



## Energy security in Poland – transformation and role of nuclear energy

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**Abstract.** Currently, Poland is facing the challenge of energy transformation towards a zero-emission energy system. In this article author presents basic assumptions of Poland's energy security system. Moreover, a particular focus is set on replacement of coal power plant, which are currently a fundament of Polish electricity production system. Therefore, in this article is examined a several aspects of transformation of national energy mix with analyse of nuclear energy as a potentially significant part of future energy security fundament. This article also presents the possibilities of implementing various types of nuclear power facilities, as well as *de lege lata* and *de lege ferenda* postulates in the Polish nuclear law.

**Keywords:** energy security, nuclear energy, nuclear law

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## INTRODUCTION

Poland, as a country, finished their state transformation in 90's of XX century in energy security area as de facto coal monoculture. Power plants in which primary source was hard coal and brown coal mined mostly in Polish territory covered in advance national demand for electrical energy. However, in last 30 years, as the effect of economic development establishes urgent necessity for higher supply of energy connected with gradually phase-out of exploitation coal-fired boilers due to end of their projected lifetime. Moreover, as an effect of Poland's accession to the European Union and development of multilateral worldwide cooperation, the state has started to become a subject and a partner in common climate policy. In recent years the European Commission set new priorities in the political and legal sphere aiming to become the first climate-neutral continent. These actions resulted in the necessity of adjusting Member States energy policy to new directives. Along with these indicators the Polish government prepared an energy transformation strategy in the zero-emission energy system direction.

Fundamental core of this strategy is the comprehensive revision of existing solutions, and in several aspects transformation will require to create completely new economy areas and branches. One of them is the nuclear energy sector, since nowadays it was outside of political energy debate in Poland. However, this sector will be crucial in future energy security policy. Nevertheless, both currently and in the future Poland's energy security will be determined by opportunities and challenges established as a result of achieving the next steps and milestones in the country energy transformation process. Successfully executed energy transformation process is comprehensive and complicated, therefore it is important to introduce their most significant aspects.

In accordance with above, it is not possible to deeply analyse all relevant issues, due to complexity and permeability of legal, political, economical and other aspects. Therefore, in this paper one significant question is set about role of nuclear energy in insurance of energy security in Poland. To answer this, it is essential to put into consideration current Polish energy mix challenges and governmental strategy papers alongside relevant issues in European Union policy changes.

The main objective of this paper is to examine Polish energy system from perspective of insurance an energy security and role of nuclear energy therein. Therefore, in accordance with above mentioned objective, achieving this aim will be essentially connected with wide, interdisciplinary approach. This is inevitable, primarily due to number and quantity of different factors directly or indirectly affect Polish energy security.

Moreover, as a result of adopted methodology and analytical approach, the author considered the role of nuclear energy as a key factor in ensuring the future energy security in Poland. As a result of internationalisation and harmonisation of nuclear law, it is necessary to acknowledge that above mentioned systems should be accompanied with comparative legal methodology to examine subject matter.

## **ENERGY SECURITY – DEFINITION AND MAIN INDICATORS**

Polish Energy Law Act defines energy security as a *state of economy enabling current and perspectival coverage of recipients demand for fuel and energy in an technically and economically justified way with obtained environmental protection requirements* (Prawo energetyczne). Polish Energy Policy to 2040 enhances the above definition with the sentence „ [...] with assurance of competitiveness of an energy efficient economy and decreased level of energy sector impact to the environment. ” (PEP2040) Polish legislator, creating definitions in legal acts and in next steps widening the scope in strategic documents aimed to obtain *de facto* legislative consensus, connecting the most comprehensive definitional scoping with the most possible accuracy and precision of implemented legal terms. Nevertheless, the energy security term is the definition related to almost all areas of state activity and more, so fundamentally important is to describe several characteristic aspects to enable a deeper point of view to certain issues. In literature and doctrine there are established energy security aspects like diversification level and exploitation of domestic and foreign sources of supply into energy resources (Braun, 2018, p. 27), quality of state supervisory and implementation of development and investment decisions (Czwolek et al, 2018), level of rely to import (Chrzan, 2015) or the ability to create international strategic alliances (Ruszel & Podmiotko, 2019).

