terms of energy, economic and environmental efficiency, which will allow to compare different types of objects, as well as developing a support tool for the most demanding investments. The action will support the process of implementing the investment policy of the area, as well as indicate priority activities and potential savings.

The action covers the creation of an inventory database of public buildings in the resources of the Communes forming the Krakow Metropolis, as well as the cyclical assessment of the consumption of heat and electricity carriers in each of these facilities. This assessment will be carried out as part of a joint analysis, along with visualization and designated efficiency assessment indicators.

The implementation of the Energy Management System will be carried out at three organizational levels, i.e. the level of the facility, the level of the Commune and the level of the Metropolis. At each level, responsible persons will be identified, along with their roles and time to complete their tasks. In order to shorten the necessary access to data, it is necessary to create a monitoring system based on cooperation with companies such as TAURON, PSG which are supplying energy and fuel to buildings.

The first task will be to make an inventory of the facilities in terms of the available heat sources, as well as the characteristics of the building envelopes. Then, only surveys will be carried out collecting information for the current assessment of the facility in terms of 4 areas:

- **Energy and heat consumption** – data will be obtained from the readings of meters, purchase invoices or heat carrier acceptance protocols. The evaluation will be conducted through the periodic survey (Appendix 1).
- **Exploitation costs** – data will be obtained from purchase invoices, and their evaluation will be carried out cyclically – as in the case of the first point, through the survey.

- **Environmental impact** – conversion data based on the readings of energy and heat consumption, as well as ecological indicators published annually by National Centre for Emissions Management (KOBIZE). For each building, the emissions of greenhouse gases and pollutants based on the fuel used will be presented. In order to make a proper comparison, a common methodology of calculating these indicators will be adopted (the procedure, formulas and source of indicators for evaluation will be determined).
- **Energy efficiency** – data obtained through the survey will be calculated in a way that allows the comparison of consumption per m^2 or m^3 of each facility. In this area, the costs of the facility operation will also be verified, as well as the comparison of the purchase costs of individual heat carriers as well converted to m^2 i m^3.

As part of the above-mentioned areas, conversions, calculations and data visualizations will be carried out, allowing for the evaluation of each building in a time function, as well as all buildings through energy efficiency indicators.

The surveys will be filled in the shortest possible cycles, with the recommendation of three-month periods. If a three-month assessment is not possible, it will be updated on a semi-annual or annual basis. However, reducing the intensity of the survey will not make it possible to compare different periods of the year (e.g. summer and winter). These periods will have fixed report submission dates, regardless of the length of administrating a given facility or the transition to a municipal resource during a given period.

The data will be aggregated in the same periods, the assessment according to the 4 criteria indicated above is recommended at least once a year, it is advisable to analyze consumption twice a year.

The action covers all buildings in the municipal resource, i.e. public buildings, municipal and social housing, farm and storage buildings.

As part of the action, an information base on the costs of functioning of the facilities will also be created, which may contribute to the implementation of the joint purchasing system in public buildings, which will enable to obtain savings related to a greater purchase volume.

The stages of task implementation include:

STAGE I

Appointing people responsible for the implementation of processes at each level.

STAGE II

Base inventory of public facilities in several Communes (can be made based on the available data, in this case only an update for December 31, 2020 is required):

- Facility survey.
- Data aggregation.
- Establishing indicators for monitoring and defining basis values.

Designation of indicators for facility monitoring.

STAGE III

Base inventory of public facilities in other Communes, as well as analysis of the model survey and discussion on its final shape along with a sample collection of data from the full 12-month period.

STAGE IV

Implementation of system improvements.

It is also possible to implement a parallel extended version of this action, with obtaining external funds, or under the simplified ESCO formula, i.e. by transferring some of the savings generated thanks to the implementation of the action. It includes the creation of an IT system that will enable aggregation and proper data visualization in an automatic manner, as well as the creation of a website accessible to all residents in order to learn about the effects of this action.

The system will consist of three elements:

- Base system, involving building panel and updating utilities consumption, including electronic survey.
- Additional elements: an extensive calculator panel and a report panel.
- Additional elements: a map with the buildings location along with the updating of data aggregated within the system for the data visualization purpose.

The basis of the base system will be the base and inventory survey and the building panel. The base survey will introduce the building to the system (e.g. new building, purchased

building), and the inventory survey will update the data (if modernization has been performed) and add consumption data for the updated period. The system will also:

- Send prompt notes to complete surveys,
- Generate reminders for people responsible for and supervising the process.
- Enable privilege distribution (FACILITY level will be able to edit only its own records, COMMUNE level - only municipal records, METROPOLIS level – all of them).
- Enable to generate statements in Excel format and summaries for a building.

