

Nuclear Energy in European Union

Lecturer **Ovidiu-Horia MAICAN**¹

Abstract

Europe's electricity network faces a three-pronged challenge. In order to tackle climate change, the European Union needs to reduce carbon emissions from its electricity infrastructure. This requires the EU to accelerate the pace and extent of electrification, while ensuring that affordability and dependability are maintained for both citizens and industries. Meanwhile, a significant portion of the clean, reliable power infrastructure is becoming outdated and needs to be updated prior to 2050. This multifaceted issue is made even more difficult by rising competitive pressures from international industries. Addressing this situation necessitates a variety of approaches. One solution that is receiving increased focus within the European Union, both at the EU level and among Member States, is nuclear power, known for its capacity to provide clean, reliable energy. Member States are engaging in the development of new nuclear facilities, linking them with energy supply, and enabling the execution of these initiatives. This could be organized by specific geographical areas, alliances of nations, industry groups, or partnerships between public and private sectors, capitalizing on collective purchasing power to order multiple reactor units, plant parts, or construction projects through comprehensive contracts. Nuclear power serves as a clean and dependable energy source that can contribute significantly to creating a completely decarbonized, reliable, cost-effective, and secure energy framework within the EU.

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JEL Classification: K33

1. Introduction

The term nuclear brings about mixed reactions; for some, it arouses feelings of fear and peril, while for others, it represents innovation and progress. It is a subject that requires careful consideration, necessitating caution during exploration. Passionate debates can be found supporting both the adoption and rejection of nuclear power. Notably, the discussion surrounding nuclear energy's role in energy security has gained prominence recently.

This renewed focus aligns with a growing number of individuals pondering its potential to contribute positively to society by enhancing energy security, reducing carbon emissions, and providing avenues for nations to lessen their reliance on specific energy-exporting countries.

The discussion must be approached with the understanding that there are some advantages while also acknowledging the genuine risks and concerns embedded in this energy source. Certain aspects of this discussion may hold greater significance and relevance than others, but as will be elaborated upon, they serve an important function in broadening our understanding of specific nuanced issues, ultimately offering a more holistic view of the current and future challenges we all encounter.

¹ Ovidiu-Horia Maican—Faculty of Law, Bucharest University of Economic Studies, Romania; ovidium716@gmail.com.

2. General aspects

Before exploring the future of nuclear energy in the European Union, particularly its potential for energy diversity and as a substitute for Russian fossil fuels, it is imperative to first examine the current proportion of nuclear power in the European consumer market, alongside the quantity, capacity, and distribution of active reactors.²

Moreover, we must assess the current political and social climate surrounding nuclear energy, which will undoubtedly influence how effectively Europe can leverage nuclear energy to compensate for the eventual void left by fossil fuels.

Nonetheless, since a country's advancement correlates with its energy usage, the most significant information pertains to the proportion of nuclear energy generated by EU nations compared to their overall energy production.

In this aspect, France remains in the lead with 67%, while Slovakia comes next at 54%, followed by Hungary at 46% and Bulgaria at 41%, all displaying comparably high figures. Proportion of electricity produced from nuclear energy across EU nations.³

Due to the strong public reaction following the Chernobyl catastrophe in 1986, several of the leading nuclear power generating nations, such as Germany and Italy, opted to gradually eliminate nuclear energy from their energy portfolio.

They reaffirmed this choice after the catastrophic event at Japan's Fukushima plant in 2011.

However, these developments do not indicate a unified stance among EU member countries, as opinions on nuclear energy vary significantly across nations.

For instance, France has established a strong identity as Europe's nuclear leader, placing a significant emphasis on nuclear energy within its energy strategy.⁴

In contrast, while many Central European nations generally regard nuclear power positively, they still engage in critical public policy discussions regarding it from time to time.

Countries like Germany, Spain, and Switzerland have shifted their perspectives on nuclear energy due to such public discourse and are currently in the process of completely eliminating nuclear energy.

Ten EU nations, including Austria, Denmark, Italy, and Norway, have successfully wrapped up their phase-out initiatives and are committed to avoiding nuclear energy in the future.⁵

Meanwhile, other nations, motivated by concerns over climate change and the need for energy independence, are contemplating reversing their decisions and are planning to reactivate or replace their decommissioned nuclear facilities, as seen in Belgium, Greece, and Lithuania.

In fact, during the 2020-21 period, as the European Union was formulating its

² Tamás Orbán, *The Fall and Rise of European Nuclear Energy* (Budapest: Danube Institute, September 2022), 2, <https://danubeinstitute.hu/api/v1/companies/381/files/3064067/download> (accessed July 30, 2026).

³ Eurostat, "25% of EU Electricity Production from Nuclear Sources," January 11, 2022, <https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20220111-1> (accessed July 30, 2026).

⁴ Orbán, *Fall and Rise of European Nuclear Energy*, 4.

⁵ Orbán, *Fall and Rise of European Nuclear Energy*, 5.

new energy taxonomy regulation, two key factions emerged in the ongoing debate.

One faction, referred to as the ‘anti-nuclear alliance,’ includes Austria, Denmark, Germany, Luxembourg, and Portugal. In contrast, the ‘pro-nuclear alliance’ began with ten countries (Bulgaria, Croatia, Finland, France, Hungary, Poland, Romania, Slovakia, Slovenia, and the Czech Republic) and later incorporated the Netherlands and Sweden.⁶

It is notable that Poland, which currently lacks any operational reactors, also champions the cause of nuclear energy, highlighting that the discussion around nuclear energy transcends individual nation interests and has significant repercussions for the entire bloc.

Despite this, when examined collectively, the overall trend in nuclear power generation across Europe has been downward for nearly two decades. Nuclear electricity output in the EU peaked in 2004; between 2006 and 2020, gross nuclear electricity production declined by 25.2%. The most significant declines were observed in Germany (-61.5%), Sweden (-26.5%), and Belgium (-26.2%), while notable increases occurred in Romania (more than doubling its output), Hungary (19.3%), and the Netherlands (17.8%).⁷

3. Legal aspects

In 1957, France, West Germany, Italy, the Netherlands, Belgium, and Luxembourg established the European Atomic Energy Community (Euratom).⁸

Although the primary aim of Euratom is to advance nuclear energy throughout Europe, it was also designed to fulfill another objective: the creation of a collective European nuclear arsenal.

In that year, the only countries with nuclear capabilities were the US, the Soviet Union, and the UK.

To enable the development of nuclear arms, France, Italy, and Germany planned to collaborate by pooling their resources and expertise to establish a European nuclear weapon.

This initiative was abandoned with the election of Charles de Gaulle as president of France and his decision in 1958 to independently pursue a nuclear weapons program.

Nevertheless, any form of sharing French nuclear weapons would certainly be ruled out with countries party to the 2017 Treaty on the Prohibition of Nuclear Weapons (TPNW).⁹

In the EU, Ireland, Austria, and Malta are parties to this agreement.

Article I of the TPNW prohibits any form of support for nuclear weaponry. Member nations cannot permit the deployment of nuclear arsenals within their borders. Moreover, both the use and the threat of using nuclear arms, along with assisting or inciting such actions, are forbidden.

⁶ Orbán, *Fall and Rise of European Nuclear Energy*, 5.

⁷ Orbán, *Fall and Rise of European Nuclear Energy*, 5–6.

⁸ Philipp Sauter, “European Nuclear Weapons: Europe’s Nuclear Ambitions and the Constraints of International Law,” *Verfassungsblog*, February 20, 2024, <https://doi.org/10.59704/e59f32931316cdbe>.

⁹ Sauter, “European Nuclear Weapons.”

There is no feasible scenario in which Ireland, Austria, or Malta could engage in nuclear collaboration with France without breaching their commitments under the TPNW.

While these states can withdraw from the treaty, the process necessitates "extraordinary events regarding the treaty's subject matter that threaten the supreme interests of the nation" and only takes effect one year after notice as stated in Article 17.¹⁰

The central aim of the NPT is to prevent the proliferation of nuclear arms. Hence, the establishment of European nuclear weapons would contradict this Common Position.

Additionally, in December 2003, the European Council adopted the EU's strategy against the proliferation of Weapons of Mass Destruction, which asserts that the NPT "must be maintained in its entirety.

Among contemporary legal scholars in the EU, the Euratom Treaty is predominantly regarded as inconsequential.

This viewpoint requires reassessment. The Treaty is being increasingly utilized as a foundation for legal legislation. Ironically, the 1986 Chernobyl disaster appears to have marked a critical juncture for the Treaty.¹¹

In the aftermath of the Chernobyl disaster, numerous measures were instituted that reference the Euratom Treaty as their legal foundation.

Additionally, Euratom has joined various international agreements, established numerous bilateral treaties, and served as the legal framework for both financial and technical assistance to non-EU countries.

This progression has paralleled the advancement of global nuclear law, which emerged as a consequence of the Chernobyl disaster. Conventions for emergency preparedness were established, and deliberations commenced on creating a scheme for preventive initiatives: including an IAEA convention concerning nuclear safety and a convention devoted to nuclear waste.

The agreement on the Nuclear Safety Directive was finalized in 2009.

It primarily draws upon the principles accepted by the international IAEA Nuclear Safety Convention, to which all Member States are already signatories.

The Directive is also founded on the IAEA's 'Safety Fundamentals,' which serves as a non-binding international framework.¹²

The aims of the Directive are articulated in a somewhat limited manner, ensuring there is no suggestion that the Member States are insufficiently active in this area.

Similar to the Nuclear Safety Convention, the Directive outlines the creation of a 'national legislative, regulatory and organizational framework.'¹³

This national structure will define the responsibilities associated with establishing national nuclear safety standards; setting up a licensing framework; providing a nuclear safety oversight system; and enforcing compliance actions. The Directive emphasizes that it is up to the Member States to decide how the national nuclear safety

¹⁰ Sauter, "European Nuclear Weapons."

¹¹ Anna Södersten, "The EU and Nuclear Safety: Challenges Old and New," *European Policy Analysis* 2012:10epa (September 2012): 3, https://sieps.se/media/lfs10vey/the-eu-and-nuclear-safety_-challenges-old-and-new-2012_10epa.pdf.

¹² Södersten, "EU and Nuclear Safety," 4.

¹³ Södersten, "EU and Nuclear Safety," 5.

standards will be established and the methods of their implementation.

In its original proposal from 2003, the Commission recommended forming a Community group of safety inspectors and implementing uniform safety standards for current nuclear facilities, but consensus was not achieved within the Council regarding these matters.

The 2008 proposal from the Commission offered a reduced scenario, suggesting that only new nuclear power reactors would adhere to common safety guidelines, but this recommendation was ultimately not included in the Directive.¹⁴

In the same vein as the IAEA Nuclear Safety Convention, the Directive encompasses sections related to regulatory authorities, which must operate independently from any entity involved in promoting or using nuclear energy.

The Directive also outlines the responsibilities of these regulatory authorities broadly. Member States are required to guarantee that national regulatory bodies possess the necessary legal authority as well as adequate human and financial resources.

It establishes the principle that the primary accountability for the safety of a nuclear facility lies with the licensee.

Additionally, while the Directive includes essential requirements for license holders (the nuclear operators), it does not specify what a license should include. Furthermore, the Directive mandates that Member States ensure their national frameworks include provisions for education and training, mirroring a similar stipulation found in the Nuclear Safety Convention.

There is also a clause regarding public information. Member States are expected to guarantee that information about nuclear safety regulation is accessible to both workers and the public at large.

However, the Directive also imposes limitations on the dissemination of this information.

Such information must be made available to the public ‘in accordance with national laws and international commitments’, and it must not ‘compromise other interests such as, among others, security, recognized by national laws or international obligations.’

This indicates that Member States possess considerable latitude in crafting their national legislation.

Member States must present a report to the Commission detailing the enforcement of the Directive every three years.¹⁵

In order to prevent overlapping responsibilities related to the international commitments of Member States and those arising from EU legislation, the Member States are permitted to utilize the review and reporting schedules established by the Nuclear Safety Convention. Similarly to the Convention, the Directive also includes a system for peer evaluation.

According to the Directive’s framework, Member States are required to conduct self-evaluations of their national structures ‘at least every 10 years’.¹⁶

They will request an international peer review from the national authorities, and the findings from this peer review need to be communicated to both the Member

¹⁴ Södersten, “EU and Nuclear Safety,” 5.

¹⁵ Södersten, “EU and Nuclear Safety,” 5.

¹⁶ Södersten, “EU and Nuclear Safety,” 5.

States and the Commission.

This aspect appears less robust compared to the Nuclear Safety Convention, which mandates that both reporting and peer review occur every three years.

Moreover, in contrast to the Convention, the Directive does not mandate the establishment of review conferences.

However, the peer review framework outlined in the Directive is not inherently inferior to that of the international Convention.

For instance, the Directive does not include a confidentiality provision regarding national reports or the results of the evaluation.

When results are disclosed publicly, it generates societal pressure in addition to the influence exerted by peers.¹⁷

The EURATOM Community and its foundational Treaty establishing the European Atomic Energy Community exemplify a fundamental inability to formulate a cohesive nuclear policy or to recognize a shared interest among the European Communities, and subsequently the European Union, related to nuclear energy advancement.¹⁸ Today, France, along with the United Kingdom, the United States, Russia, and China, stands as one of the five nuclear-armed nations under the Nuclear Non-Proliferation Treaty, alongside four states that have not declared or are not recognized, potentially with more expected.

When it comes to acquiring and selecting nuclear energy technologies, the other founding countries did not exhibit significant interest in obtaining French civil nuclear technology.

From the inception of EURATOM and even prior to its ratification, the other founding member nations — Belgium, the Federal Republic of Germany, Italy, Luxembourg, and the Netherlands — preferred to procure American technology for new nuclear facilities.¹⁹

A specific arrangement with the United States known as the EURATOM Cooperation Act was established in 1958, right after EURATOM's formation. European leaders like Jean Monnet, along with notable non-EU figures, including US President Eisenhower, believed EURATOM would promote European unity.

The EURATOM Cooperation Act of 1958 is a United States law facilitating a collaborative program between the United States and the European Atomic Energy Community.

Following the US Atomic Energy Act of 1954, this program was designed to serve as an international agreement that permitted the establishment of nuclear power plants within the territory of the European Atomic Energy Community.

For France, EURATOM represented a strategy to counteract American predominance in supplying nuclear energy to Europe.

The problem of withdrawal from EURATOM is still unclear.

Article 50 of the Treaty on European Union details the steps a Member State must follow to exit the European Union if it chooses to do so. This provision was ini-

¹⁷ Södersten, "EU and Nuclear Safety," 5–6.

¹⁸ Dörte Fouquet, "Nuclear Policy in the EU from a Legal and Institutional Point-of-View," in *The Technological and Economic Future of Nuclear Power*, ed. Reinhard Haas, Lutz Mez, and Amela Ajanovic (Wiesbaden: Springer VS, 2019), 170, https://doi.org/10.1007/978-3-658-25987-7_8.

¹⁹ Fouquet, "Nuclear Policy in the EU," 171.

tially incorporated by the Lisbon Treaty in 2007.

The relevant Article that includes, for example, Article 50 TEU as also relevant for EURATOM, is Article 106a EURATOM, which was brought in under Title III (Institutional and financial provisions).

In general terms, a Member State is required to inform the European Council about its desire to withdraw. The agreement for withdrawal must be discussed and arranged according to Article 218 (3) TFEU.

In February 2017, the UK government briefly mentioned in its White Paper on BREXIT that for the administration, triggering Article 50 TEU would also entail triggering the departure from EURATOM.²⁰

4. Practical aspects

Russia stands out as a significant global energy supplier. Following Russia's military action in Ukraine, various Western nations and the European Union have significantly curtailed their imports of energy from Russia, especially in relation to coal, oil, and natural gas.²¹

Concurrently, nuclear energy is becoming increasingly viable as a more stable energy option that can function with greater autonomy from the geopolitical conflicts that currently disrupt global fossil fuel availability. Nevertheless, through the Russian State Atomic Energy Corporation Rosatom and its numerous subsidiaries, which encompass over 400 nuclear firms and research institutions, Russia remains a formidable presence in the nuclear energy sector, particularly excelling in the overseas construction of nuclear power plants.²²

In the realm of utilizing nuclear power to reduce carbon emissions in the economy, it is significant to acknowledge how political perspectives shape public attitudes regarding nuclear energy development.

The surge of demonstrations against nuclear power in the 1970s within West Germany and France was connected to the societal movements from the 1960s: the student demonstrations of 1968, the anti-war protests, and the civil rights initiatives.²³ These events were typically linked with leftist political ideologies and led to heightened social consciousness and a willingness to participate in anti-nuclear demonstrations.

The ultimate direction of governmental policies was also affected by the unique features of political frameworks in Western Europe, especially the accessibility of political structures, which allowed for institutional influence (like political parties, legislatures, and judicial systems).

Given the strong correlation between environmentally friendly and pro-climate positions with support for nuclear energy advancement, investigating whether this rela-

²⁰ Fouquet, "Nuclear Policy in the EU," 200.

²¹ Nils Haneklaus et al., "Dependencies of the European Union and the World on Russian Nuclear Fuel Cycle Services, and How to Reduce Them," *Energy Strategy Reviews* 62 (2025): 101923, 1, <https://doi.org/10.1016/j.esr.2025.101923>.

²² Haneklaus et al., "Dependencies on Russian Nuclear Fuel Cycle Services," 2.

²³ Zbigniew Bohdanowicz, Beata Łopaciuk-Goncaryk, and Jarosław Kowalski, "Europe Becomes Pro-Nuclear? Drivers of Public Support for Nuclear Energy in Six EU Countries after the Energy Crisis of 2022," *Energy Policy* 200 (2025): 114528, 1, <https://doi.org/10.1016/j.enpol.2025.114528>.

tionship persists and if it exists consistently across various EU countries is an important endeavor.²⁴

Another aspect that affects the level of backing for advancing nuclear energy knowledge. Understanding nuclear energy as well as the factors causing climate change plays a role in favoring the promotion of the technology.

A significant number of individuals are under the impression that nuclear energy leads to elevated CO₂ output, which consequently exacerbates climate change.

Considering the considerable number of EU citizens who mistakenly believe that nuclear energy contributes to elevated greenhouse gas emissions, it becomes essential to investigate how this belief influences perspectives on the advancement of nuclear energy.

It is possible to hypothesize that, as time has passed, the impact of antinuclear movements — most prominent in Western Europe during the 1970s and 1980s — has gradually lessened.

This situation has been intensified by Russia's aggression towards Ukraine and the resulting energy crisis that occurred in 2022.

Such incidents may have led to existing worries regarding ecological safety being partially overshadowed by new concerns about energy security, which may have weakened the previously strong negative correlation between pro-environmental viewpoints and the backing of nuclear energy.²⁵

Another element that might affect attitudes is awareness, relating to both nuclear energy and the factors that lead to climate change.

A deeper examination of the correlation between understanding the reasons behind climate change and attitudes toward nuclear energy revealed significant variances in these perspectives related to differing beliefs about the role of nuclear power plants in the climate crisis. In all six surveyed countries, a substantial proportion of respondents thought that nuclear energy facilities significantly contribute to the greenhouse effect.

The European Union comprises 27 member states committed to collaborative efforts and unrestricted trade. The estimated total population of the EU stands at around 450 million.

There are also non-EU countries in the area, including Switzerland, Norway, the UK, and a few Balkan nations. In 2024, the EU electricity production mix was approximately 34% from combustible fuels (about 28% fossil fuels and nearly 6% biofuels), 23% from nuclear power, 28% from wind and solar power, and 13% from hydropower.²⁶

According to Euronuclear.org as of October 2025, Europe hosts a total of 165 nuclear reactors spread across various countries, including Ukraine and Russia.²⁷

Among these 165 reactors, there were 9 units in the Asian part of Russia under

²⁴ Bohdanowicz, Łopaciuk-Goncaryk, and Kowalski, "Europe Becomes Pro-Nuclear?," 2.

²⁵ Bohdanowicz, Łopaciuk-Goncaryk, and Kowalski, "Europe Becomes Pro-Nuclear?," 2.

²⁶ Eurostat, "Energy in Europe—2026 Edition," March 10, 2026, under "Electricity Production," <https://ec.europa.eu/eurostat/web/interactive-publications/energy-2026> (accessed July 30, 2026).

²⁷ Asra Pasha, "Powering the EU through Nuclear Energy: A Reassessment of the EU's Energy Strategy in the Current Scenario," *Journal of European Studies* 42, no. 1 (2026): 77–96, 89, <https://doi.org/10.56384/jes.v42i1.425>.

construction with a net capacity of 9,969MWe.

The rest on the European continent possess an overall installed capacity of 147,997MWe. Excluding the 36 reactors in Russia and 15 in Ukraine, Europe still operates 114 active nuclear units, with 57 located in France. Germany operates 33 nuclear facilities, but none are currently active.

In 2002, the Romanian administration showed its enthusiasm for finishing the two extra CANDU reactors at the Cernavoda location, a venture that initiated in the 1980s but was suspended after the collapse of the Ceaușescu regime.

After multiple restructurings and new financial partners, an EPC agreement was finalized in November 2024 for the completion of Units 3 and 4, with plans for delivery in the early 2030s.

RoPower Nuclear S.A., founded on September 27, 2022, has two main shareholders, each possessing equal ownership: SN Nuclearelectrica SA (the country's nuclear energy operator, predominantly owned by the State) and Nova Power&Gas SRL, which controls the location intended for the establishment of a Small Modular Reactor (SMR) Nuclear Power Plant (NPP) utilizing US NuScale VOYGR™ Power Modules.²⁸ Although EU member states hold differing views regarding the use of nuclear energy as a substitute for traditional energy sources, the European Commission is actively pursuing an energy plan aimed at enhancing and integrating a unified energy market across the union, focusing on five key objectives, strengthen energy supply security, establish a singular integrated energy market, boost energy efficiency and decarbonize the economy²⁹.

It is uncertain whether Germany's decision to phase out nuclear energy and the ongoing discussions in the German Parliament concerning the future of the Euratom Treaty will bring about change.³⁰

On one side, nuclear energy continues to be a consideration for the energy future of Europe, particularly for some member nations and utility companies.

Conversely, the stress tests conducted by the European Union on its nuclear facilities revealed that Fukushima has significantly undermined public confidence in nuclear power, although it can be argued that the safety evaluations lacked specific details and potential outcomes since the Commission does not have authority over nuclear reactors within its member states.³¹

Before the Fukushima incident, numerous nations around the globe were contemplating or had invested in the construction of new nuclear plants; this period was referred to as a nuclear renaissance by organizations such as the World Nuclear Association.

The primary motivators were believed to be climate change, as nuclear energy is perceived to emit relatively low levels of carbon dioxide, concerns about energy security arising from an unreliable supply of fossil fuels, and an approaching gap in elec-

²⁸ Stefan Kopecky et al., *Clean Energy Technology Observatory: Nuclear Power in the European Union—2025 Status Report on Technology Development, Trends, Value Chains and Markets* (Luxembourg: Publications Office of the European Union, 2026), 17, <https://doi.org/10.2760/5077071>.

²⁹ Pasha, "Powering the EU through Nuclear Energy," 89–90.

³⁰ Dagmar Kiyar and Bettina F. Wittneben, "Nuclear Energy in the European Union after Fukushima: Political and Economic Considerations," *CESifo DICE Report* 10, no. 3 (2012): 9–15, 10, <https://www.ifo.de/en/publications/2012/article-journal/nuclear-energy-european-union-after-fukushima-political-and>.

³¹ Kiyar and Wittneben, "Nuclear Energy in the European Union after Fukushima," 10.

tricity generation, particularly due to the planned decommissioning of existing nuclear power stations.³²

A significant factor driving the nuclear renaissance is the concept of energy security, which is characterized as “the continuous physical access to energy at a price that is reasonable while considering environmental issues”. This brings attention to the financial elements involved in energy creation.

Advocates for nuclear energy assert that it is financially viable when compared to other electricity generation methods, particularly due to its comparatively low fuel costs and the influence of elevated carbon dioxide pricing.

However, in recent times and as a result of the financial downturn, numerous utility firms have re-evaluated the establishment of new nuclear facilities within deregulated markets since substantial capital must be secured from investors to construct a new nuclear plant.

It is anticipated that safety protocols introduced after Fukushima could further increase the costs associated with building new nuclear installations.³³

Historically, the steep expenses linked to building nuclear power stations rarely hindered financial backing because electric utilities operated as monopolies, allowing them to transfer these costs to consumers.

Concurrently, the potential for a nuclear revival was already constrained by the increasing market presence of renewable energy sources and the decreasing costs associated with those technologies.³⁴

Presently, 12 of the 27 EU Member States (Belgium, Bulgaria, Czechia, Finland, France, Hungary, Netherlands, Romania, Slovakia, Slovenia, Spain, and Sweden) operate nuclear energy facilities.

Conversely, nations such as Austria, Croatia, Cyprus, Denmark, Estonia, Ireland, Greece, Italy, Latvia, Lithuania, Luxembourