



Analysis of financial effectiveness proved by electricity sources, within the concept of sustainable development, based on the Polish example

Ireneusz Miciuła*, Krzysztof Miciuła

Faculty of Economics and Management, Szczecin University, Szczecin, Poland

*E-mail address: irekmic@wp.pl

ABSTRACT

The article presents the issues related to EU member states - including Poland - shifting to pro-ecological sources of energy. Purpose of the article is to demonstrate limitations of quick electrical re-organization of EU member states, as well as possibilities and opportunities for utilizing the existing technologies, according to the principles of sustainable development. It also points to financial effectiveness of the described processes as well as to the arguments for stable and sustainable transformations within the energetic sector in Poland.

Keywords: renewable energy, financial efficiency, sustainable development

1. INTRODUCTION

An obligation towards the European Union, stipulated in the IED (Industrial Emissions Directive) of 8 November 2010, is related to reduction in the carbon dioxide emission [1]. The Directive is intended to make the regulations stricter and reduce the number of permissions for additional CO₂ emission. For Poland, as a country based on coal, these changes will cause enormous effects, because the structure of energy sources will be transformed. Although the pro-ecologic renewable energy sources should be applied to the benefit of sustainable

development, still other solutions must be sought for in places, where their application possibility is limited. Furthermore, changes that are too rapid and forced may exerted adverse influence on human development in the economic and social aspects. Attention must be paid to the fact that technological development allows to put forwards considerably strict requirements for coal installations, related to permissible emission standards. There are no coal installations that can function without working flue gases desulphurization, denitrogenisation and dedusting systems. In each of those cases, it becomes necessary to incur new investment outlays. According to calculations carried out by the Polish Chamber for Chemical Industry, the investment costs for a large chemical plant are estimated to reach about 120 million euro [2].

While the investments in the renewable sources of energy are often higher, and their financial effectiveness without EU grants is not justified in economic terms. Therefore, the Directive includes provisions that enables to prolong operation of heat sources operation on the previous principles, provided that the joint power does not exceed 200 MW. While holding such integrated permits, received before 27 November 2002, it becomes possible to deliver more than 50% of heat generated from those installations into the heating networks. The solutions described above will enable more neutral adjustment to the presented requirements, depending on the methods and tools applied for their realization. Purpose of the article is to present arguments for diversification of energy sources, and implementation of changes in their structures in a successive manner, in compliance with realities and opportunities in a given state. This will allow to follow the sustainable development principles, which assume relationships shaped properly and awarely between the economic growth, care over the environment and life quality.

2. METHODOLOGY OF RESEARCH AND COURSE OF THE RESEARCH PROCESS

The methodology of research is based on a statistical analysis of supply sources and possibilities to employ the renewable energy in Poland, as well as premises and conclusions. Purpose of the research process is to demonstrate that regarding the limitations and lack of possibilities of quick development of the renewable energy, it is necessary to employ temporary methods, which will guarantee stable and sustainable development of EU member states. An additional argument is the presented financial efficiency, i.e. Profitability of the process on this development stage of a given country, including Poland.

3. RENEWABLE ENERGY AS AN ELEMENT OF SUSTAINABLE DEVELOPMENT

Currently, renewable energy sources play an increasingly significant role in the world energetics. In recent decades, development of renewable energy sources has become one of the main objectives of the energetic policy adopted by the European Union member states. It is expressed, among others, by the Directive of the European Parliament and the European Council No. 2009/28/EC, of 23 April 2009, on the promotion of the use of energy from renewable sources, which established a common framework for promotion of energy coming from renewable sources, and stipulated the obligatory national objectives in relation to a total

share of energy from renewable sources in the final energy consumption. Furthermore, the Directive determined the criteria for sustainable development for biofuels. The need for energetic materials among the EU member states is enormous, what proves that EU countries consume 21% of the energy generated in the world, and they must import it to a considerable extent [3]. Undoubtedly, the sustainable energetic development based on diversification of energetic resources supply, including the renewable sources of energy, brings numerous positive aspects and ecological, economic and social advantages (Table 1).

