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CONSTENTS

Strategies of Central European countries in the energy dimension during the Russian-Ukrainian war

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Abstract: The Russian-Ukrainian war had a significant impact on the energy situation of Central European countries and significantly influenced the need to activate efforts to diversify the sources and directions of energy supply, as well as activities to reduce natural gas demand. The energy dependence built over the years by the Russian Federation was characterized primarily by the development of infrastructure and the conclusion of long-term contracts. The aim of the article was to analyze the activities of the Central European countries of the European Union during the Russian-Ukrainian war and to define the key activities that were primarily undertaken in 2022 towards ensuring energy security. The starting point was the thesis that the Central Europe countries made optimal use of the existing energy infrastructure, which made it possible to reduce the impact of the Russian Federation on the energy security of this countries and ensure the availability of commodity.

Key words: Central Europe, energy security, Russian Federation, natural gas, crude oil

Introduction

Central European countries were in a difficult political and economic position when the Russian Federation launched its full-scale aggression against Ukraine in February 2022. Undoubtedly, the war came as a great surprise and forced the countries of the region to reorganize, in many cases, the entire supply chain of energy resources. Under these conditions, it was necessary to take action on many dimensions, a key aspect of which was energy, given the heavy dependence of Central European countries on commodity supplies from the East.

For years, the Russian Federation has been expanding its energy infrastructure and seeking to make Central European countries as dependent as possible on energy supply. The measures taken were related to Russia's implementation of the Falin-Kvitsky doctrine in this part of Europe (Mróz, Paszkowski 2023: 69-82). Thus, its policy was directed, on the one hand, at reducing the importance of Ukraine for natural gas transit (vide the construction of the Nord Stream 1, Nord Stream 2 and TurkStream pipelines), while at the same time concluding long-term natural gas supply contracts, thus reducing competitiveness in Europe.

With the outbreak of war in February 2022, Central European countries were forced to take a set of measures to ensure energy security and thus minimize the possibility of energy supply disruptions. In this regard, measures were taken both on the supply side (diversification of sources and directions of energy supply) and on the demand side (reduction of demand for commodities). A key aspect of enabling such measures was the existing and developed import infrastructure. At the same time, an important aspect of the measures taken was the strengthening of cooperation with key exporters of crude oil and natural gas in the world (including Algeria, Azerbaijan, Norway, the US).

The aim of the article was to analyze the actions of the Central European countries of the European Union during the Russian-Ukrainian war and to define the key actions that were taken primarily in 2022 towards ensuring energy security. The measures introduced were part of a strategy that aimed, on the one hand, to ensure the functioning of the economy (defensive element), and at the same time to ensure freedom of action when sanctions were imposed on the aggressor (positive element). The starting point was the thesis that Central Europe countries made optimal use of the existing energy infrastructure, which made it possible to limit the impact of the Russian Federation on the energy security of the countries and ensure the availability of commodities. Despite this, given the nature of the energy markets, the war led to an increase in the price of commodities, which had a direct impact on the state of the economy of these countries.

Energy dependence on the Russian Federation

For many years, the Central Europe countries remained energy dependent on the Russian Federation, which affected the nature and type of pursued energy supply policy. Such a situation was related both to the perception by countries in the region of Russia as a guarantor of security (stable commodities supply), the availability of natural gas and crude oil from that direction, and the lack of political acceptance (partly also due to the strong influence of Russian lobbying) for the implementation of costly projects to diversify the sources and directions of crude oil and natural gas supplies.

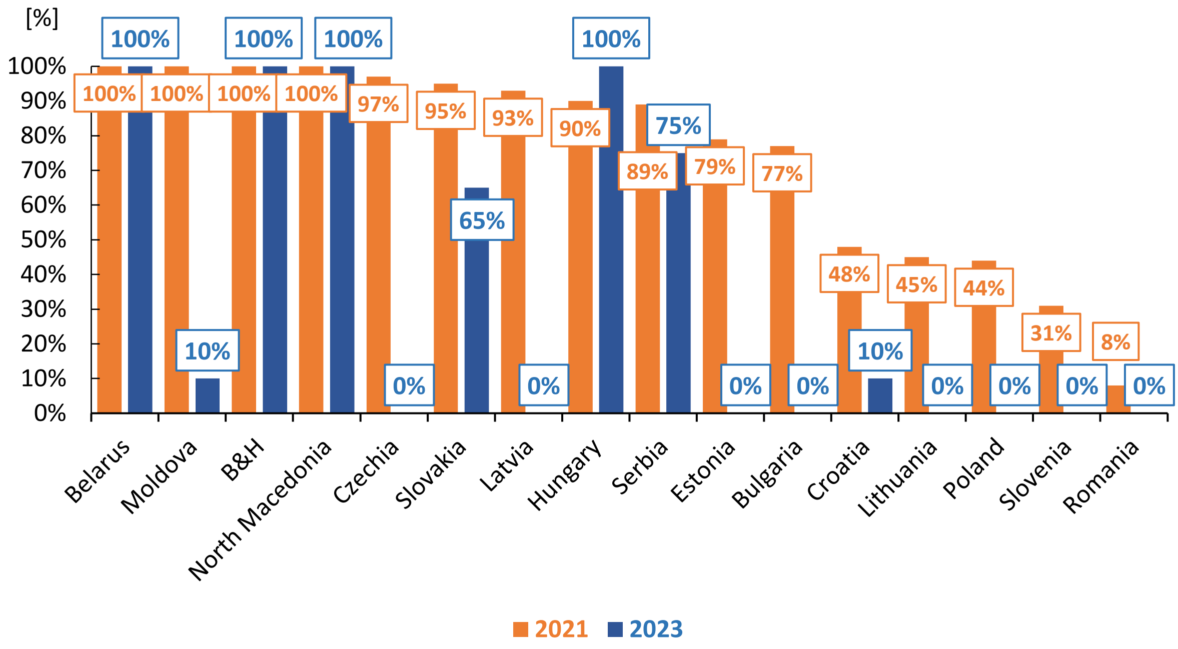
The armed attack by the Russian Federation on Ukraine in 2022 changed the perception of the aggressor in Central Europe and the actions taken by the authorities in Moscow in the international community. The negative assessment of the aggression caused countries in the region, partly also influenced by the position of the European Union as a whole, to take active measures aimed at replacing crude oil and natural gas supplies from the Russian Federation as soon as possible. Importantly, the level of energy dependence before the outbreak of war was different, which meant that the scope of the measures taken and the subsequent strategy adopted differed from country to country.

Before the war, the Russian Federation was an important supplier of crude oil to refineries in Central European countries. There are a total of 12 refineries in the region, which imported crude oil. Russia crude oil has played a key role in the facilities of most countries over the years, and investment projects have also been carried out under the Russian (Urals) grade. Importantly, the modernization and development work was primarily concerned with increasing the depth of crude oil processing, rather than building other plants or focusing on processing other grades. At the same time, an important aspect related to the operation of the refining sector was the existing infrastructure, which enabled the supply of crude oil from east to west. It was through the Druzhba pipeline that most refineries in Central Europe were supplied (Paszkowski 2022: 13-32).

Undoubtedly, both in terms of technology and infrastructure, the cooperation of Central European countries with the Russian Federation was essential and determined the level of liquid fuels produced. Only companies with access to alternative crude oil sources (mainly located on maritime basins) made efforts to change the structure of crude oil supply. Importantly, this was a difficult process, as crude oil from the Russian Federation was in most cases optimal for refineries in the region (the ideal grade in terms of optimizing processing and liquid fuels production), while being relatively comparable in price to other grades, and often cheaper.

Therefore, a large part of the available non-Russian crude oil was only a supplement to Russian crude for refining facilities.

Fig. 1. Russia's share of gas deliveries to CEE countries (2021 vs. 2023)



Source: Compiled by the author based on International Energy Agency.

With regard to natural gas, the situation was comparable and the level of energy dependence of Central European countries on the supply of this commodity was mainly due to the availability of Russian natural gas in this part of the continent, which was related to the existing infrastructure. At the same time, a characteristic feature of the natural gas market was the conclusion of long-term contracts (10-20 years) which, in terms of investment, made it possible to guarantee the costs incurred for investments, but at the same time influenced the growing energy dependence between the exporter and importer. Importantly, it should be pointed out that in many Central European countries there were political parties advocating the implementation of joint energy projects with the Russian Federation, which also affected the intensity and depth of political-energy relations.

The level of dependence of Central European countries on the Russian Federation varied in February 2022, as the country was perceived differently in international relations. Undoubtedly, there was a large share of its supply in the Baltic States, with the existing infrastructure, mainly the Klaipeda LNG terminal in Lithuania (Sytas 2022), creating conditions for increasing natural gas supplies from other directions. Also high was the level of dependence among the Visegrad Group countries, which forced a different response to natural gas supplies from the Russian Federation. In Poland, the LNG terminal in Swinoujscie, natural gas production and interconnections (Germany, Slovakia, Lithuania) played the biggest role. For Czechia, access to transmission infrastructure operating in Germany was key, while Slovakia has only partially given up on importing natural gas from the Russian Federation. In contrast, Hungary, for which Russia was for years the guarantor of energy security, continued to supply natural gas from that country (Preussen 2022). The situation was different for Slovenia, Croatia and Bulgaria, as these countries were able to rapidly increase supplies from other directions (LNG terminal on Krk Island in Croatia and the subsequent Bulgaria-Greece interconnector played a big role here). As for Romania, the country is a large natural gas producer, so the level of dependence on natural gas supplies from the Russian Federation was small.

The outbreak of the Russian-Ukrainian war took place in February 2022, a period when all underground natural gas storage facilities in Central European countries were set to extrude natural gas. Supporting, for the subsequent efforts to ensure energy security, were weather conditions (warm winter), which resulted in the storage facilities not being fully utilized. At the same time, the increase in natural gas prices on international market meant that many LNG cargoes originally destined for the Asia-Pacific region were subsequently redirected to Europe. Also, measures taken to reduce the level of demand for this commodity meant that there was no shortage of natural gas availability in Europe.

In summary, it should be pointed out that the level of energy dependence of Central European countries on the Russian Federation before the outbreak of the Russo-Ukrainian war varied and was due to a number of factors, the key one being the existing infrastructure and the perception of Russia in the country. Undoubtedly, only a handful of countries prior to the outbreak of the war took active steps to change the structure of energy supplies and thus initiated investment projects many years ago. Importantly, despite the difficulties of a logistical nature, it was possible in 2022 to reduce the level of energy dependence of Central European countries that implemented appropriate strategies in this regard.

Mechanisms used during the war

The Russian Federation's armed attack on Ukraine in 2022 came as a shock to most Central European countries. Importantly, only a handful of countries prior to this period had taken active steps to build a more diversified commodities supply structure and had developed infrastructure in this regard, including mainly natural gas pipelines. The lack of adequate action before 2022 influenced the need to develop a new strategy in the changed political and market environment.

Among Central Europe countries, the level of dependence on the energy supply was different before 2022, and at the same time the share of individual energy commodities in energy mix was different. Under these conditions, the countries of this region have differently initiated activities to enhance energy security. In this context, a set of eight activities can be distinguished. Firstly – maximizing the existing import capacity of the already existing LNG terminals (Swinoujscie, Klaipeda, Krk), which enabled natural gas supply diversification. Importantly, in 2022, but before the outbreak of war, LNG deliveries took place, but only to the Klaipeda LNG terminal (0.31 bcm in 2021 versus 0.29 bcm in 2020) and the terminal on the island of Krk in Croatia (one cargo – 0.08 bcm in April 2021) (Elh 2022). A key aspect of the activities undertaken was the establishment of cooperation with new natural gas suppliers and the continuation of cooperation with existing trading partners. Consequently, there was an opportunity to build a more diversified supply structure.

Secondly – the continuation of commodity imports from the Russian Federation and the abandonment of supplies when political conditions changed. The outbreak of the Russian-Ukrainian war took place in the autumn-winter period, when the process of extrusion of natural gas from underground gas storage facilities of this commodity was underway. Therefore, some countries decided to continue imports. However, the mechanism introduced by the Russian Federation for payment in the Russian currency (ruble) for the purchased natural gas caused many companies to decide to abandon such a solution (Papadia, Demertzis 2022). Such a stance caused Gazprom to unilaterally break contracts for natural gas supplies to Poland, Bulgaria, Finland, among others (Pokharel, Thompson 2022).

Thirdly – expansion of new import capacities aimed at securing natural gas supplies from directions other than the Russian Federation. In this context, the key activities were the construction of new regasification terminals (Inkoo in Finland – a joint project with Estonia) (Paszkowski 2022) and interconnectors (completion of the Poland-Lithuania, Poland-Slovakia, Bulgaria-Greece pipelines). As a result, there has been an increase in natural gas import capacity. At the same time, the completion of several energy projects in the region meant that there was an opportunity to increase trade between countries in the region. A key project was the construction of the Greece-Bulgaria Interconnector (IGB), which allowed natural gas supplies from Azerbaijan to Central European countries (Paszkowski 2023a).

Fourthly – participation in new energy projects that enable natural gas supply contracts through new import channels. In this case, it was possible to participate in equity in regasification projects or to conclude binding supply contracts through another import channel. This type of solution was used by the state-owned ČEZ a.s. company from Czechia, which concluded an agreement to reserve the import capacity of the Eemshaven LNG terminal in the Netherlands (opened September 8, 2022) with an import capacity of 8 bcm per year and ČEZ a.s. has a guaranteed capacity of 3 bcm per year (Gazdík 2022), which corresponds to 35% of domestic needs. In addition to access to import infrastructure, an important aspect of this was the use of existing gas pipelines that previously allowed the transportation of natural gas from the Russian Federation (this type of situation was primarily the case with the OPAL, EUGAL and STEGAL pipelines in Germany).

Fifthly – the acquisition of assets owned by the Russian Federation in Central Europe. The key problem as late as 2021 was the level of filling of underground natural gas storage facilities, as from mid-2021 Gazprom did not fill the storage facilities it owned/co-owned in Europe (storage facilities in Austria, the Netherlands, Germany, Serbia, Czechia). As for the Czechia the storage capacity owned by Moravia Gas Storage a.s.[1] of the Dambořice underground natural gas storage facility (448 mcm, or 13% of the total Czechia storage capacity) and leased by Gazprom was being filled. Nevertheless, in order to ensure energy security, in 2022 the government in Prague introduced an amendment to the Energy Act, under which the state could seize unused storage capacity and "sell" it at auction to other companies (Cyrus 2022).

Sixthly – a reduction in the level of demand for natural gas. The Russian-Ukrainian war made it necessary for Central European governments to take action not only on the supply side (search for new sources of natural gas supply), but also on the demand side. Thus, mechanisms were put in place to save energy. Nevertheless, in this case the key aspect was the price of commodities. The large increase in natural gas quotations caused companies in Central European countries to take two actions: 1) they reduced economic activity, as exemplified by the chemical sector (e.g., the reduction of production by the Lithuanian company Achema AS);

[1] The underground natural gas storage belonged to a joint venture, namely Gazprom and MND (Moravske naftove doly), which is part of the KKCG holding company of Czechia billionaire Karel Komarek.

2) many companies, if possible, used other energy carriers (coal, heavy fuel oil) as part of the so-called fuel-switching process. As a result, Central European countries saw a 17% drop in natural gas demand in 2022 compared to 2021.

