OLSZTYN ECONOMIC JOURNAL
Abbrev.: Olszt. Econ. J., 2012, 7(2)

ECONOMICS OF ENERGY MANAGEMENT IN A COMMUNE – CHOSEN ASPECTS

Waldemar Kozłowski

Department of Spatial and Environmental Economics
University of Warmia and Mazury in Olsztyn

K e y w o r d s: energy sector, municipal management, ESCO model.

A b s t r a c t

Conditions of energy sector development correlated with shrinking resources of the conventional energy sources, increased importance of environmental policy as well as continual price increases cause that the territorial governments should, within the scope of their competences and abilities, rationalise energy consumption and costs. This paper presents the tools for energy sector rationalisation in a commune with consideration of the opportunities for optimisation of energy consumption costs within municipal resources by applying the ESCO model. The paper also draws attention to the possibility of utilising the resources of renewable energy sources by communal governments based on the example of wind energy, of which Warmia and Mazury has some of the largest resources in Poland.

EKONOMIKA GOSPODARKI ENERGETYKĄ W GMINIE – WYBRANE ASPEKTY

Waldemar Kozłowski

Katedra Ekonomiki Przestrzennej i Środowiskowej
Uniwersytet Warmińsko-Mazurski w Olsztynie

S ł o w a k l u c z o w e: energetyka, gospodarka komunalna, model ESCO.

A b s t r a k t

Uwarunkowania rozwoju sektora energetycznego związane z kurczeniem się źródeł konwencjonalnych pozyskania energii, wzrostem znaczenia polityki ekologicznej oraz stały wzrost cen powodują, że samorządy gminne w zakresie swoich kompetencji i możliwości powinny starać się racjonalizować zużycie i koszty energii. W artykule przedstawiono narzędzia optymalizacji sektora energetycznego w ramach posiadanych przez gminę kompetencji, z uwzględnieniem możliwości optymalizacji zużycia energii w zasobach komunalnych przez zastosowanie modelu ESCO. Zwrócono również uwagę na możliwość wykorzystania przez samorządy gminne zasobów energii odnawialnej na przykładzie energii wiatru, której zasób na terenie Warmii i Mazur należy do jednych z największych w Polsce.

Introduction

In all countries of the world, the energy sector represents the basis of modern industry and economy; it is among the most important conditions for appropriate and comfortable functioning of society. The status of energy systems determines the energy security of states, regions and communes (PASIERB 2003, p. 78–92). Effectiveness of energy systems is based mainly on optimisation of the production and distribution processes, development of low prices, network availability and the reliability of the systems, which has a significant influence on the development of the other sectors of the economy and, above all, industry. The volumes of energy produced in the EU countries and Poland are presented in Table 1.

Table 1

Energy production in the EU and Poland

Year	Power production in the EU-27 (in billion kWh)	Dynamics in %)	Power production in Poland (in milliard kWh)	Dynamics in %)	Share of Poland's energy production in the EU-27 energy production (in %)
2007	3.19	100	139.1	100	4.36
2008	3.20	+ 0.3	140.4	+ 0.9	4.38
2009	3.03	– 5.7	133.8	– 4.7	4.42
2010	2.98	– 1.6	128.7	– 3.8	4.32

Source: Eurostat – An energy policy for Europe 2010.

For the past 3 years, a decrease in energy consumption has been recorded. Poland, as a member of the European Community, is implementing the common energy policy whose major assumptions are regulated in the documents and directives on energy efficiency[1]. The fundamental assumptions of the energy policy are presented in figure 1.

In Poland, the European legislation resulted in approval by the Council of Ministers of a document concerning the *Energy policy of Poland until 2030*[2], which assumes actions aiming at assuring energy security as well as environ-

[1] The fundamental documents determining the EU energy policy are: White Paper "Energy for the future: Renewable sources of energy" of November 1997, Directive 2001/77/EC on the promotion of electricity produced from renewable energy sources in the internal electricity market, Directive 2006/32/EC on energy end – use efficiency and energy services, EU energy policyof 10 January 2007 in which the European Commission presents the package of measures in the field of energy and climate change, the Kyoto Protocol of 1998 in which countries committed themselves to decrease emissions of greenhouse gases.

[2] Energy policy of Poland until 2030 – Resolution by the Council of Ministers No. 202/2009.

