ENVIRONMENTAL CHALLENGES IN THE PROCESS
OF EASTWARD EXPANSION OF THE EUROPEAN UNION

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RENEWABLE ENERGY SOURCES AS AN INSTRUMENT OF SUSTAINABLE DEVELOPMENT IN VIEW OF INTEGRATION WITH THE EUROPEAN UNION

Introduction

The utilisation of mineral fuels for the production of heat and electrical power in the last century has resulted in an immense degradation of the natural environment. Apart from the fuel crisis in 1973, this has become the main reason for an intensification of the quest for alternatives in the production of energy. Such "pure alternatives" are renewable energy sources (RES), i.e. sources using non-accumulated solar energy in various forms in the conversion process. This mainly includes the energy of rivers, wind, bio-masses and solar radiation energy.

The importance of RES in the EU states has considerably increased in the last decade. Also the vision of sustainable development is being more vigorously implemented there – i.e. the integration of political, economic and social actions while maintaining the natural balance in order to ensure equal access to the natural environment for present and future generations. Poland as a country aspiring to join the EU is attempting to follow increasing quality and environmental standards in the power industry observed in highly-developed countries.

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1. The priorities of the Polish Energy Policy

The Ordinance of the *Energy Law* specifies the most vital tasks for the Polish power sector. They include:
- sustainable development of the country;
- ensuring cost-saving and rational use of fuels and energy;
- ensuring the safety of energy supplies, i.e. the conditions enabling the coverage of current and prospective demand of industry and society for energy of the required type and quality;
- development of competition and counteracting the negative outcomes of natural monopolies;
- taking into consideration the requirement of natural conservation;
- taking into account the responsibilities resultant from international agreements protection of customers' interests and minimisation of costs [Szlązak, 1998].

The *Energy Law* and other valid regulations also specified the new structure of competences among the governmental administration bodies. Management of the power sector by means of directive has become the past. **The Commune** has become an independent body, that is realising designated public tasks and administers the commune's properties. Within the present commune's scope of activities are all public issues of local significance that are not restricted with acts for the benefit of other entities [Patrzałek, 1999]. One of the tasks of a commune is to **provide its residents with heat and electrical energy as well as gaseous fuels.**

Investments related to the **reduction of energy and resources consumption** (rational energy management) and the **modernisation of conventional energy generation processes** have become an important objective of a commune's energy management in the present. Recently, we have also had an opportunity of observing substantial interest arising, concerning the notions regarding the feasibility of achieving heat and electrical energy from the **renewable energy sources** (RNE).

1.1. Rational energy management

Economising is the best method of reducing environmental hazards resultant from the production and utilisation of energy. Reserves, in scope of undertakings concerning the improvement of the efficiency of energy utilisation, are so vast that still for more than ten years they may constitute the cheapest "additional" quantities of energy that will be indispensable for the further development of the country. The under-

takings in this field are very profitable and frequently can be conducted without any subsidies or subventions. The salient feature still characterising our industry is the predominance of raw-material branches of the industry, a relatively large percentage of low-processed products and high material and energy consumption. Subsequently, one of the main tasks of a commune is to carry out the comprehensive modernisation of the power industry, which presents an opportunity of coming into line with EU standards.

The scope of the modernisation should include:

- improvement of the thermodynamic performance of the processes of the thermal energy engineering;
- improvement of the status of thermal energy equipment utilisation;
- improvement of the watt-hour efficiency of energy receivers;
- improvement of waste energy utilisation;
- reduction of the material consumption of production processes;
- reduction of the usage of energy-consuming products (restructuring of industry), improvement of the utilisation of secondary raw materials [Szargut, Ziębik,1997].

The number of energy-saving oriented investments in heat distribution systems for housing and public utility purposes (thermal insulation of buildings, installation of thermostats and energy measuring instruments in central heating systems, modernisation of lightning systems in cities and their quarters) has been rapidly increasing. Thanks to these actions, the economic development of Poland that has been observed recently is not paralleled by an increase in energy consumption, which is a very favourable effect. Equally important as the above-actions are such activities aimed at spreading awareness in the Polish society that the rational use of energy is not inherent to the deterioration of the standard of life but, conversely, it can be improved by the reduction of electrical energy costs and an improvement in the quality of the environment.