Seventhly – the continuation of natural gas supplies and the conclusion of new contracts to import the resource from the Russian Federation. While most Central European countries condemned the armed attack by the Russian Federation on Ukraine in February 2022, there were also countries that continued economic cooperation with the aggressor. Under these circumstances, such action was taken by the government in Budapest, which also increased commodities supply from the East under such circumstances. Another, of this type, was to receive permission to derogate regulations for crude oil supplies via the Druzhba pipeline. Consequently, the strategy of Hungary (only partly by Slovakia and Czechia), was not to diversify the sources and directions of energy supply, but to continue trade with the Russian Federation, which is treated as a guarantor of energy security.

Eighthly – the release of crude oil and liquid fuels stocks. The launch of the armed attack by the Russian Federation on Ukraine in February 2022 had an overwhelming impact on the global crude oil market. Russia is one of the largest producers and exporters of crude oil, and the sanctions introduced in connection with the war by the US and EU countries, among others, were aimed at limiting the availability of the country's crude oil on international markets. It was originally estimated that Russia would be forced to reduce its crude oil production by up to 3 million barrels/day (International Energy Agency 2022). The potential gap in crude oil from this country could have shaken the global economy, and for this reason OECD countries decided to release accumulated crude oil and liquid fuel stocks twice, for a total of about 182.7 million barrels (62.6 million barrels and 120 million barrels).

To recapitulate, it should be pointed out that the strategies adopted by the Central European countries in the direction of ensuring energy security varied, which was due to the different level of dependence on energy supplies from the Russian Federation. Undoubtedly, the main characteristic of the activities undertaken was the need to diversify the sources of natural gas and crude oil based on existing, as well as new energy infrastructure. An important aspect of the activities undertaken was also the acquisition of assets of companies with Russian capital in key elements of energy infrastructure (such as storage facilities). Importantly, also part of the chosen strategy was to continue supplying commodities from the aggressor, as was the case with Hungary.

Importance of energy infrastructure

A change in the strategy of Central European countries towards the realization of alternative energy supplies was made possible by completed infrastructure projects. During the Russian-Ukrainian war period, new investments were also initiated to increase import and transmission capacities along the north-south route for natural gas. In this context, one can point to several projects that led to an increase in the energy security of Central European countries and were an important tool in the implemented energy policy.

Ensuring energy security in the region required the expansion of import capacity and interconnections between countries in the area of natural gas. In this context, several investments in the construction of LNG terminals and interconnectors were fundamental to increasing the availability of natural gas from outside the Russian Federation in Central European countries.

First – the FSRU LNG terminal in Inkoo, Finland (Exemplar ship), as a joint Finnish-Estonian investment to increase the supply of natural gas to the Baltic States with a regasification capacity of 5 bcm per year. Second – expansion of the import capacity of the Klaipeda LNG terminal in Lithuania from 3.75 bcm/year to 5 bcm/year (no information on the timing of the investment). Third – expansion of the Swinoujscie LNG terminal in Poland from its current import capacity of 6.2 bcm to 8.3 bcm in 2023. Fourth – the construction of an FSRU-type LNG terminal in Gdansk, Poland, with an import capacity of perhaps 12 bcm (two options are being considered, i.e. the construction of one larger terminal, or two smaller ones, which will depend on interest from other Central European countries, i.e. Czechia. and Slovakia and possibly Ukraine), to be built by 2028. Fifth – expansion of the regasification capacity of the LNG terminal on Krk Island in Croatia from 2.9 bcm to 6.1 bcm per year (according to government declarations), to be completed by 2029[2]. Sixth – the construction of the Poland-Lithuania interconnector. The pipeline became operational in May 2022 and enabled the integration of the Baltic States into the European Union market. At the same time, due to its bi-directional opportunity (2.4 bcm on the route from Poland to Lithuania and 1 bcm from Lithuania to Poland), it is possible to supply both from Poland's gas system to Lithuania and to supply natural gas also from the LNG terminal in Klaipeda to Poland. Seventh – the construction of the Poland-Slovakia interconnector. Commissioned at the end of August 2022, the pipeline allows natural gas transmission of 5.7 bcm per year towards Poland and 4.7 bcm per year towards Slovakia. Eighth – the construction of the Greece-Bulgaria interconnector which was built and put into operation in October 2022. The pipeline with a transport capacity of 3 bcm per year enables the supply of natural gas from Greece to Bulgaria (Paszkowski 2023b; Paszkowski 2023c). Consequently, there was an opportunity to increase the diversification of sources and directions of natural gas supplies to Central European countries. The pipeline itself allowed for increased availability of Azerbaijani natural gas in the region, which increased the importance of the country for regional energy security (Zespół ThinkTank Trójmorze 2022).

Undoubtedly, through the implementation of these investments, there has been an increase in market liquidity in Central European countries through greater trade. At the same time, the commissioning of pipelines and terminals on schedule (projects that have been underway for several years) or at a rapid pace (most notably, the Inkoo LNG terminal) has increased the energy security of countries from this region. Import capacity is important enough today, which means that some projects (vide the FSRU-type LNG terminal in Skulte) will not be implemented, as the already existing infrastructure guarantees adequate transportation of natural gas.

In conclusion, it should be stated that if infrastructure projects it were not initiated in the last few years (including the Poland-Denmark, Poland-Lithuania, Poland-Slovakia, Bulgaria-Greece gas pipelines), there would be no possibility of ensuring the security of natural gas supplies in Central European countries. Under these conditions, the Russian-Ukrainian war could be a factor that would prompt the Russian Federation to use energy blackmail as part of its energy policy. While there was ultimately a unilateral termination of Gazprom's contracts to supply natural gas to Poland, Bulgaria and Finland, among others, energy security was ensured in 2022 through investments planned in advance and implemented in a timely manner.

[2] In the Central European countries, the construction of an FSRU-type LNG terminal in Skulte, Latvia, with an import capacity of 1.5 bcm per year was also originally planned, but the country's government finally abandoned the project in August 2023 (A'Hearn 2023).

Conclusions

Central European countries, with the outbreak of the Russian-Ukrainian war in February 2022, had to take active measures to ensure energy security. Actions taken by the Russian Federation over the years in the energy dimension served to build dependence on the supply of energy resources and were intended, in principle, to limit the possibility of introducing sanctions against Russia at the time of an armed attack on Ukraine. It was thanks to the Nord Stream 1, Nord Stream 2 (which was not certified) and TurkStream/Balkan Stream pipelines that were built that there was an opportunity to "bypass" Ukraine and provide direct natural gas supplies to Western European and Central European countries. Consequently, prior to the application of military action, there were numerous political, propaganda and energy measures to counter potential sanctions on the aggressor.

At the outbreak of the war, the Central Europe countries took numerous measures to both ensure the availability of energy resources and reduce demand. Within the framework of the strategies adopted, the activities undertaken included such measures as the release of crude oil and liquid fuels from stocks, diversification of natural gas and crude oil supplies through the conclusion of new contracts, expansion of import infrastructure, maximization of import capacity and the acquisition of Russian assets. Undoubtedly, taking into account both the scale of dependence and the specifics of the market, the most important activities of a strategic nature were undertaken in the area of natural gas.

Reducing energy dependence on the Russian Federation was also possible by building and completing the expansion of energy infrastructure. In 2014, at the time of the annexation of the Crimean peninsula by the Russian Federation, Central European countries were not ready to reduce their energy dependence on Russia. However, within a few years they were able to systematically increase their import capacity. Such activity also involved the expansion of import infrastructure (LNG terminals) and between countries (interconnectors). As a result, in 2022 the countries of the region were able to reduce their dependence on the Russian Federation and actively take steps to implement sanctions on the aggressor.

In conclusion, it should be pointed out that Central Europe countries, through the used mechanisms and adopted strategies, were able to ensure energy security and thus reduce the impact of the Russian Federation on the level of security. Through the comprehensive use of existing infrastructure and the expansion of import, as well as transport capacities, the conditions were created for the imposition of numerous sanctions on the aggressor, including those of an energy nature. The strategies adopted, while different for individual countries, have proven to be effective.

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Energy Transition Index and World Energy Trilemma Index as an energy transition's pace measure for policy-making using the example of Poland

Bartosz Sobik

Abstract: The monitoring of the energy transition is a complex and complicated process due to its nature, which involves many technical, economic, social and environmental aspects. Thus, it is challenging to create a numerical measure to describe each country's progress in implementing the energy transition. The aim of this article is to characterise the Energy Transition Index and World Energy Trilemma Index, and present their results, together with a discussion of Poland's position in comparison with other countries. The above-mentioned indicators are globally acceptable and reliable measures of the pace and progress of the energy transition. The use of energy transition metrics is a useful tool to facilitate decision-making in the area of energy and climate policy. Nevertheless, it must be stressed policy-making must not rely just on indicators without a deeper understanding of given index and their methodology. The individual context of a country is a key factor to understand the indicator of energy transition's pace, thus the importance of this component of the index should be increased. Poland's position in both rankings is relatively low, especially when compared to countries in the Central-Eastern Europe region. The main reasons for the low ratings are the dependence on coal and the need for decarbonisation, the low share of RES generation and the low flexibility of the electric power system.

Key words: Energy transition, Energy Transition Index, World Energy Trilemma Index, energy policy, policy-making

Introduction

The energy transition is currently one of the biggest challenges facing not only the energy sector itself, but in the context of the entire economy. In addition, ongoing energy and climate policy in the European Union is making the transition to a zero-carbon economy a necessity. The decarbonisation of the economy is therefore becoming a key challenge to maintain the competitiveness of the economy and to meet increasingly strict environmental standards. Tackling climate change is becoming one of the main objectives of the European Union's energy policy.

Energy transition is becoming one of the key challenges for the Polish economy. Decarbonisation, the investment gap and exposure to climate risk are becoming key challenges for the energy sector in Poland, affecting both energy security and economic issues (Sobik, 2022, p. 15-16).

Verifying the progress of the energy transition is not easy because of the very broad significance of the economic transition and its many technical, economic, social and environmental aspects. In the paper (Kopeć, Lach, 2021, p. 133) two methodological options for verifying the progress of the energy transition have been presented:

- Reviewing the progress of the energy transition in different countries;
- Reviewing the progress of the energy transition for one country using a time series.

Globally, there are two indicators designed to verify the progress of the energy transition:

- Energy Transition Index (ETI);
- World Energy Trilemma Index (WETI).

The aim of this article is to characterise the above-mentioned indicators and present their results for 2021, together with a discussion of Poland's position in comparison with other countries. This will allow the progress of the energy transition in Poland to be assessed through objective factors and comparative analysis with other countries. The article uses data published in the Energy Transition Index and World Energy Trilemma Index reports for 2021.

Energy Transition Index

Energy Transition Index is an indicator published by World Economic Forum (WEF). It consists of two equal elements (World Economic Forum, 2021, p. 11):

- System performance;
- Transition readiness.

Sub-index system performance describes energy system performance with accordance to three major elements and twelve minor elements (World Economic Forum, 2021, p. 44):

- Security and access:
  - Security of supply (50%);
  - Quality of supply (17%);
  - Energy access (33%);
- Environmental sustainability:
  - Carbon emissions per capita (25%);
  - Carbon intensity (25%);
  - Energy intensity (25%);
  - Air pollution (25%);
- Economic development and growth:
  - GDP contribution (20%);
  - Cost of externalities (20%);
  - Fossil fuel subsidies (20%);
  - Industry competitiveness (20%);
  - Affordability (20%).

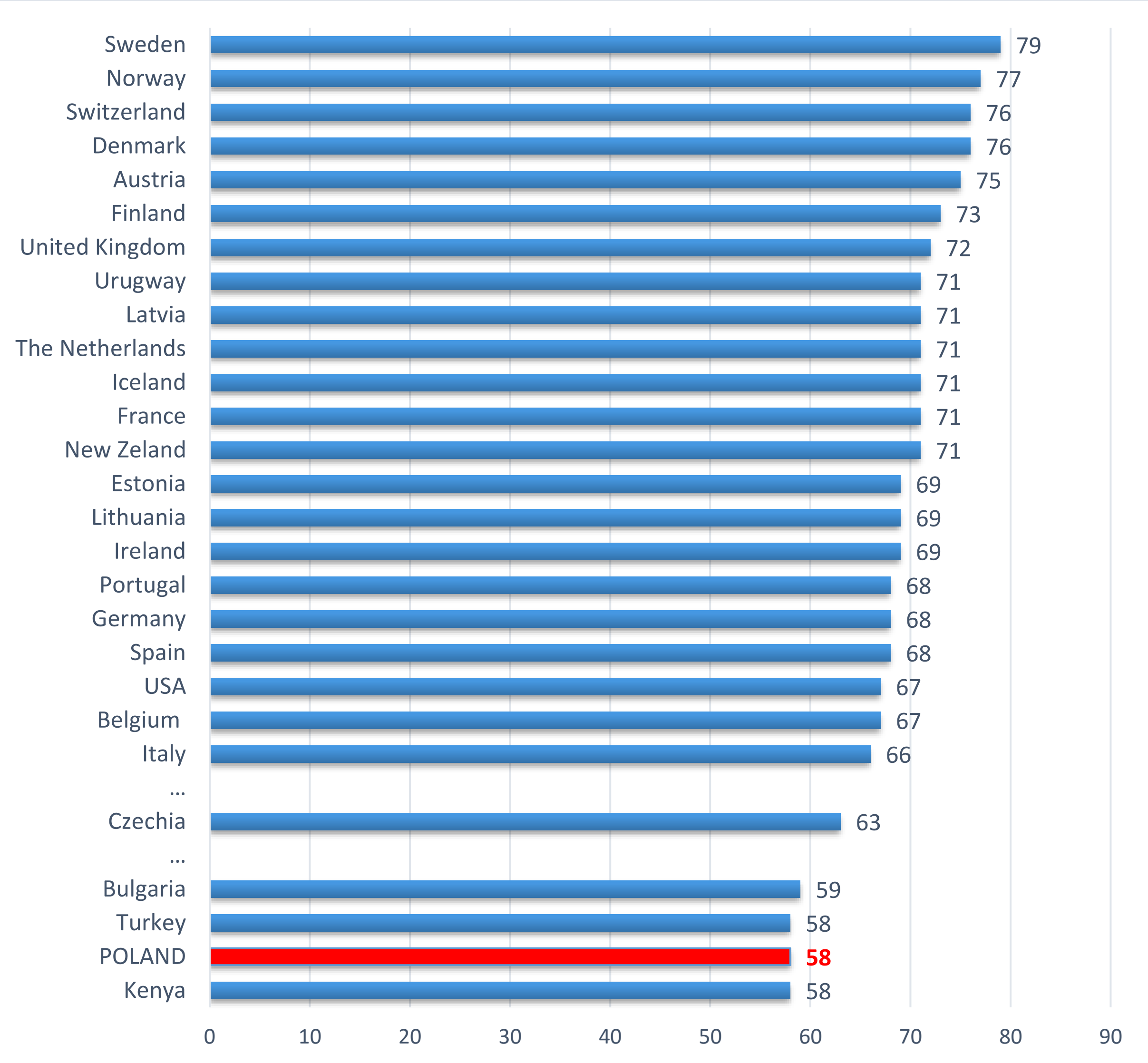
Sub-index transition readiness consists of 6 equal major elements and 17 minor elements (Ibidem):

- Energy System Structure:
  - Fossil fuel dependency (20%);
  - Electricity mix (60%);
  - Energy demand growth (20%);
- Human Capital and Consumer Participation:
  - Jobs in Renewable Energy Sector (50%);
  - Quality of education (50%);
- Infrastructure and innovative business environment:
  - Innovative business environment (33%);
  - Transportation infrastructure (33%);

  - Trade logistics (33%);
- Institutions and governance:
  - Stable finances (33%);
  - Rule of law (33%);
  - Transparency and political stability (33%);
- Regulation and political commitment:
  - Regulation to support electric energy, renewable energy sources and access to energy (60%);
  - Stable policy (20%);
  - Commitment to international agreements (20%);
- Capital and investment:
  - Recent investment into renewable energy sources (33%);
  - Access to capital (33%);
  - Ability to invest (33%).