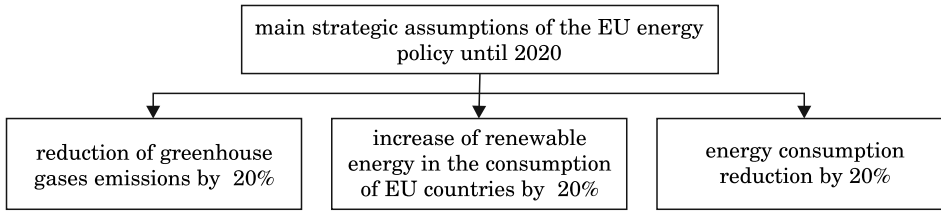


Fig. 1. Major assumptions of the EU energy policy until 2020
Source: European Parliament resolution of 26 September 2007 on a common European foreign policy on energy, http: europarl.europa.eu/meetdocs 2007.

mental protection. The document specifies priorities such as aiming at substituting heat plants supplying the heating systems of Polish towns with cogeneration sources, development of the national transmission system allowing reliable power transmissions, including closing the 400 kV loop and the power loops around the major towns of Poland, which is to improve the reliability of supply in those agglomerations as well as receiving energy from newly-established sources with particular consideration for wind power plants. Implementation of agricultural biogas production plant construction assuming creating, on average, one biogas plant in every commune by 2020 as well as the development of renewable energy from waste containing biodegradable materials, e.g. municipal waste, is projected.

The **Act on Energy law (**Dz.U. of 2006 No. 89, item 625) is the fundamental legal document influencing the energy market development and functioning energy sector enterprises in Poland. The Act aims at creating conditions for sustainable development of the country, assuring energy security, economic and rational use of fuels and energy, development of competition and preventing the formation of monopolistic structures. The regulation system created by the provisions of the Act has contributed, among others, to the gradual organisation of a system for recording and calculating the costs for every type of activity and for identification of the groups of consumers. The necessity of improving the energy management strategies at the commune level represents a research problem. The **aim of the paper** is to present a model of energy management in the commune as an important element determining the local energy security, as well as contributing to local development. The monographic method was the basic **research method employed**.

Energy sector organisation and management in the Commune

The Act on Changes to the Competences of Public Administration Bodies, as a consequence of the systemic reform of the state enacted by the Parliament on the 24th of July 1998 (Dz.U. No. 106, item 668),introduced amendments to the **Energy** Act that provided the territorial governments of communes (towns) the right, and imposed on them the duty, of formulating the energy policy assumptions for the area covered by the jurisdiction of such governments.

The commune is a sovereign entity to the extent defined by the law and its authorities are responsible for formulating the collective needs and expressing the interests of the community residing within its area. Fulfilment of the duties by the commune is represented, among others, by drafting the assumptions for the plan of demand for energy carriers. Such a document should contain information necessary for conducting an active energy policy, for which the boundary conditions are determined by the energy policy of the state, by the commune.

An active position of the regional authorities by means of, *inter alia*, drafting the energy sector strategy at the voivodship, county or commune level represents an important component supporting implementation of the European Union energy policy. For the purpose of appropriate planning of investments, including energy infrastructure development and new sources, it is necessary to prepare coherent investment plans at the level of communes and energy sector enterprises. The discussed document highlights that the communes must make the effort to draft plans and implement them for at least two reasons: due to the necessity to protect the environment and the possibility of obtaining EU and other public funds for related purposes. Communes, according to the energy policy assumptions, should implement a number of tasks concerning the energy sector as presented in Figure 2.

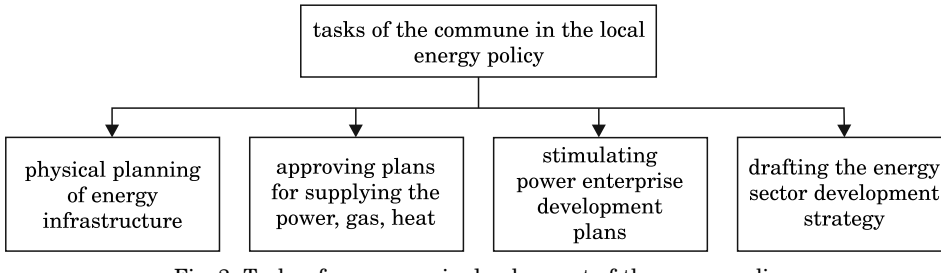


Fig. 2. Tasks of communes in development of the energy policy
Source: own work based on the Act – Energy law (Dz.U. of 2006 No. 89).

