POLISH - NORWEGIAN COOPERATION FOR CLIMATE AND ENERGY CONSERVATION

Inspirations, benefits and development prospects

POLISH AND NORWEGIAN CITIES
together for climate and energy

norway grants

POLISH - NORWEGIAN COOPERATION FOR CLIMATE AND ENERGY CONSERVATION

Inspirations, benefits and development prospects

The publication presents the most interesting activities, experiences and results of the umbrella project entitled **"Polish-Norwegian cooperation platform for climate and energy conservation"**. The project is funded under the PL04 Programme of the Bilateral Cooperation Fund, which is financed from the Norwegian Financial Mechanism (NMF) 2009-2014.

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1. Introduction

Cities and towns play a key role in the transition towards low-emission economy, based on the use of local renewable energy sources and on the responsible consumption of natural resources. Their involvement in energy-related projects and initiatives contributes to the overall sustainable development and improvement of the quality of life and health of the citizens. To be able to successfully plan and implement them, municipalities need access to inspiring good practices and platforms enabling exchange of experience and efficient cooperation with relevant stakeholders, including other local self-governments.

Norwegian municipalities are recognized as frontrunners in the implementation of sustainable development concept and for many years already they have been implementing many ambitious projects in the area of RES use, sustainable transport, energy modernisation of buildings and development of whole environmentally friendly quarters. Their experience may be valuable and inspirational for Polish municipalities, therefore it was important to disseminate and promote it in Poland and to consider replication of selected ideas in the national context.

This was the objective of the umbrella project entitled **"Polish-Norwegian cooperation platform for climate and energy conservation"**, implemented together by the Association of Polish Cities, Association of Municipalities Polish Network "Energie Cités" and Norwegian Association of Local and Regional Authorities. The project partners took steps towards the development of efficient frameworks and tools supporting bilateral cooperation between Polish and Norwegian local self-governments and results of their work are presented in this report. The publication describes, among others, results of the diagnosis of the current situation of Polish and Norwegian municipalities in terms of energy efficiency and RES use, functioning of the Polish-Norwegian Cooperation Platform and 10 innovative energy projects implemented by Bielsko-Biała, Bydgoszcz, Lublin, Milanówek, Pałecznica, Płońsk, Raciechowice, Rumia, Sopot and Sztum in cooperation with the Norwegian Partners. Enjoy your reading!

2. About the project "Polish-Norwegian cooperation platform for climate and energy conservation"

The umbrella project entitled **"Polish-Norwegian cooperation platform for climate and energy conservation"** aimed at establishing and strengthening bilateral cooperation between Polish and Norwegian municipalities, covering the exchange of experience, knowledge, technologies and best practices in the area of energy efficiency and RES use in the municipal sector. This cooperation resulted in 10 Polish-Norwegian partnerships implementing in Poland 10 most interesting ideas for energy innovation inspired by the Norwegian experience. In the future it should enable undertaking next common initiatives. The umbrella project has been implemented in three stages:

Phase I: initial diagnosis (January - April 2016)

Analysis of the current situation of Polish and Norwegian local self-governments in the area of EE and RES use; establishment of the Polish-Norwegian Cooperation Platform.

→

Phase II: open contest (May - September 2016)

Contest for the best ideas for innovation in the area of EE and RES use prepared by Polish municipalities and inspired by the Norwegian experience.

→

Phase III: implementation (October 2016 - April 2017)

Implementation of the 10 winning projects with the support of the project and in cooperation with the Norwegian Partners.

Phase I: initial diagnosis - most important activities:

- Establishment of the Polish-Norwegian Cooperation Platform;
- Development of the diagnosis of the situation of Polish and Norwegian municipalities in terms of energy efficiency and RES use;
- Development of the catalogue of Polish and Norwegian good practices in the area of energy efficiency and RES use;
- Organisation of the 1st Experience Exchange Group meeting and the 1st bilateral conference in Cracow.

Phase II: open contest - most important activities:

- Organisation of the open contest for the best ideas for innovative energy projects developed by Polish municipalities and inspired by the Norwegian experience;
- Evaluation of the submitted proposals and selection of the 10 winning projects, which were awarded with micro-grants for the preparation of analyses and documentation necessary for their implementation;
- Organisation of the 2nd EEG meeting, during which results of the contest were announced;
- Organisation of the study visit in Norway for the representatives of the winning municipalities.

Phase III: implementation of micro-projects - most important activities:

- Establishing bilateral cooperation between the contest winners and the Norwegian municipalities and organisations experienced in implementation of similar projects;
- Implementation of the 10 winning micro-projects;
- Organisation of the 3rd EEG meeting and the final bilateral conference in Warsaw.

Project results:

Although implementation of the umbrella project lasted less than 1,5 year, it helped to establish solid basis for the further development of the Polish-Norwegian cooperation, engaging cities and municipalities in the next energy-related initiatives. The most important project results include:

- establishment of the permanent Polish-Norwegian Cooperation Platform, which provides space for efficient dialogue and exchange of experience between Polish and Norwegian municipalities and their partners;
- careful analysis of the current situation of Polish and Norwegian local self-governments in the area of energy efficiency and RES use, which answers the questions about their most important needs, plans for the future and opportunities for collaboration;
- identification of the most interesting Polish and Norwegian good practices in the area of energy modernisation of public buildings, modernisation of public lighting, utilisation of different renewable energy sources, developing sustainable transport, supporting community energy projects and raising energy awareness of the citizens. These exmples can serve as a source of inspiration for other cities and municipalities;
- preparing for implementation of the 10 energy-related projects inspired by the Norwegian experience, which won the contest for the best ideas for innovation announced within the umbrella project;
- establishment of the 10 Polish-Norwegian partnerships collaborating on the implementation of the above-mentioned projects;
- organisation of a series of interesting events, which gave an opportunity to debate on the energy situation of Polish municipalities and on possible ways of improving it, also using the Norwegian experience.

3. Diagnosis of the situation of Polish and Norwegian local self-governments in terms of energy efficiency and RES use

One of the most important tasks implemented within the umbrella project entitled "Polish-Norwegian cooperation platform for climate and energy conservation" was the development of detailed and comprehensive diagnosis of the situation of Polish and Norwegian self-governments in terms of energy efficiency and RES use. The diagnosis helped to answer the following questions:

- what is the level of energy awareness of Polish and Norwegian municipalities?
- what is the state of sustainable energy planning and management in Polish and Norwegian municipalities?
- what are the major barriers and challenges faced by municipalities striving to achieve their local energy targets?
- what are the major drivers for increasing energy efficiency and RES use on the local level, as well as external factors supporting this process?
- what kind of support from the state, financing institutions, NGOs and other relevant stakeholders is needed by municipalities wishing to manage energy more efficiently and use its environmentally friendly sources?

Image 1. Diagnostic reports on the situation of Polish and Norwegian local self-governments

Polish diagnosis was developed on the basis of the results of the EEG work, results of the survey conducted among Polish self-governments and analysis of available thematic resources. It was complemented by the Norwegian diagnosis. Comparison of the results of both analyses enables determination of the cooperation and exchange-of-experience potential between Polish and Norwegian municipalities, as well as identification of Norwegian practices and solutions that can be transferred to Poland.

Complete versions of both diagnostic reports are available on the project website: www.razemdlaklimatu.eu/en/diagnoza-sytuacji-polskich-i-norweskich-jst, while the most interesting conclusions are summarised in the next chapters of this publication.

a. Situation of Polish local self-governments

This chapter summarises the most important facts concerning energy management in Polish municipalities and their activities for energy conservation and climate protection. It also describes legal, economic and social frameworks influencing energy situation of local self-governments and its development prospects.

Legal, economic and social frameworks:

- Energy situation of Polish cities and towns is significantly impacted by the climate & energy policy implemented on the EU and national level. Long-term objectives adopted both by the European Union and by its respective Member States translate into more detailed policies, regulations and tasks for local authorities (LAs).
- At present the main directions of the EU's climate & energy policy are set by so called **"3x20% package"**, adopted on the 9th of March 2007, which includes following targets to be achieved by 2020: reduction of GHG emissions by 20% (compared to the levels from 1990), reduction of energy consumption by 20% and increasing the share of RES in the overall energy balance to 20%.
- Together with undertaking efforts to achieve the "3x20%" targets, the EU started working on the next climate and energy package, called **"2030 package"**, which aims at the achievement of even more ambitious targets set for 2030. They are: reduction of GHG emissions by 40% (compared to the levels from 1990), reduction of energy consumption by 27% and increasing the share of RES in the overall energy balance to 27%.
- On the country level the most important strategy document defining the vision of its sustainable development is the Energy Policy of Poland until 2030. Local authorities tasks with respect to energy are, on the other hand, defined in the Act on Energy Law. They include: planning and organisation of heat, electricity and gaseous fuels supply, planning and covering the costs of lighting of public places and roads and implementation of measures aiming at the rationalisation of energy consumption and promotion of energy saving solutions on the municipality's territory.
- Many of the EU directives and national documents highlight the **leading role of the public sector**, including the LAs, in the achievement of energy savings and efficient energy management. By fulfilling this role, the public sector should give good example to the citizens and private bodies.
- Local self-governments are key players in the implementation of the EU and national energy policy, which results from their fourfold role with respect to energy - they are **energy consumers, energy producers, local regulators and motivators**. Being aware of these important responsibilities and opportunities, cities and towns from the whole Europe launched an initiative called the Covenant of Mayors. By signing the Covenant local leaders voluntarily commit to reduce CO_2 emissions from their territory, mobilise civil society and engage in cooperation and exchange of experience in the area of energy conservation and climate protection. Until present the Covenant was signed by more than 50 local self-governments from Poland.
- Implementation of all necessary actions supporting energy efficiency and RES use requires mobilisation of external funds. Municipal budgets are limited, while the expenditures resulting from the tasks that they need to perform are constantly increasing. Therefore implementation of many planned investments strongly depends on the possibilities of obtaining external financial support. At present there are relatively many funding sources available (EU-level and national-level financing programmes, national-level financing programmes, resources from NFEP&WP and VFEP&WM, alternative financing schemes...), but there is also significant competition between different actors applying for these resources.
- Energy awareness and related knowledge of the Polish society is systematically increasing, therefore more and more people expect that their local authorities will undertake efforts to reduce energy consumption and related emissions of air pollutants - especially of so called low-stack emissions, which are degrading air quality in many Polish cities. On the other hand the citizens rarely engage in energy-related initiatives implemented on the local level.

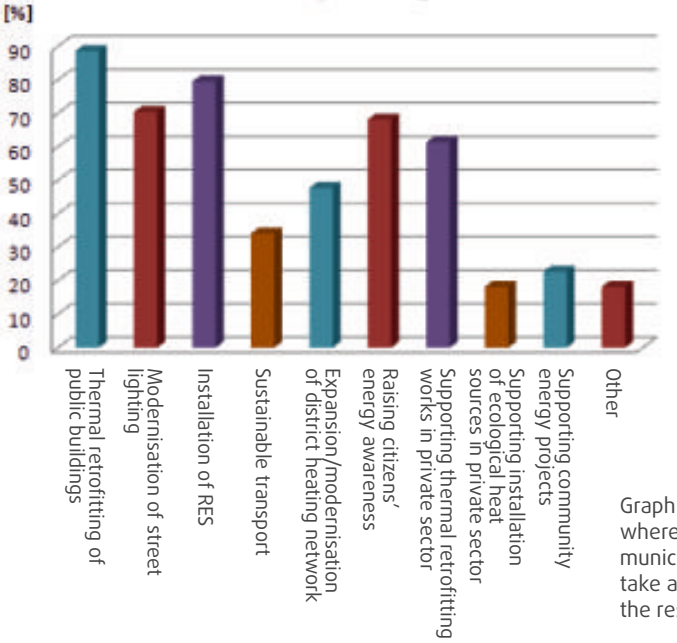
Current situation:

- It can be observed that Polish municipalities are more and more interested in the topic of energy efficiency and RES use. Growing number of them is implementing actions aiming at the

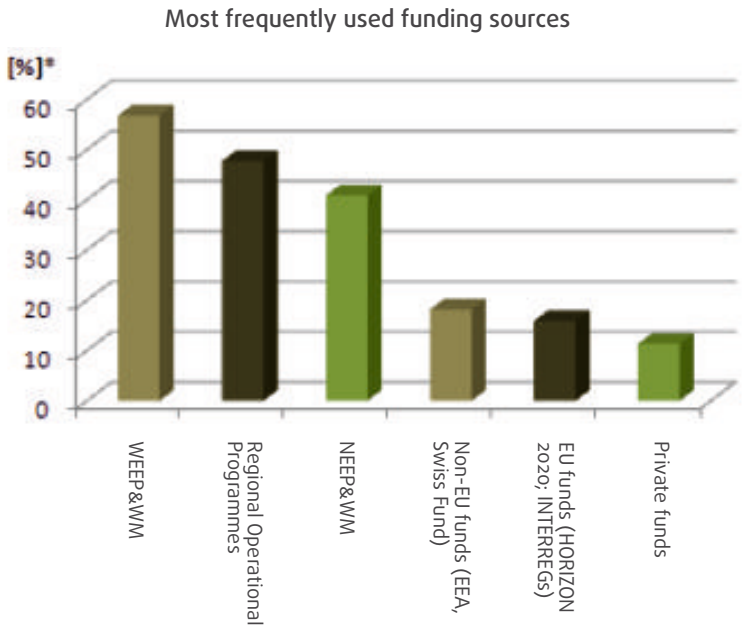
improvement of local energy situation, being aware not only of related environmental and social benefits but also of the potential financial savings that can be achieved in this way.

- Still not many Polish municipalities hire energy managers or have whole energy management units. Most often implementation of energy-related projects and activities is entrusted to the employees of other departments (responsible for environmental protection, municipal services, infrastructure, etc.), who often lack time and experience to deal with sustainable energy topics efficiently and comprehensively. Also, most of the municipalities don't monitor energy consumption in their buildings and facilities on the regular basis. As a result, they don't have full picture of their baseline situation. These two shortcomings hinder efficient energy management on the local level.
- Growing number of Polish municipalities decide on the development of comprehensive local energy strategies and action plans, which set the directions of their activities in the coming years. Except for obligatory **Assumptions for the heat, electricity and gaseous fuels supply plan** (and the plans themselves in case of need), the municipalities are preparing and adopting also voluntary **Low-Emission Development Programmes** (LEDP) and Sustainable Energy Action Plans (SEAP). Both types of plans are developed using similar methodology, which was drafted by the EC's Joint Research Center for the purposes of the Covenant of Mayors movement. The plans are meant to support the municipalities in realisation of their sustainable energy development vision by defining sets of measures which will be implemented to reduce energy consumption and increase RES use on their territories.
- The measures, which are most frequently implemented on the local level, include thermal retrofitting of public buildings, installation of RES and modernisation of street lighting. Regarding thermal retrofitting works, they are conducted mostly in educational facilities and city halls - due to the high energy saving potential and accompanying educational and demonstration benefits. Regarding renewables, the municipalities invest mostly in solar thermal collectors, PV modules and heat pumps. Moreover, many municipalities are undertaking efforts to engage citizens and local stakeholders and motivate them to make more sustainable choices. They conduct various educational campaigns or launch local programmes for co-financing replacement of old and inefficient heat sources with new, more environmentally friendly ones (including using RES).

Thematic areas where Polish municipalites currently take actions



Graph 1. Thematic areas where Polish municipalities currently take actions (based on the results of the survey)



Graph 2. Funding sources most frequently used by Polish municipalities (based on the results of the survey)

- Many of the above-listed measures are implemented using external funding. Polish municipalities are well aware of available resources and reach for them rather successfully. Most often they apply for grants and subsidies from Voivodeship Funds for Environmental Protection and Water Management (VFEP&WM) and from Regional Operational Programmes, which proves that funding programmes and mechanisms implemented on the regional level are better adapted to their needs and planned projects than the ones implemented on the European or national scale. Many actions are also (co)financed from the National Fund for Environmental Protection and Water Management (NFEP&WM). Still relatively small number of municipalities is using so called "alternative financing mechanisms", including EPC and revolving funds.
- Successful accomplishment of local climate & energy targets, especially the ones set up in SEAPs and LEDPs, requires engaging citizens and local stakeholders in energy-related actions. Majority of municipalities, which are consciously working on energy conservation and climate protection, are aware of this fact, however their efforts to mobilise civil society are often not sufficient. Most often the communication with citizens and local stakeholders is rather one-sided and consists in disseminating thematic information, conducting educational activities, etc. Still not many municipalities know how to engage the citizens in an active dialogue and common activities.
- Local self-governments interested in the exchange of experience, cooperation and implementation of common energy-related projects with other municipalities and organisations, have the opportunity to engage in many thematic initiatives and networks, existing both on the international and national level.

Barriers and challenges:

Most important barriers and challenges encountered by Polish local self-governments on their path towards sustainable energy development include legal, economic and social ones, as well as municipalities' own internal weaknesses. Most relevant barriers include: frequent and often unfavourable changes in existing law, ambiguity or lack of some important regulations, limited access to external funding sources that may be used to finance planned investments, complicated procedures for applying for funding and verification of expenses, lack of active engagement of the citizens in

local initiatives and their opposition to some types of investments. The table below summarises all important barriers and challenges highlighted by the participants of the survey and EEG members.

Legal barriers	Economic barriers	Social and other barriers	Municipalities' internal weaknesses
• Frequent and often unfavourable changes in existing law • Ambiguity of some of the regulations • Lack of regulations concerning some issues relevant for efficient energy management on the local level (e.g. concerning access to energy data, ownership of the lighting infrastructures, using ESCO scheme)	• Lack of financial resources for implementation of all planned actions • Large competition between municipalities applying for external funds • Badly designed financing programmes • Complicated procedures for applying for funding within certain financing programmes • Small number of experienced ESCOs • Long payback periods and lack of visibility of energy savings in municipal budgets • Unclear and unfavourable terms of delivering surplus energy to the grid • Inadequate support for installation of RES and thermal retrofitting works in private households	• "Shallow" energy awareness of the citizens, including relatively low knowledge of local energy situation and needed actions • Local society's opposition to some types of investments • Widespread "not in my backyard" approach • Lack of willingness to actively engage in common energy-related initiatives • Limited access to data on energy consumption on the territory of a municipality • Inadequate support from the national and regional level • Imbalance of powers between local authorities and energy utilities • Limited influence on the private sector • Ograniczony wpływ gminy na sektor prywatny	• Lack of energy managers in most of the Polish municipalities • Lack of sufficient knowledge and understanding concerning local energy situation • Lack of comprehensive, long-term energy strategies • Lack of other important strategy documents • Poor communication between different departments of local administration • Strong hierarchical structure • Long and complicated internal procedures • Significant influence of political changes on the energy policy implemented by the municipality • Inefficient communication and cooperation with the citizens

Table 1. Most important barriers and challenges encountered by Polish municipalities on their path towards sustainable energy development

On the other hand, there are also strong factors supporting sustainable energy planning and management on the local level, which include, among others, EU policy and support for sustainable energy initiatives, development of EE and RES technologies, development of ICT and some natural trends, which can be observed in the society (such as replacement of old electric and electronic equipment or replacement of old vehicles with the new, more environmentally friendly ones). Municipalities also have some internal strengths, which facilitate efficient and successful implementation of energy-related actions. These include: growing energy awareness of local authorities and municipal staff, good human capital, significant energy efficiency potential and effective tools for influencing local energy situation.

Needs:

To overcome above-listed barriers and weaknesses, as well as make use of available energy efficiency and RES use potential, Polish municipalities need support from other institutions, including national authorities, financing institutions, NGOs and research & development units. The list presented below shows what kind of support they expect to be able to implement their local climate & energy targets more efficiently. The list was prepared on the basis of the survey and the EEG works.

Most important expectations of Polish municipalities towards national authorities include....

... ensuring stable, coherent and clear legislation;

... introducing new regulations that would support energy efficiency and RES use more efficiently than the current ones. This includes, among others, regulations encouraging consumers to become prosumers, facilitating use of alternative financing mechanisms (such as EPC) and supporting establishment of energy cooperatives;

... regulating key issues, including ownership of public lighting infrastructure and responsibility for its modernisation and municipalities' access to data about energy consumption on their territory (which are crucial for efficient energy planning and management on the local level);

... establishing quality standards for coal and other solid fuels sold to individual consumers;

... simplification of public procurement legislation to enable municipalities to make more sustainable choices of contractors, based on different kinds of criteria (economic, environmental and social);

... recognising local self-governments as one of the key partners in planning and implementation of national energy policy;

... conducting wider public consultation when introducing new regulations.

Most important expectations of Polish municipalities towards financing institutions include....

... allocating more funds for projects supporting energy efficiency and RES use (e.g. by launching new and well-designed subsidy programmes, low-interest loans and amortizable loans);

... development and publication of the schedule of all planned calls for proposals at the beginning of the financing period and making sure that no changes to the terms of reference are introduced when the call is open;

... simplification of the application procedures and reporting and control procedures once the subsidy has been granted;

... better adaptation of implemented aid programmes to the real needs and capabilities of local self-governments, as well as ensuring their better consistency with existing legislation;

... organisation of dedicated trainings concerning implemented aid programmes that would help in preparation of good-quality applications and later in correct implementation and reporting of supported projects;

... launching simple and clearly structured co-financing programmes addressed to citizens (individual households), whose actions can support realisation of local climate and energy targets.

Most important expectations of Polish municipalities towards NGOs include....

... carrying out educational and training activities targeted at the citizens and municipal staff;

... providing consultancy services in the area of energy planning, energy management, and choosing optimum EE and RES solutions;

... providing technical and administrative support in the development and implementation of local energy strategies and action plans, engaging citizens and local stakeholders, etc.;

... engaging municipalities in common energy-related projects (which is especially important for smaller municipalities, who don't have enough capacities and human resources to implement relevant actions themselves);

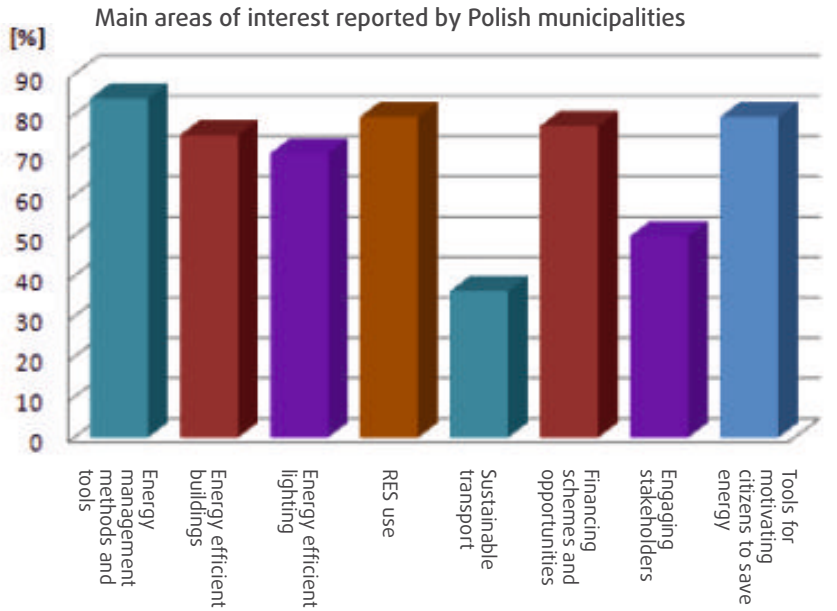
... development of networking platforms gathering local self-governments and their key partners;

... dissemination of good practices and tested solutions;

... lobbying for favourable changes in existing law.

Perspectives for the future:

It can be assumed that municipalities' interest in the issue of energy efficiency and RES use, as well as their involvement in energy-related projects and initiatives, will keep increasing. This stems from couple of already-mentioned factors, including growing energy awareness of Polish society (and local decision makers), constant presence of sustainable energy topics in the public debate, EU's engagement in climate protection and energy conservation efforts and growing accessibility and decreasing prices of many EE and RES technologies. An important factor is also an urgent need to solve the problem of low emissions degrading air quality in many European cities and to reduce municipalities' operational costs, which include the costs of energy and fuel consumption.