Table 1. Benefits from employing renewable energy sources

No.	Ecological benefits	Economic and social benefits
1.	Reduction in CO ₂ emission, responsible for the greenhouse effect.	Saving fossil fuels, non-renewable, and utilization of the energetic potential proved by the renewable energy sources.
2.	Reduction in emission of harmful substances to the environment, including SO ₂ , NO _x and organic contaminants, heavy metals, etc.	Implementation of international obligations in the scope of reduction in emission of harmful substances to the atmosphere, a possibility to participate in financial results (avoiding fines and trading permission or the renewable energy sources, e.g. biomass).
3.	Limitation in environmental degradations as a result of fossil fuels exploitation and deposition of biomass waste in the environment.	Stimulation of numerous parts of the economy, including modern technologies. Support to local labor markets.
4.	Limitation in the environmental degradation resulting from non-organized processes of biodegradability of the deposited biomass.	Improvement in living conditions of the population, increase in energetic security of the country,

Source: own work.

Attention must be paid to the financial effectiveness of changes related to energetic resources, which influence the economic process of whole economies, and a possible speed level of those transformations, resulting from environmental, economic-social and technological limitations. Additionally, the climate policy forces resignation from the energy that comes from coal, towards the ecologic energy carriers. This strategy is beneficial for those countries, where coal is currently the basic source of energy, including Poland. Especially if we say about rapid changes in this area, i.e. until 2030, all the more that there are no reasonable premises for this, even including the financial effectiveness of the proposed substitutes, which will not be advantageous without subsidies and state or EU grants (fig. 1). What is more, it causes various disturbing phenomena and interferences within energetic markets, which influence the prices within the whole economy. An exemplary problem resulting from ill considered EU strategies, are prices of permissions for CO₂ emission. These

prices were increased since the beginning of 2014 by more than 40%, to about 7 euro per tonne. Intensified demand related to recent decisions in the scope of the EU climate policy, among others the 40% goal for reduction in CO₂ emission until 2030, as well as waiting for the beginning of the process of withdrawing a part of permissions from the market [4].

