
Renewable Energy Source as Alternative Polish Conventional Energy - Analysis of Selected Spatial Aspects

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Abstract:

Purpose: The aim of the article is to indicate the role and place of renewable energy sources in the energy policy of each country, especially those dominated by conventional energy. As practice and statistical data on the development of energy based on renewable energy sources show, this type of energy can be and often is an alternative to conventional energy, especially when looking at this issue from the regional point of view.

Desing/Methodology/Approche: Concern for the climate should become an element of everyday life of every inhabitant of the Earth, every company and all countries. Economic and political alternatives to classic coal-fired energy should be sought. The research hypothesis was defined as follows: Investing private and public money in renewable energy sources is currently and will certainly be, at least until 2050, of decisive importance in counteracting visible and invisible climate change.

Findings: Each country, for which the issue of climate change is no stranger to it, should develop a model of production, distribution and consumption of energy from renewable sources appropriately adapted to its development possibilities, in which private energy producers, including prosumers, should also find their place.

Practical implications: Renewable energy sources bring many economic and political benefits, both in the macroeconomic and local aspects. Most scientific studies focus on the benefits and positives of RES development, especially in comparison to traditional energy. Many specialists focus not only on current aspects, but also on climate, political and economic effects that will take place in the future.

Oryginal/value: The article has a practical application. The results can be used by people planning the development of traditional energy system.

Keywords: Renewable energy source, power engineering, energy policy.

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1. Introduction

As practice and statistics on the development of renewable energy sources (RES) show, this type of power generation can be and often is an alternative to conventional power generation, especially when looking at the issue from a regional perspective. On a national scale, it can be difficult to confirm the assumption that RES in political or economic terms have a high development potential.

On the other hand, if we focus on the regions, the optics change. Such a point of reference can be the West Pomeranian Voivodeship, which is the leader in the amount of installed capacity in RES installations (in December 2016, approximately 1587.1 MW of RES capacity was installed in the area, of which as much as 1477.2 MW, i.e. 93% - in power plants/wind farms). At the end of 2016, the West Pomeranian Voivodeship was also the leader among all Polish voivodeships in the production of electricity from RES.

According to materials of the Regional Office for Spatial Management of the Western Pomeranian Voivodeship compiled on the basis of 2015 data from the Energy Regulatory Office, on a provincial basis, the largest share of electricity from RES was in the Western Pomeranian Voivodeship. This share was as high as 63.82% at that time.

Such indicators show, at that time (2016) RES was not an alternative, but actually the main supplier of electricity, and the Polish power grid (especially the regional grid) was able to accept such an amount of electricity from this source and mainly from one type of installation (in the Zachodniopomorskie Voivodeship electricity is produced almost exclusively from onshore wind installations, m.chronmyklimat.pl).

According to many climate change experts and scientists, global action (by countries and individual companies) to reduce global warming should move towards:

- towards the creation and development of a low-carbon (including energy) economy (as so-called "decarbonisation") and a zero-carbon (environmentally neutral) economy; this is not the case in the United States. decarbonisation) and zero-carbon (environmentally neutral) economy; this is not an easy measure to implement at present, as the growing global economy needs more and more constant and reliable energy every year, which at the same time leads to the fact that economic growth causes increasing carbon dioxide emissions (in the production of goods and services and energy itself); low-carbon and zero-carbon measures require long-term (strategic) planning, as exemplified by the European Union's 2050 climate and energy policy or the UN climate summits held (Rio de Janeiro 1992, Kyoto 1997, Bali 2007, Paris 2015, Katowice 2018);
- to the intensive development of energy based on renewable energy sources (taking into account both economic and political aspects); renewable energy

sources with falling costs of technology for energy production can reduce electricity bills resulting in a more competitive economy; renewable energy sources in many countries allow for the realisation of many of their energy and economic policy objectives, including ensuring energy independence, diversification of the energy mix and improving energy security; in global action, it is becoming crucial to convince the United States and China, the two countries that account for the largest share of global greenhouse gas emissions, of this course of change; both countries are pursuing their own energy policies by constantly seeking resources (not necessarily renewable) to fuel their economies;

- to carry out social reforms that change the carbon and climate thinking of citizens in individual countries as well as the world as a whole (by, for example, switching to more economical and environmentally friendly cars, reducing air travel, reducing domestic energy bills, walking more or bathing less; Giddens, 2010).

