

Inventory

Renewable energy and energy systems and buildings

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POLICY TARGETS

1. Which policy goals does your organization/country have regarding the use of renewable energies in buildings?

State policy goals

The most important strategic document in which the policy objectives for the use of renewable energy are indicated is the **Poland Energy Policy 2030** (PEP 2030). Today, 80% of electricity in Poland is produced from hard coal and lignite coal. The main goal is the reduction of the emission intensity and the diversification of energy sources. The general targets are, among others, to increase the **share of RES** in the final energy consumption to at least **20% in 2030**. As part of the EU target for 2030, Poland declared a 21% share of RES in final gross energy consumption.¹

PEP 2030 sets out the strategic directions for the development and modernization of the sector. It identified six priority directions, including **improvement of energy efficiency** and **development of renewable energy acquisition**. For each of these directions, the main and specific objectives were set, actions indicated, and the results of these actions forecasted.

In regard to the priority "**energy efficiency improvement**", the main objectives of PEP include **zero-energy economic growth** (i.e. development of the economy without increasing the demand for primary energy) and reduction of energy consumption to the EU-15 level.

Regarding the priority of "**renewable energy acquisition**", the objectives include, inter alia, an increase in the share of renewable energy in final energy consumption to **15% in 2020**.

In the section of PEP which is devoted to the improvement of energy efficiency, the need for the public sector to play an exemplary role is stressed. **Local governments** are to engage in the implementation of PEP by maintaining their statutory activities in compliance with PEP priorities, and the correlation of their investment plans with the investment plans of energy enterprises.

Currently, the new **Poland Energy Policy 2040** (Draft PEP 2040) is being prepared.

The second strategic document for the Polish energy sector, in addition to the long-awaited Poland Energy Policy 2040, is the **National Energy and Climate Plan for the years 2021-2030** (NECP PL); it was submitted to the European Commission on December 30, 2019² and has been developed in fulfilment of the obligation set out in Regulation (EU) 2018/1999 of the European Parliament; and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action.³ The key priority of the NECP is to present a national strategy for achieving jointly agreed targets within the EU. It defines objectives and determines measures and actions to achieve them.

NECP PL sets the following climate and energy goals for 2030:

- -7% reduction in greenhouse gas emissions in non-ETS sectors compared to 2005 levels
- the share of coal in electricity production to be reduced to 56-60%

¹ PEP 2030 – Polityka energetyczna Polski do 2030 roku; Załącznik do uchwały nr 202/2009 Rady Ministrów z dnia 10 listopada 2009 r.

² NECP PL – Ministerstwo Aktywów Państwowych, National Energy and Climate Plan for the years 2021-2030.

<https://www.gov.pl/web/aktywa-panstwowe/national-energy-and-climate-plan-for-the-years-2021-2030>

³ Rozporządzenie Parlamentu Europejskiego i Rady (UE) 2018/1999 z dnia 11 grudnia 2018 r. w sprawie zarządzania unią energetyczną i działaniami w dziedzinie klimatu.

- 21-23% share of renewable energy sources in final gross energy consumption (the government points out that the 23% target will be possible if additional EU funds are allocated to Poland, including those allocated to a just transformation), considering:
 - 14% RES share in transport,
 - an annual average increase in the share of renewable energy in heating and cooling by 1.1 percentage,
- 23% increase in energy efficiency compared to PRIMES2007 forecasts.

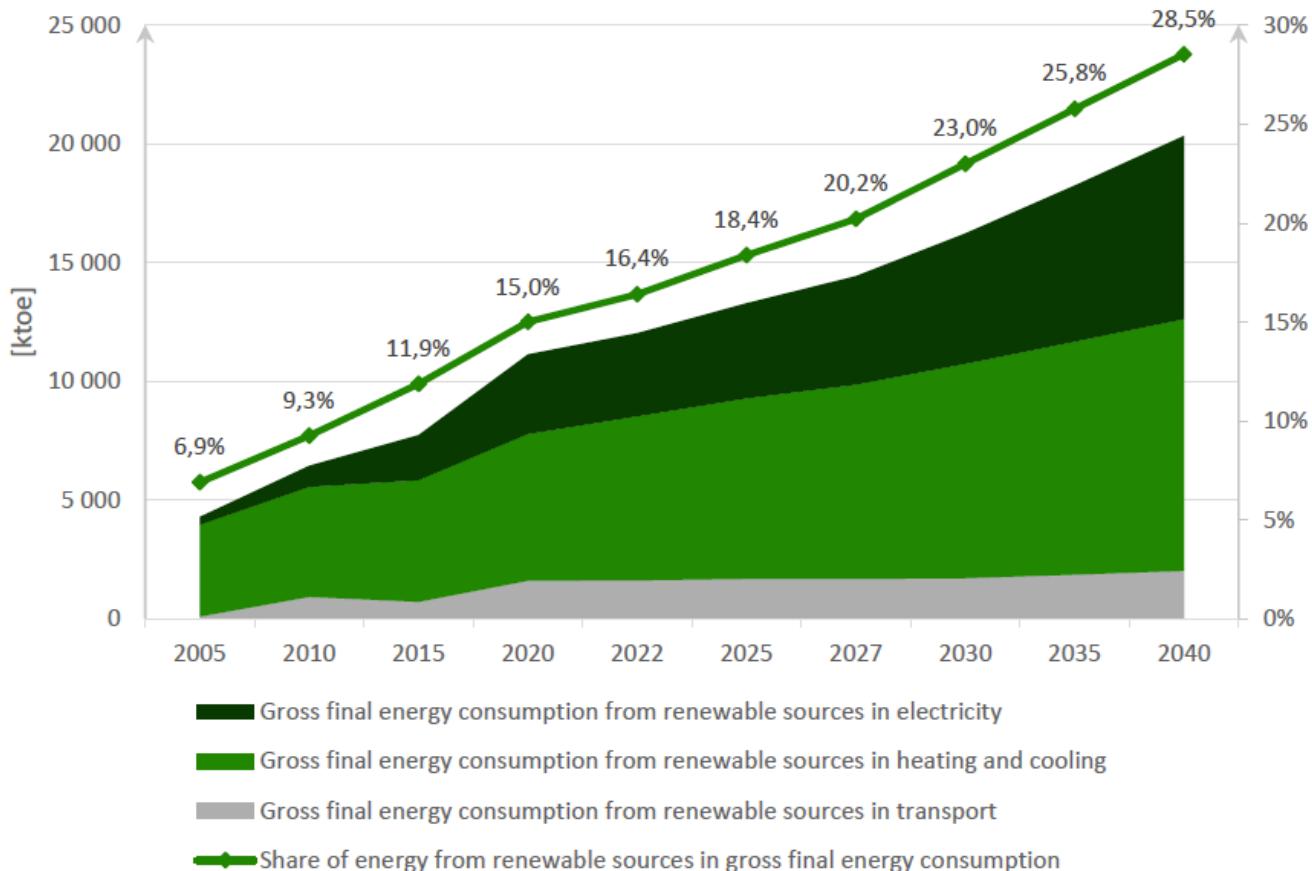


Fig. 1. RES development according to NECP PL

The government declares, that in the case of a modification of goals or strategic directions in national development policies, or draft strategies (e.g. in the draft PEP 2040), as well as new EU decisions regarding medium and long-term climate and energy policy (goals for 2030 and 2050), NECP will be adapted accordingly.

Regarding **energy efficiency** in buildings, it is said that “both in terms of energy efficiency and the improvement of housing conditions, it is important to develop a long-term strategy for the renovation of domestic stocks of residential and non-residential buildings, public and private”.

Heat supply is responsible for about 30% of primary energy consumption in Poland. Therefore, it affects the air quality and energy security of the country. Notwithstanding, NECP does not define specific objectives and methods for improving the energy efficiency of buildings and reducing the demand for non-renewable primary energy. The NECP considers **district heating** only through the prism of systems that pursue their primary function, which is the supply of heat. It does not consider a second, even larger segment of the heating sector – non-system, **individual** heating – and does not present appropriate policies and measures for it. There is also a lack of reference in NECP to the potential benefits of coordination between the entire district heating sector (system and non-system) and the national power sector.⁴

⁴ Gawlikowska-Fyk A. 2019 –Poland’s Energy and Climate Plan to 2030 – not sufficient EU perspective. Forum Energii, 26 February 2019. <https://forum-energii.eu/en/blog/uwagi-kpeik>

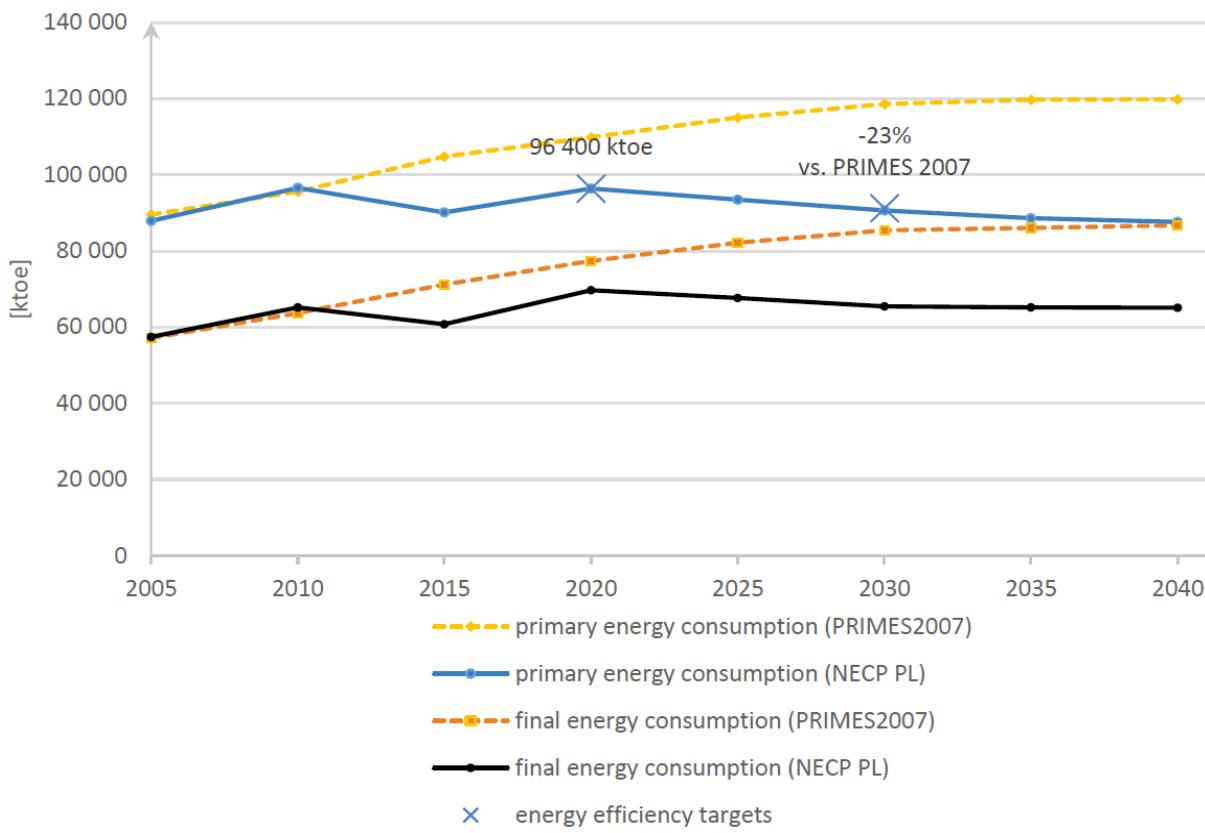


Fig. 2. Energy efficiency targets according to NECP PL

The law, which specifies the rules for shaping the energy policy of the state and the competent authorities in matters of fuel and energy management, is the **Energy Act**.⁵ Among the purposes of the Act is to create conditions for sustainable development of the country, ensuring energy security as well as economical and rational management of fuels and energy. The Act defines, inter alia, the most important tasks of the **commune** in the field of energy, including planning and organization of activities aimed at rationalizing energy consumption and the promotion of solutions reducing energy consumption in the commune. These tasks may be carried out by the local government by developing and implementing e.g. a **spatial strategy** (study of the conditions and directions of the commune's spatial development, SUiKZP), **local spatial plan** (MPZP), an appropriate **air protection program** (program ochrony powietrza, POP / air quality plan, AQP) and assumptions for the **plan for heat, electricity, and gas supply**.

The current assumptions for the development of renewable energy in Poland are set out in the **Renewable Energy Sources Act** (RES Act).⁶ The Act defines the terms and conditions for the production of energy from renewable sources as well as mechanisms and instruments for supporting RES.

From the point of view of this Inventory, the provisions concerning prosumer energy are of importance. In the new version of the RES Act, the catalog of entities that may benefit from incentives to prosumer investments has been expanded to, among others, public sector institutions and entrepreneurs. The recent (2019) amendments of the RES Act also add to the prosumer catalogue the energy cooperatives which generate electricity for their and their members' purposes. Unlike under the non-cooperative regime, electricity generation will be balanced for them at the ratio of 1 to 0.6, which will make the use of RES slightly less competitive for these entities than for individuals or entrepreneurs. Among the solutions which have remained unchanged, there is a simplified procedure for reporting prosumer installations and principles of settling with grid operators.

Pursuant to the Renewable Energy Directive (2009/28/EC)⁷, the **National Renewable Energy Action Plan 2020** (KPD 2010) was adopted in 2010. The plan defines the targets and the measures to be taken to increase the share

⁵ Energy Act, Dz. U. 1997 nr 54 poz. 348 – Ustawa z dnia 10 kwietnia 1997 r. Prawo energetyczne. Tekst ujednolicony: <http://prawo.sejm.gov.pl/isap.nsf/download.xsp/WDU19970540348/U/D19970348Lj.pdf>

⁶ RES Act – Dz.U. 2019 poz. 1524 – Ustawa z dnia 19 lipca 2019 r. o zmianie ustawy o odnawialnych źródłach energii oraz niektórych innych ustaw.

⁷ Dyrektywa 2009/28/UE Parlamentu Europejskiego i Rady z 23 kwietnia 2009 r. w sprawie promowania stosowania energii ze źródeł odnawialnych

of renewable energy in the use of final energy, considering the general objective of achieving a 15.5% share of renewable energy in gross final energy consumption in 2020. KPD also lists support systems for the promotion of the use of energy from renewable sources and defines the principles of cooperation between local, regional, and national authorities to increase the use of renewable energy. In this context, it was emphasized that public buildings need to set the benchmark use of renewable energy or be the exemplars of **transformation into zero energy buildings**.⁸

Regional policy goals in Małopolska

The **Development Strategy of the Małopolska Region 2011-2020** recommends increasing the utilisation and promotion of RES substantially (Małopolska 2020; 121-122). The Strategy recommends identifying the existing and potential development barriers, and determining the direction of the regional policy of renewable energy development as one of the key actions.

The draft **Development Strategy of the Małopolska Region** (Draft Małopolska 2030) is currently under public consultations.⁹ The **Air quality improvement** is set to be the most important direction of development policy. It is to be implemented mostly by thermal modernization of buildings, which is also an element of economical energy management. A **New urban development model** is defined in the Strategy too, which favors development within the previously invested areas and limits the spread of suburban buildings. The model is supported by several urban planning paradigms, such as a mix of uses and transit-oriented development [TOD].¹⁰

The third main direction of the Draft Strategy is **Renewable energy and Energy efficiency**.

The specific goals are, among others:

- Increasing the use of **technologies based on RES** to produce heat, cold, and electricity;
- Improving the **energy efficiency** of the **public sector** and **housing** through thermal modernization of buildings as an element of economical energy management;
- Development of energy-saving or passive building;
- **Promotion and education** in the field of lifestyle change towards energy saving and reducing its consumption.

The Strategy perceives the need to develop **smart energy grid** mechanisms in the context of monitoring.

As an important element of the strategy for the development of renewable energy and the energy efficiency improvement, intensive education and promotion of related issues are indicated as well as the system of Eco-advisors, to increase society's awareness of the importance of RES and to promote **economical management** of energy.¹¹

Indicators of achieving the main objective and specific objectives include an **increase of 8.4% in the share of renewable energy in total energy production in the region**.

The Strategy stresses an important role to be played by the **Krakow Metropolis Association** [SMK], in creating a cooperation platform for 15 associated municipalities that jointly implement integrated territorial investments [ITI], e.g. in the field of energetic modernization of buildings.

The **Małopolska Spatial Development Plan** (PZPWM 2018; 76) indicates the need to shape **compact urban structures that minimize energy demand and increase the use of RES**. In the plan's development scenarios, an increased demand for energy is expected, but also greater opportunities for prosumer energy and the use of RES. PZPWM therefore provides for a gradual increase in the share of energy from RES, but only to achieve the level assumed in Directive 2009/28/EC. The plan assumes creating conditions and mechanisms aimed at increasing the share of renewable energy generated in the region from 9.5% in 2015 to 15% in 2022, in particular based on solar energy, biogas and biomass combustion, efficient energy use including thermal modernization of buildings and RES heating, and improving the system of organizational, educational and financial solutions.

⁸ Dyrektywa 2010/31/UE Parlamentu Europejskiego i Rady z dnia 19 maja 2010 r. w sprawie charakterystyki energetycznej budynków (Dz. Urz. UE L 153 z 18.06.2010).

⁹Draft Małopolska 2030 – Uchwała NR 1612/19 Zarządu Województwa Małopolskiego z dnia 29 sierpnia 2019 r. w sprawie przyjęcia projektu Strategii Rozwoju Województwa „Małopolska 2030”

¹⁰Ibid., 31.

¹¹Ibid., 33.

The goals related to renewable energies in buildings are also indirectly included in the **Air Quality Plan for Małopolska Region 2017** (POP Małopolska 2017 / MAQP), in the sections regarding the introduction of restrictions on the use of solid fuel installations; the elimination of low-efficient heating devices; the expansion and modernization of heating and gas networks ensuring the connection of new users; the use of RES to reduce operating costs of energy; thermal modernization of buildings; and support for energy-saving housing. MAQP specifies the required environmental effects: reduction of PM10, PM2,5, B(a)P and CO₂ emissions in 2017-2019 and 2020-2023, allocated to individual municipalities [Mg/year].¹²

Sub-regional policy goals in KrOF

Strategy for KrOF Integrated Territorial Investments [ITI] (Noworól 2014) is the only strategic document setting out the goals of the Kraków Metropolis Association [SMK]. Of the main importance in the context of this Inventory is the Priority 2.1: The transition to a **low-carbon economy**. This includes the thermal modernization of buildings, smart energy management, and the use of RES. However, among the indicators adopted in the Strategy for KrOF ITI, there is none that would allow the direct control of RES development.

The specific targets are described in particular programmes and projects run by KMA. These are explained further in the next section of this Inventory, as well as in the **Plan for the replacement of coal boilers in the Krakow Metropolitan Area [KrOF] by 2022**, adopted in 2018. The plan decides and makes arrangements for inventory, management, financing, control, as well as information and promotion of activities for the liquidation of coal boilers in KrOF. SMK municipalities have agreed that:

- In 2019, an inventory of active heat sources will be carried out in all municipalities of KrOF, which will be financed from municipal budgets. The SMK office will coordinate the introduction of a common inventory tool for all municipalities.
- From 2019, a team is delegated exclusively to tasks related to boiler replacement and other air quality improvement works in each commune.
- In 2019, a joint coal boiler replacement management system will be introduced to the communes of KrOF, consistent with the inventory. A unified level of co-financing for exchanging the heat source will apply in all communes of KrOF. It is estimated that the costs of subsidizing the decommissioning of existing coal boilers in KrOF will amount to approximately PLN 260 million, which is why each commune will allocate a minimum of 1.5% of its budget annually till 2022 for activities related to subsidizing the decommissioning of boilers.
- By 2022, approximately 2,000 systemic controls of the quality of fuel will be carried out annually.
- Until 2022, during the heating season, a joint information and promotion campaign will be conducted, encouraging the replacement of boilers and the use of good quality fuels. The scope of the campaign will include messages in municipal publications, letters to residents, messages in parishes, information campaigns in coal depots, and posters. Additional activities and information will be directed to the inhabitants of KrOF who violate the regulations regarding the quality of fuel or waste incineration. All information regarding the replacement of the heat source can be found on the common website administered by the SMK Office.¹³ Communal websites devoted to the replacement of coal boilers will contain all the necessary information specified in the adopted standard.

The plan also considers external conditions. KMA municipalities have committed to:

¹² POP Małopolska 2017 / MAQP – Program ochrony powietrza dla województwa małopolskiego. Uchwała Nr XXXII/451/17 Sejmiku Województwa Małopolskiego z dnia 23 stycznia 2017 r. w sprawie zmiany uchwały Nr XXXIX/612/09 Sejmiku Województwa Małopolskiego z dnia 21 grudnia 2009 r. w sprawie „Programu ochrony powietrza dla województwa małopolskiego” zmienionej uchwałą Nr VI/70/11 z dnia 28 lutego 2011 r. oraz uchwałą Nr XLII/662/13 z dnia 30 września 2013 r. <https://bip.malopolska.pl/umwm,a,1283890,uchwala-nr-xxxii45117-sejmiku-wojewodztwa-malopolskiego-z-dnia-23-stycznia-2017-r-w-sprawie-zmiany-u.html>

¹³ WymieńPiec – Kampania Informacyjno-Edukacyjna finansowana przez gminy tworzące Stowarzyszenie Metropolia Krakowska. www.wymienpiec.info

- jointly seeking additional funds in the amount of approximately PLN 150 mln, necessary to implement the program;
- lobbying for the introduction of a statutory obligation to register a coal boiler or fireplace – necessary to effectively enforce the provisions of the "anti-smog resolution";
- lobbying for regulation at the national level on the quality requirements for solid fuels.

Local policy goals in KROF Edge Cities

The main goals of local governments in the scope of reducing energy consumption in buildings are included in the municipal strategic documents such as:

- **Municipal Development Strategies**
- **Low-carbon Economy Plans** (PGNs) which define strategic goals and detailed approaches to a low-carbon economy at the local level. The main goals of PGNs are energy efficiency improvement, an increase in the share of renewable energy in the energy mix and reduction of greenhouse gas emissions.

Renewable energies policy goals in Niepołomice

The current **Development Strategy for the City and Commune of Niepołomice** dates from 2011 and does not contain any specific provisions regarding the use of energy in buildings.¹⁴ Renewable energy is listed in two places in the Strategy:

- In the results of SWOT which mention solar energy (p. 19) as one of the opportunities but only in Domain 3: An integrated and attractive leisure offer.
- The document refers (p. 49) to the opinion of the Institute of Raw Materials and Energy of the Polish Academy of Sciences about the potential of geothermal waters, which "can be used not only for recreational purposes but also as an independent heat source, heat supporting heat pumps or conventional boilers".

The **Low-Carbon Economy Plan for the Niepołomice Commune** (PGN Niepołomice 2018) sets out the following goals in the area of the use of renewable energies in buildings:

- Strategic goal I: Reduction of greenhouse gas emissions by improving energy efficiency while ensuring sustainable development of the area – to be achieved by 2020, compared to the base year (2010), without considering the effects of the socio-economic development of the commune, to the following values:
 - a) reduction of greenhouse gas emissions by at least 18%,
 - b) reduction of energy consumption by at least 3.3%,
 - c) increase in the share of energy from renewable sources by at least 6 percentage points.
- Strategic goal II: Air quality improvement – achieving permissible levels of pollution in 2023 in accordance with the Air Protection Program (POP Niepołomice).

The list of specific objectives includes, among others, improving energy efficiency and reducing air emissions in the construction sector, increasing the share of energy from renewable sources and increasing the ecological awareness of residents in the construction sector.

As a key for the sustainable development of the commune, PGN Niepołomice 2018 indicates the implementation of activities undertaken by the Covenant of Mayors and included in the **Sustainable Energy Action Plan for the Municipality of Niepołomice** (SEAP Niepołomice).¹⁵

According to SEAP, the municipality is to achieve the goal of reducing emissions by at least 20% in 2020 compared to 2008, excluding emissions from the industrial sector. In absolute terms, the target is to reduce emissions by a minimum of 21,626 t of CO₂ by 2020.

¹⁴ Centrum Doradztwa Strategicznego, 2011 – Strategia Rozwoju Miasta i Gminy Niepołomice. http://wspolny.niepolomice.eu/dokumenty_na_strone/strategia_rozwoju_niepolomic_2021.pdf

¹⁵ SEAP Niepołomice – Plan działań na rzecz zrównoważonej energii dla gminy Niepołomice – uchwała Nr VI/48/11 Rady Miejskiej w Niepołomicach z 29 marca 2011 r.

Renewable energies policy goals in Skawina

The **Development Strategy for the Skawina Commune 2014-2020** defines, among others, two objectives related to the subject of this Diagnosis:¹⁶

- Continuation of the program of energy modernization of public buildings
- Support for investments increasing the use of RES

The **Low-Carbon Economy Plan for the Skawina Commune 2015-2020** (PGN Skawina 2020) is far more specific and sets out a long-term strategy until 2040, aiming for the reduction of energy consumption and harmful emissions – striving for the zero-emission economic development of the commune.¹⁷ The plan's specific objectives include increasing the share of RES and reducing emissions of pollutants, in accordance with the Europe 2020 strategy and related documents, including the targets set for Poland in the field of 2020 climate & energy package (15% share of renewable energy target).

The document contains an assessment of the existing condition of heating systems in the commune and plans for the modernization of heating systems. Based on the inventory, it was possible to make an assessment of energy consumption and carbon dioxide emissions by sector and the type of energy carrier. The causes of high energy demand and measures limiting the consumption of energy in buildings were determined. Based on the survey, it was determined that about 87% (1,793 people) of the surveyed residents are interested in using renewable energy, of which 3% (60 people) maintained the interest even in the absence of funding for installation.

The plan indicates the favorable environmental conditions for the installation of devices converting solar energy into electricity or heat in the Commune. The document specifies investment activities, estimated emission reductions, costs, entities responsible for implementation and financing sources. The schedule of work and expenditure also describes the detailed monitoring indicators.

The activities planned for implementation in 2015-2020 aim for a reduction of energy consumption in the commune by 74,201 MWh, and a reduction of emissions by 33,769 Mg CO₂e – this requires an investment of approx. PLN 152,513,181 (all parties involved, estimated costs). The implementation of activities will allow the Commune to achieve:¹⁸

- reduction of greenhouse gas emissions by approx. 9.8% compared to the base year,
- reduction of final energy consumption by 7.1% compared to the base year,
- renewable energy production at the level of approx. 28,893 MWh per year (production in the base year is 25,455 MWh), i.e. an increase in renewable energy use by 13.5%.

Renewable energies policy goals in Wieliczka

The current **Development Strategy for the City and Commune of Wieliczka** dates from 2014. One of its operational goals in the domain of communal services is “Reduction of air pollution and promotion of energy saving”. It is to be achieved e.g. by increasing the use of non-conventional energy sources, and the implementation of programs supporting a reduction of localised emissions of air pollutants. Concrete indicators nor targets for achieving these objectives have not been specified.¹⁹

Low-Carbon Economy Plan for the Wieliczka Commune (PGN Wieliczka 2020)²⁰ sets out the following goals in the area of the use of renewable energies in buildings (p. 701-702):

¹⁶ Skawina 2014 – Strategia Rozwoju Gminy Skawina na lata 2014-2020. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=2ahUKEwjv56Xv7ubmAhXKcJoKHTJfCW0QFjAAegQIA-RAC&url=http%3A%2F%2Fwww.gminaskawina.pl%2Fcomponents%2Fdownload%2Fsend.php%3Fpos_id%3D5053&usg=AOvVaw2npJpnX9iF7WhGy3Hh6wiw

¹⁷ PGN Skawina 2020 – Plan gospodarki niskoemisyjnej wraz z niezbędnymi elementami uzupełniającymi dla gminy Skawina na lata 2015- 2020. <https://bip.malopolska.pl/umigskawina,a,1099844,uchwala-nr-x12015-rady-miejskiej-w-skawinie-z-dnia-26-sierpnia-2015-r-w-sprawie-przyjecia-i-wdrozeni.html>

¹⁸ PGN Skawina 2020, op.cit., 105.

¹⁹ Centrum Doradztwa Strategicznego, 2014 – Strategia Rozwoju Miasta i Gminy Wieliczka na lata 2015-2022. <https://www.wieliczka.eu/mfiles/201185/28/0/z/20150609-Strategia-Rozwoju-Miasta-i-Gminy-Wieliczka.pdf>

²⁰ PGN Wieliczka 2020 – Consus Carbon Engineering, 2015 – Plan Gospodarki Niskoemisyjnej dla Gminy Wieliczka. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=2ahUKEwiqwNqd_Y_nAhV2AxAIHdMcCcgQFjAAegQIBBAB&url=https%3A%2F%2Fbip.malopolska.pl%2Fpobierz%2F1319872.html&usg=AOvVaw0qcM2HHn7UwHuzTT_rJvYS

- Strategic goal I: Reducing greenhouse gas emissions and improving air quality by increasing energy efficiency, and increasing the use of renewable energy sources, including specific objectives 2: Increasing the share of energy from renewable sources
- Strategic goal II: Improving air quality, including Specific goal 6: Increasing the ecological awareness of the commune's inhabitants.

It is declared that PGN Wieliczka 2020 is in line with the objectives set out in the EU Climate and Energy (CARE) Package,²¹ the air quality objectives resulting from the CAFE Directive;²² and is consistent with the European Strategy 2020 and the EU 20-20-20 targets. The activities planned for implementation in 2015-2020 aim to reduce energy consumption in the commune by 7,647,391 MWh (which means a 12.8% reduction in relation to 2010) and increasing the share of energy produced from RES in relation to total final energy.

By reducing energy consumption and increasing renewable energy production, the implementation of PGN will contribute to improving energy security and help maintain the competitiveness of the local economy. The document specifies investment activities, estimated emission reductions, costs, entities responsible for implementation, and financing sources. The schedule of work and expenditure also describes monitoring indicators.

The available **Air Quality Improvement Program in the Wieliczka Commune for the years 2018-2023** is very general but declares e.g. subsidies for PV installations at private facilities and obtaining funds for the exchange of non-ecological heat sources for RES.²³

2. What is the role of the different government levels (national, regional, local) and also of the stakeholders in implementing these policy objectives?

Management

National and local governments play a pivotal role in setting the conditions for the development of renewable energies in buildings. The most important provisions about the role of the different government levels in this field are described in the Energy Policy of Poland (PEP) and the Energy Act.

The Draft PEP2040 (as of 2019-06-20) contains provisions for the role of **local governments** in the implementation of specific objectives, i.e. ensuring conditions for the development of energy-sustainable areas at the local level (energy clusters and cooperatives – target: approx. 300 in 2030). The involvement of local governments and **local energy planning** will have a special role in the implementation of the National Heating (and Cooling) Plan. There are plans to activate **communes, poviats, and regions** in energy planning resulting in rational energy management, the development of clean energy sources, and the improvement of air quality. Planning should be based on real **cooperation between regional and local authorities**.

Poviats are responsible for system security, public services, and citizens' security. This obligation is extremely important in dispersed generation systems.

Municipalities are responsible for planning and organizing the supply of heat and electricity in the commune; the rationalization of energy consumption; the promotion of consumption reducing solutions; and the assessment of the potential of local electricity generation.

Municipalities and bottom-up local initiatives play a crucial role in building awareness and ecological needs, thus the combined sales, as well as various forms of financial support from public funds are to be used as incentives for using RES.

²¹ EC 2012 – 2020 climate & energy package. https://ec.europa.eu/clima/policies/strategies/2020_en

²² CAFE Directive – Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe. <http://data.europa.eu/eli/dir/2008/50/oj>

²³ Wieliczka.eu – Program Poprawy Jakości Powietrza w Gminie Wieliczka na lata 2018-2023. <https://www.wieliczka.eu/pl/201839/0/program-poprawy-jakosci-powietrza-w-gminie-wieliczka-na-lata-218-223.html>

Regional and local authorities are responsible for providing conditions for the development of clean and efficient heating systems. They are obliged to cooperate with the minister responsible for energy matters and the voivode in the planning and implementation of fuel and energy supply systems.²⁴

Regional government participates in the planning of energy and fuel supply and examines the compliance of energy plans with the national energy policy.

However, the state energy policy so far has been characterized by the lack of a long-term vision.²⁵ According to declarations of energy companies, their pro-climate investments are planned for hundreds of billions PLN, and the government is fighting for similar amounts for the energy transformation on the EU forum (modernization fund, solidarity fund, cohesion funds, Connecting Europe Facility (CEF), etc.). The energy transformation towards RES and climate protection is, however, a much more complex process than obtaining EU funds. It seems that at the national level it is forgotten that the majority of investments are to be built in municipalities, with social acceptance, and that renewable energy sources are inherently dispersed. Implementation based on climate policy requires a different approach than in the centralized generation model with central planning. Local governments in integrated energy and climate policy (RES and distributed generation) need to be treated as partners.