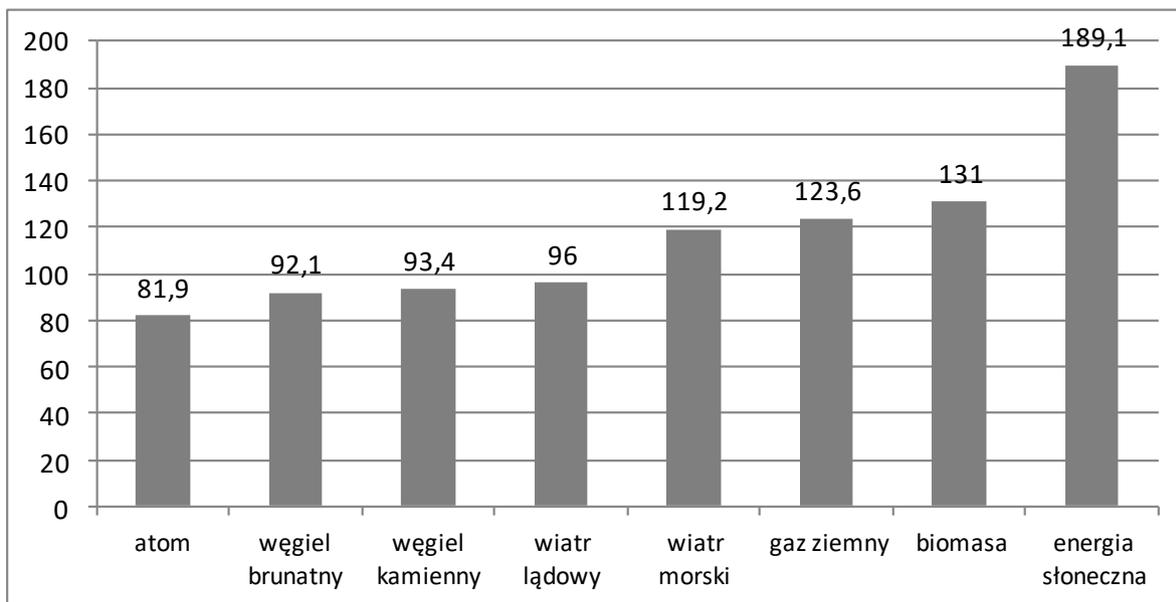


Fig. 1. Costs for production of electric energy (data in euro, cf. MWH, according to prices from 2012).

Source: ARE. Statystyka elektroenergetyki polskiej 2012. Agencja Rynku Energii S.A., Warsaw, 2013.

The strategy adopted by the EU member states should be focused on the possibility to find substitutes for energetic raw materials, which are imported to those countries in more than 55%, or to diversify the possibilities of deliveries, what will influence their prices. While the leading thought of the strategy is only the so-called energy mix, i.e. division of production and consumption of energy according to carries or production manners in particular economies, in order to reduce the carbon dioxide combustion, what can be also achieved through investments in innovative (pure) coal technologies. It is of enormous importance for economies of the countries, which have more than a 50% share of coal in the energy mix, i.e. among others Poland, Czech Republic, Estonia and Bulgaria. Moreover, the governmental report entitled “Model optymalnego miksu energetyczny dla Polski do roku 2060” (The model of an optimal energy mix for Poland after 2060) assumes that the Polish energetics will be based on coal for another 40 years [5].

This is why, the EU strategy should consider the opportunities and conditions of particular economies, not generalize and adjust tendencies to the EU decision-makers. Additionally, the arguments for well-thought and effective transformations are prognoses for increasing need for the energy, as well as limitations causing that the renewable energy sources are capable of providing about 18% of the need for energy in the EU member states

[6]. While numerous energetic raw materials, thanks to new technologies, becomes more ecological energy carriers, including first of all gas, where new possibilities to extract gas, e.g. from shale.

4. PLANS OF SUSTAINABLE ENERGETIC DEVELOPMENT FOR POLAND UNTIL 2030

In the EU member states, biomass is currently one of the main sources of renewable energy for production of heat and electricity. Regarding the necessity to achieve index objective included in the Directive, the climate and environmental requirements, it is assessed that in the nearest decades, exploitation of biomass for energetic purposes in all European states will be on a rapid increase. Regarding its limited resources, the biomass requires sustainable production and exploitation [7]. According to the definition by the European Union (Directive 2001/77/EC), biomass means fractions of products, waste and residues from agricultural industry (together with plant and animal substances), forest industry and interconnected branches of the economy, prone to biological degradations, as well as biodegradable fractions of industrial and municipal waste.

The energetic situation of Poland, as well as of numerous Central European Countries, is similar, because these countries do not have rich energetic resources, except bituminous coal and lignite. In a situation of energetic deficiency supplied from own sources, those countries - with this strategy of operation adopted by all EU member states [8] - will be forced to import significant amounts of energetic resources, especially oil and its derivative products, natural gas and certain amounts of electric energy. A dynamic growth in production of electricity could have been observed lately in power plants and heat and power plants adopting the technology of co-incineration of biomass and coal. Technical potential of biomass in Poland is estimated for about 900 PJ/year. Biomass poses one of the main sources of renewable energy, and share of permanent biomass in acquisition of all renewable energy sources reached 85.4% in 2010. In 2010, about 6305 GWh of electricity was produced from biomass, including 5593 GHh in the co-incineration technology.