Additional elements: The expanded calculator panel and report panel will allow to add new reports, as well as generate profiles based on them.

Additional elements: the spatial map with the updating of data aggregated within the system for the purpose of their visualization will be used to present the data in a panel available to residents and other stakeholders, and will also allow to generate values for import to external GIS systems.

Before implementing the system, it is recommended to define its functionality in detail and create documentation. The scheme of the action implementation, as well as the people responsible for the implementation at each level, are presented in Annex no. 2.

An additional element of the task, which will increase the involvement of building users, and will also have an educational character, will be the possibility of transferring a part of the generated heating cost savings in the form of a reward for buildings/institutions. The generated savings may result from changes in the habits of users, related to, for example, using temperature reductions during the hours when it is not used, correcting the impact of shading the surrounding greenery on energy gains or limiting excessive lighting in rooms. Ideas and recommendations for actions can be developed through the transfer of experiences and good practices, and will also contribute to the developed handbook fulfilling an educational function for the entire local community. On the website, there will be a meter showing energy and cost savings, and by voting among users, each facility will be able to set the goal for which a part of the generated funds will be allocated. Consequently, users of the facilities will have the opportunity to measure and observe the real impact of their actions.

Stakeholders

Due to the nature of the project, it is planned to establish three organizational levels, which simultaneously describe the degree of involvement in individual processes:

- **Level I – Facility** – includes the level of data collection in facilities, it will be necessary to designate a person responsible for passing the data. At this level, there will also be an initial verification of possible deviations as well as an indication of the reasons for other consumption levels. In this case, it is recommended to designate an employee employed in the facility who has full information about the functioning and will facilitate the analysis of possible deviations. It is also possible to introduce an additional level in large local governments, where, for example, the data of a group of facilities would be aggregated by a superior unit (e.g. by units serving schools).
- **Level II – Commune** – includes the level of collecting and aggregating data of a given Partner in all facilities. A person responsible for providing data on the consumption of electricity and heat carriers in each of the communes will be appointed. At this level, there will also be an in-depth verification of possible deviations compared to other facilities and previous periods. An employee employed in the Commune has full information regarding all public facilities and, due to the cooperation with people responsible for municipal investments and decision makers, constitutes the level of the stakeholder most interested in the implementation of actions reducing the costs of facility operation.
- **Level III – Metropolis** – At the level of the Association, a person responsible for the analysis and collection of data on the consumption of electricity and heat carriers at the level of the entire Metropolis will be appointed.
- At this level, there will also be an in-depth verification of possible deviations compared to typical facilities between the Communes, as well as previous periods. This person will also be able to open discussion panels with Communes representatives. An employee employed in the Krakow Metropolis will have full information about all public facilities in the region and constitutes the level of the stakeholder responsible for the implementation of the action, as well as verification of the adopted indicators.

The scheme of the action implementation, as well as the people responsible for its implementation at each level, is presented in Annex no. 2 of this document.

Energy companies are an additional stakeholder. They can support and accelerate data acquisition.

Timeframe

The action implementation will be conducted in the period of 2021-2022 within the following stages:

STAGE I
(from the plan approval to the end of the second quarter of 2021)

Appointing the people responsible for the implementation of processes at each level.

STAGE II
(from the first to the second quarter of 2021)

Base inventory of public facilities in several Communes (can be made based on the available data, in this case only an update for December 31, 2020 is required). The inventory will be divided into two stages. Some Communes will implement it as part of a pilot, others as part of proper activities.

STAGE III
(from the third quarter of 2021 to the third quarter of 2022)

Analysis of the introduced tool.

STAGE IV
(until the fourth quarter of 2022)

Implementation of system improvements.

At the same time, the recommendation process for the improvement of actions in the local air protection policy will be conducted.

Projected costs

It is projected that the process will involve people currently employed within the various units involved in the activities as part of their official duties. Therefore, no additional employee costs are expected to be carried for the action implementation. However, it should be consulted that the implementation of the survey and the preparation of summary reports by these people will be a time-consuming task, carried out in addition to the current official duties. Therefore, there

is a possible need to employ additional people or a greater automation of the process, described as a possible stage II of the action.

It is planned to carry the costs of meetings and additional expertise. Energy audits are optional element of supporting the action implementation. Audits can be implemented by municipalities depending on the resources available. In order to implement the Plan, it is sufficient to have a building energy performance certificate. or an appropriate baseline survey.

The estimated costs in this regard are:

- Energy audit of the facility: from PLN 4,000 to PLN 10,000 net for the building.
- Additional consultancy: PLN 140 net per men-hour.
- Cost of the meeting at the office of the Association or the selected Partner: no-cost, exclusive of the travel expanses of the representatives.

