

### 1.1.8 Thermal solar plants - Koscierzyna (PL)

The municipality of **Kościerzyna** is located in the northern part of Poland, in the Pomerania region, and has nearly 24.000 inhabitants. On the 23<sup>rd</sup> of March 2011, on the basis of the *Resolution of the Municipal Council n° VII/38/11*, the municipality joined the ambitious Covenant of Mayors initiative which gathers cities and municipalities voluntarily committing to increase energy efficiency and use of renewable energy sources on their territories. As a Covenant signatory Kościerzyna is undertaking efforts to reduce its CO<sub>2</sub> emissions by at least 20% by 2020 (in comparison with the baseline year which is 2000).



**Figure 6 Municipality of Kościerzyna**

The municipality of Kościerzyna joined the **Covenant of Mayors** to demonstrate its commitment towards reaching EU climate & energy targets and to improve local energy and environmental situation. Since many years local authorities have been struggling with the problem of poor air quality at the territory of the municipality, which is a result of low emission of pollutants from individual boiler houses. Often, the local boilers are fired with low-quality fossil fuels and have reduced efficiency. As a result of exceeding acceptable concentration of suspended particles (PM<sub>10</sub>) Kościerzyna was classified to one of four zones with the highest air pollution in the Pomeranian Voivodeship and was covered with the Air Protection Programme (on the basis of the *Resolution of the Pomeranian Voivodeship Parliament n° 833/XXXV/09*).

„Business as usual” scenario developed during preparation of the *Sustainable Energy Action Plan for Kościerzyna (SEAP)* proved that if the municipality will not undertake CO<sub>2</sub> reduction measures, the emission of CO<sub>2</sub> will increase by 3,15% by 2020 in comparison with the baseline year (2000). It was also calculated that - in order to improve local energy situation and to fulfill Covenant of Mayors requirements - the municipality has to reduce its emissions by **35.606,86 Mg CO<sub>2</sub>/year** in order to achieve the target level of **123.053,60 Mg CO<sub>2</sub>** in 2020. Fulfilling this commitment will be only possible by undertaking appropriate actions and measures aiming at increasing energy efficiency and RES use, including solar energy use.

Therefore, one of the actions envisaged in the Kościerzyna's *Sustainable Energy Action Plan (SEAP)* is the use of **solar thermal collectors for the production of warm usable water**. It is worth highlighting that the area, where the municipality of Kościerzyna is located, is one of the most insolated regions of Poland, so the conditions for the development of solar installations are very good.

The aim of the project "**Solar Kościerzyna - building solar installations as an opportunity for permanent improvement of air quality by using renewable energy sources**" is to improve the quality of local environment and to reduce ecological threats resulting from the use of conventional energy sources. The project envisages **construction of 125 solar installations that will be used for the production of warm usable water in residential buildings located within the boundaries of Kościerzyna**. The project will be implemented in the period from **December 2013 to December 2014**. Installation of solar thermal collectors will contribute to the reduction of fossil fuels consumption, reduction of gaseous emissions and particulate emissions and - as a result - to the improvement of natural environment on the local and regional level.

#### **Technical aspects**

Implementation of the project includes purchase and installation of **125 sets of solar thermal collectors** which will be used for the production of warm usable water in residential buildings at the area of Kościerzyna municipality. It is planned that one set for a family of four will include:

- a set of two heat pipe solar collectors connected in series, with the total absorber surface area of 3,2 m<sup>2</sup>;
- support constructions;
- vertical hot water tank;
- 400 l double-coil water heater made of steel, insulated with polyurethane foam, protected from corrosion by enamel and magnesium anode, equipped with a 2 kW electric heating element;
- 18 mm copper pipes soldered with hard solder and insulated with a 20 mm insulation;
- 18 l diaphragm expansion vessel.

#### **Environmental aspects**

Installation of 125 sets of solar thermal collectors on residential buildings of Kościerzyna municipality will contribute to the reduction of the consumption of conventional energy sources and thus to the improvement of air quality on the local and regional level. Implementation of the project will support Kościerzyna's efforts to reduce CO<sub>2</sub> emissions by at least 20% by 2020. It was estimated that the project will result in the reduction of SO<sub>2</sub> emissions by 0,37 Mg/year, reduction of NO<sub>x</sub> emissions by 38,77 kg/year, **reduction of CO<sub>2</sub>**

**emissions by 77,5 Mg/year**, reduction of CO emissions by 1,74 Mg/year and reductions of suspended particulates emission by 0,78 Mg/year. The production of clean energy will increase by 575 GJ/year and the average annual savings on energy bills of all residential buildings participating in the project will reach 27 125 PLN (approximately 6.800 €).