Graph 3. Main areas of interest reported by Polish municipalities (based on the results of the survey)

Regarding sustainable energy measures, that the municipalities want to implement in the first place, there are the ones, which can be easily financed from own or external funds (e.g. because dedicated funding programmes are available) or which are especially desired from the social perspective (e.g. because they contribute to the improvement of citizens' comfort and health conditions). They include thermal retrofitting of buildings, modernisation of street lighting and installation of RES - mostly solar thermal collectors and PV modules, which are installed on many schools and other public buildings. Many municipalities also launch or consider implementation of local funding programmes, co-financing replacement of inefficient heat sources in private households.

The graph below presents the list of the main area of interest reported by Polish municipalities. In these areas they plan to take action in the nearest future.

In the long-term perspective, municipalities wishing to follow the path of sustainable development will have to face also other important challenges, like limited access to non-repayable grants after 2020, the fact that emissions from the municipal sector constitute only small part of the overall emissions from their territory (thus it is not possible to improve local energy situation by concentrating only on this sector) and the necessity to deal with the problem of adaptation to climate change. Overcoming these barriers will require not only their active engagement, but also support from relevant institutions and enabling them to engage in an efficient dialogue and exchange of know-how, tested technologies and good practices with other cities and towns.

b. Situation of Norwegian local self-governments

This chapter summarises the most important facts concerning energy management in Norwegian municipalities and their activities for energy conservation and climate protection. It also describes legal, economic and social frameworks influencing energy situation of local self-governments and its development prospects.

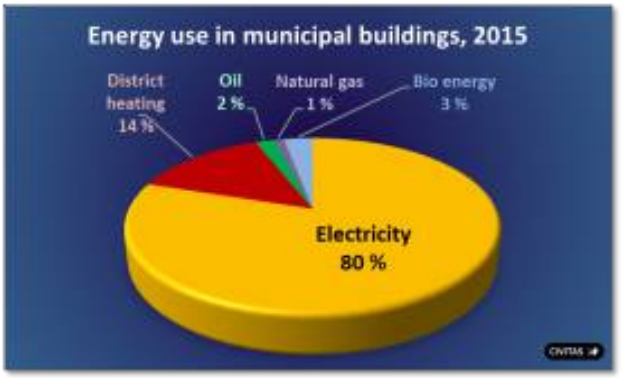
Legal, economic and social frameworks:

- Although Norway is not the member of the European Union, it closely cooperates with the EU countries, also in the area of environmental and climate protection. It fully participates in the internal energy market, both as an exporter of energy and a partner in the development of RES use. Together with the EU it also strives for the achievement of the 40% reduction of GHG emissions by 2030.
- Significant share of energy generated and used on the Norwegian territory comes from renewable sources, mostly water and wind. The national target is to reach the 67.5% share of renewables in the national energy mix.
- On the national level, there are implemented many solutions motivating (also financially) to more sustainable decisions and to the development of new, climate friendly technologies. They include, among others, carbon tax, tax reliefs during purchase of electric vehicles and national programmes for supporting and financing innovative projects, such as "Cities of the Future" or "FutureBuilt".
- The main national institution supporting and financing energy-related projects implemented by different organisations (including local self-governments) is Enova SF, which was established in 2001 and is owned by the Ministry of Petroleum and Energy. Most of its funding comes from a small additional charge added to electricity bills and is spent on financing concrete energy measures and offering active advice.

- Energy and environmental issues have been high on the Norwegian agenda for more than thirty years, including public debate, therefore the level of energy awareness of the citizens is rather high. Energy and climate-related topics are thoroughly discussed on all levels of education, while non-governmental organisations and media are among the important contributors.

Current situation:

- Norwegian municipalities have access to relatively cheap energy, enabling them to satisfy all their energy needs. Many of them are also energy producers or benefit from taxation / agreements related to local hydropower production.
- Regardless of the above, the costs of energy consumption constitute a significant part of the municipalities' total running costs. Although majority of this energy comes from environmentally friendly, renewable sources, Norwegian municipalities strive for reduction of its consumption so that the money saved could be spent on other purposes.



Graph 4. Energy use in Norwegian municipal buildings (data from Statistics Norway)

- Majority of municipalities have developed and are implementing local **Climate and Energy Plans**, which are obligatory in Norway. They are a documentation of a certain publically initiated process aiming at the reduction of environmental impact and engaging all key stakeholders. The plans foresee both actions in the areas lying entirely within municipalities' competences (such as the improvement of energy efficiency of municipal buildings, introduction of low-emission public transport or green public procurement), as well as actions motivating and encouraging citizens to adopt more sustainable choices and behaviours (such as the implementation of relevant local regulations, supporting walking and cycling or organisation of information and educational campaigns).

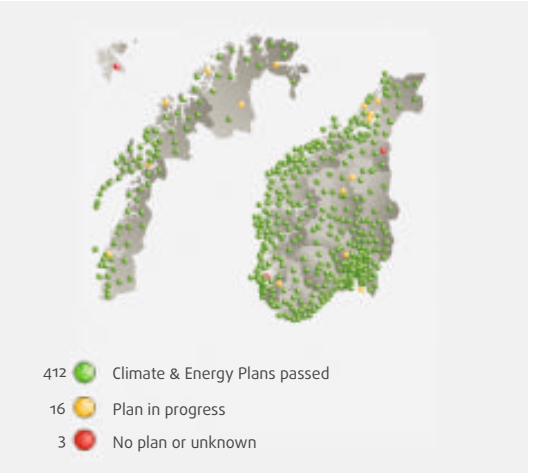
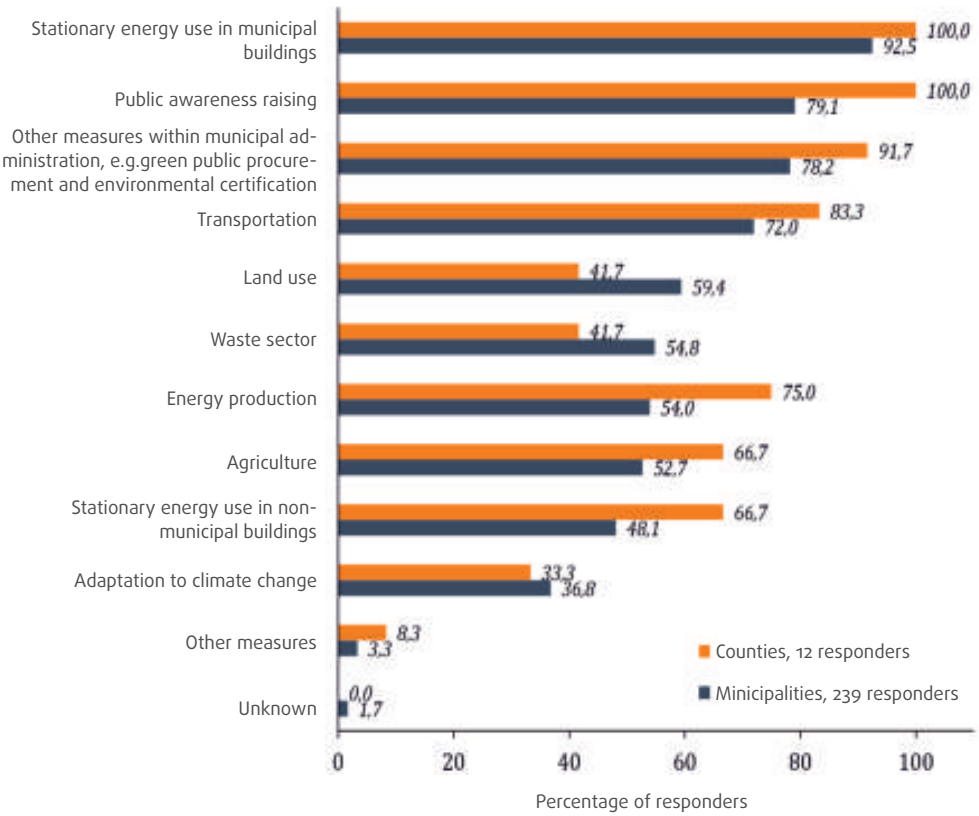


Image 2. State of the development of municipal Climate & Energy Plans in Norway (source: Enova)

- During the development of their action plans, Norwegian municipalities may use various databases, including Statistics Norway database, local energy analyses prepared by network operators and SOE Norway website. Except for that KS developed for them special planning tool called KOMPLETT. The tool is available on-line, based on a check-list and ensures (as well as documents) that local plans are developed following the requirements set on the national level.
- Non-governmental organisations are often engaged in the process of the development of local Climate and Energy Plans. They are participating in obligatory public consultations preceding formal adoption of the plans, as well as are active on the national level, e.g. organising information campaigns or "lobbying" towards local and regional authorities needs. The biggest organisation of this kind, supporting municipalities in improving energy efficiency and increasing RES use, is the Norwegian Association of Local and Regional Authorities (KS).
- The graph below presents a list of actions that are most frequently included in local action plans. It can be observed that Norwegian municipalities are especially keen to implement projects aiming at the reduction of energy consumption in their own buildings. Apart of that, they also often plan actions in the area of education, transportation and spatial planning.

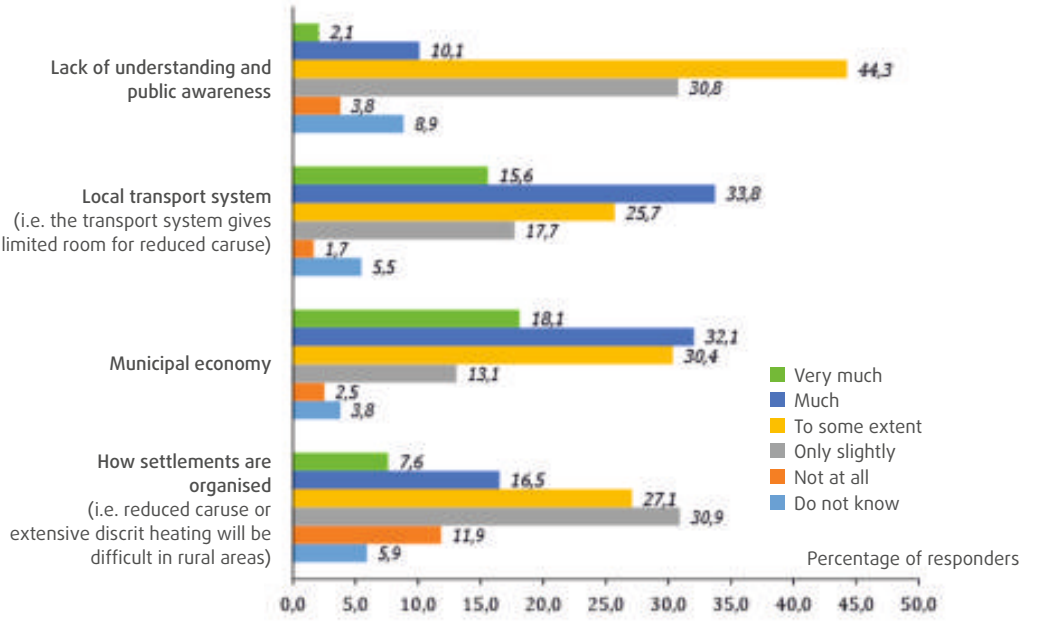


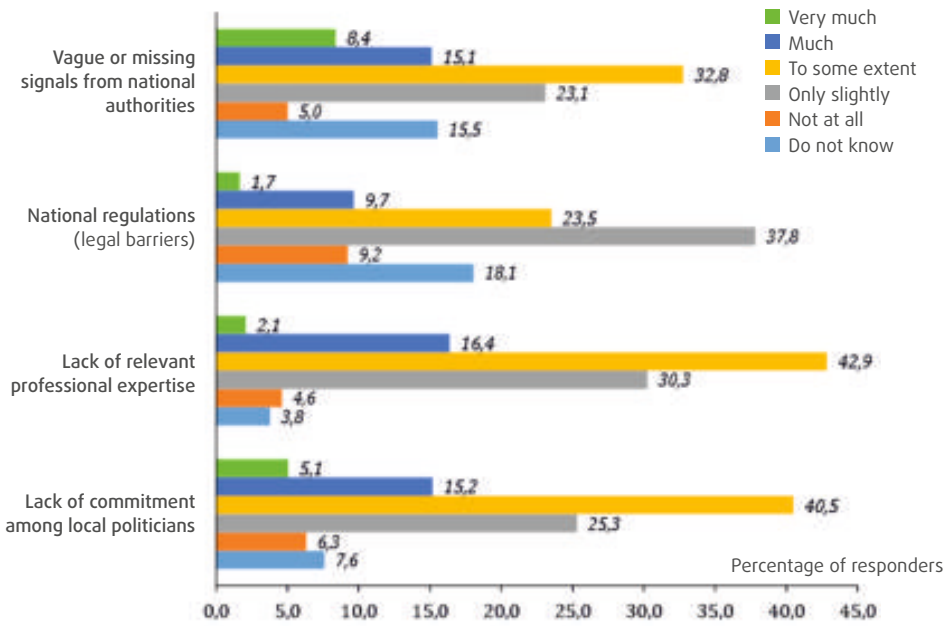
Graph 5. Main sectors included in local Climate and Energy Plans (source: Vista Analyse)

- Spatial planning is for Norwegian municipalities an important tool supporting achievement of the local climate and energy targets. When planning location of new housing estates, schools, nurseries, kindergartens, work places and services, they make sure that people are able to reach these places by foot, by bike or using public transport. Apart from that, many local plans foresee such initiatives as introduction of the city bike, car-sharing programmes or promoting low-emission and zero-emission vehicles. Municipalities also pay attention to the correct orientation of the newly constructed building and their proper location towards each other.
- The main and dominating financing source of local actions and projects aiming at energy conservation and climate protection are the municipal budgets. Even within ambitious projects, external financing will normally pose far less than ten percent of the total project costs.
- Dedicated officers for climate and energy planning, or municipal energy managers/energy experts are common only in large municipalities. In smaller ones, the ordinary planning and environmental staff handle related tasks. Also, cooperation between communities using common experts frequently take place, as well as reaching for external consultants' assistance.
- Many Norwegian municipalities actively engage in international cooperation with other local self-governments, e.g. through the ICLEI network (Local Governments for Sustainability) or the Covenant of Mayors initiative. Especially the city of Oslo takes part in many international activities and has numerous relations.

Barriers and challenges:

Norwegian municipalities' own assessment of major barriers and challenges hindering development and implementation of their climate an energy plans was mapped in a comprehensive survey carried out by Vista Analysis in 2014. Municipal economy, lack of support from the national authorities, limited possibility to act and lack of professional expertise are summed up to be the most important barriers and challenges. More detailed results of the survey are presented on the graph below.





Graph 6. "To which extent have the following aspects hampered your work on climate and energy planning"? Survey performed by Vista Analyse, 2014

Also municipalities' internal weaknesses negatively impact successful implementation of local action plans. The most important ones have been summarised below.

- Most of the Climate and Energy Plans define specific targets to be achieved with respect to the reduction of energy consumption, reduction of GHG emissions and increase in RES use. Normally they are set as a percentage of today's consumption/emission, without recalculating them into tones of CO2-equivalent or kWh of energy. As a result the municipalities don't really know how many actions (measures) need to be implement to reach these targets.
- Measures foreseen in Climate and Energy Plans are often described in a vague manner, with no description of how much GHG emission and/or energy use will be reduced as a result of their implementation. Often missing are also realistic approaches to how these measures can be implemented in practice and how to raise necessary funding.
- Many plans are missing information how much planned measures will cost, who will be responsible for them and when the work will be done.

An important weakness of many local action plans is also their excessive concentration on the emissions from the building sector. Increasing energy efficiency of buildings - although important - will not be sufficient to improve the situation. Also other sectors responsible for energy consumption need attention, especially transportation, water supply and wastewater treatment.

An opportunity for the improvement of the quality of many actions plans (and thus ensuring better effectiveness of undertaken actions) is their update. 1st generation of Climate and Energy Plans was completed in the period 2008-2010 and now it's time for the revision, which is overdue. Not many Norwegian municipalities updated their plans so far. One reason for this may be that state funding of planning work (approx. 10.000 EUR from Enova) is no longer available. The situation shall, however, improve in the nearest future.

Needs:

In order to plan and implement actions aiming at energy conservation and climate protection more efficiently, Norwegian municipalities need the following:

- receiving stronger and more distinct support from the national level, especially when it comes to the implementation of many important CO2 reduction measures, which may be not popular with the citizens, such as e.g. introduction of restrictions concerning use of private cars;
- development by the national government of more stable and predictable legislation that would encourage innovation and entrepreneurship, as well as establish good basis for their development;
- receiving stronger technical support during the preparation of the new generation of Climate and Energy Plans (in order to avoid repeating previous mistakes);
- receiving stronger financial support, especially when it comes to the implementation of solutions, which are both necessary and cost-inefficient;
- development of the national database containing data sheets for all actions envisaged in municipal action plans, as well as for all already fulfilled measures. This would facilitate exchange of ideas for the new measures between municipalities, counties and national authorities;
- wider cooperation with the private and the research and development sectors in order to develop innovative and efficient solutions that could be implemented on the local level;
- development of efficient cooperation and exchange-of-experience platforms enabling getting familiar with good practices and already tested solutions (both from Norway and from outside the country).

To ensure successful achievement of the local climate and energy targets, the Norwegian municipalities will also have to concentrate more on their role of local regulators, introducing such solutions in the area of transportation, spatial planning and construction that would encourage and motivate citizens to adopt more sustainable behaviours and decisions.

Perspectives for the future:

The most important challenge, that the Norwegian municipalities are currently facing, is the overdue revision of local Climate and Energy Plans. Otherwise much professional knowledge built during the first round of planning will be lost, and it will be harder to start from "scratch" again.

At the same time, the 2015 elections put a record number of environmentalists into Norwegian municipal councils. Although they also have focus on more traditional CO2 reduction measures, i.e. energy effective buildings, strong focus now seems to be directed on actions that are a consequence of perceiving the urban environment in a broader perspective.

Also on the national level the activity is increasingly being focused on city environment. KS has initiated a close research & development cooperation with the ministry responsible for planning and the national road administration. The common project (KIT) develops methods to calculate how improved land use and municipal measures to promote walking, use of bicycle and high-standard public transport can reduce carbon emissions.

With such calculation methods in place, it will be possible for municipalities to enter international carbon trade with extremely cost effective measures. Lesser car use will give less need for expensive road building. Municipalities will only need something in return for the political costs related to reductions of their citizens' car use. The idea was presented at the COP 15 in Paris, and the development work is already in full progress.

c. Polish and Norwegian good practices

Development of the diagnosis of the current energy situation of Polish and Norwegian local self-governments was accompanied by the identification of their good practices that could serve as a source of inspiration for other cities and municipalities, both from Poland and from Norway. Good practices have been collected in an online catalogue, available on the project website (www.razemdlaklimatu.eu/en/katalog-dobrych-praktyk), and selected ones are presented in this publication.

Sustainable energy projects and solutions, which have been described in the catalogue, concern different thematic areas, including energy modernisation of public buildings, modernisation of public lighting, utilisation of different renewable energy sources, developing sustainable transport, supporting community energy projects and raising energy awareness of the citizens. They are all characterised by a certain level of innovation, comprehensive approach to the topic and high replicability. They are a proof that there are many interesting initiatives undertaken on the local level that are worth promoting to encourage others to take their own action.

The catalogue enables searching for good practices by country, by sector and by subsector. Descriptions of all good practices are available both in Polish and in English.

Image 3. Catalogue of good practices available on the project website (www.razemdlaklimatu.eu/www.togetherforclimate.eu)

d. Potential for further cooperation and exchange of experience

Although Polish and Norwegian municipalities function in slightly different climate, legal, economic and social frameworks, their tasks and responsibilities towards their citizens are similar. They all have significant energy efficiency and RES development potential that can be used by ensuring efficient cooperation and exchange of know-how, tested technologies and good practices with other cities and municipalities, both from the country and from the abroad. Only by working together and inspiring each other to undertake new sustainable energy initiatives, local self-governments will be able to achieve their next environmental, economic and social targets.

From the environmental point of view, it is especially important to support cooperation and exchange of experience with such countries as Norway, which is known for being a leader of sustainable development. Norwegian municipalities and their partners are implementing many innovative and ambitious projects in the area of environmental protection, climate protection and energy conservation. Many of these good practices - after adequate adaptation - could be transferred to Poland. Especially when it comes to the solutions developed in such fields as modernisation of buildings to a higher energy standard, development of e-mobility, development of innovative RES technologies or development of environmentally friendly quarters (as these are the topics that the Norwegians are currently working on).

Norwegian municipalities are keen to share their experience with others and to engage in international collaboration. Also Polish local self-governments are becoming increasingly interested to take part in the international dialogue on energy generation and utilisation, as well as to implement sustainable energy projects. Many of them work on or test new solutions, which may be inspiring also for Norwegian municipalities. Therefore, the exchange of experience may be beneficial for both parties - it is only necessary to establish favourable conditions and tools supporting this exchange. And this was the purpose of the umbrella project entitled "Polish-Norwegian cooperation platform for climate and energy conservation", which is summarised in this publication.

4. Polish Norwegian Cooperation Platform

The Polish-Norwegian Cooperation Platform established within the umbrella project brings together local authorities and their partners (research institutes, financial institutions, NGOs, private companies, etc.) interested in cooperation and exchange of experience in the area of energy efficiency and use of renewable energy sources. Participation in the Platform facilitates establishing new contacts and engaging in the efficient dialogue, which helps to:

- increase knowledge and capacities in the field of energy planning & management,
- get acquainted with inspiring good practices and already tested solutions,
- use other members' experience to develop own, innovative energy projects,
- establish permanent relationships with Polish and Norwegian partners, which may result in common projects and initiatives.

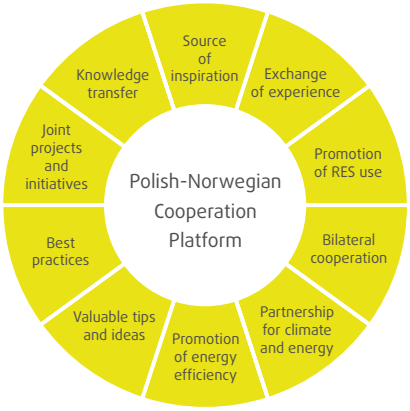


Image 4. Polish-Norwegian Cooperation Platform

Within the duration of the project the Platform members met on the occasion of different workshops, conferences, webinars and bilateral visits. Exchange of opinions and experience was also possible through the interactive discussion forum established on the project website. The forum will keep functioning after the end of the project, engaging new municipalities and organisations in the Polish-Norwegian dialogue. The issues discussed included, among others, existing EE and RES potential, proven solutions and technologies, inspiring good practices, available tools and funding opportunities for implementing sustainable energy actions and efficient ways of engaging citizens and key stakeholders.

a. Objectives

The Polish-Norwegian Cooperation Platform was established to help Polish and Norwegian municipalities and their partners to:

- enhance their actions for EE improvement and RES use;
- establish new contacts and strengthen cooperation with present partners;
- exchange experience, knowledge, technologies and best practices in the field of energy generation and efficient energy use;
- find partners for energy-related projects and initiatives;
- support and promote innovation in the area of energy planning and management.

b. EEG meetings

The opportunities for Polish-Norwegian collaboration and exchange of experience, as well as the possibilities of replicating selected Norwegian solutions in the Polish conditions, were discussed, i.a., by the Experience Exchange Group (EEG), which was established within the umbrella project. The group gathers representatives of Polish cities and municipalities, who have been working on climate protection and energy conservation issues for many years already and thus have necessary expertise concerning energy situation of Polish local self-governments and can identify their most important needs (including the ones that can be satisfied with the use of Norwegian experience). They represent metropolitan and big cities, medium towns, semi-urban municipalities and small villages. As a result, the EEG as a whole can look at different aspects from different angles giving full picture of state of the art. Within the project duration EEG members met three times - in Cracow, Poznań and Warsaw. More details and main conclusions from these meetings may be found below.