Biomass is utilized by agricultural farms for heating purposes, and incinerated by professional electro-energetics, mainly within the process of co-incineration with coal. Regarding limited resources and the calorific value, the biomass should be applied mainly locally, in the dispersed technology, because its transportation causes specific results, also in the scope of additional CO emission. Poland, willing to reduce CO₂ emission and to fulfill its obligations at the same time getting the most of the brought advantages, should undoubtedly utilize the renewable energy sources. But there is a need to think about the feasibility of EU strategies in terms of time, for particular countries, as well as about economic effects, which may arise as a result of fines and trading permissions for CO₂ emissions, and the similar processes forced by the EU. The economic practice proves that prognoses for share of particular fuels in production of electric energy in Poland for 2015 will not be fulfilled, what causes that indicators for following years will be hard to achieve. Additionally, the fact that the prognoses for the need for energy suggest a 50% growth from the current status until 2030, triggers economic difficulties in limitation of the fossil fuels share in the energy mix in Poland, with simultaneous difficulties in obtaining electricity from the renewable sources of energy, and planned two nuclear power plants [13].

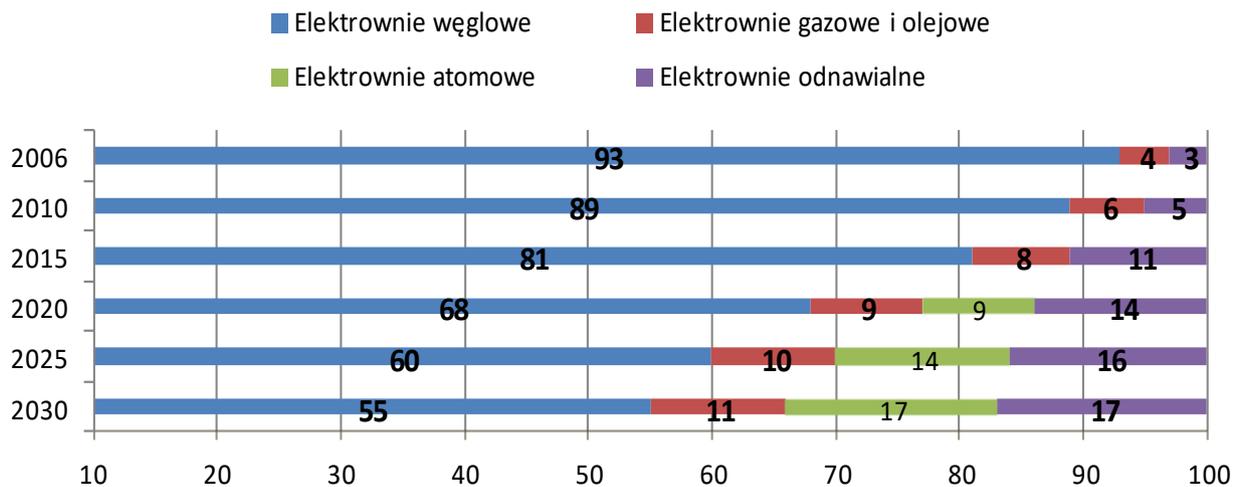


Fig. 2. Share of particular fuels in net production of electricity in Poland in 2006 and 2010, and prognoses until 2030.

Source: Report by the Ministry of Economy, “Prognoza zapotrzebowania na paliwa i energię do 2030 roku” (The prognosis of demand for fuels and energy until 2030).

In order to shift to renewable energy sources, there is a need to determine the degree, to which it is possible, taking into account particular states or regions. Table 2 presents types of renewable energy sources, which can be used by pointing their advantages and disadvantages. In turn, Table 3 presents conditions and possibilities of exploiting the renewable energy in Poland [14].

Table 2. Advantages and disadvantages of renewable energy [19].