Construction and operation of energy infrastructure requires careful planning, which is a consequence of high investment costs and the requirement of satisfying numerous legal requirements governing such activities. The Energy Act (Dz.U. of 2006 No. 89) is the fundamental legal act regulating the energy sector. Communal authorities formulate the energy policy forthe purpose for implementing investment projects as well as the expectations concerning the future supply structure of the individual energy types and the transmission or distribution network which offers the consumer the freedom of choice of energy type or energy carrier used within the competitive market. The energy management developed by the commune will influence the entire functioning of the local community.

The commune energy supply plans covering power, heat and gaseous fuels represent the fundamental task in the area of planning the energy management development at the local level. Drafting the energy supply plan in practical terms is frequently neglected as a consequence of lack of control of the commune concerning the individual system entities, activities of the national regulator, i.e. the **Energy Regulatory Office** as well as the diversity of administrative-legal structures operating within the system. The possibility of developing the energy sector administration in the commune based on rational energy use and utilisation of the local energy resources are the main outcomes of drafting such plans. Managing the energy sector in the commune should be based on 4 pillars representing the following areas: the energy policy of the commune, energy sector principles, energy sector infrastructure and organisational-financial forms as represented in figure 3.

The energy policy of the commune is based on the fundamental guidelines concerning the energy sector development contained in the European Union energy policy, domestic policy as well as the legal acts on the basis of which the plans for supplies with fuels, power, heat and gas are drafted. Drafting the plan of resource use concerning the renewable energy sources and elaboration of the investment policy represent important issues.

Communal energy resourcesrefer to the available as well as unidentified resources with particular focus on renewable energy sources. According to the adopted EU energy policy, high importance is currently attributed to the renewable energy sources that are frequently available to the communes. The basic ones include resources of wind energy, hydro energy, geothermal energy and biomass.

Energy infrastructure refers to the energy sector enterprises operating within a given area as well as the length and density of the energy networks. The infrastructure saturation of the commune allows more effective energy management by establishing strong systems.

Administrative-legal formsin the energy sector are usually represented by capital companies in the power sector and the heat sector. The commune

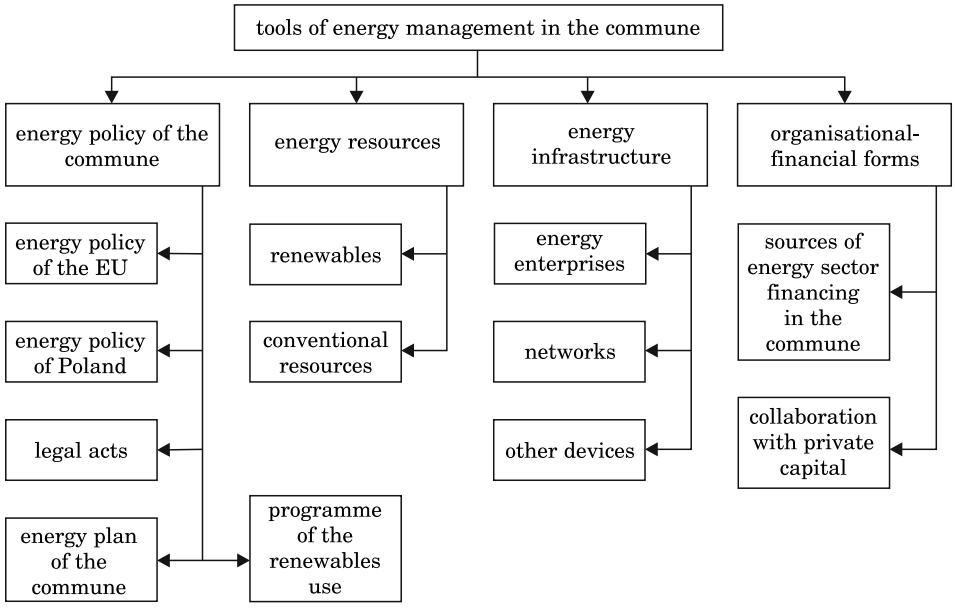


Fig. 3. Tools of energy management in the commune

Source: own work.