1st EEG meeting (Cracow, 30.03-01.04.2016)

1st EEG meeting gathered approx. 50 people and was focused on the diagnosis of the situation of Polish local self-governments in terms of energy efficiency and RES use, as well as on the identification of the possibilities of transferring tested Norwegian solutions to Poland. The latter have been presented by Gunnbjørg NÅVIK from the Norwegian Association of Local and Regional Authorities. After few presentations introducing the topic, a debate began.

Photo 1. 1st EEG meeting in Cracow

The participants discussed, among others, the following topics:

- influence of European and national legislation on the energy situation of Polish cities and municipalities;
- most important economic and social aspects related to the energy planning and energy management on the local level;
- current state of energy planning and energy management on the local level;
- EE and RES development potential in the municipal sector;
- municipalities' most important challenges and needs in the field of energy planning and management.

Representatives of participating municipalities also shared the information about their previous and planned sustainable energy initiatives.

The meeting and accompanying debates proved that Polish local self-governments have will to act and undertake many efforts to reduce energy consumption, improve air quality and diversify energy sources used. On their way towards sustainable development, however, they meet many challenges, including legal, economic and social ones. One of the ways to overcome these challenges is ensuring efficient dialogue and exchange of experience with other municipalities, both from Norway and from Poland, that had already developed some useful solutions and good practices.

2nd EEG meeting (Poznań, 13.06.2016)

The 2nd EEG meeting was focused on the evaluation of the 20 ideas for innovative energy projects inspired by the Norwegian experience that were submitted for the open contest announced within the umbrella project. In total 19 municipalities took part in the contest (one of them prepared 2 projects). Their propositions were subjected to the one-stage formal assessment and the two-stage content assessment.

Photo 2. 2nd EEG meeting in Poznań

In the 1st stage the project proposals were evaluated by the panel of experts in the field of energy, while in the 2nd stage - taking part in Poznań - they were evaluated by other cities and municipalities participating in the competition. Each contest participant had 5 minutes to present his/her idea for energy-related innovation and the foreseen engagement of the Norwegian partners. Then, the other participants completed the evaluation questionnaires, where they assessed such aspects of the proposed project as innovativeness, feasibility and potential environmental, economic and social impact. After summing up all the points, the 10 winners were announced. These were the municipalities of Bielsko-Biała, Bydgoszcz, Lublin, Milanówek, Pałecznica, Płońsk, Raciechowice, Rumia, Sopot and Sztum. Each of them received a 50 000 PLN grant for the development of the necessary project analyses and documentation, as well as for the establishment of the cooperation with Norwegian partners, who will help them in implementation of their project concepts. Representatives of the winning municipalities also took part in the study visit in Norway.

3rd EEG meeting (Warsaw, 15-16.03.2017)

Photo 3. 3rd EEG meeting in Warsaw

The 3rd EEG meeting was devoted to the presentation of the 10 micro-projects implemented by the winners of the open contest for the best ideas for energy innovations inspired by the Norwegian experience. Each winning municipality presented its project and the progress of its implementation, as well as told the others about its experiences resulting from the cooperation with the Norwegian partner and from the bilateral visits. Then, during the session organised using World Café method, the participants of the meeting had the opportunity to talk to each speaker and learn more about planned investments. In this way they could consider if there is a possibility of replicating proposed solutions in their own municipalities.

On the second day of the meeting, the participants discussed what are the best ways of making use of the experiences arising from the bilateral cooperation in the area of EE and RES use and what financial means could support related projects. The debate concerned also the real opportunities of using Norwegian proven good practices in Poland and the ways of reducing low emission on the example of the successful Polish actions in this field.

c. Bilateral conferences

Two bilateral conferences created another opportunity for discussing EE and RES use potential characterising Polish municipalities, as well as for considering possibilities of replicating Norwegian good practices and making use of Norwegian experience in Poland. One of them was organised at the beginning of the project and another one in the last month of its implementation.

1st bilateral conference (Cracow, 22.04.2016)

Photo 4. Participants of the 1st Polish-Norwegian bilateral conference

The conference aimed at the presentation of the Polish-Norwegian Cooperation Platform established to support exchange of experience in the area of energy efficiency and RES use, as well as the presentation of the initial diagnosis of the current energy situation of Polish and Norwegian local self-governments. Participants of the event also got acquainted with a number of good practices developed by Polish and Norwegian municipalities in the field of energy modernisation of buildings, modernisation of public lighting, use of RES and implementation of comprehensive energy management systems on the local level.

The conference gathered approximately 80 participants - mostly representatives of Polish municipalities from different regions of the country and the Norwegian guests. Polish and Norwegian companies operating in the area of energy efficiency and RES use - COFELY, NORPOLHOUS and ENIS - had their stands in the conference venue, where they presented their offer.

2nd bilateral conference (Warsaw, 19.04.2017)

The 2nd bilateral conference gathering representatives of Polish and Norwegian municipalities is planned for the 19th of April 2017, shortly after the publication of this report. The conference will be devoted to the presentation of the most interesting results and products of the project, including complete diagnostic report on the energy situation of Polish local self-governments, catalogue of Polish and Norwegian good practices, 10 innovative energy project implemented by Polish municipalities in cooperation with the Norwegian partners and the permanent Polish-Norwegian Cooperation Platform. Also other topics interesting for the representatives of Polish municipalities will be discussed, such as financing sustainable energy investments, reducing low-stack emissions, development of passive construction and development of electromobility.

d. Webinars

The survey, which was conducted among Polish local self-governments during the development of the above-mentioned diagnosis, enabled identification of the thematic areas that are especially interesting for them and where they plan to take action in the nearest future. In these areas in particular Polish municipalities seek Norwegian support and good practices. The list was used to prepare a series of webinars, during which Polish and Norwegian speakers presented their good practices and tested solutions, as well answered participants' questions. Polish local self-governments are becoming more and more interested in this form of obtaining new information and exchanging experience - it is efficient, cheap and doesn't take much time.

e. On-line discussion forum

Special on-line discussion forum was developed on the project website to create further networking opportunities. Participants of the forum can share and exchange their thoughts, experience and ideas for actions within several thematic categories. They can also ask questions to the experts and initiate new discussions. The dialogue can be conducted in two languages - Polish and English. Already opened discussions concern, among others, fighting the smog, improving energy efficiency in the residential sector, available funding sources for sustainable energy projects, different RES technologies and setting up of energy clusters.

Registration on the forum is possible using the following link:

http://razemdlaklimatu.eu/forum/index.php?sid=11663b58c7dbc87dbccd465dff9c978b

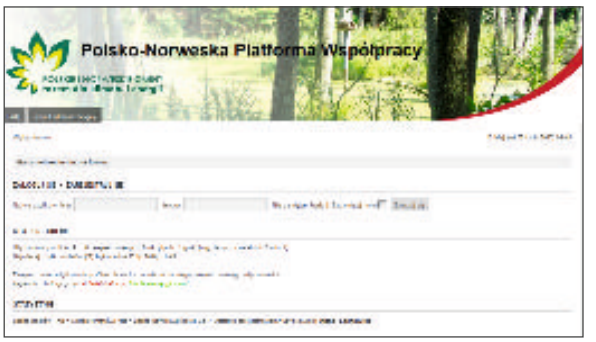


Image 5. On-line discussion forum of the Polish-Norwegian Cooperation Platform

5. Contest for the best ideas for energy innovation

The umbrella project entitled "Polish-Norwegian cooperation platform for climate and energy conservation" not only aimed at supporting overall dialogue and exchange of experience between Polish and Norwegian local self-governments, but also at transferring selected Norwegian solutions to Poland. To achieve this second important objective the project consortium announced an open contest for the best ideas for energy innovation developed by Polish municipalities and inspired by the Norwegian experience and best practices. In total 20 project proposals were submitted and the 10 most interesting and well-developed ones received micro-grants for the preparation of the analyses and documentation necessary for their implementation. The winning municipalities - Bielsko-Biała, Bydgoszcz, Lublin, Milanówek, Pałecznica, Płońsk, Raciechowice, Rumia, Sopot and Sztum - also took part in the study visit in Norway and established bilateral cooperation with the Norwegian partners, who helped them in implementation of proposed solutions. Below there may be found some more details concerning the competition.

Aim of the contest:

Supporting Polish municipalities in launching implementation of the 10 most interesting pilot projects in the area of energy efficiency and RES use by awarding them micro-grants for the preparation of necessary analyses, documentation, educational activities and other non-investment steps of the process (so called micro-project), as well as by helping them to establish cooperation with the Norwegian partners, committed to support them with their expertise and experience.

Participants of the contest:

- municipalities,
- municipal budgetary entities,
- municipal organisational units.

Terms of participation:

Project proposals submitted for the contest had to include both the description of the overall idea for energy innovation and the detailed description of so called "micro-project", i.e. soft measures necessary for the preparation of the pilot project for implementation. Such actions could be financed from "micro-grants" awarded within the contest. Submitted micro-projects had to meet the following criteria:

- include non-investment activities needed for the successful implementation of the pilot project (conducting relevant studies and analyses, development of project documentation, organistion of educational campaigns and trainings...);
- be inspired by the Norwegian experience or possible to be implemented using the Norwegian experience;
- lead to the implementation of the pilot project, which is innovative, replicable and should bring significant environmental, economic and social benefits;

- lead to the implementation of the pilot project, which will contribute to the achievement of at least one of the following objectives:
  - improved energy efficiency in buildings;
  - increased public knowledge and awareness of energy efficiency;
  - increased renewable energy production in the building energy balance;
  - reduced production of waste and reduced emission of pollutants to the air, water and ground.

Evaluation criteria:

The assessment of the project proposals covered both the overall idea for energy innovation and the micro-project contributing to the implementation of this idea.

Evaluation criteria concerning overall idea for innovation

- Innovativeness on a local, regional and national scale
- Replicability
- Feasibility in a given local conditions (economic, social, political, etc.)
- Potential environmental, economic and social benefits
- Measurability and durability of the results

Evaluation criteria concerning micro-project

- Concrete and tangible product
- Usefulness of the product for the implementation of the overall idea for innovation
- Usefulness of the micro-project for other municipalities planning similar actions
- Feasibility of the micro-project in a given local conditions
- Coherence and completeness of the micro-project concept

Additional points were granted to these municipalities, which have Low-Emission Development Programmes (LEDPs) or Sustainable Energy Action Plans (SEAPs).

Submitted projects:

In total 20 project proposals, describing both the overall idea for energy innovation and the micro-project, were submitted for the contest by 19 Polish municipalities interested in establishing co-operation with the Norwegian partner. Submitted ideas were diverse, very interesting and included, among others, development of thematic labs educating future EE/RES installers, using different RES technologies in public utility buildings, energy modernisation of buildings, implementation of comprehensive energy and water consumption monitoring systems, construction of passive buildings and using tri-generation for cooling selected administration buildings.

Each project was subjected to the one-stage formal assessment and the two-stage content assessment. In the first stage of the content assessment the proposals were evaluated by the panel of experts in the field of energy, while in the second stage - by other participants of the contest. The latter took place during the 2nd EEG meeting organised in Poznań on the 13th of June 2016. Each contest participant had 5 minutes to present his/her idea for energy-related innovation and accompanying micro-project. Then, the other participants completed the evaluation questionnaires, where they assessed such aspects of the proposed project as innovativeness, feasibility and potential environmental, economic and social impact. They also assessed the micro-project evaluating its usefulness for the implementation of the overall idea for innovation. After summing up the points from the 1st and the 2nd stage assessment, the winners were announced!

Winning projects:

The award, including a micro-grant for financing preparatory activities (such as conducing necessary analyses or development of project documentation), was granted to the 10 best pilot project inspired by the Norwegian experience. They are all very interesting, innovative and - what is very important - replicable, therefore they can serve as a source of inspiration also for other Polish local self-governments. Below there is a list of the winning projects. Their full descriptions may be found in chapter 7 of this publication.

Photo 5. Announcement of contest results

- Building of a training & research centre in the field of renewable energy sources and energy-efficient construction, Bielsko-Biała
- Clean Energy Labolatories, Bydgoszcz
- Norwegian Climate for Lublin - rational use of energy in the Lublin's "heat island" area, Lublin
- Polish-Norwegian exchange of good practice, Milanówek
- Smart house in the smart village, Pałecznica
- Towards a zero-emission city, Płońsk
- Installation of heat pumps powered by photovoltaic installations in selected public buildings, Raciechowice
- Innovative system for supplying electricity, heat and cold to the part of the Rumia town, Rumia
- Comprehensive energy modernisation of public buildings in Sopot implemented using the ESCO scheme, Sopot
- Thermal modernisation of multi-family residential buildings with active engagement of the residents and the use of innovative RES installations, Sztum

Award for the winners:

- grant for the implementation of the proposed micro-project reaching up to 50 000 PLN (approx. 11 600 EUR);
- establishing bilateral cooperation with the Norwegian partner, having necessary expertise and experience to support the municipality in implementation of the micro-project and in preparation of the more complex EE/RES investment (overall idea for energy innovation);
- participation in the study visit in Norway.

6. Visiting Norwegians - study tour for winner municipalities

Representatives of the 10 Polish municipalities, who won the competition for the best ideas for innovation in the area of energy efficiency and RES use, took part in a week-long study visit in Norway. During the visit they had an opportunity to get familiar with the model energy-related projects and initiatives implemented by Norwegian municipalities and their partners. Visited buildings and facilities encouraged them to engage in a discussion on the possibilities of replicating Norwegian solutions and experiences in Poland. The most interesting parts of the visit are described below.

DAY 1: Short introduction to the topic of climate protection and energy conservation in Norway

During the first day of the study tour the participants visited the seat of the Norwegian Association of Local and Regional Authorities (KS), where they learned basic information about climate protection and energy conservation in Norwegian municipalities. Norway is known for being a frontrunner in the implementation of the sustainable development concept and for many years already the country has been implementing ambitious environmental policies, which include pursuit for maximum use of locally available renewable energy sources.

Photo 6. Introductory presentation in the KS office

The main energy sources currently used at the area of the country are water and wind. Up to 99% of the electricity consumed comes from renewables. Present objectives are also very ambitious - like the EU Norway is aiming for the 40% reduction of GHG emissions by 2030. Moreover, the country is planning to give up oil and gas heating by 2020 and increase waste recycling rate to 75% (today most of the waste produced is incinerated). It is also actively supporting use of electric vehicles, inter alia by fast development of charging infrastructure and tax allowances. Participants of the study visit could see the results of these actions, e.g. by walking the streets of Oslo, where there were many cars driving or parking that had a registration number starting with "EL" (meaning that the car is fuelled with electricity). There were also many charging stations available.

Not only the national government, but also the local authorities, contribute to the achievement of national objectives. Municipalities develop and implement so called Climate and Energy Plans, where they concentrate on supporting further RES use, promoting public transport, promoting walking and cycling and reducing emissions from wastewater treatment and waste management.

DAY 2: Visit at Lindum AS and in Drammen municipality

On the second day of the study tour the participants started visiting selected installations representing wide range of different environmentally friendly solutions. At first, they visited Lindum AS company located in Drammen municipality, which deposits and recycles waste (mostly municipal waste and sewage sludge). Organic waste is used to produce ecological fertilizers through composting or

fermentation in the digesters. In the second case there are two products of the process - fertilizer and biogas, which is used to generate energy. The plant produces 2 400 000 m^3 of biogas per year, which could satisfy the energy demand of 850 households.

In order to improve and intensify the digestion process, and thus to obtain better final products, Lindum AS uses the thermal hydrolysis method (CAMBI technology). The hydrolysis enables deep disintegration of cell structures of the sludge, increasing their degree of dehydration, hygenisation and transformation of volatile substances into methane. When using appropriate technology, the product (biofertilizer) is free of all pathogens and can be used for agricultural purposes.

Photo 7. Installation for thermal hydrolysis at Lindum AS

In its operation Lindum AS is also trying to follow the rules of so called "circular economy". It is a model of economy, which is based on the functioning of the nature, where there are no waste products since everything is either used or safely introduced to the biosphere. In this area the company is implementing a pilot project named Food2Waste2Food, which consists in using CO2 from food waste treatment to support growth of new vegetables and fruits in special greenhouses, which are characterised by low carbon footprint. In this way another product of the waste treatment process is being used, which is in line with the principles of the circular economy.

At the end of the day, participants of the tour visited Drammen Town Hall, where they got acquainted with the municipality's development strategy. The strategy puts great emphasis on the environmental protection, efficient use of local resources (including RES) and sustainable transport. As a result of its implementation over the last couple of years Drammen changed from dishevelled industrial city into clean and comfortable place to live in.

Photo 8. Growing greenhouse tomatoes using waste CO2

Photo 9. Visit at the Drammen Town Hall

DAY 3: Visit at Power House Kjørbo and in the Fornebu district

On the next day the Polish delegation visited Bærum municipality, where they got acquainted with the environmentally friendly solutions implemented at Power House Kjørbo. It is an office building from the 80s, which was deeply modernised. As a result it was upgraded to the plus-energy building standard, which means that during its whole life cycle it produces more energy than it consumes. In case of Power House Kjørbo energy is produced mostly by PV panels and heat pumps. There were implemented also other energy-related solutions rationalising its use, including: heat

recovery from the server room, ensuring very good air tightness of walls and windows and maximum use of daylight. The investment was financed by the building owner and the renting company (being also the author of the project concept) will pay back the costs from the savings achieved as a result of undertaken energy efficiency measures.

Authors of the project concept tried to prove that it is possible to build plus-energy buildings also in the countries with colder climate and that such endeavours can be justified both from the environmental and economic point of view. The investment showed that it is feasible to practically eliminate CO2 emissions from buildings but it is still challenging to do the same with the transport. There are considered some ideas how to reduce environmental impact related with this sector. One of them is the construction of the hydrogen fueling station powered from the PV cells. This would help to make use of the surplus electricity generated from solar energy.

Photo 10. Power House Kjørbo - a plus-energy building

Photo 11. Power House Kjørbo - interior

In the afternoon representatives of Polish municipalities moved to the Fornebu quarter, where old airport area is being rebuilt into a modern, environmentally friendly residential district. New buildings are very energy efficient and constructed from good quality material. Due to the fact that all services, cultural sites and educational facilities are located within short distance from the residential area (so it is possible to go there by foot or by bike), vehicle traffic restrictions have been introduced. New quarter also has an innovative system of waste segregation and collection.

Photo 12. Participants of the study visit in the Fornebu quarter

Photo 13. Waste collection system in the Fornebu quarter

DAY 4: Visit at Akershus EnergiPark and Esval Miljøpark KF

On the last day of the study tour the participants concentrated on the topic of RES use. At first, they visited Akershus EnergiPark in Kjeller, which operates both as a local energy supplier and a research unit. The company owns 9 and co-owns 10 run-of-the-river hydropower plants, which use Francis and Kaplan turbines. Annual electricity generation comes to 2,3 Twh.

Apart from this, from 2005, Akershus EnergiPark is supplying heat to local consumers. It is produced using solar thermal collectors in the summer and burning wood chips when there is not enough

solar radiation to satisfy the energy demand. Solar thermal collectors cover the area of 30 000 m^2. The company is using also other heat sources to exploit available resources. They include heat pumps (recovering heat from the sewage), biogas from the landfill site and bio-oil produced from waste from slaughter houses and fish processing. Moreover, the company is conducting research on the production and utilisation of hydrogen fuels and organised educational activities.

The last place visited was the municipality of Nes and the Esval Miljøpark KF company. Similarly like Lindum AS, the company deposits and recycles waste, as well as produces bio-fertilizer from the organic part of the waste. Also here thermal hydrolysis is used to improve the fermentation process.

Photo 14. Participants of the study tour at the Akershus EnergiPark

Photo 15. Visiting biogas plant at the Esval Miljøpark KF

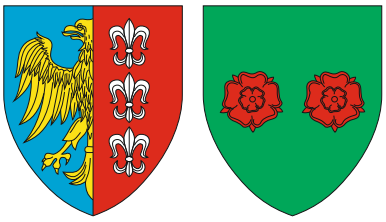
It is worth highlighting that the exchange of experience was not unilateral. Also Polish municipalities are implementing many interesting projects in the area of energy efficiency and RES use, as well as have ambitious plans for the future. Their representatives shared them with the Norwegian hosts.

7. 10 innovative energy projects implemented in cooperation with the Norwegian partners

In the chapters below we present the 10 projects inspired by the Norwegian experience, which won the contest for the best ideas for innovation in the area of energy efficiency and RES use. They include development of EE and RES labs educating future installers, using district heat for cooling purposes, comprehensive exploitation of locally-available RES, implementation of energy & water monitoring system covering both public and private buildings, as well as improving energy efficiency of waste management. The descriptions cover both the overall idea for innovation of a given municipality and the "micro-project", i.e. preparatory activities and bilateral cooperation with the Norwegian partner launched within the umbrella project.

a. Bielsko-Biała

About the municipality



Bielsko-Biała (approx. 178 000 inhabitants) is located in the southern part of Poland, in the Silesian Voivodeship. The city is very active and dynamically developing. It is located in the area, which is touristically attractive but insufficiently ventilated, which results in relatively high concentration of air pollution in the wintertime. At the same time Bielsko-Biała's authorities and citizens actively engage in different environmentally friendly projects and initiatives. The city is one of the founders of the Association of Municipalities Polish Network "Energie Cités" and one of the first Covenant of Mayors signatories. In 2010 Bielsko-Biała's City Council approved local Sustainable Energy Action Plan, which was the first document of this kind adopted in Poland. The SEAP shows how the city plans to achieve its climate & energy targets set for the period 2010-2020. In August 2015 another important document was unanimously approved for implementation - a "Low Emission Development Programme and a new Sustainable Energy Action Plan for Bielsko-Biała", which is an update of the plan from 2010.

Overall idea for innovation

Bielsko-Biała plans **building a training and research centre in the field of renewable energy sources and energy-efficient construction**. It will help to increase knowledge in these areas (especially with reference to the local context), improve the quality of services offered by local companies operating in the EE/RES sector and encourage citizens to invest in sustainable energy technologies. Bielsko-Biała already has an experienced teaching staff working in different centers educating youths, students and adults.

It is planned that the main seat of the centre will be located in the existing workshop hall owned by the ZIAD SA. The hall will be thermally retrofitted and adapted for the educational and research purposes. It will be equipped with the installation for heat recovery, modern LED lighting, control elements

characteristic for smart buildings and RES installations. The latter will both supply the building with energy and serve the educational purposes. The center will allow for organising efficient trainings for RES installers and contractor companies, as well as for conducting research on the potential of using PV panels in the region.

Photo. 16. Planned seat of the centre - workshop hall which will be subjected to the modernisation and adaptation works

Photo. 17. Upper station of the funicular - possible location of one of the test sets of PV panels

Solar energy potential of the region is relatively high due to its favourable geographical location. Moreover, Bielsko-Biała's unique positioning makes it possible to test the influence of solar installation's location on the solar energy yield. It is planned to build test solar installations at least in three places within the city area: in the dust-polluted city center, on the suburbs and in the mountain green area. Such solution will not only enable assessment of the influence of dust pollution on the production of electricity by solar installations, but also will help to analyse dust-sensitiveness of the different types of PV panels. Results of the research will help in better selection of the panels, also in the mountain and sub-mountain region, while the trainings will contribute to the increase in competences of local contractors and the development of RES use and energy-efficient construction.

Micro-project

The micro-grant awarded within the umbrella project was used to develop a planning study of the training and research centre, which is of key importance for the preparation of all further project documentation that will enable its practical implementation. In order to develop the study, the municipality collected all available technical documents, organised on-site visits, made pictures and made arrangements with the owners/managers of the facilities, which will be used in the project (sharing responsibilities and costs).

Photo 18. Visit at the training and research lab in Miękinia

Representatives of Bielsko-Biała also visited a Training and Research Lab in the field of RES and Energy Conservation, which belongs to the Cracow University of Science and Technology and is located in Miękinia. During the visit they learned how such centres operate in practice.

Cooperation with the Norwegians

In order to learn more about the functioning and equipment of training and research centres specialising in energy issues, the municipality of Bielsko-Biała established cooperation with the two Norwegian schools - Bryne High School and Dalane High School - which are located in the Rogaland

region and are managing such centres. In January 2017 representative of Bielsko-Biała visited both schools, to see their equipment and solutions used. In February guests from Bryne came to Bielsko-Biała, where they visited all facilities covered by the planning study and shared their comments and ideas how to possibly improve the pilot project. The city believes that this valuable cooperation will continue also in the future, when the training and research centre will be already operating (e.g. through conducting common research or sharing research results).