Type of renewable energy	Advantages	Disadvantages
Water	Slight troubles with maintaining and operating the power plant.	Dependence on rain, a necessity to flood large areas, resettlements of people, destroying natural settlements of plants and animals. Local climate changes.
Biomass	Large potential in certain regions, disposal of waste and sewage, management and utilization of areas for plantations	A necessity to cultivate lands, high costs, occupation of land, incineration - emission of harmful substances

Wind	A clean source of renewable energy.	High costs of construction and maintenance. Windmills occupy large territories that are lost for agriculture.
Geo-thermal	A clean source of energy.	Expensive installations, problems with maintenance of devices. Proper rocks are present in a small number of places around the world.
Solar	Solar cells do not require maintenance, they are highly reliable.	Toxic elements are employed for construction of photovoltaic cells.

Source: own work.

Table. 3. A possibility to use the renewable energy sources in Poland [19].

Type of energy	Reasons for limitation of occurrence in Poland
Wind energy	Only in some regions of the country the average winds speed exceeds 4 m/s - a minimum start speed level for majority of wind power plants.
Solar energy	In Poland, out of 8760 hours within a year, only 1390 to 1900 hours are sunny. In a major part of the country it is 1600 hours on average, what is 30-40% of the day. Total solar radiation in Poland (a sum of direct and dispersed radiation) is maximum 1 kW/m ² in optimum conditions (midday with no clouds, pure sky).
Geo-thermal energy	In Poland, geo-thermal energy provides about 4 million tons of fuel equivalent per year. The majority of waters with a temperature level up to 80 °C limits their application, mainly in the heating industry
Water energy	In Poland, such a power plant will never be used regarding lack of greater inflows and outflows.

Source: Attachment to the resolution No. 202/2009 by the Council of Ministers, of 10 November 2009, "Strategia energetyczna Polski do 2030 roku" (Energetic Strategy of Poland until 2030), The Ministry of Economy, Warsaw, 2009.

Regarding the limitations and lack of possibilities of quick development of the renewable energy, it is necessary to employ temporary methods, which will guarantee stable and sustainable development of EU member states. An additional argument is the presented financial efficiency, i.e. Profitability of the process on this development stage of a given country, including Poland. At the same time, there are numerous arguments for utilization of coal and gas, among others, innovation of coal technologies, which enable greater effectiveness of energy production and utilization of deposits that are impossible to be exploited with conventional methods. Additionally, the new technology is safer for the natural environment and it allows limitation of CO₂ and other contaminants emission. As an example, the refining plant in Gdańsk is one of the most energetically effective facilities in Europe. Therefore, we should still develop pure coal technologies [15].

The limited possibilities of application of the renewable energy sources in certain areas of the world, and impossible deadlines for changes in the energy sources structure, adopted by the EU, are proved by the fact that currently the renewable energy sources fulfill about 8.5% of population need for the energy [9]. Therefore, first of all it is most important to provide access to modern energetic service and at the same time improvement in energetic effectiveness, and only after that the increase of the renewable energy sources share in the energy mix. Because the access to energy is significant not only for consumption but also for generation of income, which ensure stable means for upkeep [16]. Sustainable energy is produced and applied in a manner supporting development of population in a social, economic and environmental aspect. We should create new energetic future, which will make use of the force of technology and innovation, to the service of humanity and the environment.

5. CONCLUSIONS

All EU member states are willing to strive for the objective, which reduction in CO₂ emission. But they are different in respect to the manner, which they want to achieve it in [10]. The EU strategy, consisting in diversification of energetic sources, will contribute to development of competition, and will allow to consider requirements of environmental protection, and it will become a reasons for balancing interests of energetic enterprises and energy recipients [11]. But attention must be also paid to limitations and feasibility of the EU plans, for particular countries, as well as to the economic results, which may arise as a result of introduction of adverse processes forced by EU, e.g. fines and the market of permission for CO₂ emission, which will touch mainly the developing countries, and will result in emergence of natural monopolies among the developed countries. Influence of such actions on operation of economic entities will be enormous [12].