The Energy Transition Index provides a variety of variables and energy indicators, being a useful information tool (Singh et al., 2019, p. 4). Results of the Energy Transition Index as for 2021 are presented in the fig. 1.

Fig. 1. Energy Transition Index in 2021 (not all countries)



Source: Own research based on (World Economic Forum, 2021).

The leading countries in the ETI ranking are Sweden, Norway and Switzerland. They received the highest scores in both the energy system efficiency and transition readiness categories. These countries are wealthy, have a diversified energy mix, make extensive use of RES, and are characterised by a high legal and institutional culture, and significant capital capabilities. Among countries belonging to the CEE (Central and Eastern Europe) region, Latvia was ranked highest with 71 points. Poland's low ranking indicates a number of challenges to be faced by the Polish economy and energy sector in the coming years. Analysing Poland's result in the ETI index study for 2021, it can be pointed out that this score of 57.74 is lower than the global average of 59.35. The components of Poland's score are the efficiency of the energy system, set at 63.7, and the readiness for transformation, which scored only 51.8 (World Economic Forum, 2022). This poor result of the transformation readiness sub-index is due to a very low score in the electricity system structure categories (24.60 against a global average of 68.45), which was mainly influenced by low scores for the flexibility of the electric power system (11.29 against a global average of 64.95) and the share of RES in the energy mix (15.29

against a global average of 38.43) (Ibidem). The results therefore indicate difficulties with the flexibility of the National Electricity System, which is largely related to the reliance on coal-fired power generation, which is an inflexible energy source. They also illustrate the insufficient development of RES. The above results highlight the issue of the structure of the National Power System, which will be a major challenge in implementing the energy transition in Poland.

World Energy Trilemma Index

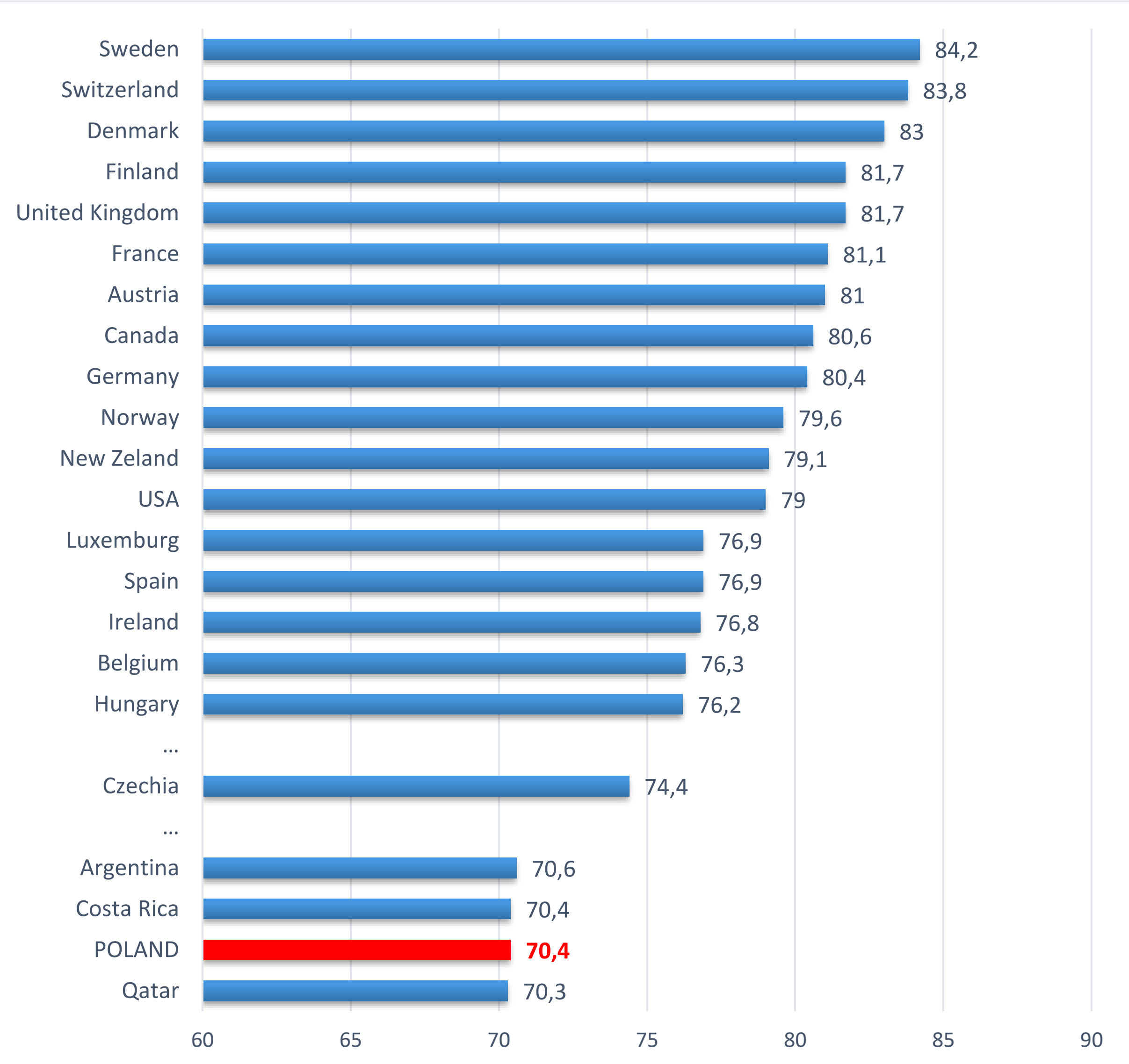
World Energy Trilemma Index (WETI) is an indicator published by World Energy Council (WEC). It consists of four main sub-indexes, which consist of minor elements (World Energy Council, 2021, p. 61):

- Energy security (30%):
  - Diversity of primary energy supply (6%);
  - Import independence (6%);
  - Diversity of electricity generation (6%);
  - Energy storage (6%);
  - System stability and recovery capacity (6%).
- Energy equity (30%):
  - Access to electricity (6%);
  - Access to clean cooking (6%);
  - Access to "modern" energy (6%);
  - Electricity prices (3%);
  - Gasoline and diesel prices (3%);
  - Natural gas prices (3%);
  - Affordability of electricity for residents (3%).
- Environmental sustainability (30%):
  - Final energy intensity (5%);
  - Efficiency of power generation, transmission and distribution (5%);
  - Trend of greenhouse gas emissions from energy sector (5%);
  - Low carbon electricity generation (5%);
  - CO_2 intensity (2%);
  - CO_2 per capita (2%);
  - CH_4 emissions from energy sector per ktoe (1%);
  - $PM_{2,5}$ mean annual exposure (5%).
- Country context (10%):
  - Macroeconomic stability (2%);
  - Effectiveness of government (1%);
  - Political stability (1%);
  - Rule of law (1%);
  - Regulatory quality (1%);
  - Foreign direct investments net inflows (1%);
  - Ease of doing business (1%);
  - Perception of corruption (0,5%);
  - Efficiency of legal framework in challenging regulation (0,5%);

- Intellectual property protection (0,5%);
- Innovation capacity (0,5%).

It is worth emphasising that this indicator refers to the Energy Trilemma concept, which indicates that energy sustainability consists of three key elements: energy security, energy equity and environmental sustainability (World Energy Council, 2021, p. 2). Thus, analysing WETI is a useful tool so as to monitor countries' contribution to energy security, energy equity and environmental sustainability (Asbahi et al., 2019, p. 705). In addition, the country context is also taken into account in the final outcome, which is important given the complexity of the energy transition issue and the large role of individual circumstances affecting each country individually. Results of the World Energy Trilemma Index as for 2021 are presented in the fig. 2.

Fig. 2. World Energy Trilemma Index in 2021 (not all countries)



Source: Own research based on (World Energy Council, 2022).

European countries are leading in the WETI ranking, led by Sweden, Switzerland and Denmark. They scored highly in all three main categories: energy security, energy equity and environmental sustainability. Of the CEE countries, Hungary ranked highest with a score of 76.2

points, mainly thanks to its 12th place in the energy security index. Poland scored 70.4 points, ex aequo with Costa Rica, which placed it 30th. The individual component indices for Poland were: energy security 64.2 points and energy sustainability 61.6 points (World Energy Council, 2022). Poland's quite low ranking was mainly influenced by low scores for diversification of the energy mix and low generation from low- and zero-carbon sources. Thus, the index confirmed the problem of low generation from RES and low-carbon sources and pointed to the need to diversify and decarbonise the electricity generation structure. Also in this ranking, Poland ranked rather distantly from other countries in the CEE region (last place among the CEE EU Member States).

Conclusions

Monitoring the energy transition is a complex and complicated process due to the nature of the transition - it affects many aspects of the economy, society and the environment. For this reason, making direct comparisons between countries is difficult (Yu et al., 2020, p. 2). The conclusion can therefore be reached that it is necessary to increase the role of country context in measuring the progress of the energy transition. The problem of monitoring complex and interdisciplinary processes means that precise quantitative measurements related to the analysis of the progress of the transition cannot be made in an unambiguously objective manner, as numerous simplifications, assumptions and approximations will have to be made. Nevertheless, the indicators presented in this publication are globally acceptable and reliable measures of the pace and progress of the energy transition. The use of energy transition metrics is a useful tool to facilitate decision-making in the area of energy and climate policy. Nevertheless, it must be stressed policy-making must not rely just on indicators without a deeper understanding of given index and their methodology (Šprajc et al., 2019, p. 8). As it was presented, the individual context of a country is a key factor to understand the ratio of energy transition.

Based on the analysis of the data presented in this article, it can be suggested that it is possible to increase the focus on the individual circumstances of each country. A long list of factors – ranging from political, geopolitical, geographical, social, economic and climatic – influence a country's current energy situation and its ability to make progress in the energy transition. Hence, countries differ in their starting point and therefore the outcome of their efforts varies, as indicated in the paper.

The results of the Energy Transition Index and World Energy Trilemma Index for Poland as for 2021 are low and indicate the main challenges for the implementation of the energy transition in Poland. Particularly highlighted are the issues of decarbonisation and the current dependence on coal, the too slow rate of RES development and insufficient flexibility of the electric power system. Poland's position in both rankings was one of the lowest among the CEE countries, indicating that the energy transition in Poland will require the greatest efforts among the countries in the region.

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Selected aspects of generating short-term electricity demand forecasts, taking into account renewable energy sources

Paweł Machał, Leszek Remiorz, Dariusz Bukowiec

Abstract: The risk of a decline in the quality of electricity demand forecasts in the short term increases due to the increase in the installed capacity of renewable energy sources (RES). This is mainly due to the high daily variability of electricity production from renewable sources, which is strongly dependent on local weather conditions. Production from renewable energy sources is a very complex time series, additionally reinforced by a significant increase in its share in total production. This applies in particular to photovoltaic sources in low-voltage networks. There is therefore an urgent need to improve the quality of forecasts in this area. The main goal of the research was to verify statistical models that often achieve good results in the complex problem of forecasting electricity demand. The main objective, regarding daily forecasts of consumers' demand for electricity, was achieved through the implementa-tion of intermediate objectives, including the development of a methodology for estimating electricity generated by photovoltaic installations.

Key words: photovoltaic, micro installation, prosumer, renewable source of energy

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Introduction

In the last 5 years, there has been an intensive development of small, distributed photovoltaic sources installed for home use (Machał, Remiorz i Bukowiec, 2022). In February 2023, the installed capacity in one of the electricity supplier amounted to 2.89 GW. Forecasting the power output of these PV systems has become critical to market and grid efficiency. In the last 7 years, peak summer demand has reached over 4.1 GW. The share of installed capacity is already 70% and is still growing. The increase in micro-installations is already significantly changing the load characteristics of the graphics unit of this electricity supplier. Micro PV installations, with a capacity up to 50 kW, connected to the Distribution System Operator (DSO), are scattered over the area of several provinces. For all micro installations from this area, the electricity supplier is obliged to make settlements in accordance with the rules set out in the Renewable Energy Sources Act.

Fig. 1. Distribution area where the electricity supplier has the largest number of customers with micro-installations (TAURON Dystrybucja S.A., 2023)

Source: TAURON Dystrybucja S.A., 2023.

Demand forecasts are typically based on statistical models (e.g., artificial neural networks) that can capture non-linear relationships between electricity load and a number of calendar variables, historical data, and weather. A significant number of PV installations in the distribution network changes these relationships through a strong correlation of photovoltaic generation with weather conditions and variability over time. Therefore, previous forecasting approaches that do not take into account the significant impact of PV, will generally show worse forecast performance.

Cloud cover is the main factor affecting the level of solar radiation intensity (Global Horizontal Irradiation - GHI) reaching the earth's surface. Clouds have very different characteristics. They arise, move, change and dissipate within hours and sometimes even minutes. So when cloud cover moves or changes quickly, forecasting solutions should also be fast (Paul, De Michele, Najafi i Avesani, 2022). The current electricity contracting process assumes forecasting demand for a horizon of 18 to 42 hours. In this case, the intensity of solar radiation (explanatory variable) is not sufficient to correctly forecast energy demand, because its forecasts are characterized by high uncertainty.

GHI forecasting methods

GHI forecasting has been developed in recent years using a wide range of methods. The most commonly used forecast models in this field are statistical models, models based on the sky images from ground-based cameras, satellite image models and numerical models (NWP).

Statistical models are models based on time series prediction. The most popular of these are linear models such as autoregressive (AR) and autoregressive moving average (ARMA) and machine learning techniques such as artificial neural networks (ANN) (Heinemann, 2006) (Hontoria, Aguilera i Zufiria, 2002) (Lauret, David, Fock, Bastide i Riviere, 2006).

Forecasting from ground-based sky images: models based on sky images obtained with 180° cameras. Sky images lead to knowing cloud conditions a few minutes ahead (Paulescu i inni, 2023) (Lin, Zhang i Wang, 2023).

Satellite image models. Geostationary satellites take pictures of the atmosphere all over the Earth with a time resolution of less than an hour. The large development that has taken place in satellite data acquisition in recent years makes this technique a very useful tool to improve GHI forecasting (Hammer, Heinemann i Lorenz, 1999) (Liwei i inni, 2020).