Table 2

Indicators characterising the local energy system

Indicator	Measure
Energy consumption structure	Share of the individual energy sources in the total energy consumption structure in %
Energy consumption in the commune	Energy consumption per resident
Energy consumption per capita	kWh/year GJ/year
Energy consumption by economic entity	kWh/year GJ/year
Average unit price of: – electricity, – heat.	 PLN/kWh PLN/GJ
Energy intensity of local economy	KWh/PLN
Air pollution emissions from energy generated	kg/kWh

Source: own work.

usually has the largest potential in ownership and management of heat energy sector companies while it has no influence on the power sector, where private companies dominate. Privatisation of the sector is the dominating market trend.

The energy system of a given commune may be characterised using qualitative and quantitative indicators, thanks to which it is possible to plan changes and evaluate them over time. The selected energy system indicators are presented in Table 2.

Commune energy resource management is based on using a number of instruments of a financial and administrative nature. The choice of individual components is presented in Fig. 5.

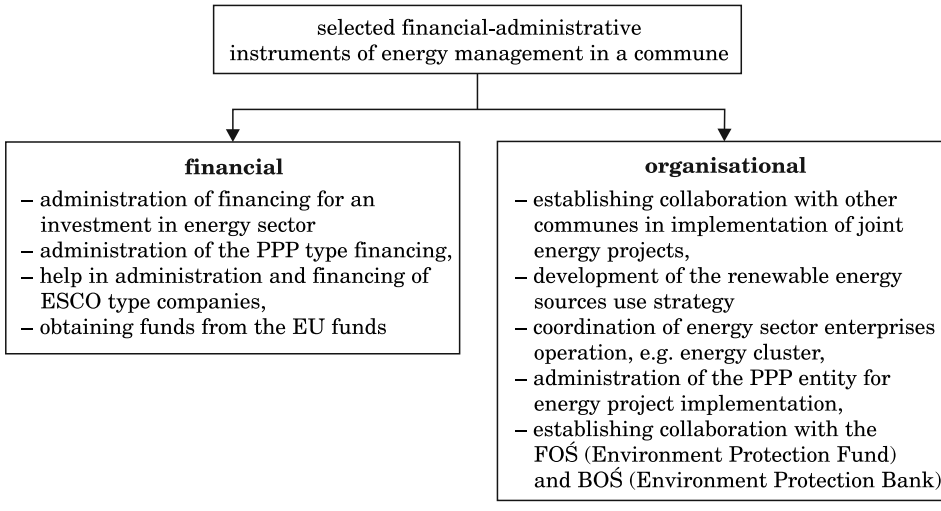


Fig. 5. Energy management instruments

Source: own work.

In addition to drafting the documents resulting from the national documents or European directives, the commune should support measures in the financial-administrative field by obtaining funds as well as creating structures allowing effective use of them. The capital intensity of investments in the energy sector requires the communal governments to search for partners for joint projects from both the territorial government field, such as the neighbouring commune, and from the private sector – offering collaboration according to the public-private partnership formula.

ESCO model in rationalisation of energy consumption in the commune

The abbreviation „**ESCO**" (Energy Service Company) represents a company offering comprehensive expert services in the energy sector through warrants to potential clients for saving energy and decreasing energy costs.

The contract made is an "outcome contract" which covers obtaining the energy outcome or another parameter specified in the contract. ESCO operation is treated more as a service activity, where all the modernisations implemented are treated as means for obtaining energy savings.

The ESCO invests its funds in the client's assets by implementation of the measures related to decreasing the consumption or/and costs of energy production. This activity is supported by energy audits encompassing the analysis optimising the recommended technical measures for energy consumption limitation. After conducting the modernisation works, the actual energy costs for the client are decreased as compared to the situation preceding the modernisation. The client, on the other hand, agrees to pay for the energy at an unchanged level for a specified period of time. This period is referred to as the outlay return period. Its length depends on the technical-economic parameters of the individual projects and, in particular, the relation between the outlays incurred and the savings obtained. The model for ESCO-type project implementation is presented in figure 6.

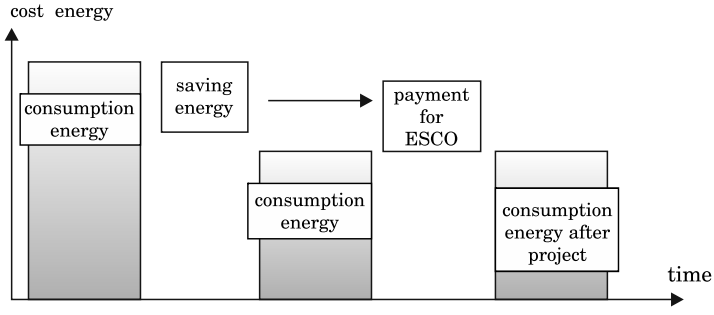


Fig. 6. ESCO model
Source: own work based on JANKOWSKI (2008, pp. 37–39).