Concern for the climate should become part of the daily life of every inhabitant of the Earth, every business and all countries. Economic and political alternatives to the classic coal-based energy industry must be sought. An example of this approach can be seen in the declarations and commitments of many international fashion brands and companies (more than 200) at the COP24 climate summit in Katowice, Poland, in December 2018, that by 2050 their production and operations would be completely climate-neutral and that 100% of the energy consumed in their facilities would come from renewable sources (either by switching to their own renewable energy sources or sourcing exclusively from such sources, i.e., sourcing energy from the 'green' energy industry).

Similar measures are being signalled and are beginning to be introduced by the European Commission, which has set a new specific target: by 2050, the balance of emissions from the Community economy was zero (Lazarczyk, 2019).

Many studies confirm the negative impact of coal and lignite combustion in the production of electricity and heat in the form of the production and emission of carbon dioxide into the atmosphere. The negative impact can already be calculated with increasing accuracy. The cost of treating people who have contracted smog-related illnesses as a result of emitting carbon dioxide and other harmful compounds into the atmosphere is rising. The number of premature deaths is increasing every year.

The costs of mining coal and burning it are increasing, resulting in electricity prices for conventionally generated electricity being much higher than those for renewable energy. Many European and non-European countries have embarked on structural changes to their energy systems with the aim of gradual and evolutionary decarbonisation, i.e., moving away from the use of coal in power generation.

An example is Denmark, which obtains its 'green' energy from developing wind technology (this process was initiated as early as the 1970s).

The Germans are investing in wind and solar farms, the Swiss and Canadians in hydropower, the Brazilians in biofuels, the USA, France, Japan in nuclear power (Square, 2015). Practice shows that this is not easy to do and very often meets many social, economic and political opponents. Today's energy systems are largely adapted to produce energy in the classic way, i.e., in conventional power plants, where large amounts of coal are burned.

The conversion of one energy system to an alternative, environmentally friendly (non-carbon dioxide emitting into the atmosphere), based on renewable energy sources is neither easy nor cheap and most often long-lasting (this applies both to the construction of new coal blocks, a new nuclear power plant and the creation of a production and transmission system for energy produced from RES). Such transitions require governments to carry out many complex and painful economic reforms and to spend considerable funds that are in short supply in their budgets.

Countries that have decided to develop energy technology based on renewable energy sources (sun, wind, water) use different models to finance this type of investment, seeking funding from external sources, loans, and passing the costs on to private investors and end users. Coal and lignite mines and coal-fired power plants are usually financed from the state budget and represent a large expenditure, while at the same time they are often higher than the aggregated benefits of their use and operation.

Investing private and public money in renewable energy sources is therefore of decisive importance now and will certainly continue to be so at least until 2050 in order to combat visible and invisible climate change.

One of the key developments in modern energy systems and measures to ensure widespread access to and uninterrupted use of energy in everyday life is a situation in which people themselves produce renewable energy from sources available to them on a daily basis (e.g., wind, water, sun) and then share the energy generated with other local and national energy users through energy networks: local, national and international (acting as prosumers).

More and more countries, and especially regions and cities, are increasingly pursuing a policy of implementing clean, "green" energy in everyday life, seeing this as an alternative, not only economically and politically, but above all socially, environmentally and health-wise, to traditional technologies and the negative effects of their use.

As a result of climate change and the lack of appropriate, adequate and sufficient policies to reduce greenhouse gases, individual societies and developed economies

(e.g., such as the European Union) have to deal with so-called externalities themselves, i.e., primarily costs that are not usually borne by those who have directly and indirectly contributed to them.

For example, almost 80% of the pollution emitted by Poland's coal-fired power plants ends up abroad and contributes to the many deaths of our closer and further neighbours that are being recorded with increasing frequency (the main causes of death associated with dirty air are cancer, heart disease and cardiovascular diseases, including cardiology).