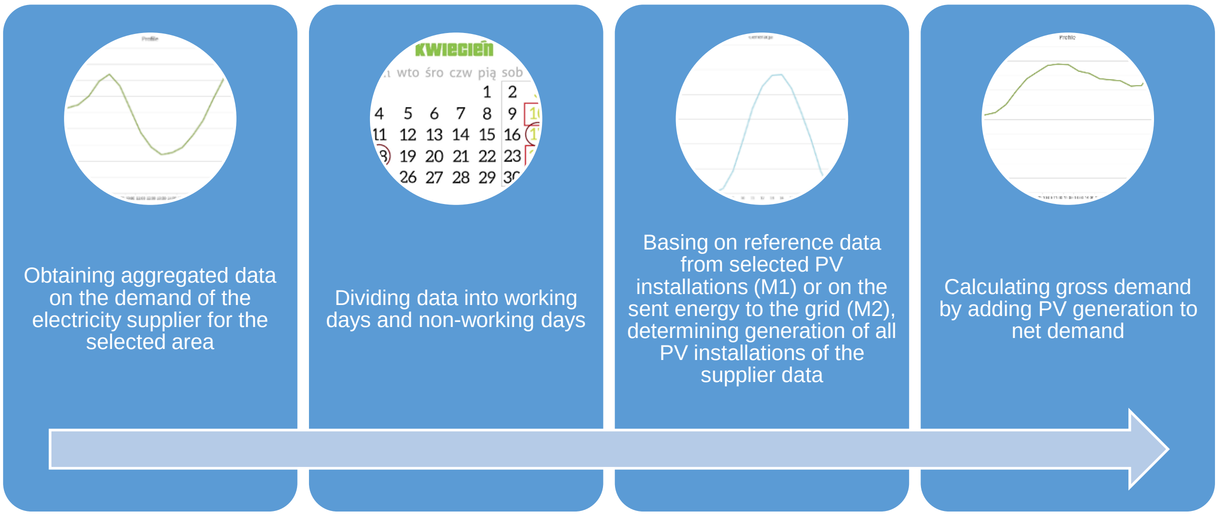
Numerical weather forecasting models (NWP) based on physical models to estimate atmospheric conditions, including cloud formation and dissolution. Physical models are described by differential equations solved by numerical methods. NWP models offer forecasting time horizons from a few hours to 15 days ahead (Heinemann, 2006) (Razagui, Abdeladim, Semaoui, Hadj Arab i S., 2020).

Despite continued advances in weather forecasting, there is a high risk of error in forecasting tomorrow's cloud sizes and paths (Deo i inni, 2023) (Lemos-Vinasco, Bacher i Møller, 2021). An additional factor of forecast uncertainty is the increasingly common use of energy storage, heat storage and electrical energy management systems in the facility (Lemos-Vinasco, Bacher i Møller, 2021) (Zhao, Gao, Qian i Ge, 2021) (Wu i inni, 2022). Due to the fact that the forecast of electricity demand carried out on day n for day n+1 is based mainly on the solar radiation intensity, which is an uncertain explanatory variable, increasing uncertainty in these forecasts can be expected.

Net demand, gross demand

The figure below shows a workflow diagram for generating the amount of electricity from photovoltaic sources and then generating a gross demand profile.

Fig. 2. Workflow diagram



Source:own work.

In accordance with the instructions of the distribution network (Instrukcja Ruchu i Eksploatacji Sieci Dystrybucyjnej, 2023), DSO determines the measurement data using the local measurement system. The DSO obtains this data in the form of:

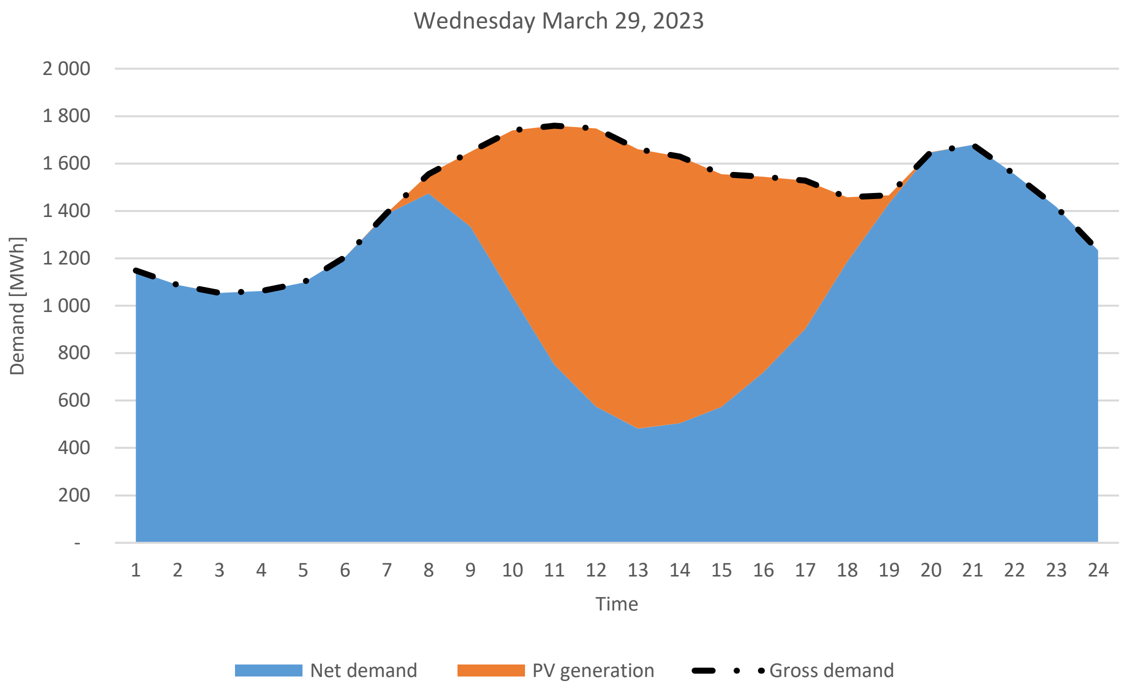
a) Hourly consumption/distribution of energy by the customer, determined on the basis of data from meters - hourly data

b) Periodic states (indications) of energy meter counters, and DSO uses standard profiles to determine hourly values.

For the purposes of Balancing Market settlements, the DSO designates and makes available hourly measurement and settlement data as aggregated Energy Delivery Sites (EDS). These data, due to their relatively quick acquisition time - 3 days after the end of the day, are used to forecast area demand. Correction of data by the DSO in accordance with the instructions of the distribution network is performed in month m and may apply to month's m-2, m-4 and m-15 (for example, October, August this year and September from the previous year may be adjusted in December).

Reconstruction of generating gross demand data are shown in the chart below (see fig. 3).

Fig. 3. Reconstruction of gross demand

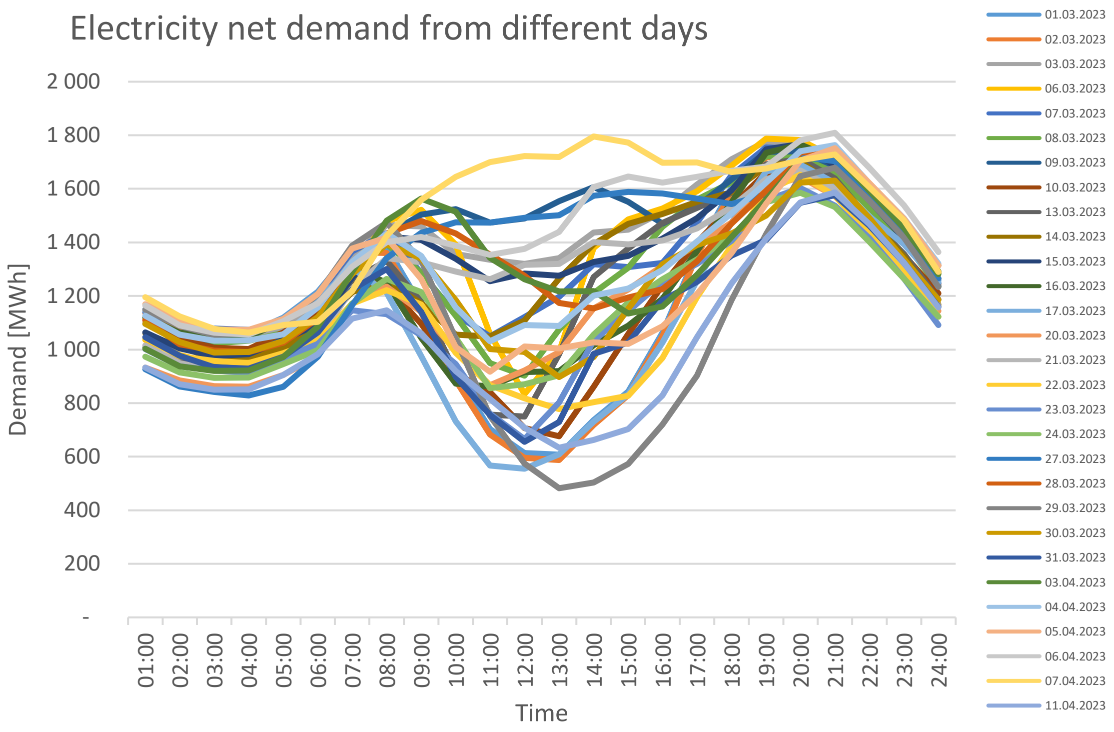


Source:own work.

The graph shows the demand profiles for March 29, 2023. It was sunny most of the day, with over 8 GWh of demand reduction due to PV generation. The dashed line in the graph shows the reconstructed gross demand , the orange area is the estimated demand reduction as a result of PV generation, and the blue area is the net demand. This approach to data analysis enables better forecasting of rapidly changing electricity demand. In addition to improved forecasting performance, the reconstructed gross demand profiles also provide important information for grid operators. They can identify the amount of electricity that can suddenly "appear" on a clear day or "disappear" during periods of heavy rain or snowfall (Power Grid, 2023).

Electricity net demand, which takes into account the impact of behind-the-meter generation by prosumers, is shown in the chart below (see fig. 4).

Fig. 4. Electricity net demand



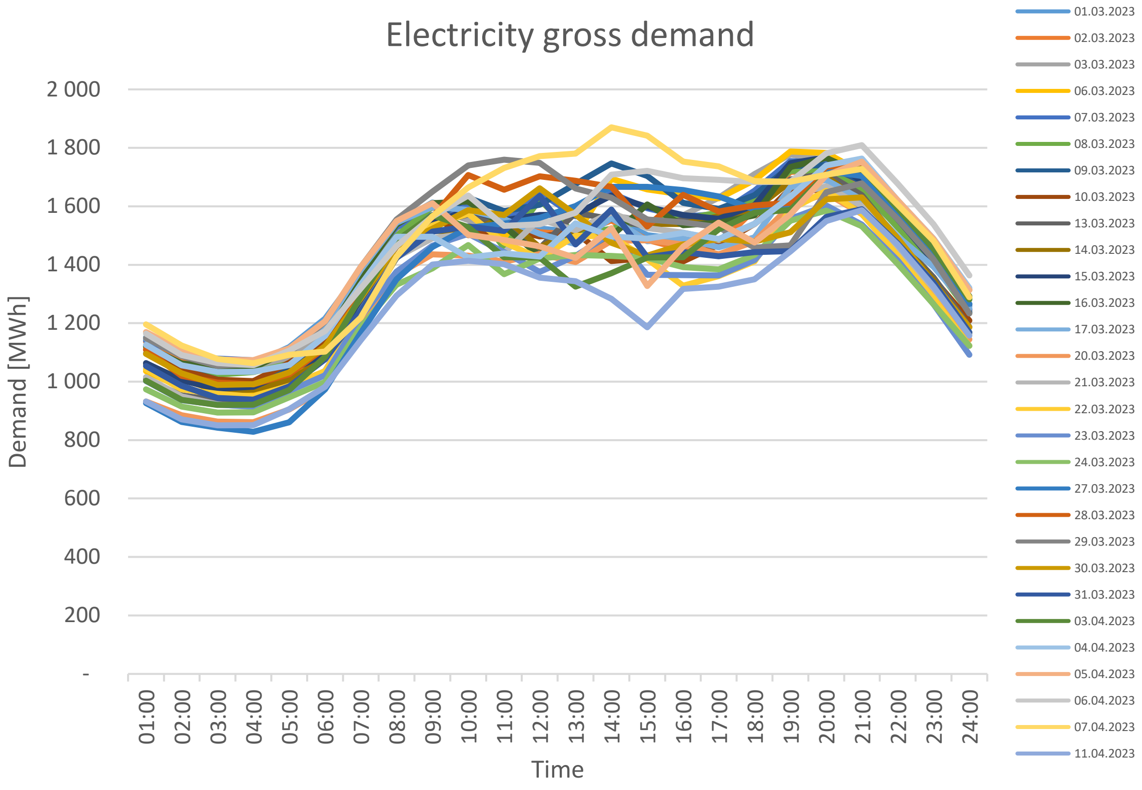
Source:own work.

The presented daily profiles contain data from March 1 to April 11, 2023 and include only working days. The previous characteristic profile with a night depression and a day peak was disturbed by the generation of PV installations. The current daily profiles in the literature are called the "duck curve" (Rubasinghe i inni, 2023) (Qingchun Hou a, Du, Miao, Peng i Kang, 2019). With generation data from these sources, it is possible to reconstruct the actual (Zap_{netto}) electricity demand profile (Zap_{brutto}) described with the formula:

$$Zap_{brutto_h} = Zap_{netto_h} + E_{Gen_h}$$

Photovoltaic generation (E_{Gen_h}) was determined indirectly, according to the method described in chapter 0. As a result of this work, a gross demand profile was created. It is shown in Figure 5.

Fig. 5. Electricity gross demand



Source:own work.

To compare the gross demand and net demand profiles, the coefficient of variation was used (Kolańska-Płuska i Gallus, 2022), which can be defined by the formula:

$$Cv = \frac{\sigma}{\bar{x}}$$

Cv is the coefficient of profile variation, $\bar{x}$ is the average demand in a day, σ is the sample standard deviation defined by the formula:

$$\sigma = \sqrt{\frac{\sum_{i=1}^{N}(x_i - \bar{x})^2}{N}}$$

x_i –is the demand for i-hour

The interpretation of the coefficient Cv is based on comparing it with standard values. The coefficient is expressed as a percentage. Value below 25% means low volatility. Between 25% and 45% means average volatility and between 45% and 100% means strong volatility.

Autoregressive models (ARX - arima and mARX - arima with an independent variable (Nowotarski i Weron, 2016)) were used for the forecasts. An integrated seasonal auto-regression and moving average model ARIMA(p, d, q)×(P, D, Q)m were used to forecast the series (Koohi-Kamali, Abd. Rahim i Sobri, 2018):

$$\Phi(B^m)\phi(B)(1-B^m)^D(1-B)^d y_t = c + \Theta(B^m)\theta(B)\xi_t$$

y_t is the term of the time series, ξ_t is a white noise process with zero mean and variance σ 2, *m* is the length of the weekly cycle (168 h), *B* is the backshift operator, *d* and *D* are the orders of differentiation (ordinary and seasonal), φ(.), Φ(.), θ(.) and Θ(.) are polynomials of degree *p*, *q*, *P* and *Q*, respectively, and *c* is a constant.

Forecasts were compared on the basis of standard assessments: Mean Absolute Percentage Error (MAPE) and Root Mean Squared Error (RMSE). MAPE is one of the most commonly used KPIs to measure forecast accuracy. It is calculated according to the formula:

$$MAPE = \frac{1}{n}\sum_{1}^{n}\frac{|y - y'|}{y}$$

y is actual data, *y'* is forecast

MAPE is the average of absolute errors divided by demand (each period separately). MAPE divides each error individually by the actual data, so it is skewed: high errors during periods of low demand significantly increase MAPE. For this reason, MAPE optimization will result in a forecast that will most likely be below demand.

RMSE is a very helpful indicator. It is defined as the square root of the mean squared error and can be calculated by the formula:

$$RMSE = \sqrt{\frac{1}{n}\sum_{1}^{n}(y - y')^2}$$

y is actual data, *y'* is forecast

RMSE does not treat every error the same. Gives more weight to the most significant errors. This means that it only takes one big mistake to get a high RMSE.

