Development of Renewable Energy Source in Poland on the background of the European Union

Rozwój odnawialnych źródeł energii w Polsce na tle Unii Europejskiej

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Summary

Polityka Unii Europejskiej w zakresie ochrony środowiska i bezpieczeństwa energetycznego to nie tylko zbiór przepisów i zakazów, ale wprowadza nowe możliwości rozwoju gospodarczego, zwiększa bezpieczeństwo ekologiczne i przyczynia się do ochrony zdrowia publicznego poprzez ograniczenie emisji gazów cieplarnianych (GHG). Polityka ta przyczynia się do rozwoju odnawialnych źródeł energii (OZE), będących niezbędnym elementem ograniczania konwencjonalnych źródeł energii i paliw kopalnych odpowiadających za obecny stan i dalsze pogarszanie się środowiska. Edukacja ekologiczna i energetyczna społeczeństwa ma znaczący wpływ na dalszy rozwój odnawialnych źródeł

energii, przedstawienie realnych zagrożeń jak i wartości płynących z rozwoju zielonej energii przy wsparciu ze strony państwa, pozwoli na realną poprawę jakości życia społeczeństwa.

Cel: Celem artykułu jest próba określenia rozwoju sektora odnawialnych źródeł energii w UE. Analizowano przepisy, dyrektywy unijne, ustawy oraz obecny rolę państwa w rozwoju rynku energii odnawialnej.

Materiały i metody: Źródło danych stanowiła bogata literatura przedmiotu oraz Eurostat. W pracy wykorzystano metody tabelaryczne, graficzne i opisowe.

Wyniki: Analizy pokazują, że bezpieczeństwo energetyczne i ochrona środowiska stanowią jedno z największych wyzwań XXI wieku. Przy szybkim wyczerpywaniu się konwencjonalnych źródeł energii, i dalszemu rosnącemu zapotrzebowaniu na energię, od której wzrost PKB jest uzależniony na całym świecie, sprawia że degradacja środowiska przyspiesza, a wraz z nią emisje gazów cieplarnianych (GHG). Polityka Unii Europejskiej w zakresie ochrony środowiska i bezpieczeństwa energetycznego poprzez swoje działania, zabiega o zdecydowany rozwój rynku energii odnawialnej, zapobiegając wyczerpaniu się zasobów i zanieczyszczeniu środowiska.

Wnioski: Obecna sytuacja UE w tym polski pokazuje, że rozwój OZE jest jednym z najbardziej palących zadań we współczesnym zarządzaniu, gdzie energia odnawialna odgrywa kluczową rolę w ochronie środowiska, ochronie zdrowia publicznego i wzroście gospodarczym, zapobiegając wyczerpaniu się zasobów, zanieczyszczeniu środowiska i ograniczeniu emisji gazów cieplarnianych, niekiedy przy sprzeciwie sektora prywatnego i jego obywateli. W dużej mierze zależne od dostępnością wsparcia finansowego ze strony państwa.

Słowa kluczowe: odnawialna energia, rozwój gospodarczy, konsumpcja energii, GHG, OZE

Introduction

Energy consumption and production contribute two-thirds of GHG emissions on the global scale. Therefore, energy also has the greatest potential for slowing down GHG-driven climate change by accelerating the pace of innovation and promoting large-scale implementation of sustainable energy technologies [8]. The global energy system faces rapidly growing and changing requirements, including the fight against climate change as well as the predicted increase in the global demand for energy. The Fourth Industrial Revolution

has the potential to resolve both economic and social problems. Sustainable energy innovation offers solutions to many of the world's greatest challenges, and it is the key to harnessing the full potential of energy as a contributor to future growth and prosperity [8].

The growing awareness about the positive impacts of renewable energy on the environment and public health, plus the availability of renewable energy subsidies and loan schemes, have considerably altered public perceptions about renewable energy generation [3]. Governments often rely on social regulatory policies in the area of environmental pollution, health protection and safety [4].