All operating and generating power stations in Poland are the source of some 5 800 premature unnecessary deaths each year across Europe. In order to reduce these negative effects and increasingly accurately calculated costs, very restrictive mostly local regulations are being introduced in many European Union countries, which oblige operating and environmentally polluting power plants to gradually reduce greenhouse gas emissions and implement the most modern green technologies available for energy production, and governments as owners and producers systematically strive to continuously improve the efficiency and effectiveness of coal-fired power plants still in operation (Poisoning Europe... 2016).

The leader of anti-smog measures in Poland is Kraków and Małopolska. For example, in the Kraków area, from 1 September 2019, only certain types of fuel, i.e. natural gas or possibly light fuel oil, will be permitted in traditional fuel combustion installations (cookers, boilers, fireplaces). In practice, this means a total ban on the use of solid energy fuels (i.e. wood, coal and other similar fuels considered to be non-organic), which will be binding for all residents.

2. Renewable Energy Sources in the Energy Market and Energy Policy

Energy demand treated as one of the highest imperatives for meeting social and economic needs has become a determinant and component of the energy policies of individual developing countries. The energy policy and its objectives usually become a long-term overall development strategy for each country, which prioritises sources of energy raw materials and energy itself (e.g., when energy has to be imported), energy production, imports and exports of energy in all forms (e.g., electricity, heat, nuclear, renewable energy).

The implementation of an effective energy policy in a country, which is designed to pursue certain objectives, primarily energy independence and sovereignty, should normally take into account its raw material, production, distribution and transmission resources. It also takes into account what is happening on the world energy markets, i.e., the shortage or oversupply of specific energy raw materials, the prices of raw materials on commodity exchanges, the policies of various organisations of raw material and energy producers and exporters, associations of

countries implementing or building their energy policies increasingly linked to the climate and its changes.

However, a serious problem and an obstacle to the implementation of energy policy objectives is becoming a situation in which the inefficiency of the state's electricity system becomes apparent, resulting from years of neglect with regard to the expansion and modernisation of transmission and distribution networks, the adaptation of the network infrastructure to the locally and structurally changing demand for electricity and the locations of its generation.

In the event of extreme weather conditions or a sharply increasing demand for electricity, there may be local threats of energy shortages. One solution to these local problems could be an alternative energy infrastructure to the conventional system based on renewable energy sources (Wasiuta, 2014).

Nowadays, the concept of an aggregate type in relation to energy production and climate change - the climate-energy policy - is increasingly used (it is the dominant course of action in the European Union). This type of policy mainly focuses on improving energy efficiency, diversifying electricity production, enhancing security of energy supply and raw materials, developing and investing in renewable energy sources and developing competitive energy markets.

For example, energy efficiency is most often understood as action aimed at more efficient energy use, i.e. better conversion of chemical energy (from fuel) through mechanical energy (in the generator) into electrical energy, reducing energy consumption and taking pro-energy measures, planning energy production and consumption.

There is an increasing demand for cost-effective environmental energy innovations (eco-innovations), i.e., innovations that, among other things, reduce environmental damage or replace harmful technologies.

However, for the development of RES in any country, public acceptance of these sources, transparent procedures for the implementation of renewable energy, stability of legal and financial mechanisms, especially for investors, technical, including a gradual decrease in installation costs are needed (Juściński, 2010).

Renewable energy sources are primarily those whose use is not associated with the possibility of a long-term shortage. One of the most important, and probably the one with the longest history of its use for human purposes, is the energy of falling water. Other renewable sources such as wind energy, solar energy, biogas, biomass, geothermal energy and tidal energy are used on a smaller scale, but are also developing intensively (depending on the country and the renewable resources available).

Renewable energy is presented by some scientific and economic circles as a kind of synonym for environmentally friendly energy. Of the large-scale energy sources in use today, nuclear energy probably has the smallest ecological effect, while both fossil-based energy - mainly in the form of atmospheric pollution - and the energy of falling water - through, among other things, sometimes irreversible changes to biological ecosystems through the construction of dams and artificial water reservoirs - have a major impact on the environment and humans.

There is a provision in the Polish Energy Law (Dz. U. 1997 No. 54 item 348) that renewable energy sources are: "sources using, in the conversion process, wind energy, solar radiation, geothermal energy, wave energy, sea currents and tidal energy, river fall energy and energy obtained from biomass, landfill biogas, as well as from biogas generated in the process of discharging or treating sewage or decomposing stored plant and animal remains".

Renewable energy sources are most often diverse in terms of their origin and the presence of local resources, while requiring the installation of appropriate systems to convert such energy into usable energy.

In Poland, as in the rest of the world, installations for converting renewable energy sources into usable energy will increasingly be used to produce usable energy, due to their numerous advantages and multifaceted positive impact on the environment. Their share in the overall energy production mix will increase each year.

The gradual increase in the share of RES in the energy mix of many countries is primarily due to the energy and climate policy implemented, where renewable raw materials are an important tool in the fight against climate change. This is being done, among others, by the European Union and many countries that are actively involved in developing effective climate tools at individual climate summits.

The main products of the renewable energy market are: electricity and transmission service, heating and cooling, fuel for transport (including biofuels). The main types of renewable energy projects include:

- installations for the production of electricity and heat using biofuels (mainly biomass or biogas) obtained by methane fermentation; biodegradable waste can thus be used in a more diverse and useful way;
- wind power plants;
- hydroelectric power plants;
- photovoltaic cells and solar collectors;
- production of biofuels or other renewable fuels;
- heat pumps and devices that utilise ambient heat or heat from within the earth.

Obtaining energy (heat and power) from sources that do not harm the environment (or do so to a minimal extent) is becoming increasingly popular among

manufacturers and consumers. Pro-environmental activities of this type are supported by various incentives, most often financial: subsidies and sources from EU funds.

Renewable energy sources are also those that, in the long term, do not cause a deficit of natural resources present in the environment. The technology used to produce it is also important, i.e., it should have as limited an impact on the environment as possible (directly and in terms of carbon footprint). The resources used for energy production are or should be renewed within a foreseeable time. Practice shows that this mainly applies to geothermal and biomass energy. In the case of wind and solar radiation, it is difficult to speak of any consumption.

The following types and examples of 'green' energy can be distinguished:

- water energy (water turbines),
- solar energy (photovoltaic cells and solar collectors),
- biomass energy (incinerators, biogas plants),
- earth energy, or geothermal energy (heat pumps).

Renewable energy sources in the future can affect three basic political and economic dimensions of a country's market and economy, namely:

- economic (the economic efficiency of the RES solutions used and their impact on the final price of energy; this is the basis for building a competitive economy based primarily on cheap electricity; the use of RES reduces to some extent the risk associated with import dependencies, and this leads to a reduction in bearing the price risk - raw material prices are more stable and less susceptible to external price fluctuation phenomena; practice shows that the price of energy from RES is stable; RES are also a good solution in case of problems of a potential energy shortage in the internal market of a given country; RES can simultaneously be one of the sources of satisfying economic energy needs of a country; RES introduce a new model of energy culture in which production is located close to consumption centres;
- smaller losses and costs arising from energy transmission and distribution);
- geostrategic and political (RES diversify a country's energy balance; RES allow to reduce the level of a country's import dependence on suppliers of energy raw materials; RES reduce a country's vulnerability to external disruptions in the supply of these raw materials; the more internally and externally diversified the energy supply system, the greater the country's overall energy security; extensive use of RES creates opportunities for greater energy independence of a country and less vulnerability to external influences on a country's internal policy; a better negotiating position is then obtained in relations with raw material exporters);

- environmental and climate (environmental, related to the implementation of the idea of economic and energy sustainability, low-carbon, anti-smog and decarbonisation measures).

The impact of RES on a country's economic and energy policy depends primarily on the following factors:

- the growth dynamics of their use in a given area and the associated political and legal regulations;
- their share in the energy balance of the national energy system;
- the consideration of the different specificities of RES (legally, technically and organisationally there are some differences between individual RES);
- the degree of differentiation of the RES power generation process, in particular taking into account the division into: large-scale energy and distributed renewable energy;
- the legal, political and strategic conditions of a country's authorities and the place of RES in them;
- the (mainly natural) energy resources a country possesses which are the basis for the development of specific forms of RES in a given area (hydrological and wind conditions, number of sunny days, biological potential for biofuel production, etc.);
- the tradition and degree of utilisation of traditional, conventional energy carriers and resources (primarily fossil fuels) that a country has and which constitute the basis for the functioning of the national energy system in use to date, for which RES may be an alternative, a competitor or a substitute;
- the degree to which the country's authorities have complied with the various international climate and sustainability policy guidelines (including those of the European Union and the United Nations);
- the degree of affluence of a given society and economy and the costs of producing energy from different sources;
- the logistical, production and economic availability of the various technologies for producing energy from RES (primarily their purchase and operation, in most cases the renewable energy source itself is free and costs energy producers nothing).