1.2. Restructuring of the Conventional Power Industry

The generation of thermal and electrical energy in a conventional manner, i.e. connected with the combustion of fuels, leads to numerous, adverse environmental effects. The extraction of primary mineral fuels is connected with the destruction of ground surface, the amassment of burrows and the discharging of saline water to rivers. Furthermore, an immense amount of contamination is emitted into the atmosphere in the form of dusts and gases [Laudyn, Pawlik, Strzelczyk, 1995]. Amongst

the attempts aimed at the reduction of the negative effects of the conventional generation of energy, the following should be enumerated:
- withdrawal of obsolete power units and their ecology-oriented modernisation;
- enrichment and processing of primary fuels (sorting, enrichment, briquetting, desulphurisation, gasification, refining, coking);
- low-emission burners;
- high-performance dust collectors;
- systems for desulphurisation and denitriding of combustion gasses;
- treatment of furnace wastes;
- respecting valid emission standards.

An important role might be played by the increasing share of low-capacity energy sources producing electrical energy in association with heat. It is viable thanks principally to major technological progress in the field of low-capacity sources and for that reason investing in high-performance local energy sources is becoming for many reasons profitable.

1.3. The development of Renewable Energy Sources

The utilisation of RES yields many positive results, both in global categories, at the national scale, as well as at a regional and local scale. For this reason, a shift in the approach of the Polish government can be noted towards the issues related to the production of thermal and electrical energy from renewable energy sources. The most significant regulations directly resultant from the Energy Law and Administrative Acts that can stimulate the development of the renewable energy sector in Poland are the regulations that:
- impose an obligation on the companies dealing with the sale of energy to purchase energy from unconventional sources including renewable sources;
- allow setting energy prices at a realistic level which results in a decrease in subsidisation of mineral fuels and, in the long run, it may lead to the incorporation of external costs (especially environmental pollution costs) into energy costs;
- obliges the Council of Ministers to take the issues of the development of renewable energy sources into consideration, while establishing plans for the national energy policy;
- enable to include expenses incurred in the development of the renewable energy sector in the price of energy.

2. The development of renewable energy sources and the sustainable development (eco-development)

The utilisation of energy from renewable sources as one of the most important components of the country's sustainable development brings measurable ecological and energetic results, and an increase in the percentage of renewable energy sources in the fuel and energetic balance helps to make non-renewable energy sources economically viable and improve the condition of the environment by reducing atmosphere and water pollution and the amount of generated wastes [Strategia Rozwoju Odnawialnych Źródeł Energii, 2000].

The conversion of wind, solar, water and earth energy or bio-mass into heat and electrical energy is associated with **minimal environmental impact.** Hence, RES is an attractive alternative with regard to currently used fuels. RES being a small, dispersed and user-friendly technology situated in less urbanised areas is naturally becoming a part of the policy, strategy and plans for regional and local development. In Polish conditions, RES can play an important role in the development of rural areas inhabited by approx. 40% of the population. These areas are characterised by the highest unemployment rates, underdeveloped technical infrastructure and an ineffective power supply system. In such conditions, the development of RES utilisation gives an opportunity of creating **employment**, better **satisfaction of energy requirements** leading to the improvement in the quality of people's life. Yet another result of RES utilisation is the **development of small and medium-sized enterprises**. It can be evidenced by the practices of the EU countries, where the RES sector as a new industry is localised principally in small companies of an innovative character and in family businesses. RES technologies can become an attractive part of **export.** At present, the sales volume on the RES technology market is estimated to be USD 100 billion annually, and in 2020 it may exceed USD 1700 billion [Wiśniewski, 1999].

The projects concerning the utilisation of ecologically pure energy generated by RES for local authorities to help cut expenses borne by communes for the purchase of electrical energy. Profits gained from the sale of electrical energy support a commune's budget. Moreover, the aspect of modern technologies for the production of energy can be used by communes as a factor contributing to the enhancement of the qualities of the given region, thus creating the image of a commune as being "environmentally friendly".

3. The potential of renewable energy sources in Poland

The current national technical potential of renewable energy sources amounts to more than 2500 PJ annually, which constitutes 60% of the domestic demand for primary energy.

Table 1. The volume of the technical potential of energy obtainable from renewable sources in Poland annually

Source of energy	Technical potential of energy [PJ]
Bio-mass	895
Water energy	43
Geothermal resources	200
Wind energy	36
Solar radiation	1340
Total	2514
Total use of primary energy in Poland in 1998	4069.6

Source: acc. to EC BREC research "Economic and Legal Aspects of the RES Utilisation" (EC BREC, 2000).

Solar radiation energy, solid bio-fuels energy and geothermal energy are the most important constituents that can be used for the production of thermal energy. Wind energy, water energy and associated energy production sectors based on bio-mass constitute natural electrical energy sources. Liquid bio-fuels based on bio-ethanol and colza esters supplement the technical potential of renewable energy in Poland in scope of the possibility of the production of motor fuels. The technical potential of RES in Poland is similar to the potential existing in the EU countries. Its utilisation is however quite different. In the EU countries it is used in 16% [Odnawialne źródła energii,1996], whereas in Poland, the domestic use of the RES potential depending on the assessment of the present energy production from renewable sources is estimated as 4% to 9% and is mainly resultant from the utilisation of wood and wood wastes for energetic purposes [Economic and Legal Aspects..., 2000].