Additionally, it can be estimated that in each Commune, it will be necessary to perform the indicated tasks by an employee of the Commune, the time and cost of which will vary depending on the number of public facilities owned, as well as the report submission period. It is expected that this cost will be approximately PLN 3,000 net per month in each Commune.

The implementation of additional elements in the form of a system for information collection and analysis covers costs in the amount of:

- System documentation: PLN 12,000 net,
- Base system, including the building panel and the updating of utilities consumption: approx. PLN 45,000 net,
- GIS map with updating data aggregated within the system: approx. PLN 35,000 net,
- Calculator and report panel: approx. PLN 30,000 net.

Sources of finance

The financing will come from the internal funds of the Communes and the Krakow Metropolis. In the case of applying for external financing, sources may be funds from the EIB for energy transformation activities, or funds from the Ministry of Development, the Ministry of Digital Affairs, the National Fund for Environmental Protection and Water Management, coming from Norwegian funds or the Regional Operational Program for 2021-2027. Specific information on the possibility of financing individual tasks should be developed on an ongoing basis, based

on the updated call for proposals schedules. At the same time, it is possible to include a project in the Regional Strategies as a key project in non-competitive formulas.

Monitoring description

Monitoring of the action will be carried out through cyclical, quarterly meetings of representatives of Communes and people involved in the Krakow Metropolis, in accordance with the presented schedule.

The primary monitoring tool will be the indicators defined in the fourth area of the assessment (**Energy efficiency**). The most important ones are:

- Heating costs in PLN/m^2 and PLN/m^3.
- Electricity consumption costs in PLN/m^2 and PLN/m^3.
- Final and primary energy demand in kWh/(m^2*year) calculated on the basis of energy consumption and the adequate emission and primary energy indicators.
- Renewable energy sources share in the final energy of the building in %,
- Water consumption in liters/user or liters/m^2.

These indicators should be analyzed in relation to the base year (i.e. up to the year of the initial survey) and to the following periods. Each of the deviations (both from the base value as well as between periods) should be analyzed and commented on in the report/analysis of the given period.

Additionally, it is proposed to introduce indicators that will enable to assess the building in terms of energy demand. For this purpose, it is recommended to stay consistent with the Technical Conditions, scientific studies and to refer them to the conditions prevailing among the Partners. For this purpose, it is necessary to create a base inventory and divide the facilities into groups (e.g. schools, public buildings, etc.).

4. Recommendations and summary

The basic direction indicated in this Plan is to create a tool to improve the energy efficiency of public buildings in the Krakow Metropolitan Area. The aim is to develop procedures as well as to increase the competencies of people responsible at the level of the facility, Commune and Metropolis in the field of energy policy, which will enable the improvement of decision-making processes.

As part of this plan, it is envisaged to ultimately obtain a product, which will be the survey for public buildings, as well as to develop the data collection system with an indication of good practices, indicators of the public buildings efficiency, and to designate areas where there is a possibility of improving this efficiency. There is a possibility of expansion and greater automation of the system, which should constitute a potential second implementation stage.

The recommendation of this document is to introduce improvements to the actions specified under the regional air protection policy, as well as to create a description of good practices, experiences and recommendations for the implementation of this action in other communes of the voivodeship. Consequently, as part of the action, a guide will be created containing guidelines for energy management of public buildings.

Benefits of implementation

Conducting the activities planned in this Plan will enable to create a wide base of public buildings located within the Krakow Metropolis, specifying those in which it is necessary to undertake modernization activities that will allow to meet the basic goal of increasing energy efficiency. Cooperation within a wide range of people dealing with the subject of public infrastructure, as well as the use of mutual experiences and practices, will enable to obtain the real environmental (by reducing the emission of pollutants into the air), energy (by reducing the consumption of heat and energy in buildings), and also exploitative benefits (by reducing the exploitation costs of these facilities).

As a consequence, the Action Plan implementation will provide a tool for officials of the Communes forming the Metropolis to plan their energy policy, mutual, positive competition between Communes and public facilities, as well as increasing the environmental awareness of users, local communities and property managers. The implementation of additional IT elements will increase the scope of the project impact on the residents of other communes

of the voivodeship, and the entire project may constitute a reference and goal for other areas of the country.

In a long-term perspective, the Action Plan, along with the recommended thermo-modernization works, will lead to achieving a low-emission public infrastructure in the Metropolis area with a minimal impact on the environment and high thermal comfort of its users.

The Krakow Metropolis Association confirms that it will promote the implementation of the plan described in this document.

I confirm that I have the legally required authorization to act on behalf of the Association, and that the authorization process was carried out properly.

Date:	
Organization name:	
Signatures of representatives:	