Described above characteristic indicators, despite of the scale and necessity of energy security assurance, presents main challenges that states have to take care of. Remaining stability of electrical energy supply in the climate change era and reducing emissions in the worldwide economy could result in significant concern in areas like environmental protection, sustainable economy or energy transition in connection with support from communities personally involved in these processes.

## **POLISH ENERGY POLICY TO 2040**

In accordance with previous considerations concerning on issues included in Polish Energy Policy to 2040 [further: PEP2040], author come to conclusion that this strategic document is setting fundamental and basic state activity directions, primarily in energy and energy transition area, with points of reference based on directions and

directives of European Union energy-climate policy, in particular European Green Deal (Komunikat, 2019). PEP2040 is based on three pillars, so-called main areas, in which this document is influential. First pillar was set as a just transition, by which legislators remain in that situation, where new job opportunities will be created in economy sectors exposed to transformation processes, by establishing new areas of industry. Particularly, the basic outline of this proposition will be the contradiction against *structural unemployment*, especially in places strongly attached to coal mines. Second pillar described in PEP2040 is zeroemissional energy system, presented as a gradual replacement of highly-emissive power plants, as coal powered boilers with low- or zero-emissional sources and in transition period use of natural gas. Third pillar is the good air quality, which is *de facto* an effect of the energy transformation path into zero-emission objective and in the long term resulting in a better condition of social health.

In PEP2040 there was set also eight particular objectives with attached to them strategic projects on fundamental meaning to established energy security in Poland. However, the most significant aspect is to enlighten these activities, which especially are a part of national energy security aspect – the capacity of fully coverage domestic power supply demand by internal resources. This objective is fundamental due to starting point of energy transformation (Herold *et al.*, 2017) alongside with creation the completely new energy system from this point (PEP2040). These strategic projects are introducing the offshore wind farms and Polish Nuclear Power Programme. First programme is currently in development phase of establishing legal framework. This contribution comes from offshore wind characteristic, which rely on high amount of individualized projects realised in *joint venture* formula, both public and private entities in cooperation with foreign partners. In the offshore wind sector, the state role is to embody regulatory and licensing framework, legal norms and institutional support to the subjects involved in the investment process. Due to PEP2040, offshore wind plants should reach 11 GWe of installed power capacity in 2040 (Polish Press Agency, 2021). Nevertheless, this type of energy has fluctuable and unpredictable characteristics, which create the necessity of introducing a stable energy source, under operation in system baseload. In the transitional period this function will be covered by gas power plants, however as a final source it would be the necessary to develop new energy producing units, which have the ability to produce electricity in constant exploitation, stability of the operational system, reluctance against external factors, the less possible emissions and extended life expectancy. Currently only one power plant type could meet these requirements and it is a nuclear power plant.

## **POLISH NUCLEAR POWER PROGRAMME AND PEP 2040**

In PEP2040 it has been described that the estimated installed capacity of nuclear energy will be around 6-9 GW, which is estimated to cover 20-25% of electricity demand in 2045. However, to obtain this objective there are several challenges, such as financial overcapitalisation, long construction time, obedience with higher and more rigorous standards in comparison with other energy sources and obligatory state involvement in the investment process. To answer these concerns, the Polish government adopted the updated Polish Nuclear Power Programme, (PNPP) as a strategic document complementary to PEP2040 (PNPP, 2021). Introduction of nuclear energy was established in PEP2040 and implemented in both just transition and zeroemissional energy system pillars. These areas, as intended will be realised by enhancing, and in several aspects rebuilding new economic areas oriented to cooperate with nuclear energy. PNPP is set as one of the most spectacular infrastructural projects in Polish history. Another aspect is concerning just transition objectives and include indicated preferred locations for nuclear power plants siting (PNPP, 2021). Besides locations set in the Baltic Sea neighbourhood this document also indicates these areas, where there are currently existing large, system power plants. Constructing nuclear power plants as a replacement of overexploitation coal powered plants will have a positive effect on the remaining workforce and therefore contradict structural unemployment. PNPP, as described above, is the fundamental aspect

of the second PEP2040 pillar – zeroemissional energy system, due to the unique characteristics of nuclear power plants as the energy source.