The assessment of the number of implemented and functioning RES systems in 1999 in the technological system and the current production of energy from renewable sources in Poland according to the data from the European Renewable Energy Centre is presented in Table 2.

Table 2. Implemented and operating RES systems in 1999 and current production of energy from renewable sources in Poland

System	Number of systems	Total power [MW]*	Energy production*	
			GWh	TJ
Thermal-electric power plants powered by wastes from the pulp and paper industry and furniture industry	50*	1000	90	12500
Wood powered automatic heat-generating plants	70	350	—	4200
Low and medium power boilers fired with pieces of wood, sawdust and shavings	100000*	5000	—	80000
Straw heat-generating plants	10	13	—	130
Straw low and medium power boilers	75*	7	—	490
Geothermal heat plants	3	26,8	—	147
Water-solar collectors	1.500*	5	—	15
Air-solar collectors	50*	1,5	—	3
Photovoltaic systems	2+156**	—	—	—
Agricultural bio-gassing (liquid manure)	1**	0,15	—	—
Communal bio-gassing (sewage depositions)	29	38,9	72,5	250
Bio-gassing on waste dump gas	16	9	30	72
Wind network power plants	13	4	4	—
Autonomous wind power plants	50*	0,5	0,2	—
Small water power plants	430	156	480	—
Bio-ethanol as an additive to fuel	3***			3800
SUBTOTAL	102455	6611,7	766,7	101607
TOTAL				104367

* approximate data,

** 2 systems supplying power to street lamps and 156 systems supplying marine navigation signs; 10 bio-gas agricultural stations were built but currently only one operates.

*** production of waterless spirit

Source: Interdisciplinary team directed by G. Wiśniewski: Economic and legal aspects of the utilisation of renewable energy sources in Poland; Warsaw, March 2000 r.

3.1. Solar energy resources in Poland

The annual density of solar radiation on a horizontal surface in Poland amounts to 950–1250 kWh/m^2, whereas the average sunshine rate is 1600 hours per year. Weather conditions are characterised by a very uneven distribution of solar radiation in an annual cycle. Approx. 80% of

the total annual amount of sunshine is divided into six months of the spring-summer season, from the beginning of April to the end of September. The time of solar operation in summer is lengthened to 16 hours per day and in winter shortened to 8 hours per day.

3.2. Wind energy resources in Poland

The assessments of wind energy resources that have been carried out so far were based on the observational material gathered by IMiGW weather stations. Since there are few measuring stations on the territory of Poland, they are localised at random and measurements are taken at the height of 11–13 m hence the results obtained should be considered as merely a rough estimate of actual conditions. Recently, new measurements have been performed according to which the conditions on the coast of the Pomeranian region are similar to those that occur in Denmark. On the other hand wind resources in the central part of Poland do not differ from those in the areas of Germany where large wind power station parks were established. The areas deemed most suitable for the development of the Polish wind industry according to the data from the Institute of Meteorology and Water Management (IMiGW) include:

- Wybrzeże Kaszubskie (Coast of Kaszuby) – from Koszalin to Hel (5–6 m/s);
- Wyspa Uznam (Uznam Island) – (5 m/s);
- Region of Suwałki – (4.5–5 m/s);
- Central part of Lower Poland and Mazovia – (4–5 m/s).

Apart from the areas mentioned above, there are places in which, due to the specific land features, there are favourable conditions for the localisation of wind power stations, e.g. such areas as Beskid Śląski and Beskid Żywiecki, as well as Bieszczady and Pogórze Dynowskie. However prior to the implementation of a project, exact research of wind conditions should be conducted, or alternatively the data from the nearest weather station, airport or other source could be applied, if they are considered to be credible.

3.3. Bio-mass energy resources in Poland

The technical potential of solid bio-fuels in Poland that can be used for energy purposes is appraised at the level of approx. 407.5 PJ annually. It includes surpluses of bio-mass produced in the agriculture of approx. 195 PJ, in forestry – 101 PJ, in pomiculture – 57.6 PJ and wood wastes from the wood industry – 53.9 PJ.

The energetic utilisation of solid bio-fuels is the sector of the renewable energy industry that is developing in Poland most rapidly. This development is taking place in market conditions without any major support from the government and is based on various technologies.