For the time being, municipal companies – most predestined to produce electricity and heat from RES – are still engaged by the national government in a system of incentives for the use of high-emission fossil fuels, e.g. modernization of coal heating systems or cogeneration, where the operating costs will grow and increasingly burden the recipients. Local governments are not involved in the process of preparing the entire country for energy transformation, and without them, the implementation of climate policy and renewable energy development will not succeed. An example is the cluster concept that has been pushed since 2016. Local governments did not participate on a significant scale in creating cluster concepts at the governmental level, but were involved in 66 cluster initiatives, for which they had to allocate relatively large funds. Cluster concepts remained until the end of 2019 without the implemented business model for commercial replication, and most EU funds reserved for these purposes had to be shifted to other activities. The municipalities' attachment to the idea of energy cooperatives turned out to be more productive.²⁶

As part of the Energie Cités' research into the needs of local governments in energy efficiency and renewable energy use, the expectations of local governments towards the state institutions were determined.²⁷ First of all, it is expected that a **stable and predictable legal environment** is created and legislative solutions that would support effective energy management, development of prosumer energy, and the use of alternative financing mechanisms (e.g. ESCO formula) introduced. The local actors indicate the necessity of:

- ensuring stable, coherent and transparent legislation enabling investment planning in advance and a preliminary assessment of the long-term local impacts (including cost-benefit accounting)
- introducing new legal regulations supporting energy efficiency and RES more effectively. In particular, regulations are needed to support prosumers and increase the investment return, e.g. by the resale of energy to the network at favourable prices
- streamlining public procurement law to allow for more green procurement, taking equal account of economic, environmental and social criteria
- recognizing local governments as partners, on par with energy enterprises, in the creation and implementation of national energy policy, including their more active involvement in the lawmaking process, and broader public consultations when introducing new regulations
- simplifying the legal provisions which should create a general framework for the functioning of local governments, and not impede their activities through excessive formal requirements and restrictions
- clarifying the requirements and legal solutions regarding local government units
- ensuring that appropriate financial resources are provided for new tasks for local governments

²⁴ The role of local governments is regulated in this context by the Energy Act, op. cit.

²⁵ Jeleński T., Dendys M., 2019 – Inventory: Economic Development on the Basis of Renewable Energies. Kraków: Stowarzyszenia Metropolia Krakowska.

²⁶ IEO, 2019 – Bez samorządów nie da się realizować transformacji energetycznej w oparciu o energetykę rozproszoną i OZE oraz skutecznie walczyć ze smogiem i zmianami klimatu. Odnowialny blog, 6.12.2019. <https://ieo.pl/pl/aktualnosci/1407-bez-samorzadow-nie-dzieje-realizowac-transformacji-energetycznej-w-oparciu-o-energetyke-rozproszena-i-oze-oraz-skutecznie-walczyc-ze-smogiem-i-zmianami-klimatu>

²⁷ Stowarzyszenie Gmin Polska Sieć „Energie Cités”, 2016 – Diagnoza sytuacji polskich JST w obszarze efektywności energetycznej i wykorzystania OZE. Kraków: PNEC, 50-51. http://www.razemdlaklimatu.eu/images/diagnoza/Diagnoza_polska_OK.pdf

- providing greater institutional, financial, and legal support for innovative local energy projects

Energy enterprises, and network operators, are expected to be more supportive in the development and implementation of local energy strategies, including the development of effective ways of transmitting the data needed for effective energy management in a commune.

Local governments also expect an increase in the effectiveness of environmental protection services and broader cooperation with private enterprises in the implementation of energy projects.²⁸

Financing institutions are expected to simplify procedures and better adapt the support programs to real needs and circumstances. Local governments need simple and unbureaucratic subsidy programs for residents, without which the air quality cannot be improved. Thus, the role of financing institutions would be:

- introducing new, well-designed subsidy programs, low-interest loans or redeemable loans, and supporting the development of municipal banks
- scheduling grant competitions for the entire funding period and ensuring greater consistency with applicable legislation
- ensuring higher levels of co-financing for individual energy projects, and greater flexibility in support programs
- ensuring legible and stable conditions, published in advance, and not burdened with excessive bureaucracy
- ensuring consistency of opinions between institutions managing support programs and financing institutions
- organization of training in implemented support programs
- regular provision of information on the possibilities of external funds for low-carbon economy projects

Education

NGOs and local governments play a fundamental role in building awareness and ecological needs, as well as providing and publicizing various forms of financial support from public funds to be used as incentives for energy saving and shifting to RES.

According to POP Małopolska 2017, mayors and powiat starosts (county governors); ecological NGOs; heat, gas and electricity suppliers; and the regional authorities are responsible for the implementation of the ecological education of residents.²⁹ In 2018 – the last year for which current data is available – Małopolska's communes and powiaty organized a total of over 1.5 thousand educational actions or campaigns related to air and climate protection, in which a total of 352,000 persons took part. This data indicates that actions are being taken in Małopolska to increase the citizens' acceptance for increasing energy efficiency and the share of RES in public and private buildings, motivated mainly by the impact on air quality.

Competence

Local governments have at their disposal many tools that allow them to influence the production and the consumption of energy.³⁰ This is due to their quadruple role in the field of energy:

²⁸Ibid.

²⁹ POP Małopolska 2017, 65.

³⁰ Stowarzyszenie Gmin Polska Sieć „Energie Cités”, op.cit.

- the role of energy **consumer** – local governments are responsible for energy consumption in their own facilities and in connection with the services they provide
- the role of the energy **producer** – being responsible for providing an energy supply to residents (electricity, heat, fuels), local governments may use the services of other professional entities supplying energy or use their own energy enterprises and installations
- the role of the **regulator** and **investor** – local governments are competent in areas such as spatial planning, the organization of the local transport system, and the introduction of norms and standards in force in the local construction sector. Many of the decisions taken by local authorities have a direct impact on the energy consumption of residents and various entities operating in the city or commune
- the role of a **motivator** – local governments can motivate residents and local entities to increase the efficiency of energy production and use through both financial and non-financial stimuli

According to the Energie Cités' poll, the role of NGOs would include even more substantive support during the preparation and implementation of energy projects, as well as assistance in the education and elicitation of residents' activity. Creating platforms for cooperation and the exchange of experiences, which are a source of inspiration and useful information for municipalities, is also an expected role of NGOs. Following NGOs' activities are particularly welcomed by the local authorities:³¹

- conducting training activities related to energy efficiency, RES development and energy management
- support and advice in the development and implementation of local energy strategies and the implementation of specific energy-related projects
- involving smaller municipalities with insufficient human resources in cooperation platforms with key partners
- dissemination of knowledge, good practices, and research in the field of energy conservation and climate protection
- informing on significant changes in legal regulations and new possibilities for co-financing of energy-related projects
- promoting local activities at regional, national and international levels
- promoting the principles of sustainable development, energy efficiency, and renewable energy use
- lobbying for the introduction of desired changes in the law

The role of universities (expected by local governments) is to conduct research on communal infrastructure and the possibilities of improving its efficiency, as well as sharing the results of these studies with local governments.³²

³¹ Ibid.

³² Ibid.

3. Can we reduce carbon emissions in metropolitan areas by employing innovative energy solutions and systems in buildings in relation with different local strategies?

If yes, how?

The state of air quality (pollution mainly by particulate matter (PM10, PM2,5) and benzo(a)pyrene (BaP)) is currently perceived as the biggest problem in Polish cities and suburban areas. There also is a growing awareness of climate change and its environmental, social and economic effects.³³ For this reason, local sectoral strategies and plans focus mainly on measures to reduce carbon emissions, whilst energy transformation is sometimes a side effect of those measures.

Spatial solutions for a low-emission built environment

The pursuit of low-carbon and energy-saving buildings needs to start from a spatial arrangement leading to the economical use of resources. Appropriate spatial planning and urban design – in relation to PZPWM 2018 and most of the spatial strategies (SUikZPs) and plans (MPZPs) in KrOF – primarily needs to prevent suburbanization. When planning the location of new investment areas, it is also important to avoid single-use zones, high-rise buildings, and to promote dense, mixed-use, low- and medium-rise, walkable, green urban tissue. Modern settlements' functions should be expanded to include services, educational and health facilities, as well as workplaces. Planning low-emission and low-energy cities requires compliance with several principles:

- Designation of new development areas and issuing building permissions only in close proximity to a heat and/or gas network, or in areas which are planned for the implementation of such utilities in the nearest future.
- In areas without access to the abovementioned infrastructure, existing buildings should be equipped with low-emission heating systems, preferably powered by RES. Such requirements should be included in spatial development plans (MPZPs).
- In areas where heating and gas networks are available, it should be forbidden to use certain types of polluting heating systems or fuels.

New development areas should be planned as compact, but permeable, urban structures. The form and location of buildings may reduce both the energy demand and the possibility of air stagnation, or the effect of a nozzle or vacuum causing air turbulence between buildings.³⁴ It is also advisable to use windproof belts, e.g. made of greenery of varying heights, as this leads to improved energy conservation.

Biologically active areas, as well as green roofs and facades, are increasingly important elements of any spatial arrangement. They affect the comfort of living and biodiversity, but also affect the emissivity and energy consumption of buildings, e.g. reducing the need for air conditioning. Therefore, provisions should be included in the local plans regulating these issues, e.g.:

- Urban greenery and water systems (blue-green infrastructure, BZI) to mitigate the urban heat island effect in such a way that they can constitute sustainable and self-sufficient natural systems, preferably connected with non-urban areas. Proper design of green, selection of resilient, native species and ensuring their connections with larger natural areas outside the urban core will ensure the sustainability of urban ecosystems, minimize the costs of maintenance, and result in the delivery of ecosystem services. The development of BZI and nature-based solutions (NBS) increase the impact of urban ecosystem services and allow reducing costs of the construction and maintenance of standard, grey infrastructure, also in terms of energy consumption and carbon emissions.
- Planting deciduous trees on the streets, squares, and between buildings, to provide shade in the summer and cool the air in the process of evapotranspiration.
- Avoiding tall evergreen trees that excessively shade buildings in heating seasons.
- Limiting the continuous development of extensive urbanized areas to ensure an adequate proportion of

³³ 44mpa 2018 – Climate change adaptation plans in 44 Polish cities: Summary report, http://44mpa.pl/wp-content/uploads/2018/12/MPA_NET-ENG-20-12.pdf

³⁴The key to good aeration is to eliminate zones of local high-speed wind. Buildings, especially tall ones, should not be located on the wind impact line, e.g. facing the prevailing wind directions in a given area. The wind should meander freely between the buildings.

biologically active areas, and such an arrangement of open spaces that allows plants to grow naturally and the city to be properly ventilated.

Such measures should be provided in relation with the **Poland National Strategy for Adaptation to Climate Change by 2020 with the perspective by 2030** (SPA 2020)³⁵ and local **Climate change adaptation plans** such as the one for Kraków.³⁶

The role of spatial planning is very important both in undeveloped and already built-up areas. It is necessary to avoid chaotic development e.g. locating multi-family buildings, especially high ones, in the immediate vicinity of detached houses (and vice versa). Such contrasts lead to conflicts when single-family houses with individual heating systems produce harmful emissions directly towards apartments in multi-family housing that are usually equipped with low-emission systems. On the other hand, high multi-family buildings can cause excessive car traffic, noise, and shading, which will not only bring discomfort to residents of low-rise houses, but will also generate higher energy consumption in these buildings.

For these and several other reasons, it is necessary to separate different building types and heights e.g. by the introduction of a form-based code which is a land development regulation that fosters predictable built results and a high-quality public realm by using physical form (rather than separation of uses) as the organizing principle. The physical (but not social or functional) separation of different forms of the built environment should be incorporated in a friendly manner for residents, enhancing walkability, e.g. through mobility infrastructure, green belts, and recreational areas.

The areas of old, historical buildings constitute specific problem for low-emission spatial planning. They should be treated individually because it is necessary to reconcile several aspects there: the quality of life of residents, urban and architectural conservation, reduction of energy use, and carbon emission. The most beneficial is the revitalization of such areas, including the thermal insulation of buildings combined with the complete modernization of the heating system (so-called deep thermal modernisation). If it is technically feasible, old buildings should be connected to the heating network. Otherwise, heat supply from individual sources needs to be based on high-efficiency devices, low-emission fuels or preferably RES.

Where interventions in building facades are restricted due to aesthetic and especially conservation reasons, thermal modernization should not be abandoned. Significant thermal modernization without insulating historical frontages is possible to achieve through the improvement of insulation of other outer partitions (roofs, foundations, basements, and floors), replacement of windows and doors (while maintaining their characteristic aesthetic values), the introduction of mechanical ventilation with recuperation, and installation of new heating and hot water systems.

Financing the thermal modernization of historic buildings is a separate problem. For example, in Tarnów, where thermal modernization is one of the priorities of the local government, all modern buildings, including most (about 100) of municipal buildings already meet the restrictive requirements for energy consumption, but the historical ones still have not undergone deep thermal modernization. The municipality is struggling to find programs granting subsidies to finance the energy efficiency improvement of historical buildings.

Territorial management instruments for low-emission building

Inventories of energy consumption and harmful emissions

As a part of the low-carbon economy programs emerging in 2014-2016, detailed inventories of energy consumption, greenhouse gas emissions, and air pollution were being performed. Databases collecting data from these inventories have been created in communes, usually in spreadsheets. Updating or supplementing them with new information may be difficult whilst to obtain a full picture it is necessary to monitor the implementation of the tasks indicated in PGNs. The need appears to prepare an instrument that would facilitate the management of the implementation of these plans and the monitoring of progress. To meet these expectations, various tools emerge on the market for managing data about objects identified as sources of emissions (CO₂, PM, B(a)P, O₃, NO_x, SO_x), systematizing information for the evaluation of the local economy and environment. Some tools also contain a database of actions, the implementation of which is to be used to achieve the strategic objectives included in the PGN, and specific objectives in the fields of:

³⁵ Ministry of the Environment 2013 – Polish National Strategy for Adaptation to Climate Change (NAS 2020), https://klimada.mos.gov.pl/wp-content/uploads/2014/12/ENG_SPA2020_final.pdf

³⁶ 44mpa – Plan Adaptacji Miasta Krakowa do zmian klimatu do roku 2030. https://www.bip.krakow.pl/?dok_id=114317

- reduction of greenhouse gas emissions
- reduction of final energy consumption
- increasing the share of energy from RES

Such data constitutes a necessary basis for the monitoring and evaluation of the effectiveness of performed activities. The assessment is facilitated by tools for the filtering and visualization of data, particularly their mapping. The development of GIS technology facilitates this functionality. The study and workshop "Challenges of Spatial Planning in the Krakow Metropolitan Area" recently run by SMK, with particular emphasis on the conditions for the integration of KrOF spatial policies, largely concerned the availability of spatial data and services used in the KrOF municipalities. The results of this study are presented in the report "Challenges of Spatial Planning in the Krakow Functional Area (Krakow Metropolis)".³⁷

Types of heating systems suitable for use in various types of buildings

For technical and economic reasons, the type of building usually determines the use of a particular type of heating system. In compact multi-family housing or mixed-use developments, the best solution is a connection to the district's heating. Central heating installations supplying a group of buildings are also used.

Energy production in such systems is substantially cheaper and cleaner than in individual installations. Despite this, the distribution of the heating network is profitable only in the compact urban areas. On the one hand, this is determined by investment costs of network construction (network length). On the other hand, the transmission of heating medium over long distances causes heat losses, and therefore also economic losses.

To prevent this and integrate RES into district heating, the 4th generation of district heating is being developed, designed to integrate high shares of variable renewable energy by providing high flexibility to the system;³⁸ and a 5th generation heat grid appears which distributes heat at near ambient ground temperature. This minimizes heat loss and reduces the need for extensive insulation. Each building on the network uses a heat pump in its own boiler room to extract heat from the ambient circuit when it needs heat, and uses the same heat pump in reverse to reject heat when it needs cooling.³⁹

In the case of dispersed single-family housing, to replace coal furnaces, gas and less often oil boilers are recommended to supply buildings with heat in a way that reduces pollutant emissions. The emission of pollutants when burning gas or light oil is much lower than when burning solid fuels. This applies especially to local emissions of harmful substances. Thus, heating installations using gas or light oil are treated in Poland as low-emission.

However, more and more often – also for economic reasons – various types of RES are used as independent or supplementary sources of heat and electricity. Depending on the local conditions, they are geothermal or solar installations using heat pumps, solar collectors and/or PV panels. Małopolska has good conditions for using solar collectors, and proper conditions for using PV. The annual solar radiation sums in Małopolska amount to 950-1000 kWh/m². The average sun exposure is about 1,450 hours a year. Climatic conditions allow collectors to cover up to 70-80% of the energy needed to produce domestic hot water. The use of wind energy and biofuels is more difficult to classify.