Photo 19. Representative of Bryne High School visiting Bielsko-Biała

b. Bydgoszcz

About the municipality

Bydgoszcz (approx. 350 000 inhabitants) is located in the central part of Poland, in the Kujawsko-Pomorskie Voivodeship. It is the leading industrial, commercial and service centre, as well as a place attractive for the tourists due to the surrounding forests and integrating Brda river into the city's urban fabric. Bydgoszcz is developing dynamically and is an active member of many organisations. Striving to preserve its natural values, it is engaging in many environmental protection projects and initiatives, also the ones focusing on energy efficiency and RES use. The city hired an energy manager, developed relevant local strategies (SEAP and LEDP) and opened RES Demonstration Centre which is operating within the Mechanical School Complex No. 2.

Overall idea for innovation

Bydgoszcz plans the **development of the network of clean energy laboratories**, which will help to solve the problem of the shortage of experts (technicians and installers) in the area of EE and RES use. Within the project it will create two new training and research centers, as well as develop special educational programmes for youths and adults, which will be based on practical experience and on cooperation with the producers of energy efficient construction materials and RES installations.

Pilot clean energy laboratories will be built in two schools: Technical School of Electrical and Electronic Engineering (field of study: refrigeration and heat engineering) and Technical School of Construction (field of study: passive housing). They will complement two already existing educational initiatives, thus creating a coherent network. This will answer the growing market demand for educated specialists in the field of energy efficiency and RES use.

Clean energy laboratory at the Technical School of Construction will be created by building additional rooms next to the existing workshop premises. Two new lab units will be established - one devoted to the different materials used in energy efficient and passive construction and the other one devoted to the installations supporting operation of the expanded facility. Technical School of Electrical and Electronic Engineering, on the other hand, will be a seat of the "living" lab of power and thermal power engineering. The building of the new lab (with usable roof) will be constructed using low energy consumption technology (reaching standard close to passive building or plus-energy building standard). It will integrate different types of renewable energy sources, including PV panels, solar thermal collectors, heat pumps and wind turbines. All installations will be accessible for the students and their performance will be measured, which will make it possible to evaluate energy efficiency of different solutions used and to conduct targeted variant tests.

Image 6. Concept of the clean energy lab at the Technical School of Construction

Image 7. Concept of the clean energy lab at the Technical School of Electrical and Electronic Engineering

Micro-project

The micro-grant awarded within the umbrella project was used to prepare detail concept of the two planned laboratories. It was developed in cooperation with the Norwegian partner and the experts from the Renewable Energy Centre at the Bydgoszcz University of Science and Technology. The concept includes, among others, propositions regarding labs' equipment, propositions regarding educational programme and estimated project budget. It will help to apply for co-financing from the Norwegian Funds within the next financial perspective.

Detailed results of the micro-project include:

- Analysis of regional and local needs regarding education in the area of energy efficiency and RES use;
- Analysis of interconnections and development of cooperation frameworks between different parties involved (RES Demonstration Center, technical schools, producers, employers, universities);
- Determination of the scope of the construction works in both schools and of their possible equipment;
- Analysis of available human resources and the demand for trainings for the teachers;
- Development of the main assumptions of the new educational programme implemented in pilot schools;
- Determination of the schedule of works and expenditures;
- Establishment of the cooperation with the 2 Norwegian schools - Dalane High School and Bryne High School.

Cooperation with the Norwegians

Two Norwegian schools - Dalane High School and Bryne High School - shared with Bydgoszcz their expertise and experience in the field of energy education. Within the established partnership

Photo 20. Return visit of the Norwegians in Bydgoszcz

Photo 21. Visit at the Bryne High School in Norway

representatives of Bydgoszcz went to Norway, where they saw the equipment used in both schools and got familiar with their educational programmes, which put great emphasis on practical activities. The visitors met with the teachers, pupils and representatives of regional authorities, who have influence on high school education. They also consulted with the Norwegian partners their initial concept of the two clean energy labs planned in Bydgoszcz and collected many useful comments and tips.

During the return visit in Bydgoszcz the Norwegians got acquainted with the results of the micro-projects, as well as visited both pilot schools and EE/RES installations already operating on the territory of the city.

c. Lublin

About the municipality

Lublin (approx. 340 000 inhabitants) is the biggest city of the Eastern Poland. It is a fast developing university and cultural centre, with many festivals and cultural events organized each year. Local authorities care deeply about environmental and climate protection and engage in many initiatives in this area. In December 2015 Lublin formally approved its Low-Emission Economy Programme, which aims at improving energy efficiency, increasing RES use and reducing GHG emissions on its territory. Already implemented actions include, among others, thermal retrofitting of public buildings, installation of solar thermal collectors and PV panels and development of environmentally friendly public transport.

Overall idea for innovation

Lublin plans **using district heat for cooling** a 12-storey administration building occupied by municipal administration. This is a pilot project, which aims at using excessive heat from co-generation plants over the summer, when there is a large demand for chilled water for air conditioning, especially in the area of so called "urban heat island".

Photo 22. Administration building, where the investment is planned

Currently the building uses standard air conditioners, which consume significant amounts of electricity, the availability of which is reduced during the summer heat waves. Most of the air conditioners used contain substances depleting ozone layer and will have to be replaced with other devices soon. A possible solution to this problem may be to implement in the building a new cooling system based on the installation of the absorption water chiller using warm water from the municipal heating network. It shall result in the improvement of the building's energy efficiency, optimization of the Lublin's energy system, reduction of CO_2 and other pollutants emissions to the atmosphere and the reduction of the amount of waste produced in the process of energy generation in municipal CHP plants. The building will also serve as a demonstration site.

Micro-project

The micro-grant awarded within the umbrella project was used to develop a **functional-utility programme**, which will serve as a basis for the development of all further project documentation and the public procurement procedures necessary for the selection of the contractor. The document

describes technical, economic, material, functional and architectonic requirements concerning using district heat for generating chilled water for cooling the pilot building. Thanks to the financial, economic and environmental analyses it was also possible to evaluate potential effects of the investment in terms of financial savings, energy savings and CO_2 emission reduction.

Photo 23. Consultation meeting in the Cracow City Hall

Additionally, within the micro-project Lublin established bilateral cooperation with the Norwegian partner - municipality of Ullensaker - and the municipality of Cracow. Employees of the Lublin's Energy Management Office visited CHP plant in Cracow, where representatives of EDF Polska S.A. company shared their experience in the area of generating chilled water from district heat in their facility. The visitors also had an opportunity to see a pilot installation for generating chilled water located in the pumping station of the Cracow's MPEC S.A.

Cooperation with the Norwegians

Within the micro-project Lublin established cooperation with the Norwegian municipality of Ullensaker, whose representatives gladly shared their experience in the area of using excessive heat for generating chilled water. Employees of the Lublin's Energy Management Office went to Norway and discussed their planned investment with their foreign colleagues. They learned more about the Norwegian approach to energy and its rational use, as well as visited environmentally friendly system for generating heat and chilled water at the Gardemoen airport (Oslo). Both heat and cool are produced by a heat pump cooperating with the open lower ground exchanger based on 18 wells. Visitors from Lublin also got acquainted with the system for recovering heat/cool from treated municipal waste coming from the nearby municipal waste treatment plant.

Photo 24. System for generating heat and chilled water at the Gardemoen airport (Oslo)

Additionally, representatives of Lublin visited a complex of educational and sports facilities and got familiar with the visualisation of the heating and electrical installations cooperating with BMS, which enable managing these buildings on-line.

d. Milanówek

About the municipality

Milanówek (approx. 16 000 inhabitants) is located in the Mazowieckie Voivodeship, near the Capital City of Warsaw. It is a resort city with thick and well preserved green areas. Together with the two neighbouring municipalities it forms so called Garden Tri-city Near Warsaw. It is an example of active and efficient collaboration between non-governmental organisations and the citizens.

Milanówek pays great attention to the environmental and climate protection. It is an active member of the Association of Municipalities Polish Network "Energy Cités" and implements local Low-Emission Development Programme. Actions envisaged in the programme include, among others, thermal retrofitting of public utility and residential buildings, modernisation and expansion of public lighting and development of sustainable mobility.

Overall idea for innovation

Milanówek plans **building of a swimming pool complex with the accompanying premises and the Environmental Education Centre meeting passive building standard**. The complex will give local community access to high-quality recreation facilities, at the same time increasing their awareness and knowledge in the area of environmental protection and efficient energy use. It is planned that the project will be implemented in two stages - in the first stage the municipality will build a whole-year swimming pool complex with the zones for different age groups (including different-size recreation pools, wading pools, Jacuzzis, geysers, back currents, mini-beaches, saunas and playing grounds) and the passive building with rooms for therapeutic treatments, group exercises and organising conferences and trainings.

In the 2nd stage of the project the municipality will build another passive building - an Environmental Education Centre - which will include rooms destined for conducting environmental education classes based on 4 elements. The Centre will be also a seat of the eco-incubator gathering representatives of companies, universities and other organisations dealing with technologies improving air and water quality. The infrastructure constructed will use such solutions as: exchangers recovering heat from the nearby sewage treatment facility, heat pumps, PV modules, solar thermal collectors, recuperation and energy efficient solutions used in construction and architecture.

Image 8. Visualisation of the recreation and leisure zone within the existing bathing area in Milanówek (author: Piotr Płaskowicki & Partnerzy Architekci)

Micro-project

The micro-grant awarded within the umbrella project was used to establish cooperation and exchange of experience with the Norwegian partner, including organisation of a three-day study visit in Norway and a return visit in Milanówek. During the latter the Norwegian guests could learn more about local social, economic and environmental conditions. Together with the Polish hosts they also analysed the most sensitive aspects of planning and implementing investments in the area of energy efficiency and RES use. Except for that, the micro-project included the development of the functional and technological concept of the planned recreation and leisure complex. The concept will not only serve as a basis for future project implementation, but also may be used as a reference for other local self-governments planning similar projects. These activities were accompanied by a widespread promotional and information campaign addressed to the inhabitants of the city and the region.

Cooperation with the Norwegians

Within the micro-project Milanówek established cooperation with the Norwegian municipality of Frogn, which current implements an investment consisting in the construction of an interactive swimming pool and a sports hall in Drøbak. On the 12th-14th of December 2016 representatives of Milanówek visited Frogn, where they discussed with their hosts the possibilities of optimising the project process, selection of the best technological solutions (including RES) and the concept of the audio-visual settings of different pool zones. Except for this theoretical discussion, the meeting included also a visit at the pool construction site and at the Ullerud Helsebygg hospital.

The knowledge obtained during the visit helped to start the work on the development of the functional and technological concept of the planned recreation and leisure complex. The concept was discussed with the Norwegian partners during their return visit in Milanówek, which took place on the 6th-8th of Februry 2017. The Norwegian guests once again presented their project of the construction of a swimming pool Drøbaksbadet og Frognhallen, acquainting municipal staff with

different stages of the project implementation and with the solutions used. They also introduced the BREEAM-NOR certification system, which is applied to all investments implemented by the municipality of Frogn. It is a multi-criteria system for the assessment of the buildings' quality and environmental impact. It is one of the established standards used in the real estate industry in Eruope and in other parts of the world. On the next day, the Norwegian guests visited the bathing area, where the swimming pool complex will be built, and met with the author of the concept and of the visualisation of the planned facility. They also shared many practical tips with the representatives of Milanówek.

Photo 25,26. Visit in the municipality of Frogn

e. Pałecznica

About the municipality

Pałecznica (approx. 3 700 inhabitants) is a small municipality located in the southern part of Poland, in the Małopolskie Voivodeship. Due to its location in the vicinity of Cracow, natural values, picturesque landscapes and numerous ravines with streams and endemic plants, Pałecznica has significant potential of the development of tourism (especially weekend and cycling tourism). The municipality is one of the stations on the St. Jacob's Route of Lesser Poland. In order to preserve these values, Pałecznica is implementing a sustainable development strategy and engages in different environmentally friendly initiatives, including the ones supporting energy efficiency and RES use. Among them there are: installation of PV modules on public buildings, supporting replacement of old and inefficient boilers and supporting construction of small wastewater treatment installations in private households. The municipality has also developed a Low-Emission Economy Programme.

Overall idea for innovation

Pałecznica plans **implementation of an innovative system for monitoring and managing energy and water consumption using GPRS technology**. Operation of the system will consist in the remote reading of the resources consumption in real time, which will be possible due to the installation of SMART energy meters and water meters (with GSM communication), as well as installation of CO2-emission meter on the chimney. The data collected will be transferred to the central recorder, which will further transfer them to the platform with tools enabling research, analysis, control and reporting activities.

Implemented system, covering both public and private buildings, will allow for constant monitoring of the current consumption of electricity, water and CO2 emissions - both using a web browser or via special application, which may be installed on the mobile phones using IOS, Android or Windows Phone systems. Planned monitoring and management system will contribute to the rationalisation of resources consumption by adapting this consumption to the real needs of the end users. As a result, also CO2 emissions will be reduced.

Micro-project

The micro-grant awarded within the umbrella project was used to establish cooperation and exchange of experience with the Norwegian partner in order to learn more about available Norwegian good practices and technologies in the area of energy efficiency that can be used in a rural municipality. This exchange helped to verify initial project assumptions and propose the most optimal solutions. Except for that, the micro-project included the development of the feasibility study of the planned monitoring system (with the financial and economic analysis). This document will help in applying for funding for the pilot project within the Rural Development Programme for 2014-2020.

Photo 27. Information meeting for the citizens

Within the micro-project the municipality also organised 5 meetings with the citizens and local stakeholders. They discussed innovative and energy efficient solutions used in Norway, as well as economic, social and environmental results of the pilot project.

Cooperation with the Norwegians

Within the micro-project Pałecznica established cooperation with the municipality of Hvaler, which is located in the southern part of Norway, in the Østfold region. The municipality has an electricity consumption monitoring system covering 100% of its buildings and now it aims at its integration with the water consumption monitoring.

The first bilateral meeting took place on the 13th of December 2016 in Hvaler. During the meeting representatives of Pałecznica had an opportunity to get acquainted with their hosts' experience in the area of smart metering and to get some useful advice concerning their planned investment. They also visited a recycling station and the main pumping station of water and sewage. An important part of the visit was the meeting in the energy utility Fredrikstad energi, which is closely cooperating with the municipality of Hvaler. As a result representatives of Pałecznica were able to identify strong and weak points of their project, as well as to resolve all the doubts concerning the investment.

Representatives of Hvaler paid a return visit in Pałecznica on the 30th of January 2017. The Norwegian guests got familiar with Pałecznica's activities in the area of energy efficiency and RES use, as well as visited an Education Centre, Municipal Public Library, water pumping station, PV installations and local educational household. Together with their hosts they also discussed the possibility of

transferring Hvaler's solutions to Pałecznica, including using the same software for collecting and analysing data from energy and water meters.

Photo 28. Representatives of Pałecznica visiting Hvaler

Photo 29. Representatives of Pałecznica visiting Hvaler

f. Płońsk

About the municipality

Płońsk (approx. 22 500 inhabitants) is located in the Mazowieckie Voivodeship, about 60 km from Warsaw. It is one of the Polish front-runners in the development and implementation of environmental actions. The city has a modern CHP plant fired with biomass, which generates heat and electricity. In 2006 the project of the plant received a prestigious Energy Globe award for the best Polish project in the area of sustainable energy. The award was handed to Płońsk representatives in the seat of the European Parliament in Brussels in 2007. The city also has and implements a Low-Emission Economy Programme, which defines a set of measures aiming at the reduction of energy consumption and air pollution emissions.

Overall idea for innovation

Płońsk plans implementation of a **set of measures reducing waste production and thus supporting implementation of the circular economy concept**. They include:

- purchase of a special container for the collection of the electronic waste, based on the Norwegian Safedrop system;
- opening of a centre for the collection and repair of used products, which are not considered as waste (the citizens can leave there all unnecessary items, which can be still used by other people, and in return, they can take something for themselves;
- using modern, automatic technological solutions for the recognition and collection of used packaging.

Implementation of all above-mentioned solutions will be combined with the educational campaign, including organisation of thematic conferences and workshops, and development of interesting educational and information material. This will bring not only environmental benefits (reduction of the amount of generated waste, reduction of the pollutants emissions) but will also raise citizens' energy awareness.

Micro-project

The micro-grant awarded within the umbrella project was used to launch the first two collection points - of the electronic equipment and of the used items. The specialised, sealed container for the electronic waste was placed in the Płońsk City Hall. The visitors can leave there used small electronic devices, such as cell phones, tablets, memory cards, laptops, pen-drives, CDs, DVDs, etc. The centre for the collection and repair of used products, on the other hand, was established at the PSZOK (selective waste collection point) in Płońsk. The citizens can leave there unnecessary but still usable products, such as furniture, ceramics, clothes and textiles, carpets, toys or bikes. In this way it is possible to solve the problem of cluttered apartments, attics and cellars.

Photo 30. Container for the collection of electronic waste placed at the Płońsk City Hall

Photo 31. Movie promoting the pilot project avilable at: https://vimeo.com/207017772

Opening of the collection and recycling centre of the packaging is still in the planning phase. It will depend on the possibility of obtaining external funding for the project. A feasibility study developed within the micro-project should be helpful in this process. The study defines in detail planned results of the project, as well as its impact on the stream of generated waste.

Additionally, the municipality conducted the widespread information and promotional campaign addressed at the citizens, especially the children and youths. It helped to inform them about the implemented solutions, as well as about the general rules and benefits from of the implementation of the circular economy concept. The campaign included, among others, organisation of special thematic workshops in Płońsk's schools and preparation of targeted movie and information leaflet.

Cooperation with the Norwegians

The Norwegian experience is very valuable for Płońsk. The country is implementing the circular economy concept for over 20 years, striving to reduce the amount of generated waste. Many of the Norwegian solutions in this area can be applied in Poland after adequate adaptation, including the Safedrop system, which was implemented in Płońsk.

The Norwegian partner, who supports Płońsk in the implementation of its ambitious project, is the municipal company Esval Miljøpark located in the municipality of Nes. Within the framework of the project the partners met four times in total - twice in Norway and twice in Poland. The bilateral visits enabled learning more about waste management in both municipal units, as well as getting acquainted with the good practices in the area of circular economy. The Norwegian partners organised a visit in the key Norwegian institutions (municipal company Esval Mijøpark, European Recycling Platform in Drammen, Waste Management Plant at Lindum AS and Used Items Collection and Sales Point in Brukanes). Being in Płońsk they also visited the Waste Treatment Plant, the PSZOK (selective waste collection point) in Płońsk and the biogas plant at the Waste Treatment Plant in Poświętne. They also participated in the "IV Płońsk waste conference - the circular economy as a challenge for the municipalities", which took place in Płońsk on the 28th of September 2016.

The bilateral contacts resulted in the enriching of the Płońsk's pilot project with the additional expertise and ideas, as well as in the establishing partnership supporting future cooperation.

g. Raciechowice

About the municipality

Raciechowice (approx. 6,2 inhabitants) is a small municipality located in the southern part of Poland, in the Malopolskie Voivodship. The main fields of activity in the municipality are agriculture and tourism. Its important values are natural resources and environmentally friendly economy. Since 1997, Raciechowice has the the status of ecological community and has been pursuing numerous environmental and climate initiatives, including implementation of RES, energy-efficient technologies and many educational activities. In 1999 Raciechowice joined the Association of Municipalities Polish Network "Energie Cités" and is still its active member. In August 2011 the Municipal Council formally adopted its local Sustainable Energy Action Plan (SEAP) and in December 2014 - it adopted also its updated version named "Low-Emission Economy Programme for the municipality of Raciechowice".

Overall idea for innovation

Raciechowice plans **installation of heat pumps powered by photovoltaic installations in selected public buildings**. Since the municipality is not connected to the natural gas distribution network, at present all public buildings are heated with individual oil-fired boilers. They are already quite old and emit significant amounts of CO_2, sulphur compounds and solid particulates. It is planned to replace them and one of the alternatives is the installation of the heat pumps as the main heat source, additionally supported by PV panels. This should result in considerable economic and environmental benefits. Especially that the solar energy is commonly available and the municipality of Raciechowice has favourable local conditions to make use of it.

Photo 32. Old oil-fired boiler in one of the pilot buildings

The project will adopt the modern technological solutions, including implementation of the comprehensive monitoring and control system. Each PV installation will be equipped with the electricity output meter, while heat pumps will have meters measuring electricity consumption and heat production. Data from the meters will be sent to the Town Hall via the Internet and will be administered by the person made responsible for the monitoring process.

Change of the heating source in the buildings will be accompanied with the modernisation of internal lighting consisting in the replacement of the old lamps with the new, LED ones, which will help to further reduce the electricity consumption.

Implementation of all these modern solutions will also have a demonstration effect, contributing to the promotion and dissemination of RES use not only among neighbouring municipalities, but also among private households.

Micro-project

The micro-grant awarded within the umbrella project was used to develop a feasibility study covering 9 public utility buildings (4 schools, 2 centers for people with special needs, 2 office buildings and 1 cultural center). The study was based on the assumptions of the energy audits and identifies the optimum project solutions. It also helps to determine the level of CO_2 emission reduction resulting from the investment. Additionally, the municipality carried out an assessment of the profitability of the investment, concerning the reduction of the demand for electricity and heat.

Cooperation with the Norwegians

Within the micro-project Raciechowice established cooperation with the municipality of Oslo. On the 10th of October 2016 both municipalities signed a letter of intent, where they committed to exchange experience and expertise in the area of RES use. Then, in November, the representative of Oslo visited Raciechowice, where he got acquainted with its plans concerning the change of the heat source in selected buildings and saw some of them. In his opinion the idea to resign from the heating oil and to replace oil-fired boilers with heat pumps is very good and should be implemented successfully. He also gave many useful tips concerning current operation of the heating system and offered his help during the verification of the technical documentation received from the contractor.

Photo 33. Representative of Oslo visiting one of the buildings, where RES will be installed

A return visit was organised in January 2017. The representatives of Raciechowice visited Olso and the facilities, which use similar solutions to the ones that they plan to implement in their buildings. One of them was the school, which - since 2010 - is powered with a heat pump equipped with two lower heat sources: vertical and horizontal one, installed directly under the asphalt surface of the school playground. Horizontal installation is mainly used in the summer, while the vertical one - in the cold season. Additionally, as a backup source in case of low efficiency of the heat pump, the oil boiler, installed in the school before, is still used.

Another visited building was also a school, but the new one, not used yet. In this case also a heat pump with a reserve electric boiler has been installed as a main heat source. Moreover, the entire facade of the school is covered with photovoltaic panels with a total capacity of ~ 100kW. The most effective was the visit to the City Enterprise in Oslo (Undervisningsbygg Oslo KF), which is responsible for the management of school buildings. In Oslo, there has been developed a plan for a central system of indoor conditions control and supervision, which now covers nearly half of the schools. An engineer from Undervisningsbygg presented to the representatives of Raciechowice the advantages and disadvantages of the automatic remote control, as well as indicated solutions aimed at improving the energy efficiency of the building. With this visit the Polish delegation had the opportunity to learn about the strengths and weaknesses of the solutions they want to introduce in their municipality.

Photo. 34. Representatives of Raciechowice get familiar with the RES technologies and solutions used in Oslo

Photo. 35. Environmentally friendly school with a façade covered with PV panels built in Oslo

h. Rumia

About the municipality

Rumia (approx. 47 500 inhabitants) is a medium town located in the northern part of Poland, in the Pomeranian Voivodeship. Together with the municipalities of Wejherowo and Reda it forms so called "Small Kashubian Tricity". It is a modern and dynamically developing town, located in the vicinity of the Tricity Landscape Park, as well as an important residential and communication center. Rumia is known for its engagement in the activisation of the citizens and local stakeholders and actively cooperates with many local and sub-regional NGOs. All planned investments are also widely consulted with the society. The municipality pays great attention to the issue of environmental and climate protection.