3.4. Geothermal energy sources in Poland

Geothermal waters are under the surface of approx. 80% of the territory of Poland. Despite such substantial occurrence of waters, their exploitation is not easy and is obstructed by the conditions of extraction, as well as the economic factors of such ventures. In Poland, geothermal waters have a relatively low temperature (up to 80°C), so their utilisation cannot be considered as fully renewable. So far, in Poland merely a fraction of the geothermal potential has been used. There are geothermal plants in Pyrzyce near Szczecin and in Bańska Niżna near Zakopane. In the period to come, the termination of the construction of geothermal heating systems for Zakopane and Mszczonowa near Warsaw is planned. There are also plans for the utilisation of thermal waters in Uniejów, Czarnków, Koło and Poddębice. Generally, the utilisation of geothermal energy in Poland is very low and amounts to 0.06% of the total national primary energy demand.

3.5. Hydro-energetic resources in Poland

In the period between WWI and the WWII there have been approx. 6500 various plants using water energy in Poland. Floods and acts of vandalism that have been occurring for more than ten years in Poland have meant that only several hundred of these facilities have survived. At the beginning of the 80's only 100 water power plants operated and they were owned by the Ministry of Energy. It is estimated that after the refurbishment approx. 650 dams could be used as MEW. The total power of these facilities will be approximately 80 MW. Additionally, approx. 400 MEWs could be built on the planned dams with a total power of 120 MW. To sum up, more than 1,000 small water power plants with a total power of approx. 200 MW could be build in Poland.

4. Ways of financing investments related to the utilisation of RES

Investments related to the use of renewable energy sources are very capital-consuming. It is very often the case that the cost of the utilisation

of renewable energy carriers in Poland is higher than in the EU countries. This is connected with a lack of experience in the realisation of such types of investments, together with low turnover on the domestic RES technology market, as well as the lack of supportive mechanisms for companies operating in this sector. This is why such investments are very rarely realised by means of an investor's own resources. Sometimes the factor deciding about the successfulness of such a project is the ability to gain foreign capital and to develop an optimal financing structure for the investment Investments in the renewable energy sector in 1998 amounted totally to 17,267,700 PLN, of which 6,223,900 PLN (approx. 1.5 million EURO) came from the budget and ecological funds [GUS, 2000]. This is 53 times less than the average expenditure on renewable energy in the EU countries at the same time [Papers of EC BREC: http://www.ibmer.waw.pl].

The key financial institutions supporting the development of renewable energy sources in Poland include: the National Fund for Environmental Protection and Water Management, EcoFund, Voivodship Funds for Environmental Protection and Water Management, the Programme for Small and medium Grants GEF. The institutions that could provide assistance for RES utilisation projects, if they support the development of agricultural areas include: the Foundation of Assistance Programmes for Agriculture, the Property Agency of the State Treasury, the Rural Development Foundation, the Agency for Restructuring and Mechanisation of Agriculture etc. The types of financial support used most frequently by the institutions mentioned above include the granting of preference loans and subsidies. Generally, the loans and subsidies amount maximally to 50% of project costs.

Apart from the resources for the development of the renewable energy industry available in Poland, there are growing opportunities of taking advantage of foreign help in this area. Apart from the World Bank and renowned European banks financing large projects in the renewable energy sector (the European Bank of Development and Reconstruction, the European Investment Bank, the Nordic Investment Bank), the specific programmes of the European Union will grow in importance, i.e.: ALTENER II, SYNERGY, 5 Framework Programme for Technological Co-operation and Presentation. In the process of the integration of Poland with the European Union, the PHARE fund still can be of importance in the further development of the renewable energy sector. It can be expected that Poland's opportunities from the utilisation of the first pre-access funds will increase, to include ISPA and SAPARD programmes and then also structural programmes.

The bilateral funds of the European countries supplement the international funds for the development of RES, e.g.: Denmark, Germany, Sweden. The forms of bilateral co-operation in the field of utilisation of renewable energy sources also include such projects as the Joint Implementation realised within the frameworks of the mechanisms for the reduction of greenhouse gas emission included in the Protocol from Kyoto.

5. Conclusions

The recent years have been a period of dynamic development of the entire economy in Poland. This has resulted in a growing demand for energy, technological development and the necessity of altering methods aimed at the solution of natural environment conservation issues. Having in mind the access to the European Union, it is necessary to continue ecology-oriented projects that have been already commenced and even accelerate them.

Currently, the local energy policy should be based on a reliable diagnosis of key problems and it also should set up priorities of activities and designate the instruments and sources of financing the investments in this sector. One of the priorities is the production of clean energy. Considering its **own sustainable development**, a commune should discern the necessity of utilising **renewable energy sources**. Their utilisation will not only improve the **quality of the environment,** but also will enable an increase in **energetic safety,** promote **employment**, stimulate **the development of small and medium-sized enterprises** and also create Poland's **ecological image.**

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