Reduction of energy costs and carbon emissions in residential buildings

Regarding old multi-family buildings, the best solution is their deep thermal modernization, by which the energy demand is reduced, while simultaneously the building is connected to the heating network or renewable energy installation.

Regarding single-family housing, a lot depends on the degree of compactness of the urban structure and the availability of utilities. In Małopolska, it is rarely possible, for economic reasons, to connect this type of building to the grid, especially when the building is located on the outskirts of the city, or far from the heating plant.

³⁷ Jeleński T. 2019 – Raport: Wyzwania planowania przestrzennego w Krakowskim Obszarze Funkcjonalnym (Metropolii Krakowskiej) dla Stowarzyszenia Metropolia Krakowska, Kraków, 23.09.2019.

³⁸ Lund H. et al. (2014). 4th Generation District Heating (4GDH): Integrating smart thermal grids into future sustainable energy systems. Energy. 68: 1–11.

³⁹ Buffa S. et al. (2019). 5th generation district heating and cooling systems: A review of existing cases in Europe. Renewable and Sustainable Energy Reviews. 104: 504–522.

Due to the need of distributed heat sources, the low-emission standard of detached buildings is achieved using RES as independent or supplementary heat sources. The range of possibilities is wide:

- **The use of solar energy** – by installing solar collectors and/or PV panels.

Further financial support for prosumers planned in e.g. RES Act, apart from already existing mechanisms (the possibility to make the installation costs tax deductible, subsidies and preferential loans), will certainly result in the increased popularity of household PV installations. All this will make such installations more attractive.

The **industry** believes that the government, unable to counter the coal energy price spikes in Poland, has come to a reasonable realization that businesses, and some individuals, might be able to shoulder some of the efforts to limit energy consumption costs and, at the same time, help Poland reach the EU renewable energy quota. The next several years may see a PV installation boom in Poland.⁴⁰

Unfortunately for the RES installation owners, the amended RES Act does not feature the solution allowing for obtaining further income for generating more electricity than has been used. It results in a situation in which, even under highly favourable weather conditions, an RES installation owner will not be able to take advantage of this fact.

- **The use of geothermal energy** – e.g. by installing heat pumps, which can be an independent source of energy, increasingly supplied from PV installations
- **The use of wind energy** – the installation of small wind turbines to power one building is increasingly observed in Poland

It should be emphasized that the use of wind turbines in the form of small, dispersed installations is often a better solution than building large wind farms due to the much smaller environmental impact of small turbines considering nature, landscape, noise and electromagnetic pollution.

Among the RES that can be used in single-family housing, biomass combustion was intentionally not mentioned. Burning biomass might be considered as a zero or low-emission solution for energy production only in the context of greenhouse gas emissions. At the same time, it is usually very harmful to the environment mostly because of PM emission. During the combustion of biomass, large amounts of dust are emitted, even greater than when burning coal. Therefore, biomass combustion should be allowed only in large power plants (especially in combined heat and power plants, where waste heat is used), which install highly efficient filtration systems to reduce harmful emissions.

Restriction of solid fuels

In KrOF, solid fuel furnaces used to be the most common heating sources used in single-family and old multi-family housing until recently. The decisive factor in reducing energy consumption and harmful emissions from heating systems in the region is the total liquidation of coal-fired boilers and in return the development of low-emission installations with gas boilers and RES. Municipal resolutions in, e.g. Kraków and Niepołomice, **prohibiting or significantly limiting the use of all solid fuels** are milestones in the modernisation of energy systems and buildings.

The total prohibition of solid fuels, including biomass, was introduced in the City of Krakow in September 2019 (UM Kraków 2014).

Since 1 July 2017, it is forbidden⁴¹ to use in furnaces, boilers and fireplaces in Niepołomice:

- fuels in which the mass share of hard coal or lignite with a grain size of 0-3 mm is above 15% (sludge and coal fleets)
- fuels containing biomass with an operating humidity above 20% (applies for firewood)

The **largest project**, which currently allows for co-financing RES in Małopolska, was implemented by the Municipality of Krakow under the ROP Małopolska 2014-2020. Residents replaced their old boilers and heating installations with modern sources and installations that met current emission standards. The program has funded

⁴⁰ Squire Patton Boggs, 2019. Final Amended Version of Renewable Energy Sources Act in Poland is Now Pending the President's Signature. Lexology, Poland, August 5 2019. <https://www.lexology.com/library/detail.aspx?g=2fe7ed8c-03f5-405d-8880-7f6e48c10975>.

⁴¹ Niepołomice 2017 – Uchwała antysmogowa dla Województwa Małopolskiego. <https://www.niepolomice.eu/inne/uchwala-antysmogowa-dla-wojewodztwa-malopolskiego-2/>

up to 100% of investment costs.⁴² It preceded the total ban on the use of solid fuels in Kraków. Unfortunately, the program actually does not promote the use of RES, nor the comprehensive thermal modernization reducing heat consumption. Gaseous fuels and light heating oil have been allowed and installed on a large scale, which may for years inhibit household investment in heating systems based on RES.

By comparison, within the same ROP Małopolska, the **Commune of Niepołomice implemented investment in heat pumps and PVs in its primary schools**. The facilities had been thermally insulated and then equipped with complete low-emission heating installations. Smart control systems used there allow for the optimisation of the operation of heating devices depending on the weather and the needs of users.

Reduction of energy demand in buildings

The main reason for the high energy demand and high emission from buildings is the insufficient thermal insulation of their envelopes. Most of the buildings in the region were built between 1945-1988 when the quality of construction was low and the requirements for thermal insulation were not observed. Buildings built after 1989, usually with the use of much better technologies and materials account for about 35%.

The reduction of energy consumption in existing buildings is achieved through **thermal modernization** which aims to minimize heat losses through a building envelope and ventilation system, as well as to improve the quality of the internal environment and reduce carbon emission.

Measures limiting the use of usable energy in buildings include:

- thermal insulation of existing buildings that do not meet current requirements
- construction of new buildings in the Near Zero Energy Building (NZEB) standard (described below)⁴³
- financial support for thermal modernization
- promotion of energy-saving and rational use of resources

The thermal modernization of buildings should **always include an insulation of the envelope** (walls, floors, foundations, roof, and replacement of windows and doors with tight ones, with a low heat transfer coefficient), as well as the provision of proper shading solutions. Where technically possible, gravitational ventilation should be replaced by **mechanical ventilation with heat recovery**. These should also be combined with the regulation or modernization of heating and hot water installations to **avoid excessive emissions from oversized heat sources**.

The order of actions is very important here. The adaptation of the heating system to the reduced heat demand (further described below) should always be preceded by the insulation works and ventilation improvement. This way, the singular building's energy demand can be reduced by up to 60%. It is estimated that the proper thermal modernization of residential buildings would **reduce heat consumption in the region by approximately 30% of current demand**.⁴⁴

The further steps to reduce the energy demand may include an intelligent control of heating, ventilation and cooling systems; the modernization of lighting by replacing lighting fittings and light sources with energy-saving ones (LED); implementation of lighting systems with adjustable parameters, adapted to the user's needs; replacement of equipment intended for home or office with energy-saving ones; monitoring and management of energy consumption.

Replacement of individual heating and hot water installations

An important reason for the high energy consumption is also the low efficiency of the heating system: technically outdated boilers and inadequately insulated installations. Whilst the replacement of heat sources with low-emission ones, due to the specifics of the situation in Poland (exceeding air quality standards, especially for

⁴² BIP Kraków 2014 – Uchwała nr CXXI/1918/14 Rady Miasta Krakowa z dnia 5 listopada 2014 r. w sprawie przyjęcia Programu Ograniczania Niskiej Emisji dla Miasta Krakowa

⁴³ Dz. U. 2019 poz.1065 – Obwieszczenie Ministra Inwestycji i Rozwoju z dnia 8 kwietnia 2019 r. w sprawie ogłoszenia jednolitego tekstu rozporządzenia Ministra Infrastruktury w sprawie warunków technicznych, jakim powinny odpowiadać budynki i ich usytuowanie.

⁴⁴ SEAP Niepołomice, op.cit., 589.

particulate matter PM10 and PM2,5, and benzo(a)pyrene), special attention should be paid to the emission of these pollutants.

Liquidation of individual heat sources should be carried out whenever technical possibilities of connecting to the heating network exist. The distance between the building and the existing heating grid determines the feasibility of connection to it, and thus the economic and ecological efficiency of such a solution. If the distance is small, the costs decrease significantly and such action may be the most profitable. If this is not feasible, then the replacement of the boiler with an individual low-carbon heat source should be preceded by an analysis of technical capabilities and financial conditions.⁴⁵

Currently, in buildings with a floor space of less than 150 m², boilers with a capacity of about 5-10 kW are installed, while older boilers, installed in the years 1970-2010, were usually characterized by a higher power of 15-25 kW. The decrease in the average boiler power in recent years is mostly due to the change in the thermal requirements of buildings. The boiler which had been properly selected before thermal modernization has become oversized in relation to the lower energy needs of modernized buildings.

The use of oversized heat sources has consequences for both users and the environment, and the most important problems are: increased fuel consumption, high content of remaining fuel in ash, and excessive release of gaseous and dust pollutants. It is worth noting that building insulation, while changing to a low-emission heating method, increases investment costs, but leads to a significant, optimal reduction of operating costs; this often means that maintaining the most innovative low-carbon heating method becomes financially affordable for users.

When modernizing heating systems, it is important to equip them with an energy management and monitoring system so that everyone can see how energy can be saved in the building. This usually leads to a permanent change in user behaviour and – as a result – to significant, long-term savings.

Technical conditions for the design of low-carbon buildings

For the development of low-carbon buildings, the design stage is of paramount importance. When describing the types of buildings in terms of their energy consumption, certain conceptual abbreviations are often used, which are not always properly understood and used.

The use of appropriate terminology is a basic condition for the relevant provisions used in public procurement when drawing up tender specifications. For the local administration, it is necessary to use the terms introduced in the **Minister of Infrastructure's Regulation on the technical conditions to be met by buildings and their location**⁴⁶, while industry and commercial terms such as "passive building" should be avoided. Such terms are of marketing character and apply to products certified by private entities, which significantly increases their prices, and does not clearly translate into the requirements of the Regulation.

Energy performance standards for new buildings

To meet the goals of the low-emission economy, the requirements for the building envelope's thermal insulation are increasingly tightened. There have been major changes in national laws regarding the approach to energy saving in buildings. The Energy Performance Directive, 2010/31/EU, adopted in 2010, introduced a standard for "**Nearly Zero Energy Building**" (NZEB).⁴⁷ The energy performance of the building reflects its demand for energy used for heating, cooling, ventilation, and hot water supply. In light of the Directive, NZEBs should have very good energy performance. NZEBs are becoming an obligatory standard in the EU member states. As the equivalent of the term "nearly zero-energy building", the term "low energy building" (Pol. *budynek o niskim zużyciu energii*) has been introduced in Polish legislation.

The directive did not impose equal parameters of NZEB buildings on all UE member states, leaving each country free to make decisions based on cost analysis. The Polish law orders new buildings to be designed and built with extremely low primary energy demand. For public buildings that are not healthcare facilities, the required rate of

⁴⁵ IRM 2016 – Program szkoleniowy dla pracowników administracji samorządowej z zakresu planowania i zagospodarowania przestrzennego. Warszawa: MIR.

⁴⁶ Ibid.

⁴⁷ Dz. U. UE 2010 z 18.6.2010 – Dyrektywa Parlamentu Europejskiego i Rady 2010/31/UE z dnia 19 maja 2010 r. w sprawie charakterystyki energetycznej budynków, (wersja przekształcona), Dziennik Urzędowy Unii Europejskiej [PL].

annual demand for non-renewable primary energy for heating, ventilation and hot water preparation is **approaching the level of a zero-energy building** (EP = 45).⁴⁸

It should be emphasized that the **technical conditions to be met by buildings and their location** have become the most important instrument of national laws that impose the reduction of energy consumption in buildings. The crucial provision of the directive is art. 9, according to which all member states have committed to comply with the following dates:

- After December 31, 2018, all new buildings occupied by and owned by public authorities are to be NZEB
- After December 31, 2020, all new buildings are to be NZEB

This provision means that the technical conditions implementing the Directive are already in force in relation to newly designed NZEB buildings owned and used by public authorities. The Energy Performance Directive indicates that **low energy demand should, as far as possible, come from renewable energy produced on-site or near the building.**

The importance of **highly qualified regional and local government staff**, e.g. Commune Energy Advisors (described in the next section) responsible for preparing **specifications for public procurement** in the field of construction and RES technologies, is growing significantly.

Thermal insulation standards for new buildings

Experts in each of the EU member states have determined the levels of minimum requirements for the thermal insulation of the building envelope, determined by the heat transfer coefficient U [W/(m²K)], as well as the ratio of non-renewable primary energy EP [kWh/ (m²year)]. Requirements in different countries differ in both the coefficients and the groups of buildings for which they were specified. Requirements for NZEB in Poland are described in the Technical Conditions in Section X and Annex 2. The heat transfer obligatory coefficient since January 1, 2014 equals 0.25 [W/(m² × K)] for walls, 1.3 [W/(m² × K)] for windows, and 1.7 [W/(m² × K)] for doors. However, requirements are currently being tightened. According to the ordinance, since 1 January 2021, coefficients decrease respectively to 0.20 [W/(m² × K)], 0.9 [W/(m² × K)], and 1.3 [W/(m² × K)].⁴⁹

This also applies to buildings that are renovated. Only historic, listed buildings are released from that regime.

Polish building performance requirements are currently some of the strictest in the EU. They impose an **obligation on local governments** to adhere to a very strict design regime, which must be accurately reflected in public procurement.

⁴⁸ Dz. U. 2019 poz.1065, op.cit. 88-89.

⁴⁹Ibid., 105-106.

4. Are there any projects/programs/incentives at local and regional level that promote the adoption of energy efficiency measures in building?

The effective implementation of low-emission economy plans, reduction of energy consumption and carbon emissions, require significant financial investments, often difficult to bear by local governments, public institutions, and private investors. Therefore, there is a number of programmes, projects, and incentives provided at the regional and local levels that promote and co-finance the adoption of energy efficiency measures in buildings. Some of them are supported by nationwide, state initiatives; therefore it is not entirely possible not to mention here the national programmes which are implemented through regional or local mechanisms. Below we present a brief description of some important ones.

Thermal Modernisation and Refurbishment Fund

Thermal Modernisation is usually highly profitable; however, it initially requires significant investments, which is why many building owners may not implement thermal modernization without financial assistance. The Thermal Modernization and Refurbishment Fund, created by the National Economy Bank, is a nationwide initiative targeting housing cooperatives, housing communities, private individuals, and local governments.⁵⁰ It provides financial assistance for investors implementing thermal modernization projects. The rules for co-financing (the so-called thermal modernization bonus) are specified in the **Act on supporting thermal modernization and renovation**.⁵¹

The bonus is granted to investors using a loan for the thermal modernization project and constitutes repayment of a part thereof (20% of the loan amount, however, not more than 16% of the costs and twice the anticipated annual energy savings, determined on the energy audit.) A detailed scope and forms of the audit are specified in the **Regulation of the Minister of Infrastructure and Development**⁵², which is an Executive Act to the Act on supporting thermo-modernization and renovation.

The audit considers:

- Heat transfer through building envelope coefficients
- The efficiency of the heating and hot water systems
- Characteristics of the ventilation system
- Economic characteristics of the optimal variant of a thermal modernization project

The energy performance of the building including the share of renewable energy sources [%] is also part of the audit.

The program is addressed to legal persons (including housing cooperatives and commercial law companies), local government units, housing communities and natural persons (including single-family homeowners).