The assessment showed that no negative impact on the environment will occur neither during the project implementation, nor during the utilization of solar thermal collectors. The devices do not emit any pollutants to the atmosphere and their operation isn't connected with the noise emission. Moreover, the installation of solar collectors will not cause significant changes in the local landscape.

### **Financial aspects**

The project will be financed from **three main sources**:

- co-financing from the Regional Operational Programme for Pomeranian Voivodeship for the years 2007-2013;
- own funds of the municipality of Kościerzyna;
- own funds of the Association "Solar Kościerzyna", which is a project partner.

The co-financing from the Regional Operational Programme for Pomeranian Voivodeship for the years 2007-2013 comes to 1.504.125,00 PLN (approximately 376.000 €), which is 75% of the total investment cost amounting to 2.200.500 PLN (approximately 550.125 €). Remaining part of the costs will be covered from the own funds of the Kościerzyna municipality and the Association „Solar Kościerzyna”, which is a project partner. The value of the single set of solar thermal collectors comes to 15.000 PLN (approximately 3.750 €). The detailed breakdown of costs of purchase and installation of a single solar set for a family of four may be found below:

- Co-financing rate: 75% of the total value of the solar installation: 11.250 PLN (approximately 2.800 €);
- Household's own contribution: 25% of the total value of the solar installation: 3.750 PLN (approximately 950 €);
- Installation cost: 1.560 PLN (approximately 390 €);
- Total value of own contribution: 5 310 PLN (approximately 1.300 €).

Within the framework of the financial analysis of the project the financial net present value of the investment (FNPV/C), which is the sum of discounted net cashflows generated by the enterprise was also calculated. FNPV/C was calculated on the assumption that the discount rate is 5%.



FNPV/C (Financial net present value of the investment)	FRR/C (Financial rate of return on investment)	FB/C ratio <sup>1</sup> (Financial Benefit Cost Ratio)
-1.799.869 PLN (approximately 450.000 €)	-7%	0,17

Financial net present value of the investment (FNPV/C) and financial rate of return on investment (FRR/C) are negative which confirms the necessity of co-financing the project.

### **Socio-economic aspects**

The positive aspect of the implementation of the action will be the **reduction of costs of health care resulting from the improvement of the quality of life of the citizens**. Moreover, reduction of the consumption of conventional energy sources will significantly contribute to the improvement of local environment, which will be directly connected with the liquidation of low emissions. The improvement of the air quality will be noticeable both on the local and regional level. It was estimated that the annual measurable social benefits resulting from the improvement of health of the citizens will come to 73.122 PLN (approximately 18.280 €).

Implementation of the project will also directly influence the development of local entrepreneurship. Estimated net profit of the construction companies will come to 107 341 PLN (approximately 26 840 €) - 6% of the investment value.

ENPV/C (Economic net present value of the investment)	ERR/C (Economic rate of return on investment)	EB/C ratio (Economic Benefit Cost Ratio) <sup>2</sup>
1.121.380 PLN (approximately 280.350 €)	13,97%	1,46

Economic net present value is positive, which means that the present value of cash inflows resulting from the project implementation dominates over the present value of cash outflows. Economic internal rate of return on investment and the EB/C ratio defining relation between socio-economic benefits and costs are also positive, which means that from the socio-economic point of view the project is efficient.

### **Organisational aspects**

The action will be implemented together by the municipality of Kościerzyna and the Association „Solar Kościerzyna”, which is a project partner and whose members have significant experience in the realisation of similar projects. The municipality of Kościerzyna will provide a free-of-charge technical, engineering and ICT support. Directly responsible for the

<sup>1</sup> the ratio of the total present value of financial benefits obtained during the service life of the project to the total present value of the financial costs.