Overall idea for innovation

Rumia plans **implementation of an innovative system for supplying electricity, heat and cold to the part of the town** located west from the railway line. The project foresees the construction of the modern polygeneration plant, which will use solutions ensuring:

- generation of district electricity, heat and cold;
- high total efficiency of the energy generation process;
- using biomass or municipal waste (in the form of RDF) as a fuel.

The plant will supply the consumers with warm usable water and heat, covering part of the overall demand. It is planned that it will be located in the premises of the Repair Works of LNG Systems Sp. z o.o. and will replace present boiler house used by the facility. Initial project assumptions envisage implementation of the modular solution, with the possibility of further development of the investment on different stages.

Photo 36. Old boiler house for modernisation

In the vicinity of the planned polygeneration plant, there are located multiple housing settlements, one primary school and several industrial facilities (including Toyota and Repair Works of LNG Systems Sp. z o.o). These are the potential consumers of the heat and cold produced by the plant. Cold production from heat in the summer period may significantly influence economic impact of the project during the whole period of plant's operation. The investment shall help to solve the problem of low-stack emission on the territory of Rumia, as well as to to reduce the storage of waste with the calorific value exceeding 6 MJ/kg.

Another important aspect, which will be considered during the selection of the fuel, is the relatively small distance and good communication between the planned plant and the Waste Management Facility EkoDolina Sp. z o.o., which is the producer of RDF. The facility is also well communicated with the place, where the polygeneration plant will be located.

Micro-project

The micro-grant awarded within the umbrella project was used to develop a detailed economic and technical analysis of the pilot investment, which will be used to make a final decision concerning the construction of the polygeneration plant and the selection of the technological solutions used. The analysis will also help in defining plant's capacity and equipment.

An important part of the analysis was the assessment of the energy demand (including its

dynamics) in order to adapt the outputs and the size of heat and cold storage facilities to the actual needs. It also included considerations on the possibilities of using different devices increasing energy efficiency both on the supply and the demand side, as well as the determination of the availability of the potential fuel.

Cooperation with the Norwegians

Within the micro-project Rumia established cooperation with the Norwegian company GLØR IKS, which shared its experience in the field of energy generation from waste, as well as communication and cooperation with the key stakeholders. Two bilateral meetings were organised - one in Norway and another one in Poland - which inspired a dialogue on the environmentally friendly and cost-efficient ways of supplying the consumers with energy.

Photos 37, 38. Representatives of Rumia vising Norway

i. Sopot

About the municipality

Sopot (approx. 32 700 inhabitants) is a resort city located in the in the northern part of Poland, in the Pomeranian Voivodeship. Together with Gdańsk and Gdynia it forms so called Tri-City. It implements many innovative projects in the different fields of activity, including environmental protection and energy conservation. For many years it has been a leader of many ranks and a laureate of many awards. Sopot's successes are the result of the consistent implementation of its development strategy, privatisation of the municipal property, development of international relationships and the creation of favourable conditions for the investors.

Overall idea for innovation

Sopot plans a **comprehensive energy modernisation of public buildings implemented using the ESCO scheme**. It is planned that 26 buildings will be subjected to the modernisation works, including municipal kindergartens, schools, Youth Cultural Centre, children's home and a swimming pool. All of them will have internal lighting modernised and energy management system implemented. In some cases also thermal retrofitting works are foreseen.

The city wants to implement the project using the ESCO scheme, i.e. in cooperation with the private partner, who will be responsible for partial financing of the investment, development of complete project documentation and conducting pre-defined modernisation works. The contractor will also manage energy consumption in pilot buildings for the whole duration of the contract. All costs

incurred by the company will be returned (partly or completely) from the energy savings achieved.

Due to the fact that still not many Polish municipalities decide to implement their projects using ESCO formula, the Sopot's investment can be considered as innovative and can serve as a good practice for other local self-governments interested in such solution. Except for the financial savings, the project should contribute to the reduction of CO_2 and solid particulate emissions, which will have positive impact on local environment. And this is very important for a city with the resort status.

Micro-project

The micro-grant awarded within the umbrella project was used to develop a pre-implementation analysis of the investments, which included all the key information and recommendations concerning the use of different possible legal and financial solutions. It also considered the possible share of risks between the private and public partner, the procedures for the selection of the contractor and the selection of the optimum implementation variant. Additionally, a market research was conducted. Relevant questionnaires were disseminated among the companies operating on the EE market and the financial institutions in order to get practical information about the possibilities and framework conditions concerning the planned investment, as well as to verify the project scope.

These activities were accompanied by the exchange of good practices and experience with the Norwegian partner and the organisation of the promotional and information campaign addressed at the citizens.

Cooperation with the Norwegians

Within the micro-project Sopot established cooperation with the municipality of Drammen, which is experienced in the implementation of different projects aiming at the reduction of energy consumption in buildings. Representatives of Sopot visited Drammen in February 2017 in order to learn more about their environmentally friendly solutions. Among others, they visited two schools: **Marienlyst** passive school and **Brandengen** school, which was subjected to the comprehensive energy modernisation works (including installation of RES). The **Brandengen** school occupies a historic, brick building. The thermal retrofitting works included thermal insulation of external walls, installation of passive windows (with the U value ≤ 0,8 W/m^2K), replacement of doors and installation of the heating system based on ground heat pumps. Also building energy management system (BEMS) was installed in the building. As a result the municipality has a building, which both preserved its historic value and is characterised by low energy consumption. The Norwegian experience will be used by Sopot when planning and implementing their own investment.

Photos 39, 40. Representatives of Sopot visiting Drammen in Norway

j. Sztum

About the municipality

Sztum (approx. 18 700 inhabitants) is a semi-urban municipality located in the northern part of Poland, in the Pomeranian Voivodeship. The municipality can boast about the rich history and many landscape and natural values. On its territory there are located many picturesque lakes, including Sztumskie, Barlewickie, Białe and Parleta (wild forest lake with diverse waterfowl and unique microclimate). The town is surrounded by the forests (covering over 4458 ha) with numerous wild game animals and rich ground cover. The above-mentioned values and the Sztum's location in the valley of the Vistula River, make the town an attractive recreation and leisure centre. Therefore, local authorities make all efforts to preserve clean environment and air. In August 2015 Sztum joined the Covenant of Mayors - an European initiative for climate protection and energy conservation. In December 2015 the Municipal Council adopted local Sustainable Energy Action Plan.

Pomysł na innowację

Sztum plans **thermal modernisation of multi-family residential buildings, with an active engagement of the residents and the application of innovative RES installations**. The project shall help to solve the problem of high energy consumption in pilot buildings, which are currently equipped with old, inefficient and highly emissive heat sources (coal-fired boilers). Significant energy consumption also results in significant energy costs, which contribute to the development of fuel poverty.

Photo 41. One of the buildings, which are planned for modernisation

The project foresees comprehensive thermal retrofitting of all pilot buildings and installation of RES, including heat pumps and wind micro-turbines with the vertical rotation axis. Also installation of green roofs and/or living walls is considered. The residents will be trained in the field of energy saving and energy costs reduction. Each apartment will be equipped with the special meter, which will measure and display energy consumption in real time, as well as show prognosis of the energy production from the wind turbine or other RES depending on the weather conditions. As a results the residents will know when to switch on the most energy consuming devices in order to use as much renewable energy as possible. Electricity generated by wind turbines will be primarily used to power the heat pumps, and then to satisfy the demand of the residents. The green roofs will ensure better thermal insulation of the buildings and will capture CO_2.

Micro-project

The micro-grant awarded within the umbrella project was used to develop all key project documents, including the initial analysis, the technical and economic analysis and the feasibility study. The analyses were connected with the energy audit of all pilot buildings. The documents will not only help to properly plan all stages of the investment process, but also to apply for external funding for the project.

Additionally, the municipality organised working meetings with the residents, during which they raised their knowledge in the area of energy saving and thus reducing energy bills. The residents (who are often poor, unemployed and/or socially outcasted people) were also invited to actively contribute to the project. Municipal representatives proposed that they can do some of the works around the building, paint the staircases and their apartments, etc. They will be supported by the

facilitator, who will show them how to carry out the tasks, how to use different tools, etc. During the meetings the residents could also inform about other interventions and repairs that are necessary in their buildings.

An important part of the micro-project was the cooperation with the Norwegian partner, whose useful comments helped to improve project documentation.

Cooperation with the Norwegians

Within the micro-project Sztum established cooperation with the municipality of Ullensaker, which has great experience in the implementation of energy efficiency and RES use projects. In March 2017 the representative of Sztum visited Norway, where he got acquainted with interesting good practices in the area of using various energy sources. Among others, he visited local airport in Ullensaker, which covers its heat demand using district heating, oil-fired boilers and heat pumps, as well as recovers heat from the sewage. In the summer it cools its buildings using energy previously stored in specially adapted warehouses, where the snow from the airfield and access roads is gathered in the winter time. In the summer months, the warehouse is covered with a layer of fresh wood chips, which dry out over the warm months and are burned in the local heating plant. This is a very interesting solution, which shows how in different weather conditions we can used what the nature gives us.

Another visited facility was the sewage treatment plant, which uses collected methane as a source of heat needed at the next stages of the sewage treatment process. At the end of the process, the sewage sludge is sold to farmers as a high quality fertilizer containing valuable nitrogen and potassium compounds.

Photo 42. Reservoir of snow used to cool the Ullensaker airport building over the summer

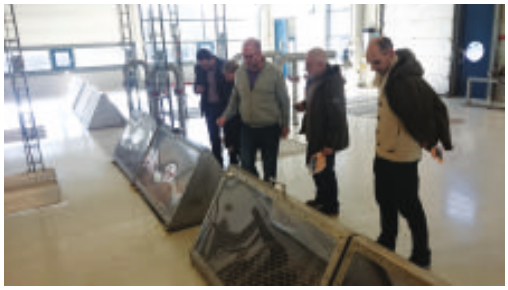


Photo 43. Visit at the sewage treatment plant

8. Most important successes and lessons learnt from the project

What are the opinions of the representatives of Polish and Norwegian municipalities participating in the project? What did they like the most about the activities that they were engaged in? What are their conclusions for the future? Answers to these and other questions may be found in the citations presented below.

Opinions of the representatives of the Polish municipalities:

"I am full of admiration for the nature of Norway. I can see that people appreciate it and care about it. I would very much like our joint project to have an impact also on the awareness of our citizens and their commitment to the nature protection - in particular though the reduction of fuel consumption."

Piotr Sołtysek
Mayor's plenipotentiary for energy management;
Municipality of Bielsko-Biała

"The aim of Bydgoszcz is to improve energy efficiency and increase the share of renewable energy in our region. We would like to achieve it through practical education of future professionals in the well-prepared "Clean Energy Labs". The concept of a network of such laboratories, which will join existing initiatives such as the Demonstration Centre for RES and Renewable Energy Centre in the University of Techology and Science, is being implemented in cooperation with the Norwegian partners: Dalane Bryne High School and Bryne High School. We plan to introduce the new educational programmes for youth and adults, which will base on practice and working with the producers from EE and RES industry."

Beata Kempa
Head of the Environmental Policy Department, Municipality of Bydgoszcz

"Poland and Norway protect the climate by the efficient use of what they already have. Using heat from the district heating network to provide cooling in the summer improves efficiency of the combined electricity and heat production. Optimization of the energy system operation contributes to the lower emission of air pollutants and greater comfort for users of buildings located in the urban heat island."

Beata Jędrzejewska-Kozłowska
Director of the Energy Management Office, City of Lublin

"Implementing principles of low-carbon economy in Milanówek will surely boost the development of the city and increase its attractiveness. Such changes will strengthen the character of a garden-city, as well as support the implementation of environmental objectives and the education of residents in the field of renewable energy. Small towns such as Milanówek can learn a lot from foreign partners, so I am glad that our project of building facilities in zero-emission technology was awarded, which gave us the opportunity to establish cooperation with the Norwegian partner."

Wiesława Kwiatkowska
Mayor of Milanówek

"The use of modern technologies and the experience of the Norwegian partners can significantly facilitate rational energy management processes in our municipality. This in turn will reduce the fixed costs of its operation. The systems for monitoring of energy and water consumption contribute to the optimisation of this consumption by enabling more flexible management and adaptation to the users' needs. Which in consequence will also translate into the reduction of CO_2 emissions."

Marcin Gaweł
Mayor of Pałecznica

"Reducing waste production and the pollution of air, water and soil is an important part of an innovative economy providing natural resources maintainance. I am convinced that cooperation of Płońsk with the Norwegian partners from Esval Miljopark will help to improve the environment in our city, the efficiency of municipal waste management and energy efficiency through the recovery of precious metals used in the production of electronic devices."

Andrzej Pietrasik
Mayor of Płońsk

"The City of Rumia is actively engaged in implementation of the principles of low-carbon economy. The opportunity to benefit from the experience of Norwegian local authorities is an important support and a source of inspiration for the planning and implementation of our next actions foreseen in this field."

Paweł Klawiter-Piwowarski
Mayors Plenipotentiary for Energy, Municipality of Rumia

"Experience of our Norwegian partner - the city of Oslo - and his knowledge of the various solutions are a valuable source of information, which will be helpful in our project implementation. As the ecological municipality Raciechowice has been continually looking for the possibilities to deliver local energy and climate protection strategy. We hope that our idea of using heat pumps powered by photovoltaic systems for heating public buildings will be not only an inspiration for our residents, but also the solution replicated in the whole country."

Marek Gabzdyl
Mayor of Raciechowice

"For many years we have been working to improve air quality in our city. Because of the growing domestic market for energy efficiency services, it is worth to learn from the best practices of sector leaders, including the Norwegians. Using the other regions' experience will improve the measures implemented on our territory"

Marcin Skwierawski
Deputy Mayor of Sopot

"In my opinion the residents should be directly involved in the energy-related actions, so that everyone could contribute to them. On the municipal territory we have two wind farms located with a total capacity of 52 MW, now we are keen to move to community energy projects. They not only have the energy and climate dimension but also the social and economic one. By investing in renewable energy sources, we create the opportunity for Sztum inhabitants to reduce the energy costs."

Leszek Tabor
Mayor of Sztum

Opinions of the representatives of the Norwegian municipalities:

"Bryne High School has new buildings using modern energy solutions. For us it is important to take full advantage of this in our education. The Polish-Norwegian cooperation platform allows us to exchange ideas and develop our teaching in this field."

Gunnar Solheim
Head of Natural Science Department
at the Bryne Upper Secondary School

"Dalane Upper Secondary School is a proud partner of the project «Polish-Norwegian cooperation platform for climate and energy conservation». We believe that the project will lead to cross-border transfer of important knowledge and experience in the area of renewable energy. This is crucial, in order to give our local communities right knowledge in their decision-making on matters related to renewable energy."

Tor-Magne Rotevatn
Deputy Principal of the Dalane Upper Secondary School

"In this project we wish to provide practical and concrete examples of how sustainable energy and green growth may be realized, and how we can learn from each other. The Municipality of Drammen has put energy and energy-related climate issues very high on the agenda. Our vision is to prepare for independence from fossil fuels and to be CO2-neutral in the future. This is why we think it is important to establish cooperation with other countries, including Poland."

Geir Andersen
Technical Manager, Municipality of Drammen

"Proper wastehandling and wastetreatment is one of the solutions on the way to zero-emission economy. How to collect and transform waste into raw materials for further production is a topic that has been looked into in the micro-project implemented with PGK and Płońsk municipality. Treating waste as a resource is a key topic to reach the goal of zero emissions."

Jonny Eriksen
Managing Director of Esval Miljøpark KF

"It has been a privilege for Frogn municipality to enter into cooperation with Milanówek municipality in Poland. Milanówek's ambitious vision to establish an environmentally friendly center for sport, swimming and culture corresponds strongly with the similar projects undertaken in Frogn. And the people of Frogn are very happy to be able to share their knowledge and experience with Milanówek in order to help them realize their own project."

Bjørn Nordvik
Municipality of Frogn

"Implementing common project with the municipality of Raciechowice we have learned that the interest for and knowledge of energy economization and reduced usage of fossil fuels have skilled and resourceful ambassadors in all parts of Europe. And that the way to a sustainable future lies in the sharing of knowledge and the ability to learn from others."

Anders Brage Mikkelsen
Municipality of Oslo

9. Development prospects of the Polish-Norwegian cooperation

Polish local self-governments are increasingly interested in improving their energy situation. They engage in numerous energy-related initiatives, especially the ones related to the energy modernisation of buildings, modernisation of street lighting and use of renewable energy sources, such as solar, wind and water energy. Their ability to reach adopted climate & energy objectives will strongly depend, however, on establishing efficient cooperation and exchange of experience with other local authorities from Poland and from the whole Europe. Such exchange allows to avoid already made mistakes, use already tested solutions and get inspiration for further projects and activities.

Norwegian municipalities are especially equipped to contribute to the sustainable development of Polish municipalities as they have large experience in implementation of ambitious and innovative projects in the area of energy efficiency and RES use. Selected examples are described in this publication, however in needs to be considered that the number of experiences and good practices, that may be used as a source of inspiration, is much bigger. And Norwegian municipalities are keen to share them with the others and engage in international cooperation.

Although climate, legal, economic and social frameworks impacting energy situation of Polish and Norwegian municipalities are slightly different, many Norwegian solutions - after adequate adaptation - can be transferred to Poland. 10 Polish municipalities, which established cooperation with Norwegian partners within the umbrella project, are the living proof of this. They received support in the preparation of their innovative energy project for implementation and they all declare willingness to continue bilateral cooperation and exchange of experience in the future. They are also considering expanding this cooperation to other fields of activity, such as cultural development or education.

Also other Polish municipalities, encouraged by the success of the 10 Polish-Norwegian partnerships and by the operation of Polish-Norwegian Cooperation Platform established within the project, can join this exchange. Especially that today it is easier than ever before. On-line discussion forums and interactive webinars enable efficient dialogue without the necessity of organising and bearing the costs of related travels. And Polish municipalities gladly and skillfully make use of these opportunities. It needs to be remembered, though, that also personal meetings have their benefits - especially the study visits which make it possible to see how implemented solutions look and work in practice. Therefore it is the best to combine personal meetings with virtual ones and to use established contacts to plan and implement common projects and initiatives. The umbrella project entitled "Polish-Norwegian cooperation platform for climate and energy conservation" created solid basis for such cooperation and both Polish and Norwegian municipalities are interested in it. Therefore there is significant potential for further Polish-Norwegian cooperation and now it needs to be considered how to make the best use of it.

10. Catalogue of good practices

The next pages present the selection of good practices developed by Polish and Norwegian municipalities in the area of energy efficiency and RES use. They have been organised into thematic groups, which are the following:

- energy efficiency in buildings (Kościerzyna, Oslo, Trondheim, Warszawa)
- use of renewable energy sources (Bærum, Niepołomice, Os, Siemiatycze)
- sustainable transport and mobility (Gdynia, Oslo)
- modernisation of street lighting (Andrychów, Jasło)
- environmental education (EURONET 50/50 MAX and Drop to Drop projects)
- development of environmentally friendly quarters (Drammen, Trondheim)

Complete collection of Polish and Norwegian good practices may be found on the project website: www.razemdlaklimatu.eu/en/katalog-dobrych-praktyk

POLISH AND NORWEGIAN CITIES
together for climate and energy

THERMAL RETROFITTING OF PUBLIC UTILITY AND RESIDENTIAL BUILDINGS IN KOŚCIERZYNA

Sector: Energy efficient buildings

Timeframe: 2005 – 2008 and 2012 – 2016

Location: Municipality of Kościerzyna, Poland

Photo: Jolanta Bork, Primary School No 1

PROJECT BACKGROUND

Kościerzyna (approx. 23 700 inhabitants) is located in the northern part of Poland, in the Pomeranian Vivodeship. The city is an active member of the Association of Municipalities Polish Network "Energie Cités". In 2011 it joined the Covenant of Mayors - bottom-up initiative for climate protection. In 2012 it formally adopted Sustainable Energy Action Plan until 2020 (SEAP) defining city's long-term vision, specific objectives and a set of planned measures supporting energy efficiency, RES use and air quality improvement. One of the actions foreseen in the SEAP is thermal retrofitting of public utility and residential buildings. To ensure its implementation Kościerzyna applied for and received funding from the National Fund for Environmental Protection and Water Management (within the KAWKA[1] programme). Supported project, named "KAWKA in Kościerzyna. Reduction of low-stack emissions through co-generation and thermal retrofitting of buildings", aims at adoption of corrective actions following directions set in the Air Protection Programme for the Kartuzy and Kościerzyna Zone.

PROJECT DESCRIPTION

First group of Kościerzyna's public utility buildings was modernised in the period 2005-2008. The scope of thermal retrofitting works included thermal insulation of external walls and ceilings, replacement of windows and doors, and modernisation of heating systems. In total 5 buildings were modernised, including public school complexes No. 1, 2 and 3, self-government kindergarten No. 7 and Kościerzyna's Community Centre. In the period 2012-2013 five more buildings were renovated with the support of the NFEP&WM granted within the Green Investment Scheme (GIS) programme. These were: primary school No. 1, primary school No. 2 (building A and building B), "Pooh Bear" kindergarten, "Rainbow three" kindergarten and social welfare centre. Another example of effective renovation combined with deep thermal retrofit is the Kashubian Entrepreneurship Incubator - its building was adapted for energy efficient exploitation thanks to the co-financing obtained from the Regional Operational Programme for Pomorskie Voivodeship for 2007-2013.

Since 2014 Kościerzyna is implementing another thermal retrofitting project co-funded from NFEP&WM, entitled "KAWKA in Kościerzyna. Reduction of low-stack emissions through co-generation and thermal retrofitting of buildings". In 2014 two municipal buildings were comprehensively modernised and in 2015 - next four. In 2016 it is planned to conduct thermal retrofitting works in 10 multi-family residential buildings (4 municipal buildings and 6 condominiums), which will be also

[1] Kawka (pol.) = Jackdaw (en.)


Photo: Joanna Bork, Public Schools Complex No 1

connected to the municipal district heating network. It is foreseen that each condominium participating in the project will raise a loan for covering 35% of the investment costs concerning its particular building.

The scope of planned retrofitting works includes thermal insulation of external walls and roofs, replacement of windows in apartments and staircases, replacement of entrance doors and construction of central heating and warm usable water installations with the circulation system. Obligatory part of the project is organisation of educational & information campaign and development of the database enabling inventory of emission sources.

FINANCING SCHEME

Total costs of the project "KAWKA in Kościerzyna" came to 4.9 Mio PLN (approx. 1.14 Mio EUR). 1.7 Mio PLN was covered from the Voivodeship Fund for Environmental Protection and Water Management in Gdańsk (including loans granted to participating condominiums) and 2.2 Mio PLN - from NFEP&WM. Remaining amount - 1 Mio PLN - was covered from municipality's and relevant condominiums' own budgets.

PROJECT RESULTS

By improving buildings' energy efficiency, the project "KAWKA in Kościerzyna" will undoubtedly contribute to the reduction of low-stack emissions on the territory of the municipality. It will also help to increase citizens' environmental and energy awareness since the investment is accompanied by educational & information campaign.

Based on energy audit data it was calculated that the thermal retrofit of 14 buildings will reduce their heat consumption by 2088 MWh/year, while CO_2 emissions will decrease by 443 Mg/year.

Until the end of 2014 thermal retrofitting works (more or less expanded) were undertaken in 151 from 189 multifamily residential buildings administered by the municipality, housing cooperatives or condominiums.

The City of Kościerzyna is a prizewinner of the 2 editions of the Eco-City contest - the prize was granted in 2013 and 2015 within the category of "Energy efficiency in cities below 100 000 inhabitants". The city was also awarded by the Ministry of Environment for the project "Thermal retrofitting of public utility buildings", which was submitted for the contest "Green cities - towards the future" within the category of "Energy efficiency in construction".

DEVELOPMENT PROSPECTS

In the period 2016-2018 further thermal retrofitting works are planned in 18 public utility buildings located within the Kościerzyna's Functional Urban Area - including 8 buildings located on the territory of the city and 10 building located on the territory of the municipality. Existing documentation includes energy audits, building designs, detailed engineering designs, technical specification for the execution and acceptance of the construction works and cost estimates.


Photo: Joanna Bork, Public Schools Complex No 2

MORE INFORMATION

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POLISH AND NORWEGIAN CITIES
together for climate and energy

DEICHMANSKE MAIN LIBRARY, OSLO
PASSIVE ENERGY BUILDING WITH TRANSLUCENT FAÇADE

Sector: Energy efficiency

Timeframe: 2009 – 2018

Location: Bjørvika, Oslo, Norway

fot. Lund Hagen Architects

PROJECT BACKGROUND

Deichmanske main Public library is planned in Bjørvika and will be built according to ambitious environmental standards. The library will have high architectural quality, and be functional and innovative in its use of future-oriented climate solutions. This will be a creative, visible, and accessible people´s library and meeting place for culture. The library will reach many user groups through new technology and new services, with a special focus on children and the young.

PROJECT DESCRIPTION

Ambitions for the new library include 50 percent reduced carbon emissions compared to today´s standard. The pre-project calculations show a combined reduction of emissions of 38 percent, and the rest is likely to be obtained through an ambitious mobility plan with practically no car use.

The building, planned to fulfil passive energy criteria, has a compact form. Ventilation is supplied via the floor structure in the second to fifth storeys, thus reducing the need for fan energy. Since ventilation air is distributed along the concrete in the floor structure, the thermal mass of the building is utilised and temperature fluctuations are reduced.

The same is true for the extensive use of exposed concrete ceilings. The concrete floors are cooled with built-in warming and cooling pipes in the concrete of the roof and floor, allowing ventilation air quantities to be reduced. Automatic external solar screening will be used to reduce the buildings cooling needs, and energy-efficient IT equipment will be required. The project is based on a district energy network for Bjørvika, which will supply the building with 100 percent energy for heating and cooling needs.

Pre-project phase calculations of greenhouse gas emissions from material use show low emissions from the chosen materials, when compared to similar buildings. A series of initiatives are underway to reduce the emissions further, among others the use of low-carbon cement, recycled steel reinforcement and recycled steel in the pile foundations. The façade consists of a composite solution with a three-layer glass with an internally positioned sunscreen. Between the glass panels there are tubes of 10 mm thick glass fibre reinforced plastic composite insulated with rock wool. Alternative façade solutions are also being evaluated to reduce greenhouse gas emissions. The floor slabs will be concrete with surfaces of natural stone, surface treated concrete and technical flooring. Interior walls are planned with recycled drywall on wooden studs. Wood based panels are also being considered.


fot. Lund Hagen Architects

PROJECT RESULTS

Gross area: 19,970 m^2
Heated area: 19,260 m^2

Greenhouse gas calculations (tons CO_2 equivalents)

	Reference	Project	Completed	Operational
Energy	17.2	6.4	–	–
Material Use	28.3	14.2	–	–
Transport	60.4	11.4	–	–

Delivered energy: 71 kWh/m^2/year (calculated)
Energy label: Label A
Net energy: 75 kWh/m^2/year – passive house
Estimated energy delivered: 80 kWh/m^2/year
Energy sources: Heat pump water-water (heating/ DHW)

The main focus of a library is, of course, cultural. But the environmental benefits will also be very visible to the users, including learning possibility for young people.


fot. Lund Hagen Architects

MORE INFORMATION

Project blog with contact details:
www.blogg.deichman.no/nyedeichman/in-english/

Future Built:
www.futurebuilt.no/prosjektvisning?lcid=1033&projectID=217300

ÅSVEIEN SCHOOL, TRONDHEIM
PASSIVE ENERGY STANDARD, LOW CARBON EMISSIONS

Sector: Energy efficiency in buildings

Timeframe: 2013 – 2015

Location: Byåsen, Trondheim, Norway


fot. Carl-Erik Eriksson

PROJECT BACKGROUND

Due to insufficient capacity, high costs and poor environmental performance the old Åsveien School needed replacement. The local politicians demanded high environmental performance, and the project has been part of the national program "Buildings of the Future" requiring at least 50 per cent reduction in greenhouse gas emissions.

The new building accommodates 630 pupils, a center for 20 autistic children and a local cultural and sports center (multipurpose hall). More rooms are flexibly arranged so that they can be made available to different user groups in evenings and weekends.


fot. Carl-Erik Eriksson

PROJECT DESCRIPTION

Even with significantly larger area than the old school, the energy consumption in the new one is reduced to a quarter. Parts of the building's heating needs are met by a geothermal heat pump with ten wells at a depth of 200 meters. Built according to "passive energy standard" with energy performance certification standard A (dark green).
The building has extensive use of timber, reducing the greenhouse gas emissions from building materials with more than 40 per cent compared to a traditional concrete construction. Loadbearing structures and internal walls are constructed using cross-laminated timber panels, and the façades are clad with slow-growing heartwood pine.
Spatial efficiency indoor and parking restrictions combined with measures to promote walking, bicycling and use of public transport help reducing energy use and carbon footprint.

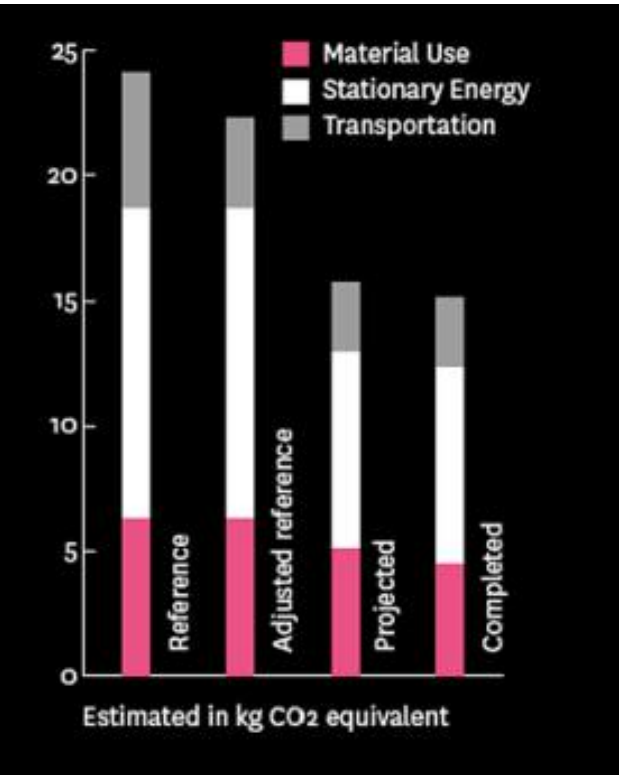
Storm water management with rain gardens and dams is one of the measures of adaption to climate change.

Owner: Trondheim Municipality

Architect: Eggen Arkitekter AS

Funding: Mainly within ordinary budgets, though with contributions from national programs

PROJECT RESULTS



Heated area:	8790 m^2
Energy label:	A (Dark Green)
Energy consumption: Net energy:	65 kWh/m^2/year.
Delivered energy:	57 kWh/m^2/year
Space heating:	6.3 kWh/m^2/year
Ventilation Heat (heating coils):	3.8 kWh/m^2/year
Hot water (DHW):	10.1 kWh/m^2/year
Fans:	6.5 kWh/m^2/year
Pumps:	0.7 kWh/m^2/year
Light:	8.3 kWh/m^2/year
Technical equipment:	8.8 kWh/m^2/year
Ventilation Cooling (cooling coils):	0.8 kWh/m^2/year

Other results: Better indoor air quality. Better adaption to climate change. Reduced car traffic to/from school – good for environment and preventing traffic accidents.

Local Community Centre established in addition to ordinary school functions. Economic and environmental gains due to intensive use – one building instead of two.

Old school demolished with high level of building material recycling.

MORE INFORMATION

See the new school being built in 12 minutes (YouTube):
www.youtube.com/watch?v=YbaDtToZZk4

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THERMAL RETROFITTING OF THE NATIONAL LIBRARY IN WARSAW

Sector: Energy efficient buildings

Timeframe: 2012 – 2015

Location: National Library,
213 Niepodległości str., Warsaw, Poland


Photo: the National Library

PROJECT BACKGROUND

Warsaw (over 1.7 Mio inhabitants) is the capital of Poland and the main city of the Mazowieckie Voivodeship. It is also the biggest city in the country located in its central-eastern part. Warsaw is an active member of the Association of Municipalities Polish Network "Energie Cités" and one of the first Polish signatories of the Covenant of Mayors, which joined this initiative already in 2009. In 2011 the city developed and adopted its Sustainable Energy Action Plan until 2020.

The National Library in Warsaw is the central and the biggest Polish library, as well as the most important humanities-oriented scientific repository. It is the main archive of Polish literature, national bibliographic agency, research institute and an important methodical center supporting other libraries in Poland. The library occupies a complex composed of the three units connected with internal gardens. It is located at 213 Niepodległości street, in the Ochota quarter.

PROJECT DESCRIPTION

Thermal retrofitting of the library was possible thanks to the funds from the Green Investment Scheme (GIS) managed in Poland by the National Fund for Environmental Protection and Water Management (NFEP&WM). Warsaw applied for and received funding within the 1st call for proposals announced under the priority programme "Part 5 - Energy management in the facilities of selected public finance sector entities". Supported project, entitled "Energy management in the buildings of the National Library" foreseen the modernisation of the whole complex.

The National Library was built in the period of the Polish People's Republic, often from poor-quality material, therefore its buildings required replacement of the most of the elements and installations. In the years 2012-2013 thermal retrofitting works were conducted in 12 buildings (A1-A6, B, B1, C, D, E and F). Scope of the works included thermal insulation of 13 000 m^2 of external walls and flat roofs and replacement of 6 000 m^2 of windows. The façades could not have been insulated from the outside due to their structure (curtain façades) and the necessity to preserve original proportions of buildings. The insulation material used were the Multipor insulation boards, which have good insulation properties and are easy to mount on the walls. Installation of mineral boards from the inside brings many benefits: possibility of heating up the building fast, reducing energy bills (approx. by 50% per year), increasing building users' comfort, improving microclimate in the interiors and ensuring safe and durable insulation. The retrofitting works included also modernisation of the central heating systems

consisting in the replacement of vertical and horizontal pipelines (approx. 20 000 m), replacement of approx. 1 100 radiators and installation of measurement units. Moreover, approx. 12 400 luminaires were replaced with new ones with energy efficient light bulbs. This activity was accompanied by the modernisation of the installation and replacement of lighting boards.

Another project proposal was submitted within the 2nd call for proposals announced under the GIS priority programme "Part 5 - Energy management in the facilities of selected public finance sector entities". It received funding and - as a result - ventilation and air conditioning systems were modernised in the library's main building at Pole Mokotowskie (building C). The scope of modernisation works conducted in the period 2014-2015 included replacement of electrical and tele-technical installations and introduction of BMS covering air conditioning system, ice water unit and district heating substation. The aim of the BMS is to integrate different installations existing in the library's building and to manage and optimise their operation. Modernisation of ventilation and air conditioning systems in building C was completed in May 2015.

FINANCING SCHEME

Main thermal retrofitting works were conducted in the period 2012-2013 within the project "Energy management in the buildings of the National Library" co-financed from the Green Investment Scheme. The scheme was launched to fund environmental projects using financial resources obtained by Poland through the sale of excessive Assigned Amount Units (AAUs) assigned to the country under the International Emission Trading scheme. These resources can be used only for environmental protection purposes related to the reduction of GHG emissions (so called "greening"). The investment implemented in the National Library was funded using money coming from the sale of AAUs to the Japanese entity named NEDO – New Energy and Industrial Technology Development Organization, operating on behalf of the Japanese government. The investment received the highest co-financing from all the projects supported within the agreement signed with NEDO. The total cost of the modernisation works came to approx. 26.6 Mio PLN (approx. 6.18 Mio EUR). Co-financing from the NFEP&WM reached 20.7 Mio PLN (approx. 4.81 EUR). Nearly 4 Mio PLN (approx. 0.9 Mio EUR) was covered from the budget of the Ministry of Culture and National Heritage and the remaining amount was covered from the National Library's own funds.

Modernisation of ventilation and air conditioning systems in building C was also financed by the NFEP&WM within the Green Investment Scheme, priority programme "Part 5 - Energy management in the facilities of selected public finance sector entities" (2nd call for proposals). The total investment cost included in the grant agreement came to 5.3 Mio PLN (approx. 1.2 Mio EUR).

Photo: the National Library

PROJECT RESULTS

Conducted retrofitting works significantly improved thermal conditions of the walls and reduced heat losses. Installed mineral insulation boards improved microclimate in the interiors, which was very important for ensuring adequate comfort of the building users. After the renovation, buildings' appearance is accordant with the original assumptions of the modernist project from 1963 (during the construction in the period of the Polish People's Republic these assumptions could not have been completely implemented). Now, the National Library is a good example of Polish modernist architecture from the 60s - functional and environmentally friendly.

Thermal retrofit of the 12 buildings occupied by the library contributed to the reduction of CO_2 emissions by 2 278 Mg/a (nearly 50% decrease), while reduction of heat consumption reached 19 717 GJ/a (66.2% decrease). The investment brought not only environmental benefits, but also economic ones as it reduced library's electricity and heating bills.

Modernisation of ventilation and air conditioning systems in building C, conducted in the period 2014-2015, should result in further CO_2 emission reduction amounting to 2 262 Mg/a.


Photo: the National Library


Photo: the National Library


Photo: the National Library

MORE INFORMATION

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POWERHOUSE, BÆRUM
WORLD'S FIRST RENOVATED OFFICE BUILDING PRODUCING MORE ENERGY THAN USED

Sector: Energy efficiency, solar energy, geothermal energy

Timeframe: 2012 – 2014

Location: Kjørbo, Bærum, Norway


fot. PNEC

PROJECT BACKGROUND

The Powerhouse consortium constructs energy-positive buildings in Norway. Among the partners are Skanska entrepreneur, state owned real estate company Entra Eiendom, architectural firm Snøhetta, the environmental organization ZERO and the consultancy firm Asplan Viak. The consortium aims to demonstrate that it is possible to create energy-plus buildings, even in colder climates, and that developing such buildings makes commercial and environmental sense.
The Kjørbo project in Sandvika, 15 km from Oslo, involved the redevelopment of two 1980s office buildings into energy-positive houses. Prior to the project, both buildings had an annual energy use of around 250 kWh/m^2. The state body Enova and local authorities supported the project.

PROJECT DESCRIPTION

Old ineffective houses are converted into modern offices buildings with comfortable and attractive indoor environment. Existing structures and building elements are reused and incorporated.

After the renovation, the buildings' energy need is reduced by 90 per cent. Local energy is produced by solar panels installed on the roof. These can supply over 200 000 kWh each year – double the amount of the building's need. Ground wells in the park outside the buildings provide heating for radiators, water and ventilation air, and cooling in the summer.

The buildings are also equipped with new energy systems (heating, ventilation, cooling and lighting), designed to be used only when needed, though with limited number of sensors and control units. Exposed concrete absorbs heat and releases it again when it becomes cooler.

A good acoustic environment without suspended ceiling was created using suspended baffles on the ceiling in addition to acoustic dampening fins around the central cores. The fins and baffles are made of recycled plastic bottles. The core wall is designed as a curved waveform, among other reasons because it traps noise and creates calm zones in the open office landscape. Facades are clad with charred wooden panels, which are almost maintenance free.

In addition to producing more energy than it consumes, the project has also been rewarded with the highest classification in the BREEAM-NOR environmental certification system 'outstanding'.


fot. PNEC

PROJECT RESULTS

The success of the project is based on close cooperation between the various partners, the ability to find the most optimal solutions and the innovative combination of these solutions. The result is a unique combination of extreme energy performance with good indoor air quality, low environmental impact and robust solutions. This is achieved through:

- Energy concept based on integrated and holistic solutions
- Good insulation values, low air-leakage and a lot of daylight
- Extensive utilisation of thermal mass
- Effective solar screening
- Energy efficient lighting controlled by sensors according to daylight and presence
- Controlling technical equipment consumption
- Energy efficient and building-integrated ventilation solution
- Thermal energy supply based on energy wells, heat pumps and use of excess heat from server facilities, optimised according to heating and cooling requirements
- A large photovoltaic system
- Reuse of materials from old building i.e. facade panels
- Comprehensive testing and commissioning of technical systems
- Training of maintenance personnel, and careful follow-up of daily energy use
- Facilitating increased bicycle and electric car use

The primary energy calculation over the 60 year life of the building results in a surplus of about 200 kWh/m^2 of heated area. Delivered energy, excluding technical equipment, is calculated to about 20 kWh/m^2/year.

Net internal area:	5200 m^2
Number of users:	225
Energy sources:	Photovoltaics (electricity), heat pump water-water (energy wells for cooling and heating). Heat pumps cover 100% of load, also DHW (separate heat pump). Heat pump water-water (waste heat from server room used for heating), district/ local heating system (backup in case of heat pump failure).
Environmental standards:	BREEAM Outstanding. Passive house. Plus energy building
Room heating:	4.9 kWh/m^2/year
Ventilation heating:	1 kWh/m^2/year
Domestic hot water:	1.4 kWh/m^2/year
Fans:	2.3 kWh/m^2/year
Pumps:	1.6 kWh/m^2/year
Lighting:	7.7 kWh/m^2/year
Technical equipement:	12 kWh/m^2/year
Ventilation cooling:	0.2 kWh/m^2/year
Other energy posts:	18 kWh/m^2/year
BUILDING COSTS:	Approx.15.9 MNOK. Project support from Enova.

MORE INFORMATION

Fact sheet (Power House):
www.powerhouse.no/en/prosjekter/kjorbo/

Web site (Future Built):
www.futurebuilt.no/prosjektvisning?lcid=1033&projectID=258201

Technical fact sheet (Skanska):
www.sapagroupmedia.com/share/?458f41ea7eff8e6aaf61d3307a9aeb431e6e0c25

POLISH AND NORWEGIAN CITIES
together for climate and energy

INSTALLATION OF RES SYSTEMS IN PUBLIC UTILITY BUILDINGS AND PRIVATE HOUSEHOLDS IN NIEPOŁOMICE

Sector: Solar energy use

Timeframe: 2012 – 2016

Location: Niepołomice, Poland

Photo: St. Nowacki, Municipality of Niepołomice

PROJECT BACKGROUND

Niepołomice (over 26 000 inhabitants) is located in the southern part of Poland, in the Małopolskie Voivodeship. As a long-standing and active member of the Association of Municipalities Polish Network "Energie Cités" it was one of the first four Polish cities, which signed the Covenant of Mayors in January 2009. Since March 2011 Niepołomice is implementing its Sustainable Energy Action Plan, which foresees CO2 emission reduction by nearly 25% by 2020, compared to the baseline values from 2008. One of the planned actions supporting achievement of this ambitious target is increasing the amount of RES systems installed on the territory of the municipality. That is why Niepołomice became a leader of the project entitled "Installation of renewable energy systems in public utility buildings and private households in the municipalities of Niepołomice, Wieliczka, Skawina, Miechów, Myślenice and Zabierzów". The project was co-financed by Switzerland within the Swiss-Polish Cooperation Programme.

PROJECT DESCRIPTION

The overall objective of the project was to improve air quality and state of the environment on the territory of 6 neighbouring municipalities: Niepołomice, Wieliczka, Skawina, Miechów, Myślenice and Zabierzów (the two latter joined the project in 2015), as well as to improve health conditions and quality of life of their citizens. Decision on the implementation of project activities was based on the need for diversifying energy sources used, increasing renewable energy production, reducing low-stack emissions and protecting natural ecosystems. The project consisted in installation of RES systems in public utility buildings and private households, accompanied by educational & information campaign addressed to the citizens. Following results were achieved: installation of solar thermal collectors on 3 900 buildings (with the total surface of 25 000 m^2), installation of PV modules on 29 buildings (with the total surface of 5 000 m^2 and capacities varying from 10 kWp to nearly 160 kWp) and installation of 9 heat pumps (including air-source heat pumps with the capacity of 8 kW used for preparation of warm usable water and heat pumps with the capacity of 204 kW satisfying energy demand of the indoor swimming pool).

The total value of the project implemented in 6 municipalities amounted to 82 704 876 PLN (22 275 030 CHF = approx. 19 233 690 EUR). 64.51% of the cost (53 352 915 PLN = 14 369 621 CHF = approx. 12 407 654 EUR) was covered from Swiss funds and remaining 35.49% (29 351 961 PLN =7 905 409 CHF = approx. 6 826 036 EUR) from municipalities' and other beneficiaries' own contributions. Citizens had to cover 30% of the costs of their individual

Photo: St. Nowacki, Municipality of Niepołomice

installations, while 5.49% was provided from respective municipalities budgets. In case of RES systems installed on public utility buildings 100% of own contribution came from municipalities budgets. The project has foreseen three types of solar thermal installations that could be installed in private households: type A (for three people) with 2 solar thermal collectors and 250-liter hot water storage tank (household's contribution = 4 020 PLN = approx. 935 EUR); type B (for three to five people) with 3 solar thermal collectors and 300-liter hot water storage tank (household's contribution = 4 660 PLN = approx. 1 084 EUR) and type C (for more than five people) with 4 solar thermal collectors and 500-liter hot water storage tank (household's contribution = 5 730 PLN = approx. 1 333 EUR) .

Implementation of the project started on the 24th of January 2012 with the signature of an agreement between the project coordinator (municipality of Niepołomice) and the Implementing Authority of European Programmes. Another important step was the signature of an agreement between the coordinator and the Info Solutions company responsible for supervising project implementation, which took place on the 5th of December 2012. Then, an open tender for the RES installer was announced and on the 4th of October 2013 relevant agreement was made with the consortium composed of Viessmann sp. z o.o and Wachelka INERGIS S.A. companies. First solar systems were installed on private residential buildings in December 2013.

Photo: St. Nowacki, Municipality of Niepołomice

At first it was planned to finalize all project activities by December 2015 but due to the increase of the CHF exchange rate (and thus increase of the project budget) they were prolonged until December 2016.

In case of Niepołomice the investment included installation of 615 solar thermal systems (with the total surface of 4 280 m^2) in private buildings, installation of 3 solar thermal systems (with the total surface of 46,4 m^2) in sports facilities and installation of heat pumps with the capacity of 90 kW and 204 kW.

The first building in Niepołomice, which was equipped with the heat pump (with seven 180-meter wells), was the Administration Centre. The wells were made under the parking area. The 2nd building was the indoor swimming pool in Niepołomice, where 3 heat pumps were installed (with 19 wells of 3 135 m in total) and are operating in a cascade system. The building was also equipped with PV panels, which were mounted on the roof, southern façade and part of the western façade. The PV plant has the surface of 1 020 m^2 and the peak capacity of 166.6 kWp. Generated electricity is used to cover building's own demand and is not supplied to the grid. The plant is integrated with the monitoring system, which allows real-time observation of renewable electricity production and related CO_2 emission reduction. Special display monitor - placed in the swimming pool's main hall - shows installation's current output, amount of electricity generated during the day and daily gain in PLN recalculated into monthly, yearly and total values. The monitor also displays daily reduction of CO_2 emissions, which is recalculated into number of kilometers traveled (on the particular day and in total) and into amount of trees planted (on the particular day and in total). Open access to the monitoring results is important for raising energy awareness of the local community. In the period from the 1st of November 2015 till the 21st of March 2016 the installation generated 20.44 MWh of electricity, contributing to the reduction of CO_2 emissions by 11.18 Mg CO_2. Such a hybrid solution (integration of PV modules with heat pumps) allows to reduce energy costs and low-stack emissions significantly.

Photo: St. Nowacki, Municipality of Niepołomice

PROJECT RESULTS

Until present (April 2016) all planned solar systems (615) were installed on private houses located on the territory of the municipality. Also works related to the installation of heat pumps and PV panels in the indoor swimming pool were completed. The only part of the investment, which still needs to be finalized, is the installation of PV modules with the capacity of 150 kW and the surface of 950 m^2, which will supply with electricity the Niepołomice's Royal Castle.