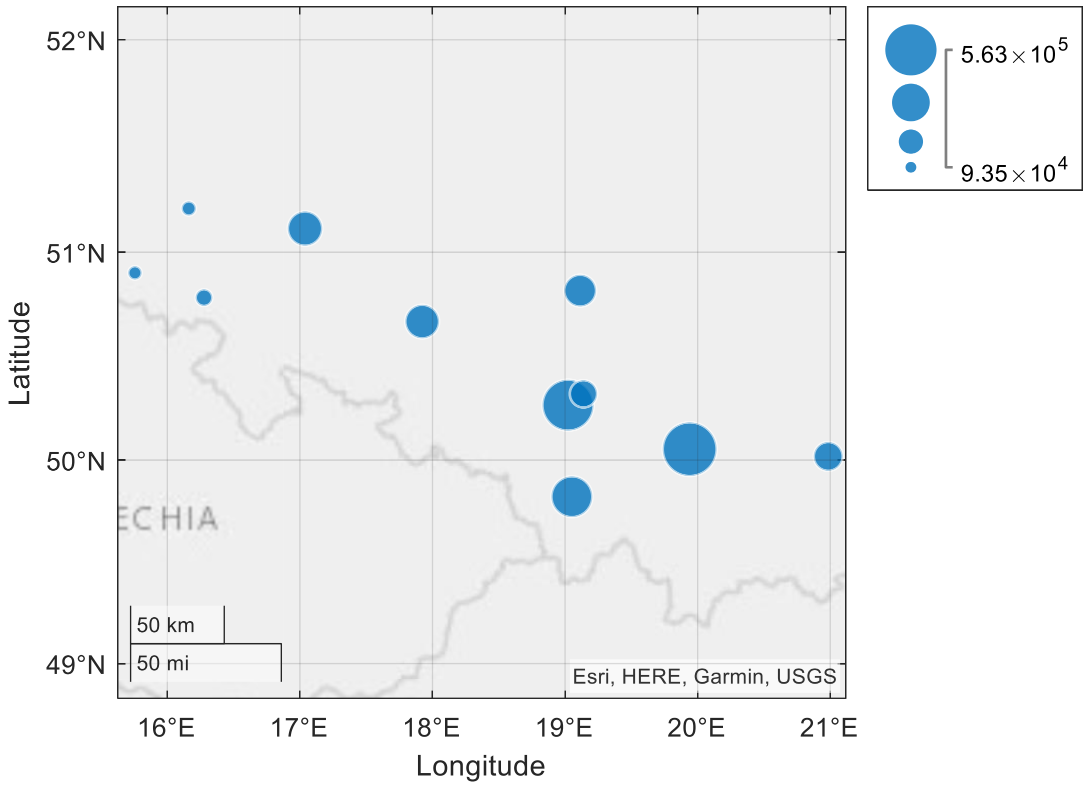
The calculations were performed on a computer with an Intel Core i5 processor (2 x 2.40GHz), 16 GB of installed RAM using Matlab software (Mathworks, 2021).

Generation behind the meter

A process of collecting data of the power installed in photovoltaic micro installations and their actual generation is proposed to take this factor into account in demand forecasts. This will enable monitoring geospatial trends in the growth of rooftop micro-installations.

Due to the high number of photovoltaic micro installations (hundreds of thousands), it is not possible to directly monitor the production of all PV installation (Gong, chen, Ji, Tang i Zhou, 2023). It is necessary to obtain data from a sufficient number of PV installation, which will be the basis for forecasting. In order to achieve this, data from several reference installations, were obtained. The data was divided geographically in the area of operation of the electricity supplier and hourly averaged in the next step. The spatial arrangement of the reference micro installations is shown on the map below (Figure 6). This method was marked as M1.

Fig. 6. Spatial distribution of reference photovoltaic installations with installed power



Source:own work.

Data on installed power and efficiency are scaled to determine the production of PV installations, taking into account the effects of local weather and the geographical heterogeneity of PV mirco installations. The estimated amount of energy produced by micro installations in the M1 method was determined in accordance with the following algorithm:

1. Obtaining data on hourly production from reference PV installations
2. Calculation of the coefficient of energy produced according to the formula:

$$W_{ER_{ih}} = \frac{ER_{ih}}{Pi}$$

ER_{ih}- Hourly actual production data from i - installation [kWh]

Pi- Installed power of i - installation [kWp]

3. Calculation of the average factor of energy produced in an hour:

$$W_{ER_h} = \frac{1}{n}\sum_{i}^{n} W_{ER_{ih}}$$

n - number of reference installations

4. Determination of the estimated generation of the area in an hour, according to the formula:

$$E_{Obsz_h} = P_{Obsz_h} W_{ER_h}$$

P_{Obsz_h} - power installed in a given period in the area [kWp][3]

An imperfection in this study is the relatively small number of PV installations with high installed power. It was therefore decided to use the data of electricity sent by prosumers to the distribution grid. The estimated amount of energy produced by micro-installations in the M2 method was determined in accordance with the following algorithm:

1. Obtaining data on the amount of electricity send to the distribution grid by micro-installations (E_{OD}).
2. Choosing of reference PV installations in the selected area. When choosing an installation, you should choose places where the density of installations is the highest and nontypical installations should be rejected (e.g. facing east or west, installations on trackers that achieve above-average performance).
3. Obtaining data on the amount of energy generated by reference installations. The data can be obtained, for example, from the website www.pvmonitor.pl .
4. Calculating the coefficient of energy produced according to the formula:

$$W_{ER_{it}} = \frac{ER_{it}}{P_i}$$

ER_{it}- actual data on production from i -installation in the period t [kWh], t – hour, day, week, month

P_i- Installed power of this installation [kWp]

5. Calculating the average coefficient of energy produced in period t:

$$W_{ER_t} = \frac{1}{n} \sum_{i}^{n} W_{ER_{it}}$$

n - number of reference installations

6. Determining the estimated PV generation of the area in period t, according to the formula:

$$E_{Gen_t} = P_{Obsz_t} W_{ER_t}$$

P_{Obsz_t} - power installed in period t in the studied area [kWp]

7. Determining the coefficient of energy sent to the distribution network:

$$W_{EO_t} = E_{OD_t} / E_{Gen_t}$$

8. Determining the hourly generation profile:

$$E_{Gen_h} = E_{OD_h} / W_{EO_t}$$

[3] Installed capacity varies over time and is currently on an upward trend.

Results

In the analyzed data, due to the impact of photovoltaic generation on the level of electricity demand, the variability at night is over 3 times lower than the variability during daytime hours. The averaged statistics are shown in the table below (see fig. 7).

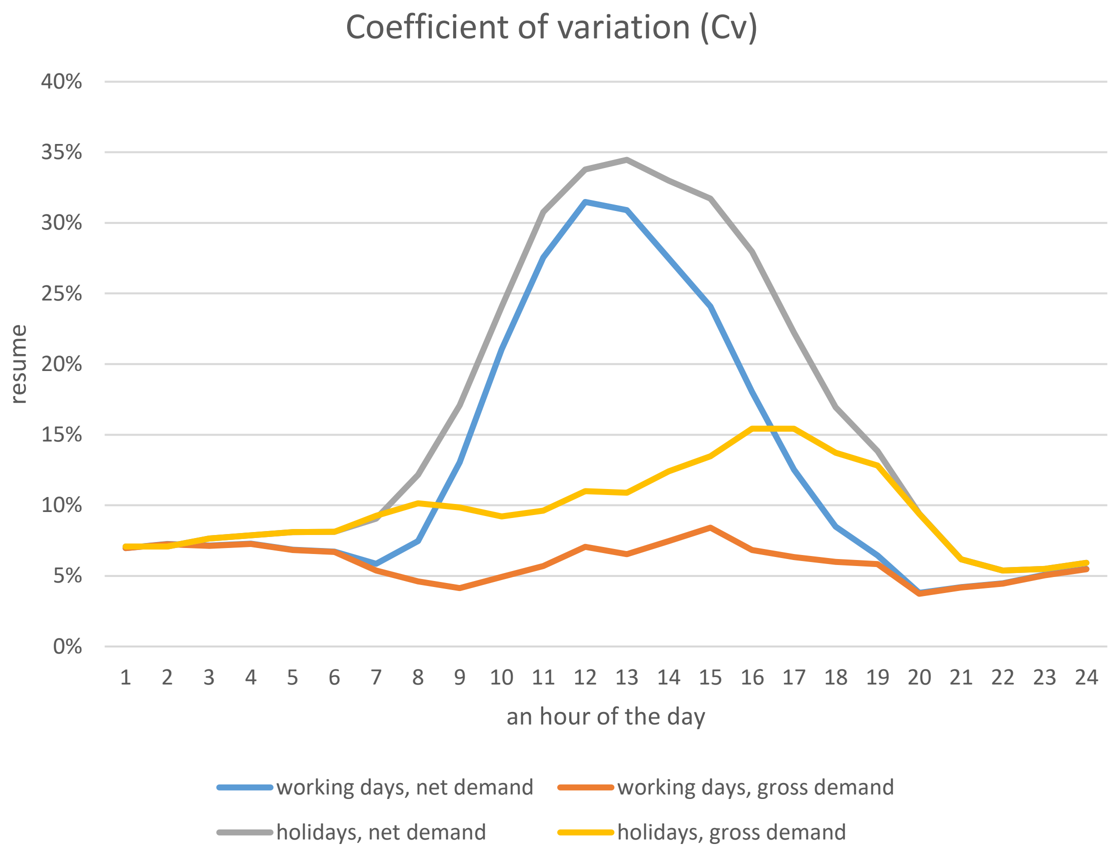
Fig. 7. Average statistics of daily profiles

Pointer – name	Working Net Demand	Working Gross Demand	Holiday Net Demand	Holiday Gross Demand
Minimum	958	1 222	806	1 012
Maximum	1 527	1,555	1 396	1 439
Mean	1 248	1 393	1 108	1 238
Standard deviation	146	82	174	122
Average coefficient volatility (Cv)	12%	6%	16%	10%

Source:own work.

For the net demand in analyzed period, average coefficient on working days was 12%, and 16% on holidays. After transforming the data into gross demand according to the M1 method, this coefficient was reduced to 6% on working days and 10% on holidays. For comparison, in the corresponding period of 2016, when the installed power in PV was approximately 0.2% of the currently installed power, the average coefficient of variation was 7.5%. Average hourly coefficients of variation are presented in the chart below (Figure 8).

Fig. 8. Average hourly coefficients of variation by working days and holidays



Source:own work.

The results of forecasting in the selected area are presented below. The data for learn models was 2022 year, and the test period was the data from January 1 to March 31, 2023. The data were presented in the following layout:

- Net demand - data unchanged.
- Gross Demand M1 - PV generation has been added to the net demand data. Generation estimated on the basis of the reference PV power plants.
- M2 Gross Demand - PV generation has been added to the net demand data. Generation has been estimated on the basis of the reference PV installations and the amount of electricity sent to the distribution network by prosumers.
- Demand 2016 - PV generation was omitted due to the little PV installed power.

Fig. 9. Results of comparing forecasts based on transformed demand data

Model	Input data	Average MAPE [%]	Average RMSE [MWh]
ARX	net demand	6.97	85.96
mARX	net demand	6.91	83.86
Naive	net demand	7.05	87.39
ARX	Gross demand M1	3.32	45.7
mARX	Gross demand M1	3.15	43.3
Naive	Gross demand M1	4.04	54.1
ARX	Gross demand M2	2.97	40.30
mARX	Gross demand M2	2.85	38.72
Naive	Gross demand M2	3.68	48.64
ARX	Demand 2016	3.20	39.9
mARX	Demand 2016	3.16	40.0
Naive	Demand 2016	4.55	54.77

Source:own work.

From the presented results (see fig. 9) we conclude that after transforming data from net value to gross value, electricity demand data is easier to forecast. The average absolute forecast error decreased from 6.9% to 2.9% and the RMSE error decreased from 84 MWh to 38 MWh. The deviations of forecasts based on transformed data are close to the deviations of forecasts based on data from 2016, in which the share of photovoltaics was negligible. The coefficient of variation for gross demand decreased from 12% to 6% for working days and from 16% to 10% for holidays.

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Legal aspects of energy price regulation for household cu-stomers and other specific entities

Katarzyna Paździorko

Abstract: In this article, the author will present issues directly related to the specific rules for the protection and supply of electricity to different groups of customers such as household customers, small and medium-sized enterprises, public institutions. By analysing legal provisions of the energy law and related laws relating to the values and objectives of the energy law, the author will determine the current legal state of affairs and, on this basis, she will try to create de lege lata and de lege ferenda conclusions. The Polish and European Union legislators are attempting to introduce normative mechanisms to the social problem of high energy prices. The range of entities encompassed by the new, protective legal instruments is broad, because it is not limited to citizens, but also includes groups of small and medium-sized enterprises, as well as various public institutions. The aforementioned entities are encompassed by the universal service namely the right to be supplied with electricity of a specified quality within their territory at competitive, easily and clearly comparable, transparent and non-discriminatory prices. In this publication, the author will try to answer the question - whether the enacted solutions are adequate and sufficient to protect the customer who is a household customer or other specific customers?

Key words: customers, energy price regulation, vulnerable customers, household customers, energy market

Introduction

Within the Polish social market economy, the energy sector ensures sustainable economic growth, stabilisation and raising the living standards. The Polish and European Union's (EU) legislators have introduced an universal service to guarantee access to electricity primarily to household customers, but also to other specific entities. However, when the price of electricity rises along with it, the risk of a larger group of society being subjected to the negative occurrence of energy poverty also increases. This may imply a situation in which access to electricity may be straightened or excluded for less affluent social groups.

The Polish and EU legislators are attempting to introduce normative mechanisms to the social problem of high energy prices. The range of entities encompassed by the new, protective legal instruments is broad, because it is not limited to citizens, but also includes groups of small and medium-sized enterprises, as well as various public institutions. Therefore, on this ground the question can be raised - whether the enacted solutions are adequate and sufficient to protect the customer who is a household customer or other specific customers?

The purpose of this article is to examine legal provisions of the energy law and related laws concerning specific rules for the protection and supply of electricity to different groups of customers such as household customers, small and medium-sized enterprises, public institutions. By analysing the provisions relating to the values and objectives of the energy law, the author will determine the current legal state of affairs and, on this basis, she will try to create *de lege lata* and *de lege ferenda* conclusions.

Values and objectives of the energy law

In unique times of high electricity prices, and their rapid spikes, defining the values and objectives of the energy law is particularly important. The energy sector should define it, implement it effectively and enforce it to protect less affluent individuals.

The objectives of energy law are set out at the national level in Article 1(2) of The Energy Law of 10th Apr. 1997 (The Energy Law – the "EL"[4]), and at the EU level in Article 194(1) of the Treaty on the Functioning of the European Union (the "TFUE")[5]. According to the provisions of the TFEU, the fundamental objectives of the European Union's energy policy are to: ensure the functioning of the energy market; ensure security of energy supply in the Union; promote energy efficiency and energy saving and the development of new and renewable forms of energy; and promote the interconnection of energy networks. In turn, the objectives contained in Article 1(1) of the EL list, and sometimes further specify, provisions of a higher order in the hierarchy of legal acts, such as the Constitution of the Republic of Poland and international agreements ratified with the consent expressed in a law. The aforementioned provision also enumerates the objectives of: creating conditions for sustainable development of the country, development of competition, counteracting the negative effects of natural monopolies, taking into account environmental protection requirements, obligations arising from international agreements and balancing the interests of energy enterprises and fuel and energy customers.