The fact that the savings generated as a result of the project implementation, as compared to the baseline from before the modernisation, will be paying off the outcomes incurred during a specified period of time, is a characteristic of financing according to the ESCO formula. Thanks to that, the client does not bear any costs related to the project at the beginning of project implementation and has the certainty that after completion of the modernisation works, the sum of payments for the energy and payoff of the investment outlays will not exceed the level from before the modernisation. An example here is the operation of the ESCO established by the MPEC (Municipal Heating Company) in Kraków[3].

[3] The Energy Saving Company ESCO LLC (POE ESCO) was established in April 2000. The MPEC S.A. in Kraków is the sole owner of the ESCO, www.esco.krakow.pl

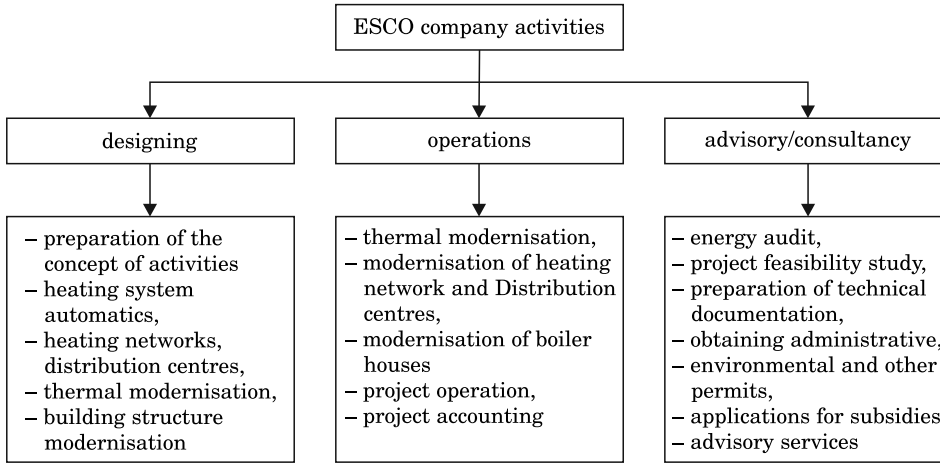


Fig. 7. ESCO company scope of activities

Source: own work.

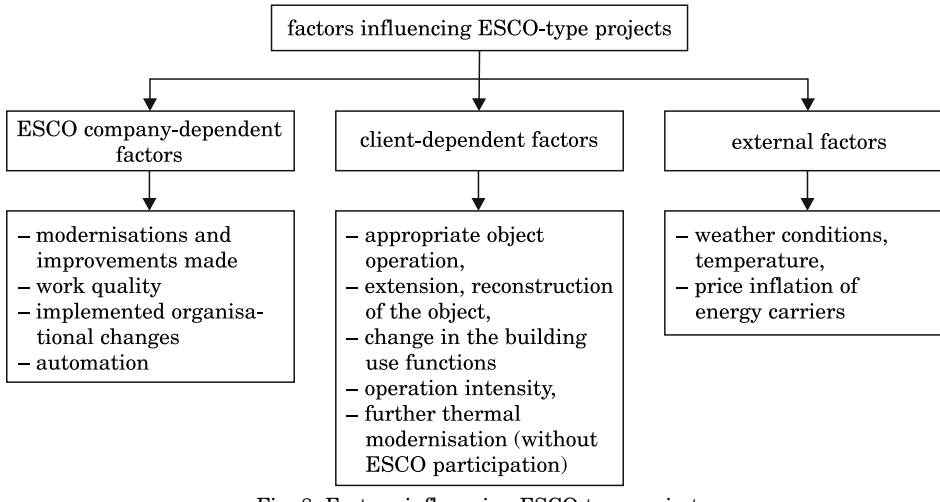


Fig. 8. Factors influencing ESCO-type projects

Source: own work.

The basic scope of works and modernisations in buildings in the case of projects implemented according to the ESCO formula is as follows:

– modernisation of the existing heat distribution centres and boiler houses,
– modernisation and installation of central heating installations,
– automation of energy generation and distribution systems,
– installation of hot water installation and liquidation of gas boilers,
– thermal insulation works,

– replacement and tightening of windows,
– projects concerning hot water consumption,
– projectsconcerning use of alternative and renewable energy sources.