3. Conclusions

Energy based on fossil and renewable sources is playing an increasingly important role, both economically and politically, in many countries and political organisations. Its importance for social and economic development has grown from decade to decade. Since the beginning of the industrial revolution, energy and its products, above all electricity, have become one of the most important economic sectors for economic development, economic independence, security and the normal functioning of ordinary citizens.

Today, countries in the world are divided into those with access to energy and those that are energy deficient. Both energy-rich and energy-poor countries are looking for alternatives, such as developing their own independent energy systems based on renewable energy sources. Renewable energy sources, through their economic and political dimensions, are increasingly implementing local and global energy policies and contributing to positive changes, especially in the area of thinking and acting to protect the climate from climate change.

Energy nowadays forms the basis of all economic activity and is therefore of strategic importance for the social and economic development of individual countries. It also occupies a key position in ensuring the economic security of the state and the fulfilment of the tasks and objectives associated with it.

Energy from various sources is essential for the uninterrupted functioning and systematic development of any state. Every state should therefore take all necessary measures, both operational and of a long-term type, to avoid energy deficit or shortage situations.

In Poland, the core of the energy system currently in operation and simultaneously being developed is based primarily on a coal-based energy culture. Its basic elements were developed at a time when market mechanisms were not widely and economically applicable and the economy was based on a centrally controlled model. The equilibrium price and production costs were either of secondary importance or not applied at all in economic practice.

During these times, economic calculation was not applicable and was not the primary tool for the operation of individual market actors. The production and distribution of energy was solely in the hands of the state and the energy system was completely monopolised. This did not force energy producers to take measures aimed at environmental protection, efficiency and the search for and implementation of new energy technologies, including those enabling the use of renewable sources.

Every country, for which the issue of climate change is not alien to it, should develop a model for the production, distribution and consumption of energy from renewable sources that is suitably adapted to development opportunities, in which private energy producers, including prosumers, should also find their place. As practice shows, a private investor will not be interested in investing his or her private financial resources in renewable energy production technologies when the total cost of energy production is greater than the potential revenue.

In the case of renewable energy sources, the costs of acquiring and operating raw materials are zero for many of their types (wind, solar, water), while the technology to produce 'green' energy becomes expensive. In connection with its production, the instability and asymmetry of its production must also be taken into account, with the consequence that the price of final energy becomes much higher than that produced

by conventional methods, despite their negative impact on the surrounding environment.

For many energy producers and consumers, it is irrelevant what negative impacts are associated with conventional energy production. The most important thing is to achieve the lowest possible marginal and unit cost of the energy produced. For producers, low costs are therefore important, as they are components of the final price delivered to final consumers, who want to buy energy at the most economically affordable price.

For prosumers and energy consumers, on the other hand, who choose an energy source for their own homes, the most important thing is to obtain the lowest possible costs for the monthly maintenance and operation of the dwelling (the choice is made for utilities with the lowest possible costs, not always of an ecological and environmentally friendly nature). External costs are neglected because they are either difficult to calculate at the time, or the negative effects only appear with a long delay and cannot be directly linked to the energy system, or there are no visible and proven methods for such a link.

Therefore, when analysing the economic aspects of obtaining energy from different resources and sources, including renewables, the following types of costs should also be taken into account: the exploitation of the social and natural environment for energy purposes, the costs resulting from the production of greenhouse gases in the case of conventional energy, the costs of treating illnesses caused by long-term breathing of polluted air, the costs of climate change, the costs of ensuring energy security or the costs of diversifying the supply of raw materials (e.g., building new installations, transmission lines, signing new contracts, etc).

Renewable energy sources bring many economic and political benefits, both in macroeconomic and local terms. Most scientific studies focus on the benefits and positives of RES development, especially when compared to traditional energy. Many specialists focus not only on the current aspects, but also on the climatic, political and economic effects that will take place in the future.

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