<sup>2</sup> EB/C ratio = the ratio of the total present value of economic benefits obtained during the service life of the project to the total present value of the economic costs.

appropriate implementation of the action will be the **Project Implementation Team** consisting of the employees of the city administration and the members of the Association „Solar Kościerzyna”, who can pride themselves on high qualifications and significant experience in different lines of business. The Project Implementation Team will be responsible inter alia for the direct supervision over the project, as well as for monitoring and evaluation of its implementation. The project envisages also the investor’s supervision. The contractor responsible for the installation of the solar sets on residential buildings will be selected in a tendering procedure. The open tender will be announced in the period April-May 2014.



**Figure 7 Municipality of Kościerzyna - meeting**

Additional support for the municipality of Kościerzyna was an opportunity to exchange experience and best practices with the municipality of **Padul - Spanish twinning partner**. During the study visit organized in July 2013 both municipalities signed the Memorandum of Cooperation committing to undertake common actions for environmental and climate protection. Moreover, representatives of Kościerzyna municipality had an opportunity to get familiar with the solar projects implemented not only in Padul (Figure 8), but also in other municipalities of the Province of Granada. They learned about the technical parameters of the installations, legal procedures, financing schemes, economic aspects, influence of the projects on local environment, socio-economic benefits and costs of installation of solar systems, main problems encountered on different stages of projects’ implementation (preparatory phase, installation phase, operation period, utilization of the devices after the operation period, etc.). The know-how transfer from the municipality of Padul was also ensured by releasing technical documentation of selected installations.



**Figure 8 Solar collectors for sports facility in Padul**

To sum up, implementation of the project entitled „Solar Kościerzyna - building solar installations as an opportunity for permanent improvement of air quality by using renewable energy sources” will directly contribute to increasing the number of modern, environmentally friendly RES installations located at the area of the municipality and thus to fulfilling municipality’s commitments undertaken by signing the Covenant of Mayors. Use of solar thermal collectors for the production of warm usable water in Kościerzyna’s residential buildings will help the municipality to draw on unlimited solar energy resources in an environmentally friendly way.

Table 8 below summarises the results of the technical, financial, socio-economic and organisational analysis of the action entitled “Solar Kościerzyna - building solar installations as an opportunity for permanent improvement of air quality by using renewable energy sources”.

**Table 7 Summary of the findings of the assessment study of the action “Solar Kościerzyna - building solar installations as an opportunity for permanent improvement of air quality by using renewable energy sources”**

<b>Technical/ Environmental Assessment</b>	<b>Title</b>	Solar Kościerzyna - building solar installations as an opportunity for permanent improvement of air quality by using renewable energy sources
	<b>Baseline scenario data (kWh, tCO<sub>2</sub>)</b>	15.590,00 MWh/year 18.567,69 tCO <sub>2</sub>
	<b>Technology employed</b>	Heat pipe solar thermal collectors
	<b>Technical specifications</b>	125 solar sets consisting of double heat pipe solar collectors with the absorber surface of 3,2 m <sup>2</sup> ; 400 l double-coil heater with a 2 kW electric heating element; 18 mm copper pipes insulated with a 20 mm insulation, 18 l diaphragm expansion vessel; pump control unit; heating medium - propylene glycol solution with a freezing point of - 30°C
	<b>Energy savings</b>	N/A



	<b>CO<sub>2</sub> savings</b>	77,5 t CO <sub>2</sub> /year
<b>Financial assessment</b>	<b>Financing scheme</b>	<ul style="list-style-type: none"> <li>• Regional Operational Programme for Pomeranian Voivodeship for the years 2007-2013</li> <li>• Own funds of the municipality of Kościerzyna</li> <li>• Own funds of the Association "Solar Kościerzyna" (project partner)</li> </ul>
	<b>Project reference period</b>	20 years
	<b>Project cost</b>	2.200.500 PLN (approximately 550.125 €)
	<b>Annual project revenues</b>	0
	<b>Discount rate</b>	5%
	<b>FRR/C</b>	- 7%
	<b>FNPV/C</b>	- 1 799 869 PLN (approximately - 450 000 €)
	<b>FRR/K</b>	- 0,1 %
	<b>FNPV/K</b>	- 256.995 PLN (approximately - 64 250 €)
	<b>Socio-economic assessment</b>	<b>Annual socio-economic benefits</b>
<b>Discount rate</b>		5,5%
<b>ERR/C</b>		13,97%
<b>ENPV/C</b>		1.121.380 PLN (approximately 280 350 €)
<b>Organisational assessment</b>	<b>Time schedule</b>	7/2013 - 7/2014