An important project result is the increase of citizens' energy awareness, which should lead to the wider use of environmentally friendly technologies, including the ones used for supplying both private and public buildings with renewable energy. Thanks to the installation of solar thermal collectors, PV panels and heat pumps in the large number of buildings, the project significantly contributed to the reduction of low-stack emissions (through the reduction of fossil fuels consumption), as well as to lowering energy bills paid by public institutions and private households involved. It needs to be remembered that optimisation of energy and natural resources consumption influences economic growth. Large number of RES installations also increases touristic attractiveness of the region.

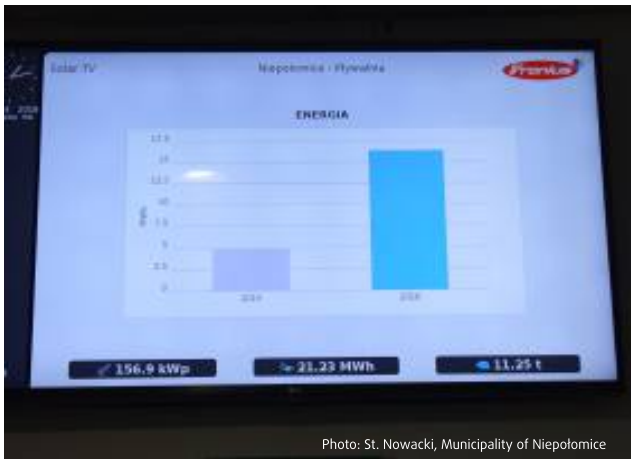

Photo: St. Nowacki, Municipality of Niepołomice

Photo: St. Nowacki, Municipality of Niepołomice

Photo: St. Nowacki, Municipality of Niepołomice

MORE INFORMATION

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OSEANA ARTS & CULTURAL CENTRE, OS
SUPPLIED WITH ENERGY FROM SOLAR CELLS AND THE FJORD

Sector: Solar energy, geothermal energy

Timeframe: 2009 – 2011

Location: Os municipality, Norway

PROJECT BACKGROUND

Os municipality had a clear vision to create a vibrant and attractive cultural centre and create a signature building of high architectural quality and optimum energy and environmental solutions. This ambitious project resulted in Norway's first low energy cultural building. It received funding from Enova (state body) in order to be a model for other cultural buildings.

PROJECT DESCRIPTION

The new 5,700m^2 performance arts centre and art gallery has a roof inspired by the sail of a local boat type, which has been made in the district for more than a thousand years.

The facade and part of the roof is covered with multicrystalline solar cells (550 m^2), and the building is placed close to the fjord, where reflection from the sea gives additional energy.

Energy efficient building techniques are applied, and heat pumps collect energy from seawater. In addition, wind turbines were planned.

From outdoor area to art galleries and restaurant right through to the auditorium, advanced LED technology is used, giving low energy lighting with high quality.

The project is developed with "Integrated Energy Design - IED" where building design and other technical installations were integrated into an architectural and energy technical entirety.

The building was designed by Grieg Architects.

PROJECT RESULTS

The project was awarded the Norwegian "Building of the year" in 2011.

Heat pumps in the fjord reduce energy consumption by two thirds, from 1,125,000 kwh to 430,000 kWh per year.

Solar cells:

- Rated power: 63.5 kWp
- Solar Type: multicrystalline silicon
- Number of solar modules 363 a 175Wp
- Area: covering 550 m^2
- Estimated production: about 42,000 kWh / year

The center is financed through a public-private joint effort consisting of Os municipality, Hordaland County, Grieg Foundation, industry players and other private contributors. Art, culture, food, nature and outdoor activities are combined in an unprecedented manner.

fot. Grieg Architects

fot. Grieg Architects

MORE INFORMATION

Web site with contact details: www.oseana.no

Building Integrated Photovoltaics for Norway: www.bipvno.no/index.html

The solar cell plant's performance can be followed live here: www.sunnyportal.com/Templates/PublicPageOverview.aspx?page=643e83f3-bec6-447c-b947-2f5992f1c37f&plant=5dd51fc3-b7dc-467b-b3f4-ee6d6e78acd8&splang=en-US

BIOGAS PLANT WITH THE CAPACITY OF 0,2 MW AT THE WASTEWATER TREATMENT PLANT IN SIEMIATYCZE

Sector: Biogas use

Timeframe: 2013 – 2015

Location: Kościuszki str., Siemiatycze, Poland

Photo: Marcin Jakimczuk

PROJECT BACKGROUND

Siemiatycze (approx. 15 000 inhabitants) is located in the southern part of the Podlaskie Voivodeship. Since 2016 the city is a member of the Association of Municipalities Polish Network "Energie Cités". Local authorities care deeply about environmental protection and engage in different environmental initiatives. One of them was construction of the biogas plant at the municipal wastewater treatment plant, which was done within the project entitled "Efficient disposal of sewage sludge through its use for the purpose of electricity and heat co-generation". The project was initiated by the municipal company named **Przedsiębiorstwo Komunalne Spółka z.o.o.**, which wanted to solve the problem of high energy consumption in the waste treatment facility modernised several years before. The project was completed in May 2015 and the biogas plant officially launched its operation in June 2015.

Investments in renewable energy sources are still rare in the Podlaskie Voivodeship. The one done by Siematycze is the first investment of this kind implemented in the whole district. Except for increasing renewable energy generation, it also helped to solve the problem of offensive odours from the sewage sludge. The sludge was stored before in open tanks and - as a result - all related gaseous pollutants were emitted to the environment.

PROJECT DESCRIPTION

The biogas plant generates approx. 1 200 - 1 600 m^3 of biogas per day. It is later combusted in the co-generation unit producing electricity and heat. Nominal electrical output of the installation comes to 190 kW, while thermal output amounts to 240 kW. Electricity generated is used for the wastewater treatment plant's own purposes, i.e. for powering equipment used in sewage sludge and wastewater treatment processes. Heat, on the other hand, is used for technological purposes, i.e. for heating the digesters and the technological building.

The biogas plant is composed of the 2 air-tight digesters. Each of them has the diameter of 13 m, height of approx. 15 m and capacity of 2 100 m^3. The biogas storage tank has the capacity of 1 040 m^3.

New installation ensures proper management of sewage sludge produced during wastewater treatment. Both surplus activated sludge and primary sludge are subjected to the anaerobic fermentation process, which was introduced in the sludge handling system. Before being directed to the process, surplus activated sludge (from secondary sedimentation tanks) is thickened and dehydrated. The outcome of the anaerobic fermentation is biogas, which is then stored in a special tank and - through the condensate dehydration system and biogas desulphurisation system - transported to the

low-pressure tank. Then, through the pressure pump, biogas is transferred from the tank to the energy co-generation unit, where heat and electricity are produced. Heat is used to maintain process temperatures in digester chambers at adequate levels, while electricity is used for the wastewater treatment plant's own purposes. Each chamber is equipped with heat circulation system and double-impeller agitators, which ensure complete sludge mixing.

FINANCING SCHEME

The total value of the project came to approx. 12 Mio PLN (approx. 2.8 Mio EUR). Out of this amount almost 7.5 Mio PLN (approx. 1.7 Mio EUR) was granted from the Regional Operational Programme for the Podlaskie Voivodeship for 2007-2013 and further 2.5 Mio PLN (approx. 0.6 Mio EUR) came from a loan from the Voivodeship Fund for Environmental Protection and Water Management in Białystok. The project also foreseen the purchase of the installation for dehydration of the digested sludge, which cost approx. 2 Mio PLN (approx. 0.5 Mio EUR) and was also co-financed from the ROP (with the 85% co-financing rate).

PROJECT RESULTS

The main aim of the investment was to ensure proper and efficient management of sewage sludge by using it to generate heat and electricity satisfying part of plant's own demand. As a result the plant managed to halve its electricity costs related with powering process equipment. Average monthly savings on energy bills reach nearly 20 000 PLN (approx. 4 600 EUR). The company managing the plant also gains profit from selling certificates of origin of electricity from promoted sources (so called "green certificates"). These additional financial resources cover part of the plant's exploitation costs.

Except for economic benefits, implementation of the project also brought social ones. It improved comfort of life of Siemiatycze's citizens as it contributed to the liquidation of bothersome odours. Air pollution was eliminated thanks to the controlled fermentation of sewage sludge. Moreover, introduction of the fermentation process resulted in decreasing sludge volume by even 30% and increasing sanitary safety of digested sludge making it usable for agricultural purposes. After degasification and mechanical dehydration, the sludge is subjected to the process of hygenisation and can be used as a natural fertiliser. Preparation of the sludge for further treatment (drying, combustion) according to global trends opened way for future investments planned by the municipal company, i.e. construction of a drying and combustion unit.

Environmental benefits related with the investment consist in using renewable energy source (biogas) to generate heat and electricity, thus allowing to reduce fossil fuels consumption.

The project entitled "Efficient disposal of sewage sludge through its use for the purpose of electricity and heat co-generation" implemented in Siemiatycze's wastewater treatment plant was nominated for the prize in the contest "Top municipal investments from Eastern Poland" carried out in 2015.

MORE INFORMATION

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DEVELOPMENT OF ENVIRONMENTALLY FRIENDLY PUBLIC TRANSPORT - TROLLEYBUSES IN GDYNIA

Sector: Sustainable transport

Timeframe: 2005 – 2013

Location: Gdynia, Poland


Photo: Marcin Czapnik

PROJECT BACKGROUND

Gdynia (approx. 247 800 inhabitants) is located in the northern part of Poland, in the Pomeranian Voivodeship. In 2011 the city signed the Covenant of Mayors and established cooperation with the Association of Municipalities Polish Network "Energie Cités" - official Covenant Supporter. In 2012 Gdynia adopted Sustainable Energy Action Plan until 2020 and in 2015 it adopted Low-Emission Development Programme. Gdynia is one of the three Polish cities with trolleybus systems. Its trolleybus network is considered the biggest and the most modern in the country and extends to two neighbouring municipalities - Gdynia and Sopot. The network comprises of 12 permanent lines and 1 seasonal line. The low-floor vehicles carry over 25 million passengers per year, travelling 5 million vehicle-kilometres. In the period 2010-2013 the city implemented a project called Trolley, which aimed at promotion of trolleybuses as the cleanest and most economical form of transport for sustainable cities and regions in Central Europe. In December 2012 the Trolleybus Communication Enterprise Sp. z o.o. in Gdynia (**Przedsiębiorstwo Komunikacji Trolejbusowej Sp. z o.o. w Gdyni**) signed contract concerning implementation of the EU research & innovation project named CIVITAS DYN@MO (carried out by a consortium of 28 partners), while in June 2015 it joined the ELIPTIC project co-financed from HORIZON 2020 programme (carried out by a consortium of 34 partners).

PROJECT DESCRIPTION

In the period 2005-2007 the Trolleybus Communication Enterprise Sp. z o.o. (TCE) implemented the EU-funded project entitled "Development of environmentally friendly public transport in Gdynia", which consisted in the construction of a new trolleybus depot in Gdynia, new trolleybus loop in Kacze Buki quarter and new trolleybus lines with the total length of 10.6 km, as well as the purchase of 10 new low-floor trolleybuses. In the period 2010-2013 TCE implemented another environmental project entitled "Development of environmentally friendly public transport in the Tri-City". Project activities included reconstruction of the traction network along the Zwycięstwa str. in Gdynia and Niepodległości str. in Sopot (together with a trolleybus loop in Reja str.), construction of 4 new and reconstruction of 5 existing traction substations, construction of the Substation Remote Control Centre with remote controlled disconnectors and purchase of 28 new low-floor trolleybuses.

The CIVITAS DYN@MO project, implemented within the CIVITAS II PLUS initiative and co-financed from FP7, included purchase of 2 new Solaris trolleybuses with an alternative power source - a lithium-ion battery, choice of a trolleybus line to be served by new hybrid trolleybuses, further expansion of the trolleybus network to cover areas, which couldn't be reached with traditional trolleybuses (due to the lack

Photo: Marcin Czapnik

of the traction network), and enhancing the overall reliability of the trolleybus transport services in Gdynia.

Enrichment of the fleet by purchasing new hybrid trolleybuses was a breakthrough moment for the trolleybus transportation system in Gdynia as the vehicles equipped with lithium-ion batteries can move also on the roads without the traction network. The previous alternative power source - nickel-cadmium batteries - weren't as efficient as the new ones and didn't bring such vast opportunities. The trolleybuses are also equipped with automatic pantographs enabling automatic raising and lowering of the current collector. Asynchronic drive with the energy recuperation system allows for collecting energy during moving and giving it back during breaking. Another task envisaged within the CIVITAS DYN@MO project was the reduction of the electric power demand of the trolleybus system through the installation of supercapacitator, as well as enhancing energy efficiency of trolleybuses and existing infrastructure. Installation and startup of the supercapacitator took place in April 2014. The supercapacitator bank was located in the area of Wielkopolska Substation, which is a hilly terrain, therefore there is higher frequency of trolleybuses braking and giving recuperative energy back to the traction network. The bank "catches" this energy and stores it for later use by other trolleybuses. Reduction of energy consumption of the network section, where the supercapacitator is installed, comes to 12-20%.

Another important undertaking implemented by TCE is the ELIPTIC project, which aims at reducing energy consumption of public transport and related costs by optimising the use of existing infrastructure and electric vehicles fleet. Project partners will also investigate opportunities for further electrification of public transport in their cities (the project ends in May 2018). Using remote control and data acquisition software purchased within the project (costing approx. 25 000 EUR), TCE will re-configure 2 network sections from one-sided to two-sided power supply. This will help to increase efficiency of energy recovery from trolleybuses braking and thus reduce network electricity consumption. Thanks to the two-sided power supply the network will be also more energy stable (optimisation of energy balance and energy management). TCE is also planning the development - in cooperation with the University of Gdańsk - of two feasibility studies concerning further electrification of public transport system in Gdynia:

- "Possibilities of recharging electric vehicles connecting Tri-City agglomeration based on trolleybus infrastructure".
- "Replacement of diesel bus lines by extension of trolleybus network based on hybrid trolleybuses using batteries as the alternative power source (based on CIVITAS DYN@MO experience)".


Photo: Marcin Czapnik

Photo: Marcin Czapnik

Photo: Marcin Czapnik

FINANCING SCHEME

The EU project entitled "Development of environmentally friendly public transport in Gdynia" had the value of approx. 54 Mio PLN (approx. 12.5 Mio EUR) and was co-financed from the European Regional Development Fund within the Regional Operational Programme for the Pomeranian Voivodeship for 2004-2006 (with the co-financing rate of 50%). The project entitled "Development of environmentally friendly public transport in the Tri-City" had the value of approx. 100 Mio PLN (approx. 23.25 Mio EUR) and was also co-financed from the ERDF within the ROP for the Pomeranian Voivodeship (with the co-financing rate of 70%).

PROJECT RESULTS

The share of the environmentally friendly trolleybus transport system in the Gdynia's overall public transport system comes up to 25%. Implementation of energy efficient vehicles contributed to the reduction of electricity consumption by more than 20%, as well as to the improvement of the passengers comfort. Both new and rebuilt trolleybuses are autonomous, i.e. they don't need traction electricity at a 5-kilometer distance. In 2010 (before the investments co-financed from the EU) annual consumption of traction electricity amounted to 13 GWh and accompanying CO_2 emission came to 11.7 Gg. After implementation of the project entitled "Development of environmentally friendly public transport in the Tri-City" in 2013 annual consumption of traction electricity decreased to 10.5 GWh, while accompanying CO_2 emission decreased to 9.45 Gg. It can be thus calculated that annual electricity savings come up to 2.5 GWh (20%), while annual reduction of CO_2 consumption comes up 2 250 tonnes.

In December 2012 the European Commission honoured Gdynia within the Access City Award contest for the transport system, which is friendly for people with disabilities. In 2013 the Interntional Union of Public Transport (UITP, **Union Internationale des Transports Publics**) recognised Gdynia's transportation system as the best one in Central and Eastern Europe. Another award - Leader of Regional Development - was granted by the Polish Agency for Enterprise Development during the II Polish Entrepreneurship Congress in Katowice in October 2014. Also in 2014 the European Commission honoured Gdynia with the prestigious Regiostars 2014 award for the project "Development of environmentally friendly public transport in the Tri-City". The project won in the category „CityStar – investments in urban public transport compliant with sustainable growth principle".


Photo: Marcin Czapnik


Photo: Marcin Czapnik

MORE INFORMATION

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POLISH AND NORWEGIAN CITIES
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RUTER#: FOSSIL FREE 2020, OSLO AREA
ALL PUBLIC TRANSPORT ON RENEWABLE ENERGY

Sector: Transport

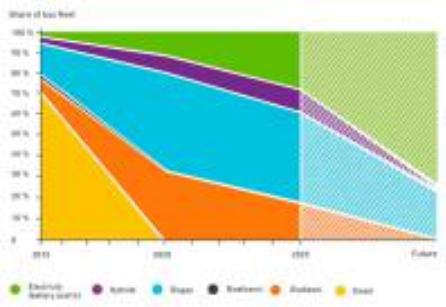
Timeframe: 2015 – 2020

Location: Oslo area, Norway

PROJECT BACKGROUND

Pollution, noise and health issues related to urban traffic is a concern for all large European cities. A growing population creates needs for a large scale, efficient and environmentally friendly public transport system. In Norway, the ambitions for public transport are high, and it is an agreed political goal that all growth in passenger traffic in major cities shall be met by public transport, cycling and walking. Handling traffic growth with environment-friendly mobility solutions is an important contribution to achieve Norway's climate goals and reduce local pollution. Stricter environmental requirements and new technological solutions are driving this process forward.

Ruter is responsible for transport services in Oslo and Akershus counties in Norway, serving 1.2 million people. In June 2015 the board of Ruter adopted an ambitious plan whereby Oslo and Akershus will have only low- and zero-emission buses that run on renewable energy by 2020 and for further developments up to 2025. Ruter's fleet currently comprises some 1,100 buses, 77 % of which run on diesel. In the future most of the buses will be electric and have the necessary driving range to be able to cover long distances. Ruter is also considering introducing electric boats on its services on the Oslo fjord.



The ambition of the public transport sector in Oslo and Akershus is to use only renewable energy in 2020. This calls for wide-ranging changes to the bus fleet and to ferries in the region. Ruter's aim is to introduce the most effective long-term solutions as quickly as possible.

Currently, Ruter's view is that electrical busses and boats are especially promising. They are therefore looking into testing a large number of electric busses and associated infrastructure in regular service during 2016-20, and are now initiating a collaborative phase where they identify partners and concretize ambitions and plans for testing of electric buses.

PROJECT RESULTS

With the introductions of EURO I-VI requirements, significant environmental gains have been achieved, including reductions in local emissions (particulate matter (PM) and nitrogen oxides (NOx)). However, greenhouse gases (GHG, most critical is CO_2) are not part of the EURO emission requirements. To improve local emissions even further and to reduce fuel consumption as well as GHG-emissions, increased usage of new bus and boat technologies is needed.
Electric infrastructure maturity is still low, and further standardization is required. Biodiesel, biogas

and bioethanol infrastructure solutions have high technical maturity and are already installed in the Oslo region.

Ruter wishes to contribute to speed up commercialization and adoption of zero-emission solutions for public transport both in Norway and in Europe. This will result in a reduction in environmental impact, less noise and higher energy efficiency in public transport. Ruter's goal is for public transport to continue to be the most environmentally friendly choice, even when in emissions from private cars become low. Becoming fossil fuel free will result in better public transport services in the region, with innovative solutions and reliable, comfortable and quiet vehicles. This will help the capital region to grow into a healthy, green and attractive place to live and work.

MORE INFORMATION

Ruter's web site:
www.ruter.no/en/about-ruter/reports-projects-plans/fossilfree2020/
Read more:
- First battery electric bus test in Oslo and Akershus are under preparation
- Plan ready for transition to running exclusively on renewable energy in 2020
- Fossil Free 2020 and testing of electrical buses
- Renewable energy powertrain options for Ruter, a report for Ruter by Roland Berger Strategy Consultants

	Bus technology maturity level 2015	Commercial ready in 2020	Infrastructure maturity 2020	Fuel/energy availability in 2020	Reduced local emissions vs. Euro V diesel	Reduced WTW CO_2 emissions towards conventional diesel	Energy consumption	TCO index 2020
Biodiesel	●	✓	●	✓	◕	◕	High	98-102
Bioethanol	◕	✓	●	(✓) 1)	◕	◕	High	103-108
Biogas	●	✓	●	(✓) 1)	◕	◕	High	108-114
HEV	◕	✓	●	✓	◕	◕	Medium	98-104
PHEV	◔	(✓)	◕	✓	◕	◕	Medium/low	114-127 3)
Overnight	◔	(✓)	●	✓	●	● 2)	Low	108-121
Opportunity	◔	(✓)	◕	✓	●	● 2)	Low	110-122
Fuel cell	◔	(✓)	◕	(✓) 1)	●	● 2)	Medium	132-151

● High ○ Low ✓ Available (✓) Partly available

1) Capacity not sufficient for whole fleet 2) Renewable electricity, excluding CO2-impact from battery production which is significant 3) PHEV with opportunity charging

Summary of analysis results by technology towards 2020[3]

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MODERNISATION OF STREET LIGHTING IN ANDRYCHÓW

Sector: Energy efficient lighting

Timeframe: 2015

Location: Andrychów, Poland


Photo: Enis Solutions

PROJECT BACKGROUND

Andrychów (approx. 20 800 inhabitants) is located in the southern part of Poland, in the Małopolskie Voivodeship. For several years the city has been planning street lighting modernisation, among others due to significant amounts of money paid for electricity consumption. The 1st step towards more energy efficient lighting was signing an agreement with the Tauron company (lighting infrastructure owner), where the municipality leased for many years all lighting poles located on its area. Then, a public procurement was launched and a contract was signed with the company responsible for street lighting replacement. As a result Andrychów became a model for other municipalities wishing to modernise their public lighting.

PROJECT DESCRIPTION

The street lighting modernisation investment included replacement of 2 513 sodium luminaires with LED ones, which were installed on the existing supporting structures of the transmission lines and on the separate lighting lines. Selection of the luminaires was based on the requirements set in the street lighting standard PN-EN 13201 and done using Relux computer programme. In this way the project team decided on the capacity of light sources, their luminous flux and light distribution. The project included also reconstruction of the 3030-meter long cable lighting installation, replacement of 121 light poles and lamps with new ones and installation of the PLANet lighting control system. The system is composed of the base stations ensuring communication and so called "telecells" (control and monitoring nodes) fitted to the luminaires. Selection of the number and distribution of the base stations was done using the computer analysis of wave propagation. As a result 6 base stations were installed in selected locations, ensuring good system communication within the whole city area. It is worth to highlight that 10 mobile communication stations working at similar frequencies cannot ensure GSM communication covering the same area. Possibility of installing only limited number of base stations is one of the important advantages of the PLANet system over the other solutions. Installation of PLANet base stations was followed with installation of the luminaires with the Telecell controlls that were


Photo: Enis Solutions


Photo: Enis Solutions

activated on the spot. Each Telecell device contains a processor for radio communication management, lighting control and monitoring of the electric grid parameters (together with the metering unit). The luminaires are switched on using a photo sensor measuring the external light levels. Depending on the street and related lighting requirements, the luminaires are dimmed to the level which takes into consideration the margin factor and re-dimensioning of the luminaires. During the night hours the lights are additionally dimmed following the decrease of traffic intensity.

FINANCING SCHEME

The total cost of the investment came to PLN 7 million. Co-financing of PLN 3,1 million and a loan of PLN 3,8 million were granted by the National Fund for Environmental Protection and Water Management within the 1st call for proposals organised under the Priority Programme **"Green Investment Scheme (GIS) part 6: Owl - Energy efficient street lighting"**.

PROJECT RESULTS

As a result of the street lighting modernisation implemented in Andrychów the capacity of street luminaires was lowered from 439,88 kW to 226,38 kW. Replacing sodium luminaires with LED ones, accompanied by further capacity reduction from automatic control, allowed for CO_2 emission reduction by 1 150 Mg per year. Installation of the PLANet lighting control system helped to additionally lower LED luminaires capacity by 48%. Annual financial savings achieved due to the project come up to PLN 500 000.

Replacement of the street lighting also contributed to the improved visual comfort and safety of the citizens and people passing through the city. This is possible thanks to the white light emitted by LEDs, which renders colours better than the light from the sodium lamps. The PLANet lighting control system enables further energy and financial savings coming from dimming newly installed LED lights to the levels established in the up-to-date external lighting standards. Expanded programming possibilities allow for optimum and energy-saving exploitation of the lighting system. Using the reports database municipal staff will be able to obtain favourable price for maintenance services after the end of the guarantee period.

Andrychów qualified for the national contest for "the best lit city and municipality of 2015", which is organised by the Polish Association of Lighting Industry since 1998. The municipality received 1st award in the category of street lighting modernisation. The contest committee came to Andrychów to see by themselves how the streets lit with LED lights look like. During the award ceremony they highlighted the very large scope of the investment, as well as the additional electricity consumption reduction resulting from the implementation of the automatic control system.

DEVELOPMENT PROSPECTS

It is possible to connect to the PLANet communication systems also other devices, following the Internet of Things (IoT) concept. At present in Europe there are conducted the normalisation works, on the basis of which the data transmission method used by the PLANet system will be in future an open platform for other IoT devices. This means that the PLANet system is an open system and may be further developed, also by connecting new luminaires coming from different producers.

MORE INFORMATION

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MODERNISATION OF STREET LIGHTING IN JASŁO

Sector: Energy efficient lighting

Timeframe: 2014

Location: Jasło, Poland


Photo: Jasło City Hall

PROJECT BACKGROUND

Municipality of Jasło (approx. 36 000 inhabitants) is located in the north-eastern part of Poland, in Podkarpackie Voivodeship. It is an active member of the Association of Municipalities Polish Network "Energie Cités", as well as the Covenant of Mayors signatory since August 2015. Within the Priority Programme "Green Investment Scheme (GIS) part 6: Owl - Energy efficient street lighting", operated by the National Fund for Environmental Protection and Water Management, it implemented a project entitled "Modernisation of street lighting on the area of the city of Jasło" which was completed in 2014.


Photo: Jasło City Hall

PROJECT DESCRIPTION

The main objective of the investment was to reduce energy consumption and CO_2 emission, thus contributing to the environmental protection and mitigation of greenhouse effect, which has negative influence on the world's climate. An important precondition for modernising street lighting within the OWL programme was that the municipality leased from PGE Dystrybucja SA light poles located on its area (the company, seated in Lublin, is the owner of the lighting infrastructure).

The modernisation project consisted in the replacement of 1495 of old luminaires (out of 3512 existing) with the new, energy efficient ones. Moreover, intelligent lighting control system was installed, as well as the power limiters. Thanks to the latter new lamps consume less electricity when the road traffic is lower. Old luminaires - mostly mercury lamps - had large capacity (over 250 W), were outworn and often failed. New sodium luminaires have considerably lower capacity: 70, 100 and 150 W. For the long time they will not need intervention from the repair services, which will also significantly reduce maintenance costs.

112 lighting circuits were modernised and each of them was equipped with a box with power limiters and an intelligent control and remote monitoring unit. The investment's scope included whole city area. Installation of intelligent control and remote monitoring system enables the supervision and maintenance services to monitor performance of the lighting system. Responsible staff immediately receives information on all failures, disturbances,


Photo: Jasło City Hall

power shut downs by the electricity provider and interventions from the maintenance staff, which enables quick reaction and immediate removal of the failures.

FINANCING SCHEME

The investment cost amounted to 2 876 982 PLN. Necessary financial resources came from the subsidy (1,3 M PLN) and the loan (1,5 M PLN) that the city received from the National Fund for Environmental Protection and Water Management within the Priority Programme OWL 2012-2015. Self-governments, who applied for funding, could receive cost reimbursement up to 45% of the investment's total eligible cost, as well as separate loan covering up to 55% of the investment's total cost. Conducted modernisation of street lighting resulted in municipality's lower expenses for electricity and for the maintenance of the lighting system.

PROJECT RESULTS

Modernisation of street lighting reduced electricity consumption by 40%. As a result, its operation costs decreased by nearly 700 000 PLN per year. Reduction of electricity consumption also contributed to the reduction of CO_2 emissions to the atmosphere by approx. 1200 Mg/year. The simple replacement of luminaires allowed already for the 30% reduction of installed capacity. Additionally, in consequence of the installation of power limiters, the power consumption is lowered during the night hours when the intensity of vehicle and pedestrian traffic is smaller. This results in 40% reduction of the demand for electricity from the grid and translates into the lower costs of is purchase. These costs not only take into account lower electricity consumption but also reduction of fixed charges. As a result, Jasło's expenditures were significantly lowered.

In 2015 CO_2 emission came to 1 233 tonnes, which is 51% of the emission level from before the modernisation. Since it was estimated to achieve 46% reduction, the effect is even higher than expected, which proves that the investment was well planned and implemented.


Programme for monitoring the parameters and exploitation proccess

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www.jaslo.pl/pl/news/1116-ton-co2-mniej-program-sowa-zako%C5%84czony

POLISH AND NORWEGIAN CITIES
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Educational & promotional campaign "Bielsko-Biała protects the Climate"

Sector: Educational & promotional campaign

Timeframe: 2011 – 2020

Location: Bielsko-Biała, Poland

Photo: Bielsko-Biala City Hall

PROJECT BACKGROUND

Bielsko-Biała has approx. 178 000 inhabitants and is located in the southern part of Poland, in the Silesian Voivodeship. In January 1994 the city joined the Association of Municipalities Polish Network "Energie Cités" as one of the first cities in Poland. It is still an active member of the network implementing many projects and actions aiming at sustainable energy development and climate protection. In January 2009 Bielsko-Biała signed the Covenant of Mayors and its representative participated in the first formal signature ceremony organised in Brussels, in the seat of the European Parliament. In 2010 Bielsko-Biała's City Council approved local Sustainable Energy Action Plan (SEAP), which was the first document of this kind adopted in Poland. The SEAP shows how the city plans to achieve its climate & energy targets set for the period 2010-2020. From the document it is clear that it is impossible to reach 3x20 goals without active engagement of different local stakeholders and without aid funds. Until now, the city has done a lot to improve its energy situation. It needs to be taken into consideration, however, that only 10% of all buildings located in Bielsko-Biała are in the hands of local authorities. Therefore, it was necessary to involve in this process as many citizens and local entities as possible.

PROJECT DESCRIPTION

In 2011 Bielsko-Biała was invited by the European Network "Energy Cities" to join the project entitled ENGAGE, which aimed at encouraging citizens and local stakeholders to play their part in building more sustainable energy future. The project was based on two main pillars: poster exhibition involving so called "Climate Ambassadors" and an open-air "Energy Days" event for the citizens. The poster exhibition was the main tool for influencing local society and comprised of 300 posters presenting silhouettes of Climate Ambassadors - over 1 000 citizens representing different social environments, institutions and families, who individually committed to undertake actions aiming at reducing energy


Photo: Bielsko-Biała City Hall

consumption and at using natural resources in a more reasonable way. The exhibition was used as a basis for the organisation of a dedicated event for the citizens called "Beskid Festival of Good Energy". Over 100 Climate Ambassadors engaged in this common event, helping to transfer knowledge about rational use of energy and other resources. Couple of thousands of people took part in the festive activities and 65 Climate Ambassadors agreed that the city will monitor the execution of their energy commitments.


Photo: Bielsko-Biała City Hall

Based on the outcomes of the ENGAGE project Bielsko-Biała launched long-term promotional & educational campaign, which received its own logo and name - "Bielsko-Biała protects the Climate". The campaign comprises of the three main elements: contests for children and teenagers called "Conserve energy and protect the Climate", cyclic meetings with institutions and businesses (over 60 different entities) aiming at promotion of local good practices and annual celebration for the citizens called "Beskid Festival of Good Energy". The event integrates the citizens around the idea of environmental & climate protection. There have been already five editions of the festival and as a result over half of the Bielsko-Biała's citizens heard about the energy conservation concept. The most valuable, however, is the cooperation with the educational community. 150 teachers coordinate campaign-related activities in their own educational centers. Thanks to their engagement


Photo: Bielsko-Biała City Hall

and permanent cooperation, thousands of children and their parents can be activated.

The benefits of the campaign are felt by more and more inhabitants of our city, who become convinced that it makes sense to use energy more reasonably as in this way they can spend less money on buying it. In the long term this will result in better air quality and improved health of the citizens.

FINANCING SCHEME

The campaign is financed from the municipal budget and supported with contributions from different local entities. It costs approx. 100 000 PLN per year. From time to time also funds from other funding sources (including Voivodeship Fund for Environmental Protection and Water Management, Operational Programme "Infrastructure & Environment", "Intelligent Energy Europe" programme, etc.) are used to finance specific elements of the campaign.

PROJECT RESULTS

It turned out that in 2011 Climate Ambassadors, who agreed to monitor their performance (65 people and institutions), saved over 7,6 million kWh of energy and nearly 4 million kg of CO_2. The value of so called "negawatts" could reach even 2-3 million PLN.


Photo: Bielsko-Biala City Hall

The monitoring procedure was different for institutional ambassadors (organisations and businesses) and for individual people. The citizens' performance was monitored on the basis of a special questionnaire designed by the municipal Energy Management Office and concerning their way of life and related carbon footprint. The questionnaire was developed on the basis of the on-line tool for calculating environmental footprint:
www.ziemianarozdrozu.pl/encyklopedia/50/moja-emisja-co2-kalkulator,
www.ziemianarozdrozu.pl/kalkulator, which was designed by Marcin Popkiewicz.

Individual Climate Ambassadors completed the questionnaire in 2011 and one year later. After entering their inputs into the special database, there were calculated energy and CO2 savings achieved for different types of energy and as a total. Data from institutional Climate Ambassadors, on the other hand, were gathered through individual contacts with people responsible for energy & environmental issues in participating companies and organisations. They concerned the same monitoring period. People and institutions, whose performance was monitored, constitute approx. 22% of all Climate Ambassadors.

Measurable results of the social campaign include also: 5 editions of the Beskid Festival of Good Energy, 300 posters presenting 1 000 citizens - Climate Ambassadors (that have already been publicly displayed 10 times), 150 teachers and 120 educational centres (kindergartens and schools) involved, 120 companies saving energy and 70 citizens trained in eco-driving.

In 2013 Bielsko-Biała received European Public Sector Award (EPSA 2013), which was granted for the "Bielsko-Biała protects the Climate" campaign. The competition aims at honouring these self-government projects, which are particularly well organised, efficient and consistent with self-governments' social mission. In this edition 230 project from 26 countries and European institutions were competing. What attracted jury's attention to the Bielsko-Biała's campaign was wide cooperation with local society, scale of activities and innovative approach.


Photo: Bielsko-Biala City Hall

Also the European Community of Natural Sciences Teachers awarded the "Bielsko-Biała protects the Climate" campaign. It received the main prize in the category of "Cooperation between the municipality and the educational community", which was handed in at the festival Best Project on Science on Stage in 2013.

Reports developed by the Voivodeship Environmental Protection Inspectorate in Katowice prove that the air quality in the city of Bielsko-Biała is slowly and systematically improving. It is especially visible in case of particulate matter PM 10, whose annual mean concentration is decreasing from year to year. "Bielsko-Biała protects the Climate" campaign is surely one of the contributors to this improvement.

MORE INFORMATION

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EURONET 50/50 MAX PROJECT – REDUCING ENERGY CONSUMPTION IN PUBLIC BUILDINGS THROUGH IMPLEMENTATION OF THE INNOVATIVE 50/50 METHODOLOGY

Sector: Energy education

Timeframe: 2013 – 2016

Location: 13 EU countries

Photo: M. Knapik-Lizak

PROJECT BACKGROUND

The 50/50 concept was created and used for the first time in Germany, in the 1990's. It actively involves public building users (originally school teachers and pupils) in the energy management process and teaches them environmentally friendly behaviours by practical action. Achieved financial savings are shared equally between the users and the local authority, which covers the building's energy bills. As a result everybody wins: building users (including teachers and pupils) get additional financial resources, local authorities reduce their energy costs and the local community gets cleaner local environment. Moreover, reducing energy consumption in public buildings involved in the scheme contributes to the achievement of local climate & energy goals.

The 50/50 concept was tested in different environments within the 1st edition of the EURONET 50/50 project, which was co-financed from the IEE programme and implemented in the period 2009-2012. Back then 50/50 methodology was introduced in over 50 schools from 9 European countries, who managed to achieve really impressive results. In total 6 900 pupils, teachers and other members of school staff launched cooperation for climate protection with their city halls. 40 schools managed to achieve energy and financial savings with the average savings per one school coming to 2 100 EUR. Altogether, the schools emitted 339 tonnes of CO_2 less to the atmosphere and saved over 1 100 MWh of energy! The EURONET 50/50 project also won the European Sustainable Energy Award 2013. Due to this huge and spectacular outcome it was decided to continue the project on a larger scale.

PROJECT DESCRIPTION

2nd edition of the project - EURONET 50/50 MAX - started in April 2013 and lasted till April 2016. It aimed at mobilizing energy savings by implementing the 50/50 methodology in 500 schools and nearly 50 other public buildings from 13 EU countries: Austria, Croatia, Cyprus, Czech Republic, Finland, Germany, Greece, Italy, Latvia, Lithuania, Poland, Slovenia and Spain. The methodology consists of 9 steps: setting up of the energy team, initial energy tour, raising building users' knowledge and awareness on climate & energy issues, extended energy tour, long-term temperature measurements and energy use assessment, proposing energy-saving solutions, development of information campaign, reporting measures requiring small investments and calculating and using the money saved. In Poland 139 schools and 9 other public buildings got involved in the project in cooperation with their city halls: Bielsko-Biała,

Bielawa, Bydgoszcz, Chorzele, Ciechanowiec, Cieszyn, Częstochowa, Dąbrowa Górnicza, Dębica, Dzierżoniów, Jasło, Józefów, Kościerzyna, Laszki, Lubin, Lublin, Miechów, Niepołomice, Nowa Dęba, Nowy Sącz, Pałecznica, Raciechowice, Spytkowice, Śrem, Warszawa and Wilkowice.


Photo: P. Zieliński

Within the project framework the energy teams created in schools were equipped with so called e-packs, including measuring devices - digital thermometer, luxmeter and energy meter. Using this equipment the team members were checking temperature and light brightness in different rooms during their watch. From the guidelines they knew what should be the optimum temperatures in classrooms, bathrooms, changing rooms and at the corridors. After in-depth analysis of the energy situation of their school and pinpointing all the places and processes where energy is wasted, the pupils looked for possible energy-saving solutions and monitored their implementation. Energy teams also shared their findings with the whole school community and taught their colleagues good, energy efficient behaviours. This precious knowledge is transferred also to pupils' homes. After the full year of 50/50 activities it is possible to calculate the savings. In order to learn how much money and energy have been saved, it is necessary to collect data from invoices issued for the reference years (3 years back in case of heating and 1 year back in case of electricity) and for the 50/50 implementation year. To reduce impact of weather conditions it is also necessary to take into consideration heating degree days for this period. After gathering the data, the municipal coordinator (municipal employee responsible for the project) enters them into the special on-line programme and receives a report on energy and financial savings achieved. Half of the savings is then paid back to the school (or other public building participating in the 50/50 scheme). A very important aspect of the EURONET 50/50 MAX project is engaging energy teams in taking decision on the use of the money received. In some schools they have been used to fund small investments further improving energy efficiency of the building (e.g. installation of thermostatic valves at the radiators), while in others to purchase additional equipment for classrooms (e.g. multimedia boards, projectors, laptops).

In order to facilitate municipal and school coordinators' work, the consortium of the EURONET 50/50 MAX project created special on-line calculation tool, which helps to calculate how much money and energy each building has saved and how much CO_2 less has been emitted to the atmosphere as a result of the undertaken actions. They also created special Facebook profile enabling exchange of experience between schools and other buildings involved in the project. Here they can share their opinions and ideas for energy saving, as well as display pictures from project activities or posters prepared by pupils. Moreover, a set of new brochures, guidebooks, articles and information material was developed for all those that might be interested in implementation of the 50/50 methodology in their municipality or school. In order to

Photo: J. Płazak

award pupils for their energy-saving efforts, each year 50/50 festivals took place in selected municipalities. After the 1st year of the 50/50 implementation such event was organised in Dąbrowa Górnicza (29th of May 2015), gathering over 200 pupils and 30 teachers from 28 schools. Next year the event took place on the 15th of April in Częstochowa and gathered over 160 pupils and 20 teachers from 12 schools.

FINANCING SCHEME

The project was co-financed by the European Commission within the Intelligent Energy Europe (IEE) programme. The co-financing rate was 75% of the project cost.

PROJECT RESULTS

It was already the 1st year of 50/50 implementation at schools that proved that the energy saving pays off. The calculations made show that most of the schools managed to save electricity, heat or both of these energy sources. Out of 136 Polish schools, for which the calculations were finalized, in 2014 83 (i.e. 61%) achieved total savings. Together they managed to save 2 665 186 kWh of energy (with the average of 32 110,67 kWh per school), which gives financial savings amounting to 623 482,86 PLN (with the average of 7 511,84 PLN per school). As a result 848,14 tonnes of CO_2 less were emitted to the atmosphere.


Photo: M. Najdek

Another unquestionable success of the EURONET 50/50 MAX project is the popularization of the 50/50 methodology among Polish local self-governments. Over 90 schools from 4 voivodeships (podkarpackie, pomorskie, śląskie and małopolskie) have recently joined the 50/50 Network gathering energy saving institutions. Part of them has already been provided with necessary measuring equipment and guidebooks on 50/50 implementation, as well as took part in the trainings organised within mini-projects co-financed by relevant Voivodeship Funds for Environmental Protection and Water Management.

Soon, another group of schools will start their adventure with energy saving.


Photo: A. Jaskuła

MORE INFORMATION

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STRØMSØ, DRAMMEN
CLIMATE-FRIENDLY CITY DEVELOPMENT

Sector: Community energy project

Timeframe: 2009 – 2020

Location: Strømsø, Drammen, Norway

PROJECT BACKGROUND

Strømsø is centrally located on the south side of the Drammen river. The area is about 340 acres with about 220,000 m^2 of buildings. The potential for increased density is calculated to be about 200,000 m^2. Central part of Strømsø is dominated by offices and small retail facilities, and it is home to about 1800 people. There is a relatively high rate of movement of people in and out of the area, and the population is culturally very mixed. The area has many small and some large property owners, and the businesses are poorly coordinated. Drammen's train station, which is the fourth busiest in the country, and the local and regional bus hub is located nearby.

PROJECT DESCRIPTION

Strømsø will be developed into a low carbon neighbourhood with both businesses and residences.

The municipality has in cooperation with local energy suppliers conducted a feasibility study for a future-oriented energy system, including technical possibilities and limitations on how to reduce greenhouse gas emissions from the energy system. A three-year pilot scheme was launched in 2013 to advice on the rehabilitation and energy-efficiency improvements of existing buildings. For a number of buildings using different materials that are typical for Strømsø and Drammen, a brief building assessment and proposed rehabilitation measures were introduced.

Street parking is widely eliminated and measures are planned to ease access for buses, pedestrians and bicyclists. A new common parking house is built with concrete produced with low CO2-emission cement, energy saving LED lighting, green roof and charging facilities for electric cars. In 2013 a safe "bicycle hotel" with 250 places and charging facilities were opened at the train station.

A cultural historic site analysis, which includes the mapping of cultural monuments as a spatial resource for development, was completed in Strømsø in 2013. The analysis provides a knowledge base in connection with the further development of the area.

As part of adaptation to climate change, a flood strategy is developed, including the nearby river.

PROJECT RESULTS

In April 2012 the city council adopted objectives for the further development of the area. Through the planning process, and cooperation with

stakeholders, the objectives are now turned into results, i.e.

- Potential for increased density of about 150,000 m^2 business
- 300 to 500 new homes
- Numerous example projects
- High architectural and environmental quality
- Increased energy-efficiency of the existing building stock
- Development of working practices that contribute to the involvement of property owners, residents and other groups who use Strømsø in the planning process
- Knowledge sharing, viewing and profiling

MORE INFORMATION

Association of Norwegian Architects:
www.arkitektur.no/stromso-climate-friendly-city-development-in-drammen?lcid=1033&coty=3308aadd-567d-4c99-a45b-babec9e65005

POLISH AND NORWEGIAN CITIES
together for climate and energy

BRØSET, TRONDHEIM
A NEW ECO-FRIENDLY WAY OF LIVING

Sector: Community energy projects

Timeframe: 2009 – 2020

Location: Trondheim, Norway

PROJECT BACKGROUND

Brøset, four kilometres outside Trondheim City Centre, is a former agriculture and hospital area. Its location and topography makes the area a valuable resource for urban development, in accordance with the municipality's densification policies. The city wanted a forward-looking district where an environmentally friendly lifestyle is encouraged.

PROJECT DESCRIPTION

A new urban district for about 4000 people (approx. 1800 dwellings) is being developed. The area will also have three kindergartens, an elementary school and a health and welfare centre. The land use plan, adopted in 2013, is based on a parallel commission, where four interdisciplinary teams presented their visions. The results from the parallel commission are among Norway's most interesting examples of how new sustainable districts can be planned and developed.

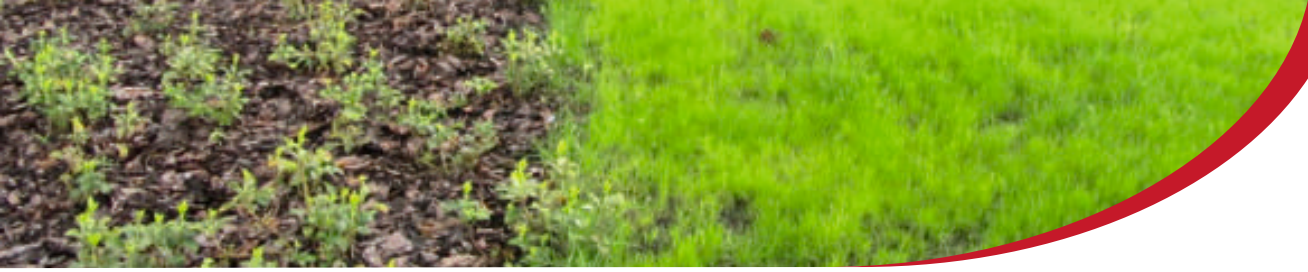
Each resident will be responsible for a maximum of three tonnes of CO_2 emissions per year. The average today is between eight and eleven tonnes. To ensure this, the plan makes the functions needed in daily life available without use of cars. This implies relatively high utilization in residential areas, though with extensive public green structures. Green corridors and a central park are both important for recreation and floodwater treatment. The transport system gives priority to pedestrians, cyclists and public transport, rather than private cars. With twice as many dwellings as parking spaces, the parking coverage is about 1/3 of the current norm in Trondheim.

Planned waste system incudes individual measuring and prizing, stimulating to more sorting and less waste. Local recycling and reuse workshops will be established.

Life cycle analysis regarding CO_2 emissions will be required for all buildings, including production of materials, construction, operation, maintenance, demolition and waste management.

Prerequisites for detailed planning imply a climate neutral district, energy consumption lower than specified in national technical regulations, and extensive use of energy from renewable sources. Sum of stationary energy use shall annually be equal to the supply from local renewable energy sources, including sun and geothermal energy.

Local storm water management will be in open systems. In addition, a high proportion of green surfaces will infiltrate and delay water from heavy rain, reducing future expected flood problems.



PROJECT RESULTS

The area is not yet developed, but the land use plan implies:

- Passive energy standard for all new buildings, and energy performance certification standard A (dark green)
- Maximum three tonnes of CO_2 emissions per resident per year
- Environmentally friendly lifestyle
- Designing for pedestrians, bicyclists and public transportation
- Efficient adaption to climate change

In addition to being useful for the Brøset area and Trondheim municipality, the ideas from the four parallel commissions have inspired planners and developers all over the country.

MORE INFORMATION

Ministry of the Environment, Cities of the Future (2009):
www.regjeringen.no/en/topics/municipalities-and-regions/by--og-stedsutvikling/framtidensbyer/the-participating-cities-/trondheim/a-new-city-of-the-future/id548223

Association of Norwegian Architects:
www.arkitektur.no/buildings-of-the-future

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