The catalogue of values relevant to energy law includes: a common energy market with effective competition, energy security, energy efficiency and conservation, and environmental protection primarily through the promotion of renewable energy sources and the pursuit of climate policy.

Energy market participants

Participants in the energy market are customers who have entered into a contract with a specific energy company. They are therefore a significant group of entities that have a legal relationship with an energy company. On the grounds of Polish and EU regulations - within the group of "customers", a distinction is made between final customers, household customers, non-household customers, active customers, wholesale customers, vulnerable customers, energy poor customers and others.

Under Article 3(3a) of the EL, a final customer means a customer who purchases fuel or electricity for its use. The definition is similar to the definition of the identical term from Directive 2019/944 of the European Parliament and of the Council of 5th Jun. 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU ("Directive 2019/944) where it is indicated that a final customer is a customer who purchases electricity for own use.

A household customer within the meaning of Article 2(5) of Directive 2019/944 is a customer who purchases electricity for the customer's own household consumption, excluding commercial or professional activities. This definition corresponds to the content of the

[4] Ustawa z dnia 10 kwietnia 1997 r. Prawo energetyczne (consolidated text: Journal of Laws 2022, item 1385, as amended).

[5] Treaty on the Functioning of the European Union (consolidated text: Official Journal of the European Union of 2012, C 326).

definition adopted under the EL in the provision of Article 3(13b). A non-household customer within the meaning of Directive 2019/944 means a natural or legal person who purchases electricity that is not for own household use, including producers, industrial customers, small and medium-sized enterprises, businesses and wholesale customers. Directive 2019/944 also distinguishes ”wholesale customers”, which means a natural or legal person who purchases electricity for resale inside or outside the system where that person is established (Article 2(2).

A specific group of customers are “vulnerable customers” (Article 28(1) and (2) of Directive 2019/944). Member States shall take appropriate measures to protect customers and shall ensure, in particular, that there are adequate safeguards to protect vulnerable customers. In this context, each Member State shall define the concept of vulnerable customers which may refer to energy poverty and, inter alia, to the prohibition of disconnection of electricity to such customers in critical times. The concept of vulnerable customers may include income levels, the share of energy expenditure of disposable income, the energy efficiency of homes, critical dependence on electrical equipment for health reasons, age or other criteria. Member States shall ensure that rights and obligations linked to vulnerable customers are applied. In particular, they shall take measures to protect customers in remote areas. They shall ensure high levels of customer protection, particularly concerning transparency regarding contractual terms and conditions, general information and dispute settlement mechanism (Article 28(1) of Directive 2019/944).

The vulnerable customers group is the group that is included in the household customers group. Directive 2019/944 prohibits the disconnection of electricity to the groups of customers whose is in critical situations. At the same time mentioned Act directs Member States to ensure their respective rights and obligations by taking measures to protect this group of customers in remote areas. Article 29 of Directive 2019/944 directs Member States to establish and publish a set of criteria, which may include low income, high expenditure of disposable income on energy and poor energy efficiency.

Energy poverty means a situation where a household run by one person or by several persons jointly in a self-contained dwelling or in a single-family dwelling in which no commercial activity is carried out cannot afford sufficient heat, cooling and electricity to supply appliances and lighting, where the household collectively fulfils certain conditions (Article 5gb of the EL).

Universal service as a guarantee of access to electricity

Services of general economic interest (Article 14 of TFEU) are a basis of the European social model, are an expression of the common values of the European Union and contribute to increasing the quality of life, promoting social and territorial cohesion (Article 36 of the Charter of Fundamental Rights of the European Union[6]) and eliminating social exclusion. Universal services are different from ordinary services because public authorities (specific States) recognise that certain types of services must be provided - even when there is insufficient market prosperity for them or the market does not provide sufficient incentives for their provision[7].

[6] Charter of Fundamental Rights of the European Union (consolidated text: Official Journal of the European Union of 2012, C 326/391).

[7] Communication from the Commission — Services of general interest in Europe (Official Journal of European Union of 2001, C 017, 19.01.2001), point 14.

The provisions of Directive 2019/944 provide for the empowerment and protection of customers by guaranteeing them the right to purchase electricity at a specific price. According to Article 10(1) of Directive 2019/944, Member States shall ensure that all final customers are entitled to have their electricity provided by a supplier, subject to the supplier's agreement, regardless of the Member State in which the supplier is registered, provided that the supplier follows the applicable trading and balancing rules. In turn, the provision of Article 27 of the aforementioned Directive indicates that Member States shall ensure that all household customers, and, where Member States deem it to be appropriate, small enterprises, enjoy universal service, namely the right to be supplied with electricity of a specified quality within their territory at competitive, easily and clearly comparable, transparent and non-discriminatory prices. The provision of universal service understood in this way is an obligation of the Member States.

Under Polish law, this obligation is implemented through the regulation of ex officio sellers. They are appointed by the President of the Energy Regulatory Office by way of a tender in which energy enterprises holding concessions for trading in gaseous fuels or electricity may participate. In addition, an energy company engaged in the transmission or distribution of gaseous fuels or energy is also obliged to conclude a grid connection agreement with entities applying for grid connection on an equal treatment and connection basis (Article 7 of the EL). In turn, the institution of a lump-sum energy allowance (Article 5c(1) of the EL) is intended as a solution to assist the economically weakest electricity customers.

Electricity price on the energy market

In economic terms, price is the quantity of goods given or received in exchange for another good[8]. Within the numerous groups of energy market participants, a distinction is made between prices for customers, which include specific groups of customers such as household customer, vulnerable customers, enterprises, state institutions and public use entities (e.g. hospitals, libraries). Other types of prices are wholesale prices (prices of energy producers) and infrastructure prices (related to storage, transmission and distribution of electricity).

The price of electricity is part of the cost that customers are obliged to pay. The total monetary sum of the sale and distribution of energy to the consumer is a composite cost, including: costs (cost of electricity), public charges in the form of taxes (goods and services tax, excise duty), fees (e.g. power fee, distribution fee, quality fee, renewable energy fee, cogeneration fee).

Energy prices depend on price tariffs. The term "price tariffs" is defined in Article 3(17) of the EL as a set of prices and fee rates and the conditions for their application, developed by an energy company and introduced as applicable to the customers specified therein by the procedure set out in the Act. The tariff consists of the designation of the tariff group, the contracted power and the time zone.

In Poland, the general regulation is that licensed energy companies set energy tariffs, which must get approval from the President of the Energy Regulatory Office, and propose their duration (Article 47(1) of the EL). However, an announcement from the President of the Energy Regulatory Office of 31st Oct. 2007 led to the exemption of energy enterprises with electricity

[8] Fetter A. Frank, *The definition of price, The American Economic Review*, vol 2, no. 4, 1912. https://www.jstor.org/stable/1828191 (access: 01.07.2023).

trading licences from the obligation to submit tariffs for approval[9]. By order of 14th Dec. 2007, the obligation to submit tariffs for the tariff group G11 for approval was imposed[10].

Under Article 57(1) of Directive 2019/994, each Member State shall designate a single regulatory authority at the national level. The Polish regulatory authority is the President of the Energy Regulatory Office. It is an independent, professional, specialised authority, which has been equipped by the national legislator with the powers defined by the EL. Regulatory authorities should also be granted the power to contribute to ensuring high standards of universal and public service obligations by market opening, to the protection of vulnerable customers, and to the full effectiveness of consumer protection measures (Directive 2019/944).

There are mainly four tariff groups: "A", "B", "C", "G". Tariff group "A" includes the largest electricity customers (e.g. mines, factories). Group "B" includes large enterprises and "C" – small and medium-sized enterprises and households. Group “G” is dedicated to household customers. Contracted power is the amount of electricity that the distribution system operator can supply to a specific point of consumption under a contract between the electricity company and the customer (§ 2 (17) of Polish Decree of the Minister of Climate and Environment of 22nd March 2023 on detailed conditions for the operation of the electricity system[11]. The definition of time zones allows appropriate billing to be made for electricity consumption, indicating the time units in which it is more or less expensive for its customers. Sometimes, the letters “b”, “a”, “w” are also added to the tariff designation to indicate how the day is divided into time zones.

The multiplicity of variants of electricity tariffs is dictated by the need to adapt the relevant price rates to the abilities and needs of specific customer groups. As a general rule, tariffs are set in advance for a long period, which implies that the current energy system is not focused on rewarding customers’ flexibility and shifting consumption according to demand and sales. The above-mentioned makes it possible to describe the Polish electricity pricing system as a “rigid” system, which is not prepared for new, more demanding challenges related to the development of technology, the increasing popularity of renewable energy sources, and the current energy crisis.

In the Polish and European public space, dynamic tariffs are a topic of discussion, which could solve problems related to excessive or too low demand for electricity at certain times of the day. The assumption is that the price rates for electricity in a dynamic tariff could reflect the actual value of energy in actual time, thus avoiding a situation of electricity production over demand, as occurred on 23th Apr. 2023 in Poland, when the Transmission System Operator (TSO) declared a security of electricity supply alert[12] The TSO's announcement was made due to the production of electricity from renewable energy sources being in excess of its demand.

It should be emphasised that some outlines of the concept of dynamic tariffs are already to be found in Directive 2019/944, which introduces a new type of contract called “dynamic

[9] President of the Energy Regulatory Office’s information: https://www.ure.gov.pl/pl/urzad/informacje-ogolne/komunikaty-prezesa-ure/3032,Informacja.html (access: 01.07.2023).

[10] *Ibid.*

[11] Polish Decree of the Minister of Climate and Environment of 22nd March 2023 on detailed conditions for the operation of the electricity system (consolidated text: Journal of Laws 2023, item 819).

[12] The Transmission System Operator has identified a danger to the security of electricity supply, https://www.pse.pl/-/komunikat-osp-o-wystapieniu-stanu-zagrozenia-bezpieczenstwa-dostaw-energii-elektrycznej?safeargs=696e686572697452656469726563743d74727565 (access: 01.07.2023 r.).

electricity price contract" and a new participant – "active customer". The first term means an electricity supply contract between a supplier and a final customer that reflects the price variation in the spot markets, including in the day-ahead and intraday markets, at intervals at least equal to the market settlement frequency (Article 2(15) of Directive 2019/944). An active customer is a final customer, or a group of jointly acting final customers, who consumes or stores electricity generated within its premises located within confined boundaries or, where permitted by a Member State, within other premises, or who sells self-generated electricity or participates in flexibility or energy efficiency schemes, provided that those activities do not constitute its primary commercial or professional activity (Art. 2(8) of Directive 2019/944).

Directive 2019/944 assumes that an active customer responds to signals from the energy market and in return receives some benefits (mainly financial). The first type of active customer is prosumers using *net billing* – a type of charging and rewarding prosumers, based on the real market value of electricity. The establishment of universal dynamic tariffs would make it possible to extend the group of active customers to other groups. However, the introduction of universal dynamic tariffs would allow the group of their customers to be extended to other groups, but in this situation, certain legislative as well as factual changes are required – for example, the replacement of current metering systems with smart metering systems and the modernisation and expansion of transmission and distribution networks.

Tariffs, according to Article 45 of the EL, must be developed based on two main principles. The first one is the principle that tariffs cover the energy companies' justified costs and the second is the principle that tariffs ensure a return on the energy companies' capital. Under Article 3(21) of the EL, justified costs are costs necessary for the performance of obligations arising in connection with an energy undertaking's operations in the field of production, processing, storage, transmission and distribution, and trade in fuels or energy, and adopted by the energy undertaking for the calculation of prices and fee rates set in the tariff in an economically justified manner, with due diligence aimed at protecting the interests of customers; justified costs are not tax-deductible costs within the meaning of the tax legislation. Subject literature emphasises that justified costs should be based on reasonable and proven costs of producing and supplying energy to customers. The decision as to whether to consider a cost as justified should be preceded by appropriate mathematical, economic and financial processes. It is a limiting principle, self-limiting the state's discretion to protect customers from unreasonably high electricity prices. It does not allow the realisation of excessive, monopolistic profits of energy companies.

However, the application of this principle involves certain dangers, which are expressed in the recognition that if the justified costs are high, the price level of electricity must also be kept high. On the one hand, the EU and national legislators indicate that access to electricity is a universal service with a strictly guaranteed character. On the other hand, Article 27 of Directive 2019/944 constitutes that Member States shall ensure that all household customers, and, where Member States deem it to be appropriate, small enterprises, enjoy universal service, namely the right to be supplied with electricity of a specified quality within their territory at competitive, easily and clearly comparable, transparent and non-discriminatory prices.

Given the above - how does the term and *ratio legis* of "justified costs" introduced by the Polish legislator corresponds with Article 27 of Directive 2019/944, as well as with the values and objectives of the Energy Law. In a situation of high energy prices, there is a possibility of a conflict between an entity that is not capable of paying the cost of the electricity purchased and the financial bill of the energy company concerned. However, subject literature points out that there is one principle, of the most general nature, which collects the other principles. This is the common good, understood as the sum of social, economic, political, and cultural conditions that allow individuals and their organisations to develop to their full potential. Energy policy should be pursued so that every member of society can develop fully within it.

The term “cost of capital”, in turn, is commonly understood in economic science and business practice of enterprises as the cost of compensation of the equity capital employed, which should be reflected in the size of the dividend, or the cost of raising external capital, i.e. debt, which from a balance sheet point of view is the cost paid to the parties financing the activities of the energy enterprise concerned. This principle means that an energy company's tariff should compensate the cost of either equity or third-party capital employed in financing the company's operations.

Price regulation mechanisms for energy customers

Energy poverty is a specific situation that can affect different groups of customers. Eurostat data conducted for 2022 shows that 9.3% of the European population was affected by this negative effect, while in 2021 this number was 6.9%[13]. It means that in 2021, 29.9 million Europeans could not afford to keep their homes adequately warm, according to Eurostat[14]. The Polish legislator, wishing to protect different groups of customers in the difficult situation of high electricity prices, introduced several extraordinary and timely mechanisms to solve this social problem. These include: anti-inflation shields, a reduction in excise duty on electricity, and a freeze on electricity prices. There is also the institution of an energy allowance under Polish energy law.

In connection with the difficult economic situation at the beginning of 2022, the Polish legislator decided to introduce the incidental institution of an anti-inflation shield through the Anti-inflation Shield Act of 17th Dec. 2021[15]. This is a form of support for household customers affected by the increase in prices of electricity, food, heating. Anti-inflation shields consist of granting eligible entities a one-off cash benefit, paid in one or two tranches. It is intended to compensate for the increase in the cost of heating buildings and flats. The justification of the bill for the above-mentioned Act states that the anti-inflation shield is intended to support 6.84 million households in Poland and is intended to help pay part of the energy costs and the related rising food prices[16]. The main criteria for granting it are Polish citizenship, residence and actual stay in the territory of the Republic of Poland and an income criterion. There is also a possibility that foreigners who have their place of residence and reside in the territory of the Republic of

[13] Eurostat (June 2022 - Inability to keep home adequately warm, European Union - 27 countries from 2020): https://ec.europa.eu/eurostat/databrowser/view/ILC_MDES01/default/table?lang=en (access: 01.07.2023 r.).

[14] European Commission, The ‘’Inability to keep home adequately warm’’ indicator: Is it enough to measure energy poverty?, https://energy-poverty.ec.europa.eu/about-us/news/inability-keep-home-adequately-warm-indicator-it-enough-measure-energy-poverty-2023-02-03_en (access:01.07.2023) and also Data from Eurostat (June 2022 - Inability to keep home adequately warm, European Union - 27 countries from 2020).