The growing share of renewables in the national energy system decreases the demand for energy from conventional sources. The above decreases the consumption of primary energy generated from fossil fuels, which contributes to environmental protection [3]. The global production of renewable energy is determined by local energy potential, national policy and the support for renewable energy projects [3].

The government and specialist institutions provide oversight because market mechanisms are not effective in controlling the operations of businesses that are unwilling to limit emissions of harmful substances. Therefore, pollution control is regarded as the responsibility of the government [4].

Transformational change in sustainable energy generation is a complex process that should balance the priorities of economic growth, energy security, and environmental sustainability. This process requires close collaboration between innovators, regulators, system planners, investors, and end users. Governments and the private sectors should maximize their efforts and seize the opportunities offered by public-private cooperation to resolve problems that neither governments nor businesses can solve on their own [8].

Economic, environmental and social aspects of the development of renewable energy sources in the EU

Energy security and environmental protection pose one of the greatest challenges in the 21st century due to their indisputable effects on human health. The existing state of knowledge and scientific and technological advancement support the implementation of measures that effectively contribute to energy security, promote energy safety, and protect public health. The ability to harness the forces of nature in the process of developing renewable energy sources (RES) will play a key role in the race against time to minimize the adverse effects of climate change in the coming years.

Despite the surge in clean energy investments in the EU, fossil fuels continue to be subsidized in many countries around the world, and the adoption of carbon pricing and emission charges is not highly effective. The carbon-based socioeconomic system has contributed to a behavioral and economic lock-in in various end-use categories, thus limiting the implementation of sustainable energy solutions [8].

Despite its huge dependence on coal, Poland is gradually limiting its share in the economy. Therefore, it is forced to introduce alternative energy sources, which sometimes cause opposition from the mining lobby and the local community. Institutional support for research and development as well as direct capital investments is needed to promote renewable energy projects [6].

Energy is the backbone that powers all economies and modern human activity, and it delivers multiple benefits for society. Concerns over local air pollution have become critical in many countries, which gives priority to sustainable generation of energy that is affordable, secure, and available to all consumers [8]. The high costs associated with renewable energy generation and certain opposition from local communities, in particular with regard to the location of production facilities, pose certain barriers. Therefore, a robust system of legislative solutions, tax credits and financial incentives is required to distribute economic returns across society [6].

The costs associated with electricity production based on renewable energy sources (RES) vary and are largely dependent on local resource availability in the different regions and countries of the world. At present, energy generated from traditional sources is cheaper than renewable energy in many countries, including Poland. For this reason, renewable energy projects must receive initial support from the State [6].

Despite its growing popularity, renewable energy generation also faces opposition from critics who argue that clean energy installations are unduly expensive. However, equipment costs are borne only once, and the return on investment considerably exceeds start-up costs [59].

Renewable energy sources represent the key technology for reaching the energy poor by offering green electricity to communities that depend on conventional energy sources and expensive fossil fuels. Renewable energy technologies are particularly effective in meeting this goal because they provide small-scale solutions that meet the needs of the people affected by poverty. In the last decade, the reduction in equipment costs has made RES increasingly competitive with fossil fuels. Despite the above, these technologies continue to face numerous social, economic, and structural challenges [14].

Clean energy installations also reduce particulate pollution and improve public health, which is another important consideration. Wind energy has seen growing popularity relative to other renewable energy sources such as water and solar energy because „*it can be harvested with relatively little constraints regarding the location*" [15]. However, most protests address the location of renewable energy sites, such as wind farms, the resulting increase in noise levels, decrease in land value, infrasound emissions, and loss in tourism and the turbines can kill migrating birds.

For biogas, the main concerns expressed by members of the local community include high levels of heavy traffic during substrate transport and odor emissions. However, well-designed and properly managed agricultural biogas plants provide many benefits. Renewable energy facilities have more advantages than disadvantages because they use energy sources that are constantly renewed through anature cycle [3]. Dissemination of knowledge often sways negative opinions regarding renewable energy projects, which is why environmental and energy education is crucial [16].