Therefore, care should be taken over actions, which will guarantee sustainable development of all countries that belong to the European Union, and ensure energetic security in a manner based on the principles of rational and effective exploitation of energetic resources. This suggests that the percentage share of coal and gas will still be higher than it is predicted in the prognoses in the adopted EU strategy. Therefore, in order to deal with emission of carbon dioxide, there is a need to do it through development of modern technologies. Additionally, the EU climate policy should consider specificity of energy mixes of particular countries, not to impose a single energetic criterion on all states [17].

The European Commission should consider the specificity of particular states and developmental strategies, and first of adjust the deadlines of required changes to a given country. Therefore, changes in the manner of energy production, and shifting to the tendency of sustainable development in accordance with the EU assumption, require time. Furthermore, such arguments as economic efficiency of production and the possibility to apply production manner developed for other purposes, as well as the technological development that remains compliant with the ecology, support stable and well-thought changes, which will lead to the path of sustainable development of the world [18].

References

- [1] The Directive of the European Parliament and the Council No 2010/75/EU, of 24 November 2010, on industrial emissions (so-called IED).
- [2] Redukcja CO₂, wspólny cel, różne drogi, Polska Izba Przemysłu Chemicznego, www.pipc.org.pl, access: [20.01.2014].
- [3] Kowalski M, Jaka energia dla Europy, Wprost, February 2014, p. 86.
- [4] Wieczerek – Krusińska A, [http://www.parkiet.com/artykul/1362044-Rosnace-ceny-praw-do-emisji-CO₂-](http://www.parkiet.com/artykul/1362044-Rosnace-ceny-praw-do-emisji-CO2-) 20.02.2014.
- [5] Chancellery of the Prime Minister of Poland, the Department of Strategic Analyses, Model optymalnego miksu energetycznego dla Polski do roku 2060, Warsaw, November 2013.
- [6] <http://www.bp.com/en/global/corporate/about-bp/statistical-review-of-world-energy.html> - Statistical Review of World Energy 2015 – 10.08.2015.
- [7] European Commission, *European Energy and Transport Trends to 2030 – update 2009*, Brussels, August 2010.
- [8] Oettinger G., *UE Proposes Tough Energy Efficiency Package*, News from Business Green, March 2011.
- [9] <http://www.bp.com/en/global/corporate/about-bp/statistical-review-of-world-energy-2013.html> - Statistical Review of World Energy 2013 - 10.01.2014.
- [10] EU energetic policy, European Economic Congress, published: www.eecpoland.eu, access: [14.01.2014].
- [11] Balmaceda M., *The Politics of Energy Dependency*, University of Toronto Press, London, 2013.
- [12] Thaler H. (red.), *Prognozy dla globalnego rynku energetycznego*, Frost & Sullivan, 2014.
- [13] Haas, Reinhard, et al. "Efficiency and effectiveness of promotion systems for electricity generation from renewable energy sources—Lessons from EU countries." *Energy* 36(4) (2011) 2186-2193.

- [14] Bazmi, Aqeel Ahmed, and Gholamreza Zahedi. "Sustainable energy systems: Role of optimization modeling techniques in power generation and supply, A review." *Renewable and Sustainable Energy Reviews* 15(8) (2011) 3480-3500.
- [15] Smit, Barry, and Olga Pilifosova. "Adaptation to climate change in the context of sustainable development and equity." *Sustainable Development* 8.9 (2003): 9.
- [16] Wojtaszek H., *Selected aspects of innovative motivation*, World Scientific News, 44 (2016) 1-12.
- [17] Wagner, Ms Nancy L., and Ms Dora M. Iakova. *Financial sector evolution in the Central European economies: Challenges in supporting macroeconomic stability and sustainable growth*. No. 1-141. International Monetary Fund, 2001.
- [18] Attachment to the resolution No. 202/2009 by the Council of Ministers, of 10 November 2009, "Strategia energetyczna Polski do 2030 roku" (Energetic Strategy of Poland until 2030), The Ministry of Economy, Warsaw, 2009.

(Received 06 May 2016; accepted 30 May 2016)