Since 2020, the thermal modernization bonus has increased from 16 to 21 percent of the value of the thermal modernization in the case of the simultaneous installation of renewable energy installations (including PV and wind turbines). This is to encourage investors toward comprehensive investments aimed at improving energy efficiency.⁵³

⁵⁰ BGK, 2017 – Thermal Modernization and Refurbishment Fund [Poland] http://publenef-project.eu/wp-content/uploads/2017/04/GP37_PUBLNEF_Poland_factsheet.pdf; <https://www.bgk.pl/samorzady/fundusze-i-programy/fundusz-termomodernizacji-i-remontow/>

⁵¹ Dz. U. 2008 nr 223 poz. 1459 – Ustawa z dnia 21 listopada 2008 r. o wspieraniu termomodernizacji i remontów. <http://prawo.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20082231459>

⁵² Dz. U. 2015 poz. 1606 – Rozporządzenie Ministra Infrastruktury i Rozwoju z dnia 3 września 2015 r. zmieniające rozporządzenie w sprawie szczegółowego zakresu i form audytu energetycznego oraz części audytu remontowego, wzorów kart audytów, a także algorytmu oceny opłacalności przedsięwzięcia termomodernizacyjnego. <http://prawo.sejm.gov.pl/isap.nsf/download.xsp?WDU2015001606/O/D20151606.pdf>

⁵³ Gram w zielone 2019 – Rząd zwiększy premię termomodernizacyjną w przypadku zastosowania OZE, [online:] <https://www.gram-wzielone.pl/energia-sloneczna/100817/rzad-zwiekszy-premie-termomodernizacyjna-w-przypadku-zastosowania-oze>, [access:] 20.06.2019

Thermal modernization relief

The Act on supporting thermal modernization and renovation is supported by the recently amended **Act on personal income tax**.⁵⁴ With a view to ensuring the improvement of energy efficiency of thermal modernization projects and their impact on improving air quality, the Act provides that the taxpayer who is the owner or co-owner of a single-family residential building has the right to deduct from the tax calculation basis, expenses incurred for construction materials, equipment and services related to the thermal modernization of the building (including solar installations). The deduction cannot exceed PLN 53,000 in relation to all implemented projects of that kind of which the taxpayer is the owner or co-owner.⁵⁵

Clean Air program

The implementation of statutory regulations at the national level will primarily be supported by the Clean Air program implemented by the **National Fund for Environmental Protection and Water Management** (NFOŚiGW).⁵⁶ The aim of the program is to reduce the emission of harmful substances that arise as a result of heating single-family homes using outdated heat sources and low-quality fuel. The program offers co-financing for replacing old and ineffective heat sources for modern ones, including RES, together with other thermal modernization works on the building. The program provides funding on:

- replacement of old stoves and boilers for solid fuels with installations based on new heat sources meeting the program requirements
- insulation of building envelopes
- replacement of windows and doors
- assembly and modernization of heating and hot water installations
- installation of RES (e.g. air and ground heat pumps)
- installation of mechanical ventilation with heat recovery

Loans can be obtained at:

- installation of solar collectors
- assembly of PV micro installations

The program does not qualify the costs of heat sources installed solely for the production of domestic hot water.

The maximum eligible cost per building depends on the solutions used, e.g. biomass boiler up to 20,000 PLN, modern coal boiler up to 10,000 PLN, gas or light oil boiler up to 15,000 PLN, heating substation or electric heating up to 10,000 PLN, air heat pump up to 30,000 PLN, ground or water heat pump up to 45,000 PLN, internal installations up to 15,000 PLN.⁵⁷ Under the Clean Air Programme, the applicant can count on a grant or a 15-year loan. The amount of the subsidy depends on the income per person in the household.

Despite the huge budget of PLN 100 billion for 10 years (2018-2029), the program does not meet expectations for now. The problem is the low level of funding for individual installation; unfriendly questionnaires – difficult for laymen; and up to six-month delays in processing applications.

From July 29, 2019, the application form for the grant was simplified to facilitate the process of its completion by the laymen. **Municipalities may also be involved in processing the applications**. Before, only **Regional Funds for Environmental Protection and Water Management** (WFOŚiGWs) were entitled to accept documents, which significantly delayed the process.

What is very important for homeowners, one can benefit simultaneously from thermal modernization relief and the Clean Air program, which is of importance when an investment exceeding PLN 53,000 is planned. The

⁵⁴ Dz.U. 2018 poz. 2246 – Ustawa z dnia 9 listopada 2018 r. o zmianie ustawy o podatku dochodowym od osób fizycznych oraz ustawy o zryczałtowanym podatku dochodowym od niektórych przychodów osiąganych przez osoby fizyczne. <http://prawo.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20180002246>.

⁵⁵ Infor.pl, 19.12.2019 – Fundusz Termomodernizacji i Remontów - zmiany 2020 r. <https://mojafirma.infor.pl/nieruchomosci/3582002,Fundusz-Termomodernizacji-i-Remontow-zmiany-2020-r.html>

⁵⁶ NFOŚiGW 2020 – O Programie Czyste Powietrze. <http://www.nfosigw.gov.pl/czyste-powietrze/o-programie-czyste-powietrze/>

⁵⁷ Małopolska w zdrowej atmosferze, Dofinansowanie. <https://powietrze.malopolska.pl/dofinansowanie/>

homeowner can obtain a subsidy from the Clean Air program for replacing an old furnace, and deduct expenses on house insulation.

STOP SMOG Program

STOP SMOG was launched by the Ministry of Entrepreneurship and Technology in mid-2019. Under the program, one can receive a grant covering up to 70% of furnace replacement costs and thermal modernization of residential buildings. A maximum of PLN 60,000 can be spent on one building. **The first to implement the program in Poland was the Commune of Skawina**— one of the KrOF Edge Cities. This is directed primarily towards the poorest residents of Skawina. By June 2022, 300 single-family buildings will undergo thermal modernization. For that, the commune received over PLN 11 million.⁵⁸ In 2020, also Wieliczka and Niepołomice intend to join the program.

Clean Air, STOP SMOG, and communal funding can merge if the applicant qualifies for all three subsidies.⁵⁹

Prosumption and renewable energy storage

Pursuant to the Act on RES, prosumers may generate electricity from RES in order to use it for their own needs, and the surplus is transferred to an energy network for its temporary "storage".⁶⁰ This system is based on the so-called **net-metering**, or a **periodic billing system**, in the form of a discount on the invoice. For installations up to 10 kW, for each 1 kW produced, it is possible to receive up to 0.8 kW of energy delivered. In the case of installations above 10 kW, for each 1 kW produced, up to 0.7 kW of energy can be recovered.

My Electricity program

The Ministry of Energy, in cooperation with the Ministry of the Environment, has prepared a program for co-financing PV installations. The main goal is to increase energy production from **PV micro installations** (2-10 kW). The program is addressed to households. Co-financing may be granted only for new devices (manufactured not earlier than 24 months before installation). The project does not support the increase of power of the already installed PV installation.⁶¹ If an applicant has received other funding or is in the process of implementing a PV investment under another program, he may not apply for re-support under the My Electricity program.⁶²

Under My Electricity, individuals can expect a PV installation purchase subsidy up to PLN 5,000 per installation. A budget reserve of PLN 1 billion has been earmarked for executing the program. The Minister of Energy claims that, in the event of a warm public welcome and the budget drying up quickly, expanding the support pool is possible.⁶³

Operational Program Infrastructure and Environment 2014-2020 (POIŚ 2014-2020)

POIŚ is a national program supporting the low-carbon economy, environmental protection, mitigation and adaptation to climate change, and energy security. Under axis I, actions are implemented aimed at a low-emission economy. Support is offered under two priorities:

⁵⁸ Dz. U. Woj. Małopolskiego, Poz. 6211 – Uchwała Nr XI/144/19 Rady Miejskiej w Skawinie z dnia 28 sierpnia 2019 roku w sprawie przyjęcia regulaminu realizacji przedsięwzięć niskoemisyjnych budynków jednorodzinnych w ramach programu STOP SMOG oraz sposobu i warunków wnioszenia wkładu własnego... http://edziennik.malopolska.uw.gov.pl/WDU_K/2019/6211/akt.pdf

⁵⁹ Gmina Skawina 2019 – Skawina walczy z niską emisją. www.GminaSkawina 09-10-2019. https://www.gminaskawina.pl/index.php?option=16&action=news_show&news_id=18786&menu_id=0

⁶⁰ Dz.U. 2018 poz. 2389, op.cit.

⁶¹ NFOŚiGW 2019 – Program „Mój Prąd” – założenia szczegółowe. http://www.nfosigw.gov.pl/o-nfosigw/aktualnosci/art_1450,program-moj-prad-zalozenia-szczegolowe.html

⁶² Ministerstwo Klimatu 2020 – Mój Prąd. <http://nfosigw.gov.pl/moj-prad/>

⁶³ Squire Patton Boggs, 2019, op.cit.

- PI 4.3 (Supporting energy efficiency, intelligent energy management and renewable energy use in public infrastructure, including public buildings, and the housing sector) – support may apply to the following types of activities:
 - thermal modernization of buildings
 - modernization of lighting to energy-saving
 - replacement of heating systems (including a heat source)
 - implementation of building management systems
 - microgeneration installations for personal needs
 - RES installation in modernized buildings
- PI 4.5 (Promotion of low-carbon strategies, particularly for urban areas) – supports investments under low-carbon economy plans including heat exchange.

Polish Sustainable Financing Facility for small and medium enterprises (PolSEFF²)

PolSEFF (now PolSEFF²) was initiated by the European Bank for Reconstruction and Development (EBRD) supported by the European Union as a part of EBOiR's Polish Carbon Development for Small and Medium Enterprises and implemented under the NFOŚiGW Priority Program (NF) with the support of the EU as a credit line worth EUR 200 million, distributed through banks participating in the form of loans to small and medium enterprises to finance investments improving their energy efficiency.

Projects qualified for the program include the thermal modernization of commercial, residential or administrative buildings subject to energy certification, and related investments in RES. The above investments must have a minimum energy saving ratio of 30%.⁶⁴

Programs and incentives from NFOŚiGW

NFOŚiGW runs a number of national and regional programs and support mechanisms, including those focused on the field of low-emission economy, energy efficiency, and renewable energy use. They include various forms of support, including subsidies and loans; **municipalities may benefit from many of them**.⁶⁵

An example of the NFOŚiGW program supporting the reduction of CO₂ emissions by increasing energy production from RES is **BOCIAN – distributed renewable energy sources**. The program is being implemented between 2015-2023 and provides co-financing in the form of a loan, the beneficiaries of which may be entrepreneurs implementing renewable energy projects in Poland.

The budget is up to PLN 570 mln. The program minimum targets are:⁶⁶

- 430,000 MWh / year of electricity from RES
- 990,000 GJ / year of thermal energy from RES
- 400,000 Mg / year reduction of CO₂ emission

NFOŚiGW also manages the national **Green Investment Scheme (GIS)**, which derives from the emission allowance trading mechanism. The scheme guarantees that the funds obtained as a result of selling surplus emission credits will be used for broadly understood climate and environmental protection. GIS priority programs include **energy management in public buildings**.⁶⁷

NFOŚiGW also implements – with the participation of **partners from all 16 regions of Poland**– the **Energy Advisory Program** for the public and housing sectors, as well as enterprises in the field of energy efficiency and

⁶⁴ PolSEFF – About PolSEFF2. <http://www.polseff2.org/en/about-polseff2>

⁶⁵ NFOŚiGW 2020 – NFOŚiGW. www.nfosigw.gov.pl

⁶⁶ NFOŚiGW 2020 – BOCIAN—rozproszzone, odnawialne źródła energii. <https://www.nfosigw.gov.pl/oferta-finansowania/srodki-krajobwowe/programy-priorytetowe/bocian-rozproszzone-odnawialne-zrodla-energii/>

⁶⁷ NFOŚiGW 2020 – System Zielonych Inwestycji GIS. www.nfosigw.gov.pl/oferta-finansowania/system-zielonych-inwestycji---gis

renewable energy.⁶⁸ So far, 48,458 consultations, 48,067 advices, and 2,194 education and training activities have been provided.

As part of the Energy Advisory Program, free training programs for **Commune Energy Advisors** are provided. The Commune Energy Advisor (gminny Energetyk) is an employee of the municipality, who supports the implementation of investments in a way to reduce energy consumption and air pollution and create new RES installations. The Energy Advisor supports not only the municipality but all **entities within the commune**, including entrepreneurs, cooperatives and housing associations, as well as natural persons. The Advisor's competencies include:

- knowledge of legal regulations
- tender procedure (e.g. construction of NZEB)
- planning support (e.g. PGN, energy supply, POP)
- identification of investment opportunities
- obtaining financial support
- promotion of energy saving and renewable energy use
- organization of educational events

A competence of the Commune Energy Advisor is also **raising awareness** among the commune's inhabitants about energy efficiency and RES.

NFOŚiGW also runs a number of incentive programs implemented through **Regional Funds for Environmental Protection and Water Management** (WFOŚiGWs) described below.

Regional instruments

According to the **Report from Evaluation of actions taken under priority axis 4 of the Małopolska Regional Operational Program 2014-2020⁶⁹** to improve energy efficiency and build a low-carbon economy in the region, during Stage 1 (until March 2018) activities financed from the following sources were implemented:

1. Regional Operational Programme for Małopolska (RPO WM)
2. Operational Program Infrastructure and Environment (POIŚ)
3. Rural Development Program (PROW)
4. Swiss-Polish Cooperation Program (Swiss Fund)
5. EEA Financial Mechanism and the Norwegian Financial Mechanism (EOG i NMF)
6. Programs implemented by Kraków WFOŚiGW
7. Thermal Modernisation and Refurbishment Fund (FTiR)
8. LIFE Program

Some of the most important instruments and mechanisms promoting the adoption of energy efficiency measures in buildings are still relevant and described below.

Air Quality Plan for Małopolska Region (POPWM 2017 / MAQP)

The Plan is based on the analysis of variants of corrective actions for the entire Małopolska Region in order to determine the most ecologically and economically effective undertakings.⁷⁰ The document was based on analyses

⁶⁸ Ogólnopolski system wsparcia doradczego dla sektora publicznego, mieszkaniowego oraz przedsiębiorstw w zakresie efektywności energetycznej oraz OZE, see: NFOŚiGW 2014 – Doradztwo energetyczne. <http://nfosigw.gov.pl/o-nfosigw/doradztwo-energetyczne/>

⁶⁹ Fund Eko, 2018 – Ewaluacja działań podejmowanych w ramach 4 osi priorytetowej Regionalnego Programu Operacyjnego Województwa Małopolskiego na lata 2014-2020 na poprawę efektywności energetycznej i budowanie gospodarki niskoemisyjnej w regionie – etap I: Raport cząstkowy z 9 marca 2018. https://www.rpo.malopolska.pl/download/program-regionalny/o-programie/przeczytaj-analityzy-aporty-i-podsumowania/ewaluacja/2018/05/Raport_czastkowy_4_os.pdf

⁷⁰ POP Małopolska 2017 / MAQP, op.cit.

for the base year 2015. The implementation of activities has been planned to 2023. The effect of implementing the Program should be to reduce the emissions of air pollutants.

The program indicates a number of directions of activities in the field of air protection, including:

- introduction of restrictions on the use of solid fuels
- elimination of low-efficient heating sources
- expansion and modernization of heating networks ensuring the connection of new users
- expansion of gas networks ensuring the connection of new users
- use of renewable energy sources to reduce the operating costs of low-emission heating
- thermal modernization of buildings and support for energy-saving construction in housing

The implementation of these and other corrective actions indicated in the Plan is associated with high financial costs, which only in the area of reducing surface emissions amount to almost PLN 4.8 billion. Due to the important social aspect of improving air quality, a large part of these funds is to be allocated from public funds, particularly from NFOŚiGW, the **Regional Fund for Environmental Protection and Water Management in Krakow** (Kraków WFOŚiGW), and budgetary resources of municipalities and voivodships.

To ensure the rational placement of public financial resources, the indicated actions were analysed in terms of their economic efficiency. The Plan indicates that the improvement of air quality will bring financial benefits through the reduction of indirect costs of e.g. medical services, breaks at work or environmental damage caused by air pollution. It is estimated that savings from emission reduction from the municipal and residential buildings sector may amount to as much as PLN 3 billion per year.

The Air Quality Plan is accompanied by a **Resolution of the Małopolska Regional Assembly on the introduction of restrictions and bans regarding the operation of installations in which fuel is burning**.⁷¹ Such a legal solution is provided for in the Environmental Protection Law (POŚ).⁷² In the event of exceedances of air quality standards in Małopolska, and because of the violation of the right to life and protection of human health, as well as failure to comply with Poland's obligations under EU law, the application of restrictions set out in the Resolution is a measure adequate to the goal of reducing pollution to levels in accordance with applicable law. In accordance with art. 96 section 1 POŚ, in order to prevent a negative impact on human health and the environment, in January 2017 the Regional Assembly introduced above mentioned restrictions and/or bans. The effects of these activities have been briefly described in section 3.

Regional Operational Programme for Małopolska 2014-2020 (RPOWM 2014-2020)

The scope of the program in Małopolska includes e.g. the replacement of old boilers, furnaces, heating devices using solid fuels in individual households for modern heat sources, including RES or connection to the heating network. The generation of electricity from RES is also supported. The maximum total project co-financing level is 60%, subject to projects covered by public aid and/or de minimis aid. Co-financing is **granted through the commune**.⁷³

Some of experiences of KrOF Municipalities in implementing RPOWM are described below and in the next section.

Eco-partners for solar energy in Małopolska

This project functions under the RPOWM 2014-2020, 4 Priority Axis – Regional Energy Policy, Measure 4.1 – Increasing the use of renewable energy sources; Sub-measure 4.1.1 – Development of renewable energy infrastructure. 32 local governments participate in the project. It subsidizes PV panels on almost 800 private buildings

⁷¹ Uchwała Nr XXXII/452/17 Sejmiku Województwa Małopolskiego z dnia 23 stycznia 2017 r. w sprawie wprowadzenia na obszarze województwa małopolskiego ograniczeń i zakazów w zakresie eksploatacji instalacji, w których następuje spalanie paliw. <https://bip.malopolska.pl/umwm.a.1283900,uchwala-nr-xxxii45217-sejmiku-wojewodztwa-malopolskiego-z-dnia-23-styczna-2017-r-w-sprawie-wprowadze.html>

⁷² Dz. U. 2016 r. poz. 672 -Obwieszczenie Marszałka Sejmu Rzeczypospolitej Polskiej z dnia 19 kwietnia 2016 r. w sprawie ogłoszenia jednolitego tekstu ustawy – Prawo ochrony środowiska

⁷³ RPO Małopolska – Regionalny Program Operacyjny 2014-2020. <https://www.rpo.malopolska.pl/o-programie/zapoznaj-sie-z-prawem-i-dokumentami/regionalny-program-operacyjny-2014-2020>

in all communes of the **Wieliczka powiat**. The leader of the project is the Green Ring of Tarnów Association, and the **municipality of Niepołomice** is the coordinator of its part for Wieliczka powiat.⁷⁴

332 PV panels will be installed on houses in the Commune of Niepołomice and 240 in Commune of Wieliczka. The subsidy will cover 60 percent (minus VAT) of installation costs. The residents participating in the project will cover the remaining costs – about PLN 14-15,000 per household (with an assumed gross price of up to PLN 5,000 for the installation producing 1kW of energy).

- The total value of the project is over PLN 110 mln
- Total eligible expenditure is over PLN 98 mln
- EU (ERDF) co-financing amounts to over PLN 59 mln

The investment is planned for two years (until June 2021).

Regional Fund for Environmental Protection and Water Management in Krakow (Kraków WFOŚiGW)

Kraków WFOŚiGW implements e.g. programs for air protection and renewable energy, addressed to various beneficiaries, including municipalities, NGOs, entrepreneurs, and natural persons. For example, the **JAWOR program** implemented by WFOŚiGW consists in granting loans up to 90% qualified costs for insulation of building envelopes. One of the conditions for co-financing is to provide an energy audit or energy performance certificate for the building (a reduction in heating demand by at least 25% is required).⁷⁵

One of the most important programs implemented by WFOŚiGW for energy efficiency and renewable energy in communal buildings could be the **Program for Reduction of Localised Air Pollution in the Region of Małopolska** (PONE Małopolska).⁷⁶ A commune joining the program must have a municipal AQP [POP] or another equivalent regulation which implements the provisions of the Strategic Program for Environmental Protection and POP Małopolska 2017 / MAQP.⁷⁷ PONE supports e.g. replacement of old boilers, solid fuel-fired furnaces with low-emission boilers or connection to geothermal sources, or municipal heating networks, together with the replacement of the internal heating and hot water installations.

Unfortunately, this program also finances the assembly of new boilers for gas, oil, and even modern coal or biomass boilers (whose combustion still causes high PM emissions).

Integrated LIFE project – Implementation of the Air Quality Plan for Małopolska Region – “Małopolska in a healthy atmosphere”

The LIFE project funds innovative solutions for environmental protection in Europe and integrated projects are a flagship instrument to support the implementation of strategies for improving the quality of the environment in a large area. The LIFE project in Małopolska involves a total of 62 partners, and its goal is to accelerate the implementation measures to improve air quality goals of the POP Małopolska 2017 / MAQP. The project value is approximately PLN 70 million, of which EU funding is PLN 42 million. It has been implemented since October 2015 and will run to the end of 2023.

Thanks to the participation of the Skawina and Wieliczka Municipalities in the LIFE project, the inhabitants of these communes can take advantage of the free assistance of Eco-advisors.⁷⁸

The basic tasks of the Eco-advisor include:

⁷⁴ Niepołomice 2018 – Ekopartnerzy na rzecz słonecznej energii Małopolski. <https://www.niepolomice.eu/ogloszenia/ekopartnerzy-na-rzecz-slonecznej-energii-malopolski/>

⁷⁵ WFOŚiGW w Krakowie 2019 – Program Priorytetowy „Jawor” Poprawa efektywności energetycznej – termomodernizacja budynków jednorodzinnych. <https://www.wfos.krakow.pl/oferta/programy/jawor/>

⁷⁶ PONE Małopolska – Program Ograniczenia Niskiej Emisji na terenie województwa małopolskiego. <https://www.wfos.krakow.pl/program-dofinansowania-zadan-ze-srodow-wfosigw-w-krakowie-realizowanych-przez-gminy-w-ramach-programu-ograniczenia-niskiej-emisji-na-terenie-wojewodztwa-malopolskiego/>

⁷⁷ However, a commune which has received funding under the KAWKA program cannot apply for funding from WFOŚiGW. Ibid.

⁷⁸ Despite the fact that Niepołomice did not join the LIFE project, the services of Eco-advisors are provided there by the commune.

- providing advice to residents on the replacement of heating and hot water sources (selection and optimization of the type and power of the source) and on the entire thermal modernization of the building (including thermal imaging)
- providing education for residents, and organizing workshops on energy saving and ecological and health benefits from the replacement of heat sources
- cooperation with local media, action groups, parishes, NGOs, Volunteer Fire Brigade, Police, medical doctors, energy companies, road engineers, chambers of commerce/agriculture, etc.

Metropolitan EKO TEAM project

Recently the decision was made for financing the EKO TEAM project, which will be implemented under the ELENA Program of the European Investment Bank. The project concerns the **employment of 44 Eco-advisors** in municipalities (39) and SMK office (4), and covers employment costs for a period of 3 years (2020-2022).

Eco-advisors will be involved e.g. in the **Plan for the liquidation of coal boilers in the Krakow Metropolis by the end of 2022**, advising on thermal modernisation and OZE, searching for sources of co-financing thermal modernization and renewable energy installations, and helping residents in obtaining and settling grants.

Municipal instruments

Low-Emission Economy Plans

Low-Emission Economy Plans (PGNs) are expected to contribute to achieving CO₂ reduction goals, increasing the share of energy from renewable sources, reducing final energy consumption, and setting out specific actions that local authorities and possibly the private sector will take to achieve these goals at the scheduled time.

PGNs should cover the entire geographical area managed by local authorities, and plan low-emission and resource-efficient activities, including improvement of energy efficiency and the use of local renewable energy potential. The priority of the Low-Emission Economy Plan should be the reduction of final energy consumption.

PGNs should compulsorily cover the sectors of the economy in which local authorities have an impact on energy consumption, i.e. the sector of public buildings and municipal housing, technical infrastructure, including street lighting, heating networks, and transport.

A PGN is a comprehensive document - in addition to activities in the public sector, it should cover the private sector as broadly as possible, i.e. participation of local entities that are producers or consumers of final energy, including cooperatives and housing communities, trade, services, and industry.

The local community should be involved as much as possible in the work on the Plan. A PGN should contain a description of activities promoting and educating the local community in order to change the attitudes towards the consumption by end energy users. Local authorities should also provide human resources to support PGNs.

Indicators should be defined in a PGN that will allow monitoring of the results in terms of implemented measures, as well as the reduction of CO₂ emissions in relation to the base year.

The actions presented in a PGN, which are influenced by the local government (municipality, an association of communes), must be reflected in the provisions of the Multiannual Financial Forecast (WPF).⁷⁹ Activities under a PGN are financed from municipal budgets and external sources (in the form of non-repayable grants, loans, preferential loans, ESCO financing). A detailed PGN implementation schedule should consider the deadlines for applying for external financing. The municipality should regularly verify the possibilities of applying for potential external financial resources.

⁷⁹ WFOŚiGW w Krakowie 2019, Plany gospodarki niskoemisyjnej. <https://www.wfos.krakow.pl/doradztwo-energetyczne/plany-gospodarki-niskoemisyjnej/>

Exemplary subsidy programmes and projects at Commune of Skawina

STOP SMOG programme in Skawina

As part of PGN's implementation, tasks related to the thermal modernization of single-family buildings are currently implemented, including the currently run modernization of 300 houses; this will reduce energy use by 8 160 MWh/year and significantly reduce emissions:

- PM10 by approx. 8 Mg per year
- PM2,5 by approx. 7 Mg per year
- SO₂ by approx. 25 Mg per year
- BaP by approx. 15 kg per year

Subsidies are also planned for replacing old solid fuel boilers, which is expected to reduce CO₂ emissions by 39.48%, PM10 by 99.94% and PM2.5 by 99.85%.

The call for applications for the replacement of solid fuel stoves and boilers for low-emission sources began on September 23, 2019. Subsidies can be applied for by natural persons with a legal real estate title located in the Skawina Commune. A prerequisite for obtaining a subsidy is the liquidation of all existing heating furnaces or boilers fueled by solid fuel in a building where there is no business activity. The subsidy will be transferred to the owner as reimbursement of costs incurred, after the investment is complete.

Clean Energy Near Krakow

The Skawina Commune participates in the project Clean Energy Near Krakow which is being implemented by five Partner Communes of the Krakow Powiat: Czernichów, Liszki, Skawina, Świątniki Górnne, and Zabierzów. The project leader is the Local Action Group "Near Krakow". The project enables financial support under RPOWM Measure 4.1 – Increasing the use of renewable energy sources, sub-measure 4.1.1 – Development of infrastructure for the production of energy from renewable sources.

The subject of the project is the purchase and assembly of RES installations for heat and electricity, i.e. PV panels, solar collectors, heat pumps and biomass boilers. As part of the project, these devices will be installed in individual households and public utilities in the area of Partner Communes. The implementation of the project is to contribute to the elimination or reduction of pollutants released into the atmosphere by single-family buildings and public buildings.

Expected number of purchased and installed units:

- solar collectors - 333 pcs (including 154 in the Skawina commune)
- photovoltaic installations - 583 pcs (including 128 in the Skawina commune)
- heat pumps - 104 items (including 21 in the Skawina Commune)
- biomass boilers - 360 pcs. (including 212 in the Skawina commune)

The total estimated value of the project is PLN 28,4 mln. Co-financing from the European Regional Development Fund will amount to PLN 15,2 mln.⁸⁰

Municipal low-emission program for the Skawina Commune 2019-2023

The strategic goal of the Program⁸¹ is to improve air quality in the Skawina Commune by:

- reducing the demand for heat in single-family residential buildings
- replacement of heating and hot water utilities and systems in single-family residential buildings to meet low-emission standards

⁸⁰ LGD Blisko Krakowa 2018 – Czysta Energia Blisko Krakowa. <http://www.bliskokrakowa.pl/aktualnosci/2018/1262-czysta-energia-blisko-krakowa.html>

⁸¹ BIP Małopolska 2019 – Gminny program niskoemisyjny dla Gminy Skawina na lata 2019 – 2023. Załącznik do Uchwały Nr IX/111/19 Rady Miejskiej w Skawinie z dnia 19 czerwca 2019 r. w sprawie ustanowienia „Gminnego programu niskoemisyjnego dla Gminy Skawina na lata 2019 - 2023”. https://bip.malopolska.pl/umigskawina.a_1625224.uchwala-nr-ix11119-rady-miejskiej-w-skawine-z-dnia-19-czerwca-2019-r-w-sprawie-ustanowienia-gminneg.html

- liquidation of heating and hot water systems that do not meet low-emission standards, and connecting the residential building to a heating or gas network

The plan also indicates the necessary educational, informational and promotional activities. The total value of planned activities related to ecological education in 2018-2022 is about PLN 200,000, including the co-financing of projects by the EU under RPOWM and Kraków WFOŚiGW.

5. Do you know about any experience in edge cities of your area concerning energy efficiency in public building?

If yes, what are they and how were they implemented?

Kraków Functional Area [KrOF]: Activities of SMK

Among the SMK activities, particularly noteworthy are those in line with the **Plan for the liquidation of coal boilers in the Krakow Metropolis by the end of 2022** and projects implemented by the municipalities of SMK as part of the Regional Operational Program of the Lesser Poland Voivodeship for 2014-2020, e.g.:

Sub-action 4.3.1 – Deep thermal modernization of public facilities, including the **Modernization of school complexes in Niepołomice** with the use of heat pumps and photovoltaics, as well as the **Thermal modernization of public buildings in the Wieliczka commune** - stages I and II.

Action 4.1 – focused on the thermal modernization of public and residential buildings, intelligent energy management and use of RES. This includes the installation of RES devices in municipal and private facilities, as well as a solar farm in the commune of Wieliczka.

Sub-action 4.1.1 is the closest to the idea of energy transformation and was implemented in Edge Cities through such projects as **Clean Energy Near Krakow** and **Eco-partners for solar energy in Małopolska**, both described in section 4.

KrOF: Kraków Energy Lab system implementation

In 2017, the City of Krakow, in cooperation with PGE Energia Ciepła SA, implemented a system for the monitoring of media consumption in communal public buildings. The action taken by the City Hall results from the municipal Low-emission Economy Plan. The system covers 636 buildings, where all used utilities are monitored: water, electricity, heat from the municipal network, and gas.

This action was implemented in cooperation with a local branch of PGE Energia Ciepła energy company. A specialized system has been used (developed by specialists from the PGE heat and power plant in Kraków) to **assess the energy efficiency of buildings**. The assessment is provided in four key areas: **media consumption, environmental impact, energy efficiency, and costs**. In communal buildings, consumption of heat, gas, electricity, and water is monitored. These activities bring measurable financial effects: in 2018, the total cost of media consumed in the monitored buildings dropped by almost PLN 700,000 compared to 2017.⁸²

⁸² CIRE 2019 – PGE Energia Ciepła wspiera Kraków w monitorowaniu zużycia mediów w budynkach użyteczności publicznej.
<https://www.cire.pl/item.179596.8.0.0.0.0.pge-energia-ciepla-wspiera-krakow-w-monitorowaniu-zuzycia-mediow-w-budynkach-uzyteczosci-publicznej.html>

Monitoring is an introduction to the implementation of an **energy consumption management system in municipal public buildings**. The whole process leads to the introduction of the ISO 50,001 standard.

In 2018, for the implementation of the system for monitoring media consumption in public buildings, Krakow received the ECO-CITY award in the category of energy efficient buildings in cities over 100,000 residents.⁸³

The city is planning further actions to **rationalize operating costs**, such as the verification of electricity purchasing conditions (selection of tariffs, number of connections, size of ordered power, reactive power compensation), replacement of lighting with LEDs, and the installation of solar panels. The Kraków Energy Lab system also has an educational dimension, thus providing training, e.g. **for Edge Cities officers responsible for monitoring media consumption** (see Section 8).

KrOF: experience of Edge Cities

All KrOF municipalities develop and implement **Sustainable Energy and Climate Action Plans** (SECAPs) and **Low Carbon Economy Plans** (PGNs). They elaborate **audits** and **energy performance certificates of municipal buildings** and SWOT analyses of the local energy situation; implement **energy-focused investments** reducing emissions and costs of energy consumption in schools and other municipal buildings; **activate local communities**; **employ Eco-advisors** and **organize Energy Days**. They also cooperate with partners from other regions and from other EU countries.

All the Edge Cities of KrOF implemented the project entitled, "Installation of renewable energy systems in the municipalities of Niepołomice, Wieliczka, Skawina, and Miechów on public buildings and private houses" – the so-called **Solar Project**. As a part of it, thermal modernization of educational institutions and sports facilities was carried out, including **modernization of ventilation**, the **application of heat pumps and PVs**, financed both from the communes' own resources and external sources. For more on the implementation of this project in certain municipalities, see below and in section 9's "Good practices".⁸⁴

Niepołomice

Niepołomice is one of the most advanced among Poland's cities (with a population below 100,000) as regards supporting the development of RES and international and inter-municipal cooperation for energy efficiency.⁸⁵

As one of the first four municipalities in Poland, Niepołomice joined the **Covenant of Mayors** – a worldwide multi-stakeholder movement and the technical and methodological support offered by dedicated offices.⁸⁶ Consequently, Niepołomice belongs to the **Polish Network Energie Cités** (PNEC), an association of municipalities which, since 1994, cooperates with local governments to shape the local low-carbon economy, the efficient use of energy, the promotion of RES, and environmental education and climate protection. PNEC belongs to the European city network, "Energy Cities".

The **Solar Project in Niepołomice**⁸⁷ - described in more detail in section 9 as a good practice – brought the following effects related to energy efficiency in public building in the city:

⁸³ Krakow 2018 – Kraków z nagrodą ECO-MIASTO 2018. http://krakow.pl/213212,1962,223640,powietrze.krakow_z_nagroda_eco-miasto_2018.html

⁸⁴ Gmina Skawina 2017 – Konferencja podsumowująca „Projekt Solarny”, Aktualności OP 24-04-2017. https://www.gminaska-wina.pl/index.php?option=16&action=news_show&news_id=14641

⁸⁵ PNEC 2017 – Niepołomice—perła wśród samorządów. <http://www.pnec.org.pl/pl/component/content/article/3-aktualnoci-kat/593-niepołomice-perła-wśród-samorządów%20>; PNEC 2016 – Członkowie naszego Stowarzyszenia po raz kolejny wśród laureatów konkursu ECO-MIASTO. <http://www.pnec.org.pl/pl/component/content/article/3-aktualnoci-kat/515-członkowie-naszego-stowarzyszenia-po-raz-kolejny-wśród-laureatów-konkursu-eco-miasto%20>

⁸⁶ The EU Covenant of Mayors for Climate & Energy brings together thousands of local governments voluntarily committed to achieving and exceeding the EU climate and energy targets, improving the quality of life of residents, and creating new jobs. The Covenant of Mayors is capitalising on the experience gained over the decade in Europe and beyond, and is building upon the key success factors of the initiative: the bottom-up governance, the multi-level cooperation model and the context-driven framework for action. See: NFOŚiGW 2014 – Porozumienie Burmistrzów. <http://www.nfosigw.gov.pl/o-nfosigw/porozumienie-burmistrzow>

⁸⁷ Niepołomice 2017 – Realizacja projektu „Instalacja systemów energii odnawialnej w gminach: Niepołomice, Wieliczka, Skawina oraz Miechów na budynkach użyteczności publicznej oraz domach prywatnych”. <https://www.niepolomice.eu/informator/projekt-solarny/>

- 4 solar installations on large public buildings (MKS Puszcza Niepołomice, LKS Czarni Staniątki, TSO in Niepołomice, CKZiU)
- installation of 2 heat pumps in the indoor swimming pool in Niepołomice, and in the administrative centre of Bocheńska
- the thermal modernization of 15 public facilities (schools, community centres, Volunteer Fire Brigade buildings, indoor swimming pool, Niepołomice Royal Castle) with the assembly of PV installations
- equipping a modern workshop for teaching technicians in the profession of renewable energy devices and systems

As part of the project, a monitoring system for electricity and heat consumption, as well as renewable energy production, was installed.

The **Euronet 50/50 Max** project in Niepołomice aims to mobilize energy savings in public buildings through the implementation of the 50/50 methodology; it was tested in 500 schools and nearly 50 other public buildings from 13 EU countries.⁸⁸ The methodology consists of 9 steps: setting up the energy team; the initial energy tour; raising building users' knowledge and awareness on climate and energy issues; an extended energy tour; long-term temperature measurements and an energy use assessment; proposing energy-saving solutions; the development of an information campaign; reporting measures requiring small investments; and calculating and using the money saved.

Achieved financial savings are shared equally between the building users and the local authority, which covers the energy bills. A very important aspect of the Euronet 50/50 Max project is engaging energy teams in taking action on the use of the money received. In three years, between 2013 and 2016, the project has achieved **11% annual energy reduction** (on average) in the 311 public buildings involved, generating significant economic savings in the energy bills.⁸⁹ In Poland, 139 schools and 9 other public buildings got involved in the project in cooperation with their local governments, including **8 schools in the Niepolomice Commune**.⁹⁰

Skawina

In the Skawina Commune, tasks of **deep thermal modernization of educational institutions and sports facilities** were carried out in the first place, including investments in ventilation systems, the use of heat pumps, and PVs – both from the commune's own resources and external sources.

Along with Niepołomice and Wieliczka, Skawina participated in the **Solar Project** financed by the Swiss-Polish Cooperation Program. ("The installation of renewable energy systems in the municipalities of Niepołomice, Wieliczka, Skawina, and Miechów on public buildings and private houses.") As a part of this project, two facilities were **comprehensively thermally modernised** in the Skawina Commune: a swimming pool and a public school complex. As part of this work, the buildings were insulated, and PV panels and heat pumps were installed. The boiler rooms were modernised and **energy management systems** were implemented. Solar installations were installed on four other educational public buildings.

The implementation of the project made residents aware that RES installations not only improve the state of the environment, but also **increase the quality of life**.⁹¹

Wieliczka

Under the **Solar Project** in Wieliczka, over 600 solar collectors were installed, including 10 in public buildings in the Commune. 23 public buildings have been insulated. In total, at least 15 public buildings were equipped with solar installation in the Commune until 2015.⁹²

⁸⁸ Euronet 50/50 Max 2013 – O co chodzi w projekcie EURONET 50/50 MAX? <http://www.euronet50-50max.eu/pl/about-euronet-50-50-max/what-is-the-euronet-50-50-max-about>

⁸⁹ Intelligent Energy Europe, 50/50 European Network of Education Centers spreads across Europe. <https://ec.europa.eu/energy/intelligent/projects/en/projects/euronet-5050-max>

⁹⁰ Energie Cités 2013 – Euronet 50/50 Max Project – Reducing Energy Consumption in Public Buildings through Implementation of the Innovative 50/50 Methodology. http://www.razemdlaklimatu.eu/images/dobre_praktyki/EURONET_5050_MAX_EN.pdf

⁹¹ Gmina Skawina, Konferencja podsumowująca „Projekt Solarny”, Aktualności OP 24-04-2017. https://www.gminaskawina.pl/index.php?option=16&action=news_show&news_id=14641

⁹² PGN Wieliczka 2020, op.cit., 721.

The thermal modernization of public buildings, including the replacement of old boilers, is continued under the **Operational Program**.

In 2019, the **Eco-partners for solar energy in Małopolska** program (previously mentioned in section 4.) was launched, which is to bring about 1,000 PV installations, including several dozen in public buildings in the Wieliczka Commune. The estimated value of works in the Commune is PLN 4.2 mln (PLN 2.3 mln from subsidies). In the Wieliczka powiat, the total value of this project exceeds PLN 17 mln. Niepołomice received PLN 3.6 mln in subsidies for a project costing over PLN 6.8 mln.

6. Do you think that new jobs could help the public administration to better understand/implement policies and initiatives for energy efficiency in building? If so, what kind of investments should the public school/educational system make as a whole to create such new professional figures?

According to municipal officers, communal services should include persons who have knowledge in the design of installations to reduce energy consumption and monitor their work, and be aware of innovative solutions in energy efficient building that have been positively verified by research institutions.⁹³ In terms of helping residents in the process of improving energy efficiency (the most important goal), officers indicate that soft competencies – interpersonal skills – are even more important in this context than technical competencies.

The first significant step to help people better understand and implement policies and initiatives to increase energy efficiency and the use of RES in buildings was to employ Eco-advisors in the municipalities. As part of the LIFE Małopolska project, 39 communes in Małopolska, including the cities of KrOF, have employed Eco-advisors in the last years. They activate the inhabitants and encourage the use of subsidies for the thermal modernization of buildings. Thanks to Eco-advisors, people can directly obtain detailed and relevant information, e.g. on building thermal modernization, replacement of a heat source, the installation of RES, and finding available funding programs.

Until November 2019, the Eco-advisors provided on a regional scale⁹⁴ over 530,000 consultations to residents and over 2,800 thermovision examinations of buildings. Almost 16,000 applications for co-financing were serviced and additional co-financing in the amount of over EUR 450 million was obtained.⁹⁵

As part of the LIFE Małopolska project, local informational and educational activities in the field of air protection were also carried out. Informational materials about Eco-advisors were prepared for distribution in churches and health care facilities, and scenarios for lessons were prepared as part of the Małopolska Educational Cloud.⁹⁶

As part of the LIFE Małopolska project, guidelines were also prepared regarding the required education, qualifications, and experience required from candidates for the position of Eco-advisor. Recruitment criteria and an exemplary scope of activities of the Eco-advisor were presented to local governments.⁹⁷

Training is provided by, e.g. the Małopolska Centre for Low-energy Building at the Cracow University of Technology (MCBE). The employees of the Centre are a team of experts competent and experienced in consulting information, training, and promotional services in the field of transfer of innovative technologies, entrepreneurship, and the stimulation of innovative projects in the field of low-energy construction. MCBE experts have established cooperation with scientists from all over Poland, who, in addition to scientific research, have experience

⁹³ This assumption is based on interviews with several municipal officers in KrOF and the Staff of the CUT's Małopolskie Centre for Low-energy Building, which cooperates with municipalities in the Region on energy audits and educational programmes.

⁹⁴ Powietrze Małopolska 2019 – Efekty projektu. <https://powietrze.malopolska.pl/life/efekty/>

⁹⁵ Ibid.

⁹⁶ Podsumowanie realizacji projektu LIFE-IP Małopolska: LIFE14 IPE/PL/021, Listopad 2019. Załącznik nr 1 do uchwały Nr XXXII/451/17 Sejmiku Województwa Małopolskiego z dnia 23 stycznia 2017 roku. <https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=2ahUKEwi6kNXkvZXnAhWDAXAIHV04BqUQFjAAegQIBhAB&url=https%3A%2F%2Fpowietrze.malopolska.pl%2Fwp-content%2Fplugins%2Fdownload-attachments%2Fincludes%2Fdownload.php%3Fid%3D33544&usg=AOvVaw0PZrl6F5t2vruiRHqj7olw>

⁹⁷ Powietrze Małopolska 2019 – Efekty projektu, op.cit.

working with industry. Such collaborations of scientists and MCBE experts enables the development and implementation of modern technologies in the field of energy-saving construction. When applying to MCBE, stakeholders receive an individual supervisor who monitors the process of advisory, training, transfer, and promotion of energy-saving technologies on an ongoing basis.

At the same Cracow University of Technology, the International Centre of Education has been offering postgraduate studies in Sustainable Urban Management. The curriculum and diploma projects concern various aspects of the low-carbon built environment.

Postgraduate studies in the field of air protection and energy were also created at AGH University of Science and Technology, addressed to public administration employees willing to further study the technical aspects of construction, emissions of air pollutants, etc.

These examples show the substantive potential of the education sector in Małopolska, and that its offer is probably sufficient to prepare competent employees of local administrations who could help to better understand and implement policies and initiatives to increase energy efficiency in construction. It seems that currently, the supply of educational services in this field is even higher than the demand for lifelong learning in the field. However, this does not result from the lack of interest among prospective students and trainees, but rather from the lack of awareness of decision-makers on the importance of properly educating administration employees in the field of energy efficiency, urban management, and low-impact building.

More funds are needed for lifelong education in the field. Post-graduate studies and training are too expensive for most officers to pay by themselves. Therefore, new programs of grants and educational vouchers are necessary, thanks to which every interested person could take advantage of the rich educational offer of Małopolska's universities and training centres. Similar vouchers are currently offered by, for example, the Małopolska Regional Development Agency, to improve qualifications and competencies through training, post-graduate studies, e-learning, consulting, mentoring, and exams. Vouchers can cover up to 80% of costs. However, the project is directed only to entrepreneurs from Małopolska and their employees, and is not available to public administration employees.

7. What measures should be taken to increase citizens' acceptance of energy efficiency measures in private/public buildings?

In Małopolska, activities aimed at promoting renewable energy and increasing citizens' acceptance appear primarily as a remedy for air quality problems, and in this context, citizens are encouraged to invest not only in RES, but also gas, and light oil boilers.⁹⁸ In Kraków, the exchange of furnaces and boilers, in spite of the ban on solid fuels, has not contributed so far to the promotion of renewable energy as an alternative way to provide heat and electricity in households.

The report presented by the Pro-Akademia R&I Centre indicates a high level of acceptance of investments in energy efficiency measures among municipal authorities.⁹⁹ There is also a growing number of arguments to convince the public to accept such investments (cleanliness, environmental and health benefits, reduction of energy prices, technological progress, new jobs, energy security, and income for the commune and residents). However, the promotion of RES knowledge should be increased to provide municipalities with comprehensive data. There is not enough awareness on, e.g. differences between fuels regarding CO₂ and PM emissions. Quite often, biomass is treated as a clean fuel even if, when incinerated in installations without filters, it contributes to high PM emissions. It is important that the thermal modernization campaign promotes the replacement of old boilers with truly clean energy installations, such as hybrids of PV and heat pumps.

A wider information campaign promoting the reduction of energy demand for buildings should be launched; in the case of all new buildings, and the thermal modernisation is subsidised by a government, the obligation to use clean and renewable energy sources might be needed.

⁹⁸ Małopolska w zdrowej atmosferze, Dofinansowanie. <https://powietrze.malopolska.pl/dofinansowanie/>

⁹⁹ Pro-Akademia 2014 – Kochańska E. (red.), Determinanty rozwoju odnawialnych źródeł energii, Seria wydawnicza Acta Innovations

Regional and local measures to increase citizens' acceptance of energy efficiency improvement in private and public buildings

Providing practical knowledge

It is necessary to prepare suitable information materials to support residents in the selection of the appropriate scope of solutions, sources of financing, and the selection of reliable, competent contractors.

The municipalities in Małopolska willingly engage in projects conducive to energy transition financed by EU funds. In the promotion of energy transition in Kraków, universities and research institutes play a significant role. They organize conferences and events which are aimed not only at the professional exchange of knowledge, but also the popularization and promotion of RES.

Innovative educational and promotional campaigns should include, first and foremost:

- 1) saving energy through thermal modernization and other methods of reducing the consumption of both heat and electricity
- 2) promoting the use of low-carbon heating sources

Regional and local authorities are responsible for planning a long-term information and education campaign for residents. It is advisable that these activities are prepared with a view to shaping attitudes towards long-term goals related to air and climate protection. The campaign should be planned in a way that allows reaching out with information, and shaping desired attitudes on cognitive, emotional and behavioural levels. Educational campaigns should be provided not only in schools and kindergartens, but also during various public events and nationwide and international occasions, such as Clean Air Day (November 14) and International Earth Day (April 22).

Additionally, some citizens need to be presented with the benefits of thermal modernization through word of mouth marketing.

Economic aspects

According to municipal officers, the most effective tools to encourage the energy efficiency of buildings improvements are:

- financial incentives through subsidies
- tools enabling the realization of an investment from a loan and repayment of its costs from savings generated from the investment.

The issue of air pollution has been a leading motive in public discourse in the region and throughout Poland for several years. Therefore, the modernization of buildings and installations is mainly motivated by the impact on the quality of the environment. Economic aspects are much less frequently undertaken in the discourse. It seems that public opinion is still not sufficiently aware of the long-term positive economic effects of increasing the energy efficiency of public and private buildings. The massive replacement of boilers and heating installations carried out in a few KrOF municipalities is primarily the result of administrative pressure and subsidy programs covering up to 100% of the costs. The relatively slow start of the boiler replacement program in Krakow has shown that only the most conscious citizens are aware of the economic benefits that heating system modernization will bring.

The functioning of existing financial instruments might be improved and extended by alternative financial instruments. They do not necessarily need to subsidize, but improve, payment capacity, e.g. through low-interest loans without the need to provide creditworthiness as required by standard credit institutions.

Role of the business and industry

All stakeholders should be actively involved in educational activities. The interests of producers and building owners are coherent, but the flow of information to individual stakeholders is incorrect – producers and contractors do not sufficiently engage in the process of education, optimization of investment implementation, and the functioning of devices so that the investment could meet its potential. Any improperly implemented or misused measure causes negative promotion, distrust, and a decrease in interest in improving the energy efficiency of buildings and internal installations.

Need for more eco-advisors

Both in the municipal offices and in the milieu associated with the field of energy modernization of buildings, there is a widespread opinion that many more environmentalists are needed to conduct direct education. The Wieliczka Commune, like most of the communes implementing the LIFE Małopolska project, currently employs one Eco-advisor. The municipal offices of Niepołomice and Skawina belong to the few offices in which two Eco-advisors are currently operating. The **scale of needs** in this field, and the **possibilities of financing various types of activities**, is so large that the ability to reach potentially interested residents and entrepreneurs should be increased many times over.