Review of legal provisions

The implementation of the EU policy in the area of environmental protection and energy security contributes to the rational management of energy sources and increases the proportion of energy generated from renewable sources (wind energy, solar energy, geothermal energy, tidal power, biofuels, and biomass) as alternatives to fossil fuels, thus limiting greenhouse gas (GHG) emissions. This policy has been announced by the IPCC special report Global Warming of 1.5 °C (2018) [1]. Effective management of energy sources is a priority goal of the EU policy that aims to reduce CO_2 emissions and minimize the harmful effects of climate change [2].

The EU policy aims to further reduce CO_2 emissions. This goal will be achieved by developing and implementing energy-efficient technologies in the industrial sector and by increasing the proportion of energy generated from renewable sources [5].

The Ministry of Energy develops energy laws and is responsible for Poland's energy policy. According to Directive 2009/28/EC of the European Parliament and the Council of 23 April 2009 on the promotion of the use of energy from renewable sources, the Member States, including Poland, must establish mandatory national targets to generate a certain proportion of their energy from renewable sources by 2020. In the EU, the transition to a modern, low-carbon, and energy-efficient economy and the development of RES led to the decoupling of

GHG emissions and energy consumption from economic growth, for the common good. The EU is well on track to achieveits 2020 target for reducing GHG emissions by 20% relative to 1990 levels [9].

Poland has signed the Kyoto Protocol on climate change, and it hosted the 2018 UN Climate Change Conference in Katowice, which saw the adoption of the Katowice Package as a rulebook for the implementation of the 2015 Paris Agreement [6].

In July, 2018 three countries of the EU: France, Spain and Portugal established that the issue of renewable energy is important for not only the EU, but also the world as a whole. The Paris Agreement pointed out the important role of the EU in the decarbonization of the EU, and to promote convergence in Member States [12]. EU Member States are also required to keep the global average temperature rise well below 2 ° C above pre-industrial levels [10].Legal norms that are consistent with the EU targets and are effectively implemented play a key role in energy security. The energy policy is not separate from socioeconomic processes that are regulated by numerous documents and laws in various segments of the economy [13].

The move towards a sustainable and carbon-neutral society requires transformations of socio-technical energy systems around the world. This is common political goal in the international arena. However, there are concerns about some EU Member States' deviation from renewable energy action plans, different speeds and forms of energy transition processes, as well as policies that lack long-term consistency. Despite considerable efforts within the EU to transition to renewable energy, the change process is often thwarted by vested interests, institutional barriers, and path dependencies in the power sector [11].

Despite legal solutions that limit financial support for the development of renewable energy projects, the share of RES in Poland's overall energy balance will continue to increase in coming years [6].

Aim and Methodology

The purpose of this paper is to present an attempt to determine the development of the renewable energy sector in the EU and its importance in development in Poland. Taking into account regulations, the state of the economy, external factors, and internal policies of EU countries, we can observe differences between them in the process of increasing the share of renewable energy sources in energy production. The regulations, EU directives, laws and the current role of the state in the development of the renewable energy market were analyzed. The source of data was rich literature on the subject and the Statistical Office of Eurostat,