In case of the ESCO-type projects, high importance is attributed to the factors on the client side concerning the appropriate use of the object following the project.

Wind energy as an instrument of the energy policy of the commune

Wind energy is a major renewable energy source and it is considered environmentally clean (disregarding the energy input for building the wind power plant) because energy generation does not require the combustion of any fuel. In Poland, wind energy has been developing for some years. The first wind turbine was installed in 1991 next to the earlier existing power plant in Żarnowiec, in Pomerania. Saturation with wind power plants in Poland is among the lowest in Europe. The capacity installed in wind power generation per capita is to 0.012 kW while per 1 km^2 of land surface it is 1.44 kW (Tab. 3).

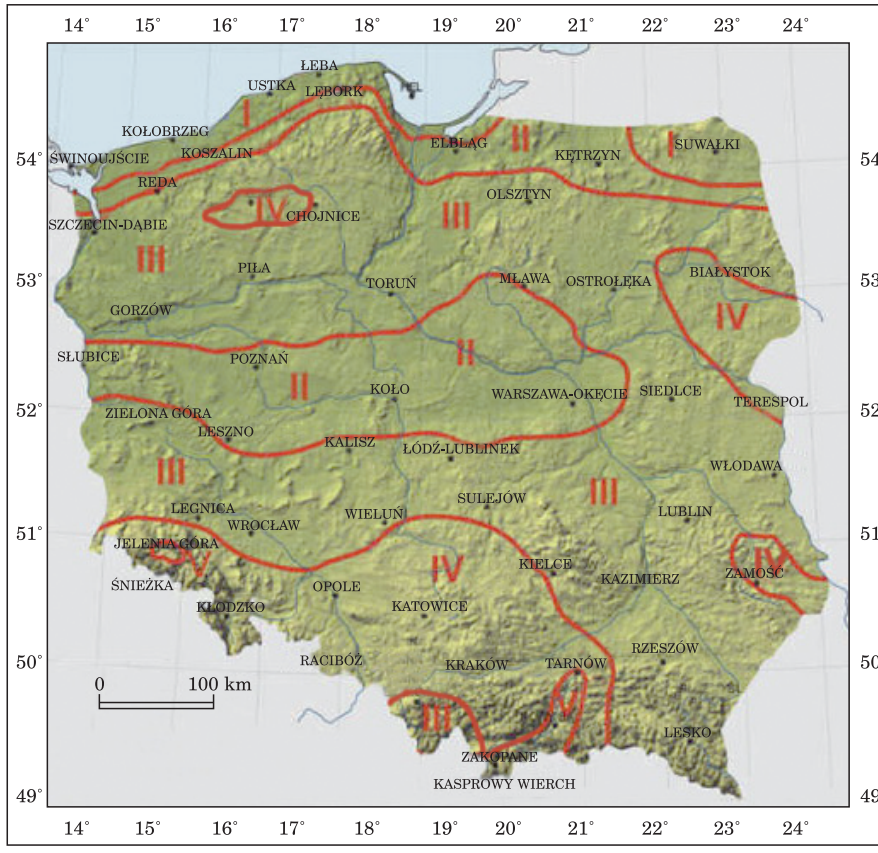
Table 3

Wind energy production in Poland

Year	Energy generated	Dynamics (in %)	Share of wind energy in total energy consumption (in %)
2004	142.3 [GWh]	100	0.10
2005	135.3 [GWh]	95.1	0.10
2006	388.4 [GWh]	272.9	0.28
2007	494.2 [GWh]	347.3	0.35
2008	790.2 [GWh]	555.3	0.55
2009	1 029 [GWh]	723.1	0.76
2010	1 485 [GWh]	1043.6	1.06
2011	1616 [GWh]	1135.6	1.14

Source: own work based on the GUS 2010.

The most favourable wind resources according to the Institute of Meteorology and Water Management are available in the central part of the seashore, in the Suwałki area, in central Wielkopolska and Mazowsze, Beskid Śląski and Żywiec area, Bieszczady and the Dynów Heights (Fig. 9).