Citizens' awareness of climate change, and the **threat of a climate disaster**, needs to be increased. This should be associated with the widespread use of indicators related to e.g. CO₂ emissions. Current air protection programs mainly use indicators of local importance, i.e. the concentration of substances directly affecting human health: particulate matter PM10 and PM2.5, and polycyclic aromatic hydrocarbons (PAHs) – including benzo(a)pyrene B(a)P. One rarely uses ozone emission indicators – O₃, nitrogen oxides – NO_x and sulphur dioxide – SO₂. In the context of the energy efficiency of heating systems and buildings, as well as renewable energy, the practical arguments and indicators regarding global threats, such as **CO₂ levels and their effects on the climate**, are much less frequent.

The CO₂ emission indicator appears in documents such as POP Małopolska 2017 and must be used by all municipal offices in the region. In the section, "Long-term actions to be undertaken", POP sets out for each municipality the required ecological effect in the form of reduction of PM10, PM2.5, B(a)P and CO₂ emissions in 2017-2019 and 2020-2023 [Mg/year].

Although PM10, PM2.5 or B(a)P have a more direct impact on human health and life, the modeling of dispersion of pollutants made for the needs of updating the Air Protection Program for Małopolska (POP Małopolska 2017) shows that surface sources (Pol.: *emisja powierzchniowa*) from municipal and household pollution (but mainly from residential buildings) account for around 25% of CO₂ emissions (see Fig. 3). Reducing the energy consumption in that sector can, therefore, have a **very significant effect on reducing CO₂ emissions**.

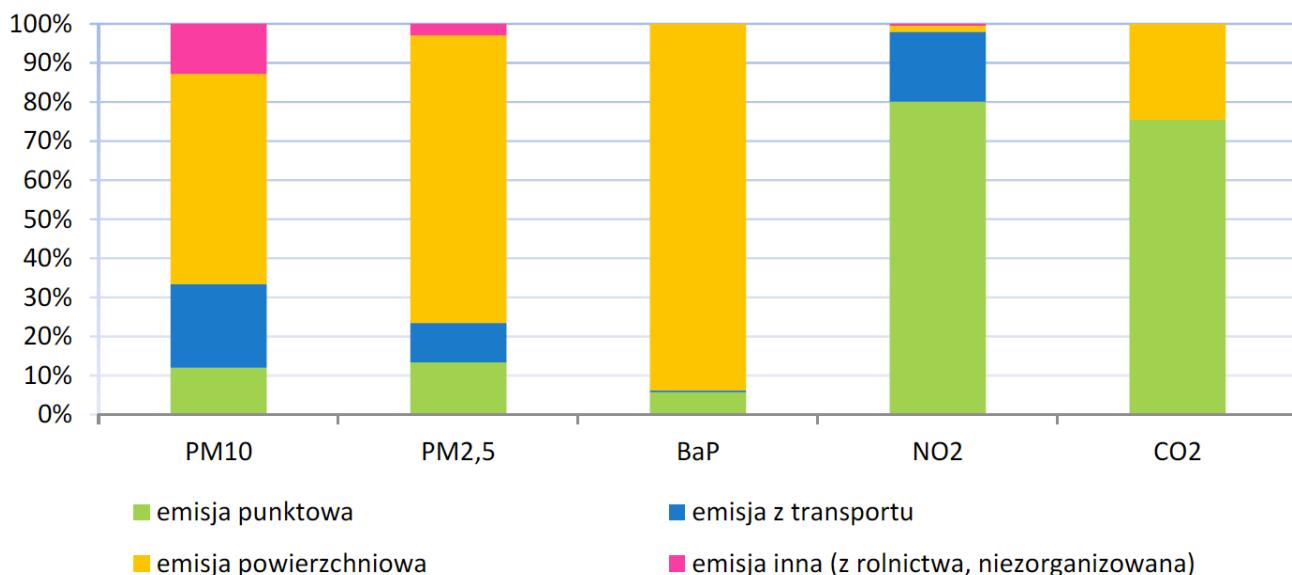


Fig. 3. Emission values of PM10, PM2.5, benzo(a)pyrene, nitrogen dioxide and carbon dioxide by source type in Małopolska, in 2015 (POP Małopolska 2017, 34).

8. What are the monitoring/evaluation tools to check environmental, social, and economic benefits deriving from energy efficiency measures?

Monitoring system

The basic instrument for monitoring environmental benefits is the **State Environmental Monitoring** (SEM), which was created by the Act of 20 July, 1991, on the Environmental Protection Inspection to provide reliable information on the state of the environment. The **Regional Inspectorate for Environmental Protection** (WIOŚ) is responsible for developing long-term Regional programs for the public environmental monitoring, approved by the Chief Inspector of Environmental Protection. The Program for the State Environmental Monitoring for Małopolska (for the years 2016-2020) includes tasks arising from various Acts, the international obligations of the Republic of Poland, and other needs arising from the environmental policy of the state.

After transposition into Polish legislation of the Directive of the European Commission of 28 August, 2015, which established provisions on reference methods, data validation, and the location of measuring stations for air quality assessment, WIOŚ undertook adapting the air quality measurement system to the requirements of the directive in the 2016-2020 perspective.

In 2016-2020, Małopolska WIOŚ (MWIOŚ) conducts measurements of PM10, PM2.5, SO₂, NO₂, NO, NO_x, O₃, benzene, CO_x, as well as Pb, As, Cd, Ni, and B(a)P concentrations in PM10 dust, in accordance with methodologies set out in the Regulation of the Minister of the Environment regarding the assessment of air substance levels.¹⁰⁰ The measurement plan includes 27 stations. These measurements are carried out continuously (automatic measurement), systematically (manual measurement), and periodically (mobile station – automatic and manual measurement).¹⁰¹

Test results and annual air quality assessments are used by the Małopolska Regional Assembly to update air protection programs. MWIOŚ, as part of the Air Quality Monitoring System in Małopolska, publishes on a regular basis the measurement results, transmitted directly from the measuring stations, on an interactive map available at <http://monitoring.krakow.pios.gov.pl>.

The regional and local authorities, as well as the **MWIOŚ**, the **SMK**, and **municipalities** near Krakow, also cooperate with the **Polish Smog Alarm** (PAS) - a non-governmental organization, thanks to which the topic of air pollution has been permanently present in public debate in recent years. PAS conducts and publishes its own air quality tests using portable dust meters.¹⁰²

What is of growing importance, as part of the protective actions specified in the Air Quality Plans (POPs), the mayors are responsible for **controlling home furnaces** with respect to compliance with the ban on waste incineration and, in the case of Krakow, also the ban of burning solid fuels.

Regarding the monitoring or assessment of benefits used by the municipalities in relation to investment and subsidy programmes, currently used monitoring tools, e.g. in Skawina, are based on **testing the efficiency of completed installations**, such as PV panels. Other benefits from the implementation of investments in improving the energy efficiency of buildings are not monitored – their effectiveness is determined based on design assumptions. Acquiring data from individual buildings, especially single-family ones, is time-consuming and inefficient, while the monitoring of the impact of investments in public buildings – according to the officers themselves – comes to the background because of the tight schedules of the municipal offices. Therefore, incentives are needed for municipalities to make an effort to monitor the environmental, social and economic benefits of improving the energy efficiency of buildings.

In the **Environmental Impact Assessment of the Strategy for KrOF ITI** (ATMOTERM SA 2014; 73, 108), the following indicators related to renewable energy were proposed for the annual control:

¹⁰⁰ Dz. U. 2012 poz. 1032 – Rozporządzenie Ministra Środowiska z dnia 13 września 2012 r. w sprawie dokonywania oceny poziomów substancji w powietrzu. <http://prawo.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20120001032>

¹⁰¹ MWIOŚ 2015 – Program Państwowego Monitoringu Środowiska Województwa Małopolskiego na lata 2016- 2020. http://www.krakow.pios.gov.pl/Press/monitoring/pms/wpms_2016_2020.pdf

¹⁰² MWIOŚ 2019 – „Małopolska bez smogu” – czym oddychają mieszkańcy podkrakowskich gmin? Podsumowanie akcji <http://krakow.pios.gov.pl/2019/12/17/malopolska-bez-smogu-czym-oddychaja-mieszkanci-podkrakowskich-gmin-podsumowanie-akcji/>

- Capacity of RES devices implemented by KrOF projects [MW]
- Low voltage electricity consumption per capita [kWh]
- Number of new RES installations in municipal facilities implemented by KrOF projects.

Regional Control system

The MWIOŚ conducts inspections in Małopolska municipalities on account of the implementation of the POP Małopolska 2017 / MAQP. Until October 2019, MWIOŚ inspected dozens of municipalities, imposing administrative fines for a total of PLN 750,000. The main criteria was the reduction of PM10 emissions (MG/year), and the municipalities were to **document their activities by replacing high-emission heating devices**. The degree of PM10 emission reduction is an exponent of the effective operation of municipalities; if they do not comply with the timetable recorded in the MAQP, administrative fines are imposed on municipalities.¹⁰³

MWIOŚ, in cooperation with the Regional Assembly, **enforces from municipalities the correct inventory of heating devices in residential buildings**. Correct database maintenance will allow determining the real progress of reducing emissions and to supervise their functioning. During the inspection, inspectors of WIOŚ oblige municipalities to actively and effectively **raise awareness** and inform residents that by 2023 they will have to **liquidate all non-class heating devices**. Local governments can do this by a variety of methods, including combustion controls, especially during the heating season.

In addition, in 2019, MWIOŚ started its own controls of low-power furnaces used by business entities. Cooperation was also established with **State Trade Inspection** (PIH) in the determination of questionable **quality in fuel trading**. In this way, in consultation with municipalities, the ban on burning mules and fleets is enforced.

MWIOŚ also asked the **Construction Supervision** (NB) to check if the **proper heating devices** were being installed in the completed buildings. In 2020, particular attention is to be paid to monitoring the implementation of Air Quality Plans/Programmes (POPs) in the municipalities around Krakow, including the municipalities of the Edge Cities of KrOF.

The role of PGN Coordinator

Continuous Low-emission Economy Plans (PGNs) monitoring is necessary to **track progress in implementing activities and achieving assumed goals**. Monitoring of PGN implementation at the commune level would be conducted in accordance with the general guidelines for PGN monitoring for the Krakow Metropolitan Area, included in the chapter 'Monitoring and reporting'.

The PGN Coordinator (or coordinating team) is responsible for collecting data for tasks implemented at the commune level, and for updating the Emission Base in the field of energy data.

Apart from the funds necessary to maintain the position(s) of the PGN coordinator at the commune level, no additional financial resources, significant from the point of view of the commune budget, are allocated for monitoring and assessing the implementation of the Plan. In the event of creating a coordinator or coordinating team responsible for the implementation of PGN, the scope of responsibilities should be defined.

Inventory of heat sources

The necessary introduction to the monitoring is an inventory. A good practice is provided by the Niepołomice Commune, which conducted a full inventory of households in the years 2018-2019. 7,750 households were inventoried. The inventory of heating installations was accompanied by an information campaign about the possibility of obtaining subsidies from various programs, including for boiler replacement and thermal modernization of buildings.

In the Commune of Niepołomice, at least 420 furnaces have been replaced in the last three years. There are still available funds for the liquidation of another 250 coal boilers to be used in 2020-2021. In cooperation with the

¹⁰³MWIOŚ 2019 – Program Ochrony Powietrza. Kontrole WIOŚ w Małopolsce.<http://krakow.pios.gov.pl/2019/10/18/program-ochrony-powietrza-kontrole-wios-w-malopolsce/>

Regional Assembly Office, in the first months of 2020, the first 150 energy audits are to be carried out in homes whose owners wish to participate in the project.¹⁰⁴

Energy Lab

Another good practice comes from the City of Kraków. The Energy Lab system – introduced in section 5. of this Inventory – developed by specialists from the PGE Energia Ciepła heating plant, and used by the municipality of Kraków, collects information about the level of consumed media and enables rational planning of projects that increase the energy efficiency in public buildings. Energy Lab is based on a self-improving loop. It processes and analyses data on media consumption, visualizes objects in space, subjects them to a multi-criteria evaluation. As a consequence, it recommends specific actions in a given object or group of objects. The key element of the system is the generation of quarterly reports.

The added value is training for interested entities managing municipal buildings, provided by the PGE team with the use of the Kraków Energy Lab system. PGE Energia Ciepła, together with the Municipal Department of the City of Krakow, offers training on monitoring media consumption which currently covers over six hundred buildings belonging to the Krakow City Commune.

9. Give a good and a bad example of how the economic development deriving from the use of renewable energies in energy efficiency measures in building takes place. Briefly describe the reasons why it is a good/bad practice.

| Good practice | |
|--|--|
| Name | Installation of renewable energy systems in the communes of Niepołomice, Wieliczka, Skawina and Miechów on public buildings and private houses |
| Context | All the Edge Cities of KrOF participated in this project. It was inaugurated in 2009 by its leader – the commune of Niepołomice. Communes of Wieliczka, Skawina, Miechów, Myślenice, and Zabierzów joined the project as partners in 2015. Until April 2017, as part of the activities financed under the Swiss-Polish Cooperation Program, 4,058 private houses and 32 public buildings in all partner communes were equipped with solar installations. 40 buildings were thermally modernized and PV panels were installed in 20 public facilities. Heat pumps have also been installed in nine facilities. Lighting in 18 public buildings, and 400 street lighting lamps, were replaced. |
| Main stakeholders involved | Municipalities of Niepołomice, Wieliczka, Skawina, and Miechów; Swiss-Polish Cooperation Program |
| Web links | https://www.niepolomice.eu/informator/projekt-solarny/ |
| Why is the practice considered “good”? | Of the 75 applications submitted to the Program by Polish municipalities, the application from Niepołomice was rated best. Residents could receive a nearly 70% subsidy from the Swiss-Polish Cooperation Program. The project's objectives were exceeded. All partners expressed satisfaction with the results. |

¹⁰⁴ Białek J. Wielkie gminy liczą piece. Szykują się do projektu „Stop Smog”. Dziennik Polski 29.11.2019. <https://dzien-nikpolski24.pl/wielkie-gminy-licza-piece-szykuja-sie-do-projektu-stop-smog/ar/c1-14616971>

| Bad practice | |
|---------------------------------------|---|
| Name | Improving energy efficiency: Part 3) Subsidies for loans for the construction of energy-efficient houses |
| Context | <p>In 2013, the Priority Program "Effective use of energy. Subsidies for loans for the construction of energy-efficient houses" was started. Under this program, two energy standards were defined for multi-family and single-family residential buildings: NF15 and NF40. They denote the values of indicators of the demand for usable energy for heating and ventilation purposes, amounting to 15 and 40 kWh / (m²·year), respectively.</p> <p>In order for the beneficiary to obtain funding under the program, the building, in addition to the appropriate EUco threshold, had to meet certain minimum technical requirements, including those regarding mechanical ventilation with high-efficiency heat recovery, heating installation, and utility water preparation.</p> <p>According to the information provided on the NFOŚiGW website, until 6 May, 2014, 27 grants from the 12,000 planned for the entire program were awarded. In 2015, in order to meet the expectations of potential beneficiaries, the Management Board of NFOŚiGW decided to introduce simplifications in the program implementation by introducing a milder approach to the technical conditions necessary to meet as part of applying for funding. The changes were primarily aimed at facilitating the achievement of the energy standard of buildings by, among others, lowering the level of indicators and introducing the flexibility of their selection in the design process, which was to improve the cost-effectiveness of projects.</p> <p>In May 2015, NFOŚiGW announced the cessation of support under this program. The Fund assessed that it did not live up to expectations and that <i>more accessible, and more effective, solutions should be sought</i>.</p> |
| Main stakeholders involved | NFOŚiGW |
| Web links | http://nfosigw.gov.pl/oferta-finansowania/srodki-krajowe/programy-priorytetowe/doplaty-do-kredytow-na-domy-energooszczedne/informacje-o-programie/ https://certyfikatorzy.org.pl/pliki/opracowania_sciae/2014.05.31s%20-%20NFOŚiGW%20NF15-NF40.pdf |
| Why is the practice considered "bad"? | <p>Too strict requirements (especially for NF15) and low co-financing, resulted in low profitability of investments with a payback time of over 50 years for NF15. Part of the guidelines under the NF15 program were more than twice as stringent than those set out in the Technical Conditions for NZEB buildings after 2021.</p> <p>The requirements were not transparent, difficult to interpret (even for professionals), and almost impossible to implement in practice.</p> <p>The typical beneficiary did not have information about the potential benefits of constructing a house in the NF15 and NF40 standards, and therefore could not assess the profitability of such an investment.</p> |

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