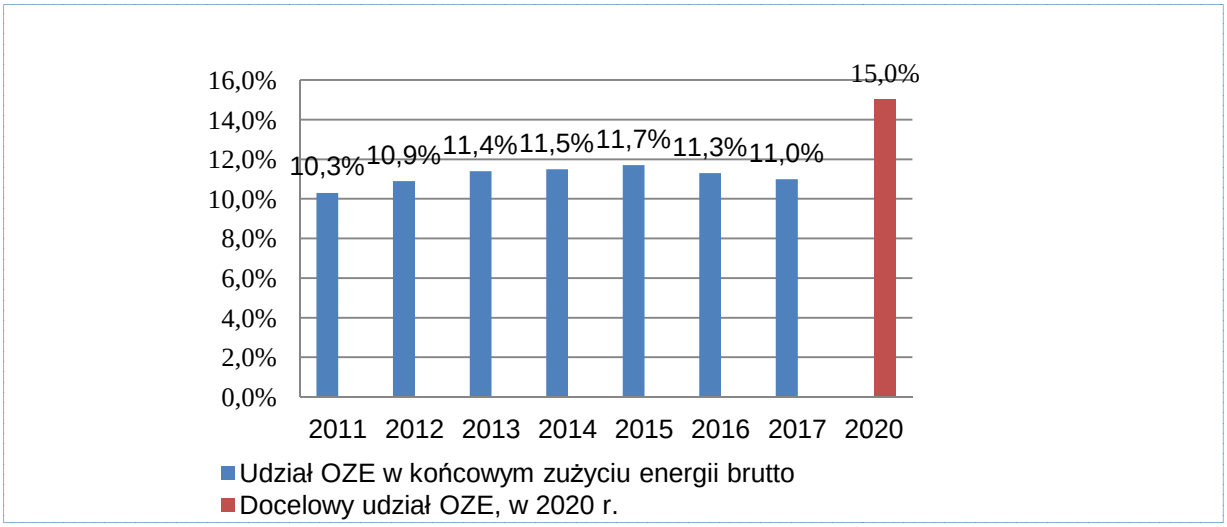
Central Statistical Office. To present the result this work uses tabular, graphic methods, whereas to analyze the results the Authors of the paper used descriptive methods. The time frame of the research falls between 2010-17 with a perspective until 2020. The areas analyzed are EU countries, including Poland.

Results

The development of RES is one of the most pressing tasks in contemporary governance. Renewable energy plays a key role in environmental protection, protection of public health and economic growth and it depends on policy.

Poland for example established the target of 15% of share of renewable energy in gross final energy consumption, but in 2017 it achieved only 10.9% (fig. 1).

Figure. 1. Share of renewable energy in gross final energy consumption[%]



Source: [GUS] 2018 [18]

In Poland, the share of energy from renewable sources in gross final energy consumption decreased from 11.3% to 10.9% in 2017 in comparison to 2016. There is a risk that Poland will have to engage in an energy transfer from countries that have met their targets and have an excess.

The following Member States have surpassed their 2020 targets by 2017: Croatia – by 7.3%, Denmark – by 5.8%, Sweden – 5.5%, Estonia – by 4.2%, Finland – by 3%, Lithuania – by 2.8%, Bulgaria – by 2.7%, Czech Republic – by 1.8%, Italy – by 1.3%, Romania – by 0.5%, and Hungary – by 0.3% (Table 1).

Poland is one of the few countries in the world where the share in energy sources is entirely subject to a gross energy consumption decrease in 2016 and 2017. Thisdecreasecan be attributed mainlyto the adoption of a law that imposed new restrictions andadditional charges on the construction of wind farms, thus decreasing their profitability. Another reason was the decrease in the prices of green certificates, which were introduced to boostcompetition in the green energy sector. These measures decreased the profitability of wind farms and pellet fuel. Some wind farms were closed [3]. The development of the renewable energy sector is influenced not only by State support, but also by rational law-making.

Table 1. Share of renewable energy sources in final gross energy consumption in the EU (%)

Countries	2004	2010	2011	2012	2013	2014	2015	2016	2017	2020 target
UE-28	8.5	13.1	13.4	14.7	15.4	16.2	16.7	17	17.5	20
Belgium	1.9	5.6	6.3	7.2	7.5	8	7.9	8.6	9.1	13
Bulgaria	9.4	14.1	14.3	16	19	18	18.2	18.8	18.7	16
Czech Republic	6.9	10.5	11	12.8	13.9	15	15	14.9	14.8	13
Denmark	14.9	22.1	23.5	25.7	27.4	29.7	31.4	32.6	35.8	30
Germany	6.2	11.7	12.5	13.6	13.8	14.4	14.9	14.9	15.5	18
Estonia	18.4	24.6	25.4	25.5	25.4	26.2	28.4	28.6	29.2	25
Ireland	2.4	5.8	6.6	7.1	7.6	8.7	9.1	9.3	10.7	16
Greece	6.9	9.8	10.9	13.5	15	15.4	15.4	15.1	16.3	18
Spain	8.3	13.8	13.2	14.3	15.3	16.1	16.2	17.4	17.5	20
France	9.5	12.7	11.1	13.6	14.2	14.8	15.2	15.9	16.3	23
Croatia	23.5	25.1	25.4	26.8	28	27.8	29	28.3	27.3	20
Italy	6.3	13	12.9	15.4	16.7	17.1	17.5	17.4	18.3	17
Cyprus	3.1	6	6	6.8	8.1	8.9	9.4	9.3	9.9	13
Latvia	32.8	30.4	33.5	35.7	37	38.6	37.5	37.1	39	40
Lithuania	17.2	19.6	19.9	21.4	22.7	23.6	25.8	25.6	25.8	23
Luxembourg	0.9	2.9	2.9	3.1	3.5	4.5	5	5.4	6.4	11
Hungary	4.4	12.7	14	15.5	16.2	14.6	14.4	14.3	13.3	13
Malta	0.1	0.8	1.8	2.8	3.7	4.7	5.1	6.2	7.2	10
Netherlands	2	3.9	4.5	4.7	4.7	5.5	5.7	5.9	6.6	14
Austria	22.7	29.9	30.1	31	32	33.2	32.8	33	32.6	34
Poland	6.9	9.3	10.3	10.9	11.4	11.5	11.7	11.3	10.9	15
Portugal	19.1	24.2	24.6	24.6	25.7	27	28	28.4	28.1	31
Romania	16.2	23.1	21.2	22.8	23.9	24.8	24.8	25	24.5	24
Slovenia	16.1	20.4	20.3	20.8	22.4	21.5	21.9	21.3	21.5	25
Slovakia	6.4	9.1	10.3	10.4	10.1	11.7	12.9	12	11.5	14

Finland	29.2	32.4	32.8	34.4	36.7	38.8	39.3	39	41	38
Sweden	38.7	47.2	48.7	51.1	51.9	52.4	53.6	53.8	54.5	49
United Kingdom	1.1	3.7	4.2	4.2	5.3	6.5	8.4	9.2	10.2	15

Source: Own elaboration based on Eurostat data [17] (https://ec.europa.eu/eurostat/statistics explained/images/4/4d/Share_of_energy_from_renewable_sources_in_gross_final_consumption_of_energy%2C_2004-2017).

Such countries as Bulgaria, Czech Republic, Croatia, Hungary, Austria, Poland, Portugal, Romania, and Slovakia have decreased the share of renewable energy in gross final energy consumption. Reasons for these decreases are numerous.

The data included in Table 1 confirms that the biggest shares of renewable energy in gross final energy consumption in 2017 were in: Sweden (54.5%), Finland (41.5%) and Latvia (39.0%). The smallest shares of renewable energy in gross final energy consumption in 2017 were in: Luxemburg (6.4%), Netherlands (6.6%) and Malta (7.2%).

Along with the increase in the share of energy from renewable sources, technologies for their production are developing. This contributes to the gradual displacement of fossil fuels that are unable to compete with the rapidly developing and effective renewable energy industry. Prices of CO_2 emission allowances are constantly rising, which means that some energy sources are already becoming cheaper than energy produced in coal-fired power plants. The average production cost of coal-fired power plants worldwide is $ 0.07 per kWh. Since the average cost of electricity production from coal is not expected to fall, the implementation of IRENA forecasts announces that in three years renewable energy may have a permanently lower average price than energy from coal-fired power plants [19].