Zones: I – very favorable, II – favorable, III – sufficient, IV – insufficient, V – bad

Fig. 9. Wind energy zones in Poland
Source: Institute of Meteorology and Water Management, 2010

It is an undisputed fact that obtaining wind energy has a positive influence on the natural environment by limiting the emissions of pollutions produced during energy generation from conventional sources (mainly by the combustion of coal) and some unconventional sources (as in the case of nuclear power). According to the data of the European Union Energy Committee (Thermie programme), the installation of a single wind power plant with a capacity of 300 kW allows reducing the yearly production of pollution by 4–7 tons of sulphur dioxide, 3–5 tons of nitrogen oxides, 500-1000 tons of carbon dioxide and 30–60 tons of ash.

It is estimated that generating 1 MW of energy at a grid power plant brings environmental damage totalling PLN 133 (at 1995 prices) and PLN 560 (at

2006 prices). A wind power plant with the capacity of 12 MW (6x2 MW) with the average yearly production of 30,000 MW offers savings amounting to ca. PLN 16,389,000. Considering the fact that the estimated operational life of the power plant is 20–25 years, the total savings can be estimated at PLN 385–500 million during the power plant lifetime (Ligus 2010, pp. 14–20).

Conclusion

Implementation of a local energy policy is a big challenge for a commune government, but at the same time it offers great benefits. The **challenges** caninclude:

– organisation of competent services to implement the local energy policy by drafting the plans and programmes,

– promotion of projects and innovative measures of a holistic and long-term character aiming at energy efficiency improvement, involving local communities in its implementation,

– creating in their own strategic documents the conditions supportive for local energy security improvement, energy infrastructure development, energy efficiency improvement and intensification of renewable energy source use,

– skills in actively developing and making use of the free energy market,

– creating platforms for all energy market users for rationalisation of energy use.

The **benefits** that the commune may achieve by long-term strategic energy sector management are:

– limitation of the operational costs related to public utility facilities and operation of commune-dependent entities,

– increase in the energy security level with the existing systems of supply with energy media,

– decreasing emissions representing a burden to the natural environment,

– limitation of conventional energy use and, as a consequence, leaving larger reserves of fuel for future generations,

– energy use efficiency improvement for premises that are controlled by the commune as well as those managed by other entities,

– increased use of energy from renewable sources.

Optimal use of the benefits resulting from involvement in this difficult area of commune activities requires specifying the measures which must be taken to achieve the defined goals:

– managerial measures, requiring no investments aiming at rational energy use in premises controlled by the commune (ESCO-type projects),

– consideration of energy-saving solutions at the stage of new investment project development,

– Implementation of so-called green procurement as concerns equipping the communal facilities with energy-saving electrical equipment and devices,

– educational activities for the entire local community, starting with school-age children,

– measures supporting the development of the competitive energy market,

– collaboration with scientific and industrial communities.

Finding administrative-legal solutions to provide energy security for the commune, while maintaining an appropriate quality of services through optimisation of costs, is an important issue. Planning and organisation of the demand for power are, according to the Energy Law Act, among the responsibilities of the commune. In this context, collaboration which is not only institutionalised, but also less formal, takes on greater importance. The President of the Energy Regulatory Office serves to support all forms of collaboration between bodies, public institutions and other entities, e.g. in the PPP form that aims at energy security improvement. The President of the Energy Regulatory Office is a major pillar of support for local and regional authorities for new and existing energy initiatives. Measures promoting rational energy management at the local level will be continued and developed by the Energy Regulatory Office.

Translated by JERZY GOZDEK

Accepted for print 4.07.2012

References

Act Energy law. Dz. U. of 2006 No. 89, item 625.

Directive 2001/77/ECon the promotion of electricity produced from renewable energy sources in the internal electricity market. O.J. L 283 of 27.10.2001.

Directive 2006/32/ECon energy end-use efficiency and energy services. O.J. L 114/64 of 27.04.2006.

Energy policy of the EU2007, http: europarl.europa.eu/meetdocs 2007.

Energy policy of Poland until 2030, Resolution by the Council of Ministers No. 202/2009.

JANKOWSKI A. 2008. *Po co gminie energetyk?* Przegląd Komunalny, 9.

LIGUS M. 2010. *Efektywność inwestycji w odnawialne źródła energii.* Cedewu, Warszawa.

PASIERB S. 2003. *Założenia gospodarki energetycznej w gminach ze szczególnym uwzględnieniem OZE*. Konferencja „Energetyka w gminie", Ustroń.

The Kyoto Protocol, Dz.U. of 2005 No. 203, item 1684.

White Paper "Energy for the future: Renewable sources of energy". Eur-lex-europa.eu. COM(1997)0599.