[15] Ustawa z dnia 17 grudnia 2021 r. o dodatku osłonowym (consolidated text: Journal of Laws 2022, item 1, as amended).

[16] Bill of the Shielding Allowance Act of 17th Dec. 2021 (Parliamentary print no. 1820, p. 11 of the file): https://orka.sejm.gov.pl/Druki9ka.nsf/0/70EDD6EF4AB92EBBC12587A300678F49/%24File/1820.pdf (access: 01.07.2023 r.).

Poland may be included by the anti-inflation shield after fulfilling other criteria listed in Article 2(4) of the Anti-inflation Shield Act of 17th Dec.2021.

The energy allowance, which is also referred to in the Anti-inflation Shield Act of 17th Dec.2021, is intended for a narrower group of customers - vulnerable customers. By Article 3(13c) of EL a vulnerable customer can obtain an energy allowance when the customer has been granted a housing allowance[17], is a person who is a party to a comprehensive agreement or an agreement for the sale of electricity concluded with an energy company and resides at the place of electricity supply. In turn, housing allowance is granted to persons who fulfil certain housing, income and area criteria. This requirement is absolute and the above-mentioned Act does not provide for any exceptions in this respect. The legislator has not left it to the administrative body adjudicating on these matters to act within its administrative discretion.

Under Article 9(1)(2) of the Excise Duty Act of 6th Dec. 2008[18], the sale of electricity to a customer in the territory of the Republic of Poland is subject to excise duty. In turn, the provision of Article 89(3) of the aforementioned Act indicates that the excise rate for electricity is (as a standard) PLN 5.00 per megawatt-hour (MWh). The already repealed Article 9 of the Act of 12th May 2022 amending the Act on Goods and Services Tax and certain other acts[19] indicated that a seller selling electricity to a customer was obliged, until 31st Dec. 2022, to provide that customer with information on the exemption from excise duty or the reduced rate of excise duty on electricity, respectively:

(1) by enclosing that information each time with the invoice or other document from which payment for the electricity was derived, or

(2) separately, where the invoice or other document giving rise to the payment of the amount due for the electricity was sent after 31 Jul. 2022.

The excise duty reduction of electricity was originally intended to be in force until 31 May 2022, but due to the continuing situation of high prices in the Republic of Poland, the legislator decided to extend the condition in question until 31 Jul. 2022. In the end, the mechanism remained in force until the end of 2022.

Through the enforcement of the Act of 27th Oct. 2022 on emergency measures to reduce electricity prices and support certain customers in 2023[20], the Polish legislator has established an "electricity price freeze". It is based on the fact that an energy company performing economic activity in the area of electricity trading or generation applies a maximum price in settlements with eligible customers connected to the distribution or transmission network. The purpose of this legislation is to reduce the rising costs of purchasing electricity for these entities, particularly as a result of the increase in energy purchase prices on the wholesale market, which in turn is reflected in the level of prices in contracts concluded by these entities with sellers for the sale of electricity. The price of electricity in the period from 1st Dec. 2022 to 31st Dec. 2023 was originally to be frozen at the 2022 price level for the following limits:

[17] Article 2(1) of Housing Allowances Act of the 21st June 2001 (Ustawa z dnia 21 czerwca 2001 r. o dodatkach mieszkaniowych - consolidated text: Journal of Laws 2021, item 2001, as amended).

[18] Ustawa z dnia 6 grudnia 2008 r. o podatku akcyzowym (consolidated text: Journal of Laws 2009, item 11).

[19] Ustawa z dnia 12 maja 2022 r. o zmianie ustawy o podatku od towarów i usług oraz niektórych innych ustaw (consolidated text: Journal of Laws 2022, item: 1137, as amended).

[20] Ustawa z dnia 27 października 2022 r. o środkach nadzwyczajnych mających na celu ograniczenie wysokości cen energii elektrycznej oraz wsparciu niektórych odbiorców w 2023 roku (consolidated text: Journal of Laws 2022, item: 2243, as amended).

- up to 2 MWh per year - for all households,
- up to 2.6 MWh per year - for households with persons with disabilities,
- up to 3 MWh per year - for households with a Large Family Card and farmers,
- up to 250 kWh per year - for a plot in a family allotment garden.

The justification for the bill to an Act being commented on specifies the three main groups of customers for whom the legislator decided to enact it. It was pointed out that *"(...) high electricity prices are most affected by household customers, in particular vulnerable customers and those affected by energy poverty. Another group of customers sensitive to electricity price fluctuations is the broadly defined public utilities"*[21].

To qualify a customer as an "entitled customer" within the meaning of the commented Act, it was necessary for that customer to submit a special declaration by 30th Jun. 2023. The declaration was submitted to the "entitled entities", i.e. energy companies carrying out business activities in the field of electricity trading. The amount of compensation was calculated by the energy sellers. They are due for each calendar month from the date on which the entitled entity started to apply the maximum prices for electricity trading in its settlements with entitled customers.

However, the commented Act is at the stage of amendment and the regulations presented above may change[22]. The government's bill to amend the Act on special solutions for the protection of electricity customers in 2023 in connection with the situation on the electricity market and to amend certain other acts provides for the extension of customer support by, inter alia:

- increasing the basic energy consumption limit subject to the price freeze at the 2022 level for households (from 2 MWh to 3 MWh), households with disabled persons (from 2.6 MWh to 3 MWh) and families with a Large Family Card and farmer households (from 3 MWh to 4 MWh);
- a reduction in the maximum price of electricity from 785 PLN/MWh to 693 PLN/MWh in the 4th Quarter of 2023 to provide additional support to small and medium-sized enterprises, local governments, public utilities and other vulnerable entities.

EU climate and energy policy and its impact on current electricity prices

The wording of Article 194(1) TFEU leaves no doubt that the European Union's energy policy is implemented in close connection with the establishment and functioning of the internal market. This is supported by the fact that ensuring the functioning of the internal market is listed as the first objective of EU energy policy.

Three principles of the European Union's internal market seem to be of particular relevance to that issue[23]. The first one is the principle of third-party access to the transmission and

[21] Justification of the bill of the Act of 27th October 2022 on emergency measures to reduce electricity prices and support certain customers in 2023, p. 56 of the file https://orka.sejm.gov.pl/Druki9ka.nsf/0/73BA58EBE9B26B38C12588DB006482B2/%24File/2697.pdf (access: 01.07.2023).

[22] Progress of work on the government's bill of an Act of 27th October 2022 on emergency measures to reduce electricity prices and support certain customers in 2023: https://sejm.gov.pl/Sejm9.nsf/PrzebiegProc.xsp?id=14FAD3A8E5F41166C12589E900541876 (access: 01.07.2023).

[23] Lissoń P. points to the existence of five major principles of the European Union internal market: 1) the principle of third-party access to the transmission and distribution system, 2) the principle of approval of tariffs or the methods used to calculate them, 3) the principle of freedom of choice of supplier (seller) of electricity, 4) the principle of setting supply (sale-) prices of electricity based on market mechanisms, 5) the principle of separation of energy

distribution systems based on published tariffs, applicable to all customers and applied objectively and without discrimination between system users (Article 6 of Directive 2019/944). The second is the principle of freedom of choice of energy supplier (seller), as expressed in Article 10 of Directive 2019/944, regardless of the Member State in which the supplier is registered. The third is the principle of setting the prices for the supply (sale) of electricity based on market mechanisms, which implies a fundamental abandonment of the regulation of these prices (Article 59 of Directive 2019/944). Article 5(1) of the aforementioned Directive said that suppliers shall be free to determine the price at which they supply electricity to customers. Member States shall take appropriate actions to ensure effective competition between suppliers. Member States shall ensure the protection of energy poor and vulnerable household customers pursuant to Articles 28 and 29 by social policy or by other means than public interventions in the price setting for the supply of electricity (Article 5(2) of Directive 2019/944).

EU in Article 27 of Directive 2019/944 provides the right to be supplied with electricity of a specified quality within Member States' territory at competitive, easily and clearly comparable, transparent and non-discriminatory prices. The provision indicates that, to ensure the regulation of universal service, Member States may designate a supplier of last resort.

In a situation of high electricity prices, the EU legislator introduces solutions to reduce the effects of electricity prices by, inter alia, reducing energy demand and redistributing surplus revenues and profits of the energy sector enterprises and household customers. The above is set out in Council Regulation (EU) 2022/1854 of 6 October 2022 on an emergency intervention to address high energy prices (the "Regulation 2022/1854")[24]. Regulation 2022/1854 introduces a voluntary target to reduce total monthly gross electricity consumption by 10% (Article 3(1) and a mandatory target to reduce electricity demand by at least 5% on average per hour (Article 4(2). The act also allows for Member States (under certain circumstances) to intervene by either fixing the price of electricity supply for small and medium-sized enterprises or setting the price of electricity below cost, provided that four criteria are met[25] (Article 13 of the Regulation 2022/1854). Another form of support for energy consumers is the establishment of a temporary solidarity levy for EU companies and permanent establishments, active in the oil, gas, coal and refining sectors, which is based on taxable income, as determined by national tax legislation, in and throughout the fiscal year 2022 or fiscal year 2023, over a 20 per cent increase in average taxable income, as determined by national tax legislation, in the four fiscal years starting on or after 1st January 2018.

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transmission or distribution activities from other activities not related to energy transmission or distribution (unbundling).

[24] Council Regulation (EU) 2022/1854 of 6 October 2022 on an emergency intervention to address high energy prices (Official Journal of the European Union of 2022, LI 261/1).

[25] See an Article 13 of the Regulation 2022/1854: *By way of derogation from Union rules on public interventions in price setting, when applying public interventions in price setting for the supply of electricity pursuant to Article 5(6) of Directive (EU) 2019/944 or to Article 12 of this Regulation, Member States may exceptionally and temporarily set a price for the supply of electricity which is below cost provided that all of the following conditions are fulfilled: (a) the measure covers a limited amount of consumption and retains an incentive for demand reduction; (b) there is no discrimination between suppliers; (c) suppliers are compensated for supplying below cost; and (d) all suppliers are eligible to provide offers at the price for the supply of electricity which is below cost on the same basis.*

Summary

In the difficult situation of high electricity prices, both - the Polish and the EU legislators are introducing temporary solutions to the problem. However, these mechanisms are not part of LE, but are included in separate, specially enacted Acts by the legislator, thus contributing to the problem of law inflation and its lack of transparency. The above-mentioned attempts to introduce various customer protection regulations imply the conclusion that the general provisions of energy law at both (national and EU level) are not adequate to the possibility of sudden energy price spikes. Customers should have a guarantee that the electricity price is fair, expected and adequate to their economic and financial possibilities.

The above indicates that in energy market crises at both EU and national levels, the protection of household customers is complex, but not sufficient. Because the energy market is closely related to the international economy and affected by the current geopolitical situation, the possibility of further situations in which customers will have to face high energy prices, should not be ruled out. This implies the thesis that the Polish and EU legislators must take appropriate actions to introduce protective mechanisms for various entities. It is essential for these mechanisms to be part of the energy law and to ensure the customers' access to energy at a fair, expected and adequate price.

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Update of Poland's Energy Plan 2040 in Light of European Union Strategic Documents: Directions, Challenges, and Perspectives

Maciej Mrozowski

Abstract: Poland, possessing abundant coal resources, has been dependent on this raw material for many years, utilizing it as the primary source of energy in the country. However, due to global regulations and the European Union's commitment to achieving climate neutrality by 2050, Poland, like other nations, has set a goal for the transformation and modernization of its energy sector. Additionally, there is an emphasis on increasing the role of renewable energy sources in the national energy mix. The Energy Plan for Poland 2040 (PEP 2040) is a crucial document outlining the directions for the development of the energy supply in Poland for the next two decades. In light of new strategic documents introduced by the European Union, it is essential to update this plan to align it with overarching goals related to combating climate change, electricity production, and energy sources. "RePowerEU" is a significant EU document that outlines actions aimed at rapidly reducing dependence on Russian fossil fuels, accelerating the development of renewable energy sources, and hastening the ecological transformation of the continent. This article proposes changes to the Energy Plan for Poland 2040 (PEP 2040) in the context of European Union strategic documents. The analysis focuses on key aspects and recommendations of the EU, such as diversifying supplies and supply routes, increasing the pace of renewable energy development, improving connections within European energy networks, and enhancing the European energy security system. The article discusses major threats arising from past energy policies and presents the benefits that the implementation of the updated PEP 2040 will bring.

Key words: REpowerEU, European Union, energy transformation, Poland energy plan

Introduction

In the face of the global climate crisis and international commitments related to the reduction of greenhouse gas emissions, energy policy has become one of the key areas where European Union member states must take decisive actions. Poland, as an active participant in this EU community, not only influences the energy policy of the region but also must align its energy goals with the requirements of the European Union.

The update of Poland's Energy Policy until 2040 gains particular significance in light of new documents and guidelines issued by the European Union. The shift towards a green economy, sustainable development, and low CO2 emissions has become a priority on the European continent. The European Union has committed to achieving climate neutrality by 2050 and reducing greenhouse gas emissions by at least 55% by 2030 compared to the 1990 level.

Poland, as an integral part of the European Union, has an obligation to adjust its energy policy to achieve these goals and collaborate with other member countries in the pursuit of sustainable and environmentally friendly development. In this article, we will examine the essence of updating Poland's Energy Policy until 2040 in the context of new documents and guidelines from the European Union, emphasizing both the challenges and opportunities associated with this process. We will also explore the benefits of accessing EU funds for projects related to energy transformation. Poland faces key challenges and opportunities in transforming its energy sector, and our article aims to shed light on this important issue.

Polish Energy Policy until 2040

Poland's energy policy for the next two decades takes shape within the framework of the Energy Plan for Poland 2040. This ambitious document outlines key goals and assumptions regarding the development of the energy sector in Poland. Here are the main points of this plan:

1. Less Coal, More Renewable Energy Sources: One of the main goals of the plan is to reduce the share of coal in Poland's energy mix. Coal currently constitutes the primary source of energy, but it has a negative impact on the environment. The plan envisions a gradual replacement of coal with more environmentally friendly sources, such as solar and wind energy. According to projections, a significant decrease in the share of coal in the structure of electricity generation is expected by 2030. Annual consumption of hard coal is expected to remain around 36 million tons until 2027, but according to Poland's Energy Policy until 2040, the share of coal in the balance of primary energy production will decrease from approximately 57% to around 39%. This phenomenon is mainly a result of international commitments, such as the European Union's goals for reducing greenhouse gas emissions and increasing the share of renewable sources (Kielar et al., 2019: 4).

2. Development of Renewable Energy: The history of renewable energy in Poland dates back to the early 20th century when the first hydroelectric power plants were launched in Leśna on the Kwisa River with a capacity of 2.7 MW and a larger power plant in Plichowice with a capacity of 13.3 MW. Despite the fact that the share of renewable energy in Poland increased to 12% in 2017, it is worth noting the introduction of a law by the Polish government that restricted the construction of wind farms and imposed additional fees on existing ones, reducing the profitability of electricity production (Sowa, 2018: 4). The new plan envisions a significant increase in the share of renewable energy sources in the Polish energy mix. The goal is to achieve a 23% share of renewable energy by 2030 and 28.5% by 2040. This entails investments in technologies such as photovoltaic panels and wind farms (PEP2040, 2021).

3. Energy Security: Diversification of energy sources and supplies is a fundamental aspect of strategies aimed at ensuring the energy security of nations. In the context of this challenge, both sovereign states and international organizations, such as the European Union, strive to diversify their energy carrier portfolios, encompassing both imported resources and domestic energy reserves. A widely adopted norm in European Union countries is not to purchase more than 30% of an energy carrier from a single exporter (Nagy et al., 2005: 5). The Polish Energy Policy Plan until 2040 aims to enhance energy security through the diversification of energy supply sources. Poland hopes to reduce dependence on a single major natural gas supplier and increase the utilization of LNG (PEP2040, 2021).

4. Power Plant Modernization: The aging energy infrastructure in Poland, characterized by significant decapitalization of the transmission network, requires immediate modernization. The average age of transmission lines is estimated at 40 years, bringing them close to technical obsolescence. In Poland, especially for high-voltage networks, as much as 82% of 220 kV lines and 25% of 400 kV lines are over 30 years old, imposing constraints on the transmission of electrical energy and the connection of modern generation sources, especially renewables (Jankiewicz, 2018: 3). The plan entails investments in clean combustion technologies and solutions that will reduce greenhouse gas emissions from coal-fired power plants, as well as the modernization of transmission lines (PEP2040, 2021).

5. Electromobility: Currently, the electric vehicle market in Poland is in a developmental stage, as evidenced by the limited availability of charging infrastructure and relatively low interest in this service in locations where it already exists. Additionally, the sales of electric cars remain at a relatively low level. In 2017, only 907 electric passenger vehicles (PEVs) were registered (a total of 1,692 from 2011 to 2017). This includes 475 battery electric vehicles (BEVs) (totaling 848 until 2017) and 432 plug-in hybrid vehicles (PHEVs) (totaling 844 until 2017). Comparing these figures, it can be concluded that despite some progress, the electric vehicle market in Poland still requires further development, especially in charging infrastructure, to gain popularity among consumers (Sendek-Matysiak et al., 2018: 2). As part of the plan, the promotion of electromobility is anticipated, including the construction of charging infrastructure for electric vehicles and financial incentives for electric vehicle purchases, which can contribute to the reduction of CO2 emissions in transportation (PEP2040, 2021).

6. Energy Efficiency: In the broadest sense, energy efficiency refers to the effective utilization of energy resources in the context of achieving results, providing services, producing goods, or the consumption of energy in the processes. In the light of Directive 2006/32/EC, it is a measure of the effectiveness of energy use within economic activities. Efficient energy management is one of the key tools supporting entrepreneurship and innovation. Modern society increasingly recognizes the reduction of energy losses not only as economically beneficial but also as a significant step towards sustainable social development. Therefore, the pursuit of energy efficiency not only contributes to the optimal use of resources but also aligns with widely accepted values of sustainable development (Skoczkowski et al., 2016: 2). Increasing energy efficiency is a crucial element of the plan. These actions are intended to help reduce energy consumption in construction, industry, and transportation.

7. Support for Small Energy Sources: The plan envisages the development of micro-installations of renewable energy sources, such as photovoltaic panels on house roofs and small wind turbines, to increase the involvement of citizens in energy production.

8. Social Policy and Retraining of Workers: The transformation of the coal sector entails the need to support the industry workers. The shift from coal mining should primarily rely on natural workforce attrition, involving career path changes or retirement. Additionally, a crucial aspect should be to curb the influx of new workers into this sector. Miners opting for a change of industry should be supported in the retraining process, which, in turn, requires early identification of gaps in their skills and assets. Optimal outcomes of this process can be achieved through close collaboration with mining companies, support from public employment services, and potential new employers, contributing to the effective transition of workers to new job opportunities (Kiewra et al., 2019: 4). The PEP2040 plan includes social programs designed to help workers adapt to new market conditions.

Poland's Energy Policy until 2040 is a bold step towards a sustainable and efficient energy policy. However, its success will depend on the collaboration of various stakeholders, investments, and consistent monitoring of progress in achieving the set goals. The paramount value is to ensure Poland's secure, stable, and environmentally friendly access to energy in the upcoming decades.

RePowerEU

RePowerEU is the European Union's initiative aimed at reducing dependence on Russian fossil fuels through a transformation towards renewable energy, diversification of supplies, and enhancing the energy security of the EU. The initiative stems from Russia's aggression towards Ukraine and seeks to achieve both climate goals and secure energy supplies. Here are the main points of this plan:

1. Energy saving: Energy saving is a key element of the transition towards clean energy, enhancing the resilience of the EU economy and shielding it from high fossil fuel prices. The plan involves long-term investments in energy efficiency, such as modernizing buildings, as well as immediate energy savings through behavioral changes.

2. Diversification of energy imports: The European Union is working on diversifying the sources and supplies of energy to minimize the rise in energy prices by creating a Union energy platform with three main goals: connecting and structuring the demand, optimizing the infrastructure, and engaging in international actions. Diplomatic visits are being conducted to countries that can replace Russia in terms of energy raw material supplies, seeking alternative sources and partners in the energy supply sector. As a result of these efforts, the European Union has achieved significant success, as in 2022 it was already noted that non-Russian gas imports with connections to Europe increased by 14 billion cubic meters (Ciechanowska, 2023: 2). This initiative aims to reduce dependence on a single energy supplier and lower costs, contributing to the stability of energy supplies in the EU.

3.Replacement of fossil fuels and acceleration of Europe's transition towards clean energy: As is widely known, Poland possesses some of the largest reserves of hard coal and lignite in Europe. The registered balance reserves of hard coal in Poland exceed 58,000 million tons, and lignite reserves exceed 20,500 million tons (Gawlik et al., 2017: 3-5). In Poland, the share of coal in electricity generation is approximately 69%, making this aspect extremely important for our country, as it focuses on the plans and goals of the European Union regarding the energy transition towards clean energy and reducing dependence on fossil fuels. The European Commission proposes increasing the use of renewable energy and promoting environmentally friendly technologies. The plan includes increasing the capacity of renewable energy production, including photovoltaics and wind energy. Furthermore, the European Union aims to increase the production and use of renewable hydrogen as an alternative to fossil fuels (REPowerEU Plan, 2022).

4.Smart Investments: The implementation of the REPowerEU program entails the need for additional investments amounting to 210 billion euros by 2027, in addition to the funds required to achieve the goals set within the "Fit for 55" package. These additional investments are deemed cost-effective, and it is anticipated that they will enable the European Union to save 80 billion euros annually in gas imports, 12 billion euros annually in crude oil imports, and 1.7 billion euros annually in coal imports by 2030. The REPowerEU plan envisions a significant shift in the energy system in terms of quantity and directions of energy flows. Consequently, the European Commission encourages the implementation of many long-awaited infrastructure projects, especially cross-border connections, to create an integrated energy market that secures supplies in the spirit of solidarity (REPowerEU Plan, 2022).

5.Enhancing Preparedness: Europe must be prepared for potential disruptions in gas supplies. The European Commission calls on member states to take actions aimed at securing gas supplies, including replenishing reserves, implementing energy savings, updating emergency plans, accelerating technical work in transmission systems, establishing solidarity agreements, defining priorities in deliveries, developing an energy demand reduction plan, and reviewing readiness plans in the electricity sector.

RepowerEU faces the task of coordinating and accelerating the energy transition in the European Union. This initiative has the potential to transform the European energy sector into a more sustainable, efficient, and environmentally friendly system. The key challenges facing RepowerEU include increasing the role of renewable energy, improving energy efficiency, strengthening international cooperation, as well as supporting innovation and technological development. In summary, RepowerEU faces a significant challenge but also has tremendous potential. Its success depends on effective collaboration among member states, investments in renewable energy sources, the development of modern technologies, and commitment to achieving ambitious climate and sustainable energy goals in Europe.

Poland's Goals - Adapting to EU Standards Challenge

Poland has declared its own climate and energy goals. Although Poland's specific goals may change over time, in the early 21st century Poland was planning to gradually reduce greenhouse gas emissions by 30% by 2030 compared to the 1990 level. However, faced with increasing pressure to reduce emissions, Poland must increase the level of emission reduction by at least 20% compared to current plans. In response to EU guidelines, Poland will strive in the coming years to increase the significance of the share of renewable energy sources such as solar, wind, and biomass in the country's energy economy. Our policy initially aimed to achieve a 23% share of renewable energy by 2030, which, in light of the new plans of the European Union, is insufficient. Poland must increase the share of renewable energy by an additional 25-30% by 2030.Energy efficiency is also a crucial aspect to which our country must pay special attention due to both emission reduction and improving energy efficiency. The introduction of carbon dioxide emission fees will increase costs for CO_2-emitting companies and encourage investment in more environmentally friendly technologies. Another important commitment is the transformation of the industry, essentially restructuring it towards a more sustainable and low-emission production model. It is essential to invest in environmentally friendly technologies and make changes in production processes.

Challenges of Adapting to EU Standards

As a member of the European Union, Poland faces a complex task of aligning its energy and climate policies with EU standards. This challenge, although crucial from the global environmental perspective, brings with it many specifics that must be taken into account. One of them is undoubtedly the transition to more sustainable energy sources and the reduction of greenhouse gas emissions, which requires significant investments. Poland must allocate substantial financial resources to implement new technologies, develop renewable energy sources, and modernize its energy infrastructure. These investments extend beyond the public sector, since the private sector also plays a significant role. Adapting to EU climate standards will require new financing models and partnerships between the public and private sectors. The key challenge is the efficient use of these funds, ensuring that these investments yield the expected benefits for the environment and the economy. Another topic is the change in Poland's energy structure, as the country still relies heavily on coal as its primary energy source. This poses a challenge both in terms of reducing greenhouse gas emissions and achieving long-term sustainable development. Transitioning to a more sustainable and low-emission energy structure entails gradually phasing out coal and increasing the share of renewable energy sources. This may raise concerns and resistance, especially in mining regions where many jobs depend on the coal sector. Poland must develop support strategies for these regions that consider both the need for environmental protection and securing the future of these areas. Additionally, it is essential to conduct an open dialogue with stakeholders taking into account their needs and concerns and providing accurate information about the benefits of the energy transition. Increasing awareness and social engagement in the adaptation process are crucial.

The Importance of EU Funds in the Context of Poland's Energy Transformation

EU funds play a crucial role in the process of Poland's energy transformation. They provide significant financial support, enabling the implementation of projects related to renewable energy sources, improving energy efficiency, and reducing greenhouse gas emissions. Access to these funds helps Poland meet EU requirements regarding emission reduction and the share of renewable energy. Furthermore, these funds help to lower the costs of transformation, which is essential for both consumers and businesses. With financial support, companies can invest in new technologies, modernize energy infrastructure, and align with EU regulations contributing to their competitiveness in the European market. Additionally, access to these funds stimulates innovation in the energy sector, leading to the development of new technologies and solutions in the field of renewable energy. EU financial resources also attract investors who see the potential for energy transformation in Poland. This, in turn, can contribute to increased investments and the creation of new jobs. Finally, EU funds support the sustainable development of the country, helping Poland adapt to environmental protection challenges and climate change mitigation. Therefore, they are a key tool in achieving the goals of Poland's energy and climate policy.

Perspectives and Opportunities Arising from the Harmonization of Polish and EU Plans

The harmonization of Polish energy plans with EU goals, including RepowerEU, brings forth numerous perspectives and benefits for both Poland and the European Union as a whole:

1. **Increasing Competitiveness and Innovation:** Striving to achieve EU goals, such as increasing the share of renewable energy or improving energy efficiency, fosters investments in modern technologies and innovative solutions. This, in turn, can stimulate the development of the energy sector and create opportunities for Polish companies to participate in research and development projects.
2. **Improving Air Quality:** Poland experiences some of the highest levels of air pollution in the European Union, as seen in indicators such as the concentration of suspended particulate matter PM10, which can lead to conditions such as asthma, allergies, and

respiratory system failure. In November 2015, Poland ranked second, just behind Bulgaria, in terms of PM10 levels. Concerning benzo(a)pyrene, a recognized carcinogen, permissible limits were exceeded in 42 out of 46 air quality monitoring zones in Poland (Zagórska et al., 2018: 2-3). Transitioning to more environmentally friendly energy sources, such as wind and solar power, can help reduce air pollution emissions and improve the quality of life for Poland's residents, particularly in areas affected by smog-related issues.

3. Reduction of Greenhouse Gas Emissions: Undoubtedly, climate warming is evident at every spatial scale, from global to local. Over the past 50 years, most observed signs of warming are likely the result of an increase in atmospheric concentrations of greenhouse gases induced by human activities. The absence of effective climate policies will likely lead to a temperature increase exceeding the 2°C threshold by the year 2100 (Kundzewicz, 2011: 9-10). Aligning Polish energy policy plans with EU climate goals, including RepowerEU, contributes to global efforts to mitigate climate change by reducing greenhouse gas emissions.

4. Job Support: Development of the renewable energy sector and modernization of energy infrastructure can create employment opportunities in sectors related to production, assembly, maintenance, and management of new installations.

5. Energy Security: Russia had been our primary supplier of fossil fuels for many years. In 2012, Russia's share in crude oil imports was 95.5%, and by 2022, it had decreased to 72% (Pangsy-Kania et al., 2022: 10). Investments in renewable energy sources help diversify energy supply sources, contributing to greater energy security for the country. Poland is becoming less dependent on a single type of fuel or a single supplier.

6. Access to EU Funds: Harmonizing with EU goals enables Poland to access EU funds for projects related to energy transformation. This can support investments in energy infrastructure, the development of renewable sources, and the improvement of energy efficiency.

7. Increased Energy Independence: The development of renewable energy sources, including wind and solar energy, can help to increase Poland's independence from the import of fossil fuels. This is a strategic goal in the context of energy security.

8. Improving Poland's Image: Actions towards a sustainable energy transformation can contribute to improving Poland's image in the context of combating climate change and caring for the natural environment.

9. International Cooperation: Harmonizing with EU goals enables Poland to actively collaborate with other EU member states in implementing cross-border projects.

As a result, aligning Polish energy plans with EU goals, especially RepowerEU, can bring a range of benefits in terms of sustainable development, economic growth, environmental protection, and improved quality of life for citizens. This works towards the common good of both Poland and the entire European Union.

Summary

The article discusses key aspects of Polish energy policy and its alignment with European Union standards, particularly in the context of the RepowerEU initiative. Poland has set ambitious goals for reducing greenhouse gas emissions, promoting renewable energy sources, modernizing power plants, and increasing energy efficiency. The RepowerEU initiative aims to reduce dependence on Russian fossil fuels through energy savings, supply diversification, fossil fuel substitution, and intelligent investments. Poland must align its climate goals with EU standards, which requires significant investments, industrial restructuring, and changes to its energy structure. EU funds play a crucial role in Poland's energy transformation by supporting investments in renewable energy sources and energy efficiency improvement. Harmonizing Polish plans with EU goals brings such benefits as increased competitiveness, improved air quality, emission reduction, job creation, enhanced energy security, improved Poland's image, and international cooperation. Adapting Polish energy policy to EU standards is crucial for environmental protection, addressing climate change, and the country's economic development. It is both a challenge and an opportunity to transform Poland's energy sector into a more sustainable, efficient, and environmentally friendly industry. Poland has the opportunity to co-create a sustainable and competitive future for energy in Europe. By aligning its energy policy with EU standards, especially within the RepowerEU initiative, Poland can play a significant role in achieving global climate goals. Access to EU funds supports these efforts, and both Poland and the entire European Union will benefit from harmonizing Polish plans with EU goals. Energy transformation is a challenge but also a tremendous opportunity to create a more sustainable and environmentally friendly future for energy in Europe.

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