Table 2. Global (LCOE*) of utility-scale renewable power generation technologies, 2010–2018 [USD/kWh]

Year	Bioenergy	Geothermal	Hydro	Solar photovoltaic	Concentrating solar power	Offshore wind	Onshore wind
2010	0,075	0,048	0,037	0,371	0,341	0,159	0,085
2018	0,062	0,072	0,047	0,085	0,185	0,127	0,056

Source: The International Renewable Energy Agency (IRENA) Report: Renewable Power Generation Costs in 2018. * LCOE (Levelized Cost Of Energy) shows the cost of energy produced, taking into account many factors, such as investment, fuel cost, operation and installation maintenance costs and financing. A method commonly used is to compare different energy sources.

Today in most of parts of the world, renewable energy sources are becomingthe cheapest source of new power. Data from the IRENA report show that since 2010, the global

average cost of electricity (LCOE) from bioenergy, solar, geothermal, hydro, terrestrial and marine energy has been competitive with the cost of producing energy from fossil fuels [19].

Conclusion

Conventional energy sources are being rapidly depleted, and the growing demand for energy around the world accelerates this process. Supportive laws, policies, and conditions are required to promote the growth of renewable energy markets, prevent resource depletion and environmental pollution, and to reduce GHG emissions [3].

The growth of the renewable energy sector is largely determined by the availability of government financial support [5]. Air pollution continues to rise despite alarming medical reports. Article 68 of the Polish Constitution states that public authorities are responsible for preventing health risks associated with environmental degradation. Therefore, the prevention of environmental pollution is not only a fundamental task of government, but it represents every citizen's right to live in a clean and healthy environment [6].

Due to numerous problems in the renewable energy sector and the drawbacks of the Renewable Energy Act, successive amendments have already been scheduled by the Ministry of Energy to address the existing issues and market imperfections. Market failures enforce government intervention, but the imperfect nature of the State and the political system should also be taken into consideration. The State can be an equally ineffective mechanism of resource allocation as the market [7].

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Summary

The European Union's policy on environmental protection and energy security is not only a set of regulations and bans. At the same time, it introduces new opportunities for economic development, it enhances ecological safety and contributes to public health protection by limiting greenhouse gas (GHG) emissions. This policy contributes to the development of renewable energy sources (RES) and those take an essential part in limiting consumption of basic energy sources and fossil fuels that are responsible for the current state and further deterioration of our environment. Environmental and energy education of our society has a significant impact on further development of renewable energy sources. It presents real dangers but also values derived from the development of green energy with the support of the state. It will bring a tangible improvement in the society's quality of life.

Aim: The main purpose of the article is to attempt to determine the development of the renewable energy sector in the EU. The regulations, EU directives, laws and the current role of the state in the development of the renewable energy market were analyzed.

Materials and Methods: The source of the data was the extensive literature on the subject and Eurostat. This work used tabular, graphic and descriptive methods.

Results: Analysis show that energy safety and environmental protection are one of the greatest challenges of the 21st century. With the rapid depletion of conventional energy sourcesand the continued growing demand for energy, on which the growth of GDP depends globally, causes accelerated degradation of the environment, and with it , greenhouse gas (GHG) emissions. As far as energy safety and environmental protection is concerned, the policy of the European Union , through its actions,strives towards development of the renewable energy market . This in turn prevents the depletion of resources and environmental pollution.

Conclusions: The current EU situation, including countries like Poland, shows that the development of renewable energy is one of the most pressing issues in modern management, where renewable energy plays a key role in protecting the environment, public health and economic growth. It also prevents resource depletion, environmental pollution and reduces greenhouse gas emissions. It sometimes occurs with the opposition of the private sector and its citizens. To a large extent it is dependent on the availability of financial support from the state.

Key words: renewable energy, economic growth, energy consumption, GHG, OZE