## IMPORTANCE OF NUCLEAR ENERGY TO POLAND'S ENERGY SECURITY

PNPP, whose main target is to introduce nuclear energy in Poland, is one of the key elements in the process of ensuring energy security in understanding both the Energy Law Act and PEP2040. To obtain this objective, there are plans to construct 6 nuclear reactors with a total installed capacity of 6-9 GW, based on big, proven PWR units. Expanding the above sentence, PNPP is focused on *big nuclear*, which means large-scale nuclear reactors with power output above 1 GWe. This approach exclude *small modular reactors*, also called SMRs, because in general they are projected on power output typically 50-300 MWe. Second fundamental criteria in PNPP is that nuclear reactor, besides of indicated power, have to be also prepared in PWR technology, *pressurized water reactor*. This type of technology is currently the most worldwide widespread and there was none nuclear accident with significant releases into environment. Moreover, low financial costs of exploitation are prioritising this type of technology and their maturity and construction experiences can ensure they stick with the schedule set in PNPP. In this strategic document it is described that only one type of nuclear reactor will be chosen, due to less financial expenditures and *scale effect*.

Another important question is to explain what *energy mix* means. In PEP2040 it isn't defined, however from phrases used in this document *explicite* it follows that *the energy mix is the comprehensive system of all generation sources*. This system could be presented as a chart of all generation sources or percentage value of a particular generation source in general electricity production. In this part of the article is necessary to point that different energy sources have other level of installed capacity usage, *capacity factor*. In practice this factor result in paradoxical situation, where high installed capacity is not connected with significant amount of produced electrical energy. As a result of doctrine and subject literature analysis with other factors, in strategic documents are set probability measures to describe future energy mix. The PNPP time horizon is set to 2045, two years after last, sixth nuclear reactor connection to the electrical grid.

As a result of presented above aspects, author conclude that characteristic indicator of nuclear power is high capacity factor. Therefore in PNPP future energy mix nuclear reactors despite of approximately low installed capacity should cover from 20 to even 27 per cent share of Poland's energy mix in 2045 (PNPP 2021). In comparison, offshore wind sector with estimated installed power capacity 9,6 GWe will have only 18% share in future energy mix. Moreover, energy production in nuclear power plants are *constant*, undisturbed by external conditions, including weather threats. As a result, nuclear power plants have unique characteristics of operation in system baseload. This aspect creates the opportunity to increase the percentage share of other energy sources, especially unstable renewable energy sources such as solar panels or onshore and offshore wind farms. Cooperation and coexistence of renewable energy sources with stabilisation role of nuclear energy could potentially complete second pillar objectives set in PEP2040 – zeroemissional energy system.

Ensuring the stability of electrical energy supply alongside independence from hostile actions, which could threaten the stability of the energy system, are described as fundamental aspects of energy security. Nevertheless, this term also includes other factors. Nuclear power plants can also operate in cogeneration feature, with specific outcome where heated water can be utilised in cogeneration process to supply district heating systems in Polish cities. Cogeneration in particular focus on using power plants to other purposes than produce electrical energy, in example district heating or hydrogen production. This process can decrease of highly-emissional coal-powered steam boilers in electroheating plants and therefore increase energy security. Second important aspect of nuclear energy is the availability to utilise overproduced energy to power electrolyzers to obtain clean hydrogen, which will be meaningful addition to Polish Hydrogen Strategy (Ministry of Climate and Environment, 2021). Moreover to energy security influence one more factor – stability of fuel supply to power plants. In nuclear energy, compared

with gas or coal, the cost of nuclear fuel is insignificant and the overall quality and safety of its overview is set by the International Atomic Energy Agency in cooperation with the European Atomic Energy Agency (Euratom).

PNPP also contains some basic arguments on behalf of the advantages of including nuclear energy in the national energy mix. These arguments are related to the overall agreement that zero-emission sources, including nuclear power, was helpful to avoid 1,84 million premature deaths between 1970 and 2009 (Kharecha & Hansen, 2013). Experts also indicate that nuclear power has low demands for concrete and steel per unit of produced electricity (Peterson et al., 2005) and in the construction process, it does not possess a significant demand for rare earth materials as the renewable energy sources energy technologies (IAEA, 2017). Nuclear power plants also need the lowest amount of space to generate the same amount of energy as the other sources in the energy mix (Fritsche *et al.*, 2017) and what is more important, the life cycle of NPP could be extended to 80-100 years, i.e. Turkey Point and Peach Bottom NPPs in the USA.

## **NUCLEAR ENERGY DEVELOPMENT TO 2040 – CHALLENGES AND THREATS**

The above position of nuclear energy in the energy security system was focused on the narrow, domestic scope level of this definition. However Poland, as a country located in the middle of Europe in geopolitical meaning, can not define energy security with only internal factors. In the currently globalised world, success of long-term financial demanding infrastructure projects, as PNPP, depends on many fluctuations. These projects in one hand are the part of state foreign policy alongside with strengthening national economy potential. On the other hand, establishing in Poland perspective nuclear energy sector should be described as state obligation and even as a state duty, despite of costs of investment. This approach is available due to overnational consensus that in climate change era, nuclear energy is this investment which shows that clean and reliable energy source is the necessity in Poland.

In external meaning energy security is described in connection with regional and international cooperation, politics and influence. Poland, as a European Union member state, from 2004 have multiple benefit from this status, but also is obliged to several actions. One of them is to reduce CO<sub>2</sub> emissions from national energy system, with acquired starting point, in example high percentage of coal in Polish energy mix. Poland, as the only one country in Soviet Union did not introduced nuclear energy as a part of national energy mix from variety of reasons (Nowacki, 2014). As an effect nuclear power plant in Żarnowiec and in EJ WARTA near Poznań construction was abandoned and energy production was based on coal. To change this direction, nuclear energy in Poland is a necessity in the nearest future. is this project should have chance to become successful, cooperation with European Union is a necessity.

To fully understand the current situation in the European Union concerning nuclear energy it is important to describe two events. First was oil crisis from 1973, which shows the dependance of gas and oil, therefore creating the strong necessity of diversification of supply from multiple directions. The effect in the European Union created a strong pro-nuclear movement, with the Messmer plan from France in the front (Morrison, 2015). However, the Chernobyl accident in the Ukraine from 1986 resulted in anti-nuclear movements rising and several countries stopped their nuclear plants construction and closed operational nuclear reactors, replacing them with renewable energy sources and natural gas. This turnover was observed especially in Germany, where as a part of Energiewende political nuclear power was presented as a dangerous source to society. Only a few European countries still recognised nuclear energy as an important part of the national energy mix, or even as a state ratio (Nowak, 2019).

The European Union set the European Green Deal, the strategy aimed to conduct an energy transition in zeroemissional continent to 2050 and to climate neutrality. As a basis of this project is massive support to renewable energy sources, which are planned to decarbonise the commonwealth economy with insurance of

energy security. One of the financial mechanisms to ensure this *green turn* is the so-called *taxonomy*, system in which *sustainable and do not cause significant harm to the environment* project will have financial support from the European Commission. This conception for a long time excluded nuclear power, due to political tendencies in the EU.

Nevertheless, in recent years significant change has happen. Countries, where nuclear power is the important part of the national energy mix, to those who are planning to develop this type of energy source started actions aimed to reintroduce nuclear energy into the Old Continent. These actions *de facto* created a new movement called the European Renaissance and it is fundamental to obtain climate neutrality objectives to 2050, set in the European Union. In this case France, Poland, Czech Republic, Hungary, Romania, Slovenia and Slovakia together sent the letter to the European Commission President, which postulated the inclusion of nuclear energy into the climate targets of the European Union (Polish Prime Minister, 2021).

Presented aspects were based on the fact that Poland and other EU Member States became not only a part of the European Union, but also the European Atomic Energy Community, Euratom. This organization was created alongside other union structures and the Euratom Treaty has the same legal position as the EU Treaty (Merger Treaty, 1963). Moreover, in the Euratom Treaty, European Union is obliged to fast promote and develop nuclear energy in cooperation with Member States, who are planning to introduce nuclear power into the national energy mix (Euratom Treaty, 2012).

Despite coexistence in the legal area of the European Union and Euratom, the second organization seems like being stopped from significant activity. However, the process of reinstatement of Euratom importance has begun, but this process was trying to be stopped by several EU countries with anti-nuclear politics. One of these states is Austria, which pledged a case against a former member of the European Union, Great Britain in the case of the newly build Hinkley Point C nuclear power plant, to the Court of Justice of the European Union, which on 22 September 2020 dismissed this Austrian case (CJEU, 2020). This ruling has significant importance in the Euratom nuclear law system, primarily due to precedential value thereof. In particular, the Court considered that state aid from the Great Britain government to facilitate new nuclear build in the UK can be approved by the European Commission and at the same time be compatible with the internal market. Moreover, in this sentence CJEU addressed legal matters previously omitted in the case law, alongside with indicated dual legal regimes coexisting in the European Union – TFEU and Euratom Treaty, in which several provisions can be potentially mutually influencing, i.e. state aid law. Therefore, it is necessary to indicate some of the comprehensive aspects of this CJEU judgement.

*Primo*, this sentence *de facto* is a reinstatement of the Euratom Treaty and reminds of their legal position in the legal sources system in the EU, as a one of the fundamental and most important legal act in the European Union.

*Secundo*, dismissal of Austrian case, supported by Luxembourg creates a legal precedent in following cases in this area. Moreover, the Advocate General of CJEU stated that this case could be presented as a part of a legal dispute between countries supporting nuclear energy and those who are diminishing it.

*Tertio*, to Member States which are planning to introduce nuclear energy as a part of national energy mix to provide energy security now have a legal basics to facilitate and financially support the new nuclear built, recognised an importance of the point 77 from CJEU sentence, which stated “that those measures was a part of a set of energy policy measures taken by the United Kingdom in the context of the reform of the electricity market, **designed to ensure security of supply, diversification of sources and decarbonisation** [...] according to the Commission, it would not be to adress the future gap in energy generating capacity [...] by relying solely on renewable energy sources”.

Hinkley Point C NPP will be containing EPR, European Pressurized Reactor, 1.650 MWe, which should provide approximately 7% of total UK demand (HM, 2020).

Nevertheless, CJEU referred to above case in the second judgement in state aid to new nuclear power plant matter in case T-101/18 (CJEU, 2022). In this sentence, the Court significantly ruled in accordance with the sentence in the previous case. Moreover, it can be observed a comprehensive consistency with acknowledging of

Euratom Treaty provisions concerned on promotion of nuclear power as a common interest of the Member States.

From the perspective of the nuclear industry and pro-nuclear Member States, the first CJEU ruling was precedential and created a legal basis to impose Euratom Treaty provisions as a *lex specialis* over other Treaties and therefore eliminate one of the challenges to promote new nuclear built in the European Union. Second judgement is a confirmation of the importance of the Euratom Treaty and a reflection of the rising shift in nuclear law.

To conclude, there can be observed kind of nuclear renaissance in Europe, caused by obligatory fit into new climate neutrality and zero-emission legal framework. Alongside these tendencies, legal and political criteria to countries planning to introduce nuclear energy to their national mix gradually are more and more suitable to these intentions, which could allow safe predictions that nuclear energy will be more significant in future energy mix. However, with development of new nuclear power plants construction or plans, several countries will be more determined to create anti-nuclear rhetoric in their foreign policy, which could potentially be dangerous to nuclear energy and therefore to provide energy security in Poland in PNPP and PEP2040 definitions.

## **ENVIRONMENTAL ASPECTS OF NUCLEAR ENERGY IN POLISH ENERGY TRANSFORMATION**

As was mentioned before, in 2022, Poland continues their dependency on high-emission coal power plants, which have significant influence not only to human health, but more importantly to environment. Due to governmental plans to conduct energy transformation to zero-emission system, these power plants will have to be replaced by other sources. Before energy crisis situation in Europe, natural gas was recognized as a transitional source, less emission than coal, before renewable energy sources will be more common and widespread. However, the current situation in the gas market creates difficulties, but also new opportunities to accelerate one forgotten energy source in Europe. Nuclear energy is responsible for 25% of all energy demand in the European Union, and for 50% of low-emission energy. (IEA, 2019). Moreover, nuclear energy has the lowest carbon footprint of all energy sources, which can be understood as a „green” incentive to build more nuclear reactors. Also, nuclear energy is recognized as a source that is currently more important, as a key technology to mitigate climate change and environmental aspects. (Dabetic Ex Filipovic *et al.*, 2017).

Nuclear energy and nuclear power plants development in the European Union should be recognized as a key element not only to achieve and counter energy crisis, but more importantly, as a fundamental aspect of mitigating climate change and providing environmental protection, due to replacement of coal powered plants. In the following years, to achieve a zero-emission energy system and become the first climate-neutral continent, the European Union should create a new strategy, particularly focusing on nuclear energy to establish a sustainable process of mitigation of climate changes.

Dabetic Ex Filipovic *et al.* (2017) study shows that: A detailed insight into relevant scientific papers published in prestigious scientific journals produced a conclusion that nuclear power compared to fossil fuels has significant ecological advantages, especially when it comes to decarbonisation of the economy. The majority of papers state that nuclear energy, under normal conditions, almost does not produce harmful gases, and that small amounts of radioactive gases, which are regularly released under controlled conditions, can not cause effects such as acid rain, smog and ozone depletion. Thus, nuclear energy can be considered as a good support to global action to mitigate climate change.

## **CONCLUSION**

To provide energy safety as a fundamental aspect of Poland’s energy security is determined by several factors. In strategic planning of energy transition into zero-emission future it is not enough to take into account only

internal aspects, which are dependent on domestic actions of the state. In the current, globalized world, a number of factors influencing the state energy policy created necessity of coordination international multilateral cooperation with 20 or 30 years time horizon. That's why nuclear energy could be this factor, which guarantee stability and zero-emissional character of the national energy mix in the long term. This type of energy source is also part of state interest security, energy sovereignty, diversification factor in electroenergetic system and a part of national foreign policy, also in their energy sector.

Moreover, currently can be observed gradually externalisation of a positive approach to nuclear energy development in European Union climate policy and adjustment of legal requirements in domestic, regional and multinational level to energy transition into zero emission target. As an effect of a tendencies described above, nuclear energy has a chance to become one of the key elements to provide energy security in Poland. However the time horizon set in PNPP is far away and the schedule contains milestones, which will demand to keep up this community consensus and political support for nuclear energy.

As a result of adopted methodology and hypothetical considerations, it should be indicated that nuclear new build is currently reconciled as a fundamental of future Polish and European energy security. This approach is reinforced by CJEU rulings, in which not only enhanced role of the Euratom Treaty over the TFEU, but also the importance of state aid and support to nuclear power plants in Europe. This trend on a regional level is a clear sign of the incoming European Nuclear Renaissance. This also creates new opportunities to Poland, where there are plans to build not only Westinghouse AP-1000 PWR reactors in cooperation with state-owned PEJ company, but also South Korean APR-1400 reactors in public-private PGE-ZEPAK-KHNP partnership. Moreover, there are plans to construct undisclosed number of SMR – small modular reactors by public and private companies, i.e. BWRX-300 and scientific project concerned on High-Temperature Gas-Cooled HTGR research reactor construction. All of those new nuclear builds potentially can benefit from state aid and compliance with European Commission requirements.

In the current economic and geopolitical situation in the European Union, conducted with challenges caused by the natural gas market and with armed conflict in Ukraine, there is currently more than ever a fundamental necessity of changing the approach to nuclear energy in the European Union. Extraordinary and unusual problems that EU was faced in 2022 autumn and winter could be recognized as an opportunity to rewrite EU political, economic, energy and most importantly, environmental policies and strategies. Renewable energy sources will and should be enhanced on EU level to construct as much as possible offshore and onshore wind farms, PV panels and to introduce energy efficiency and energy saving policy in European Union. However, these actions should be backed up by a stable, reliable, environment-friendly source that can be a baseground to accelerated development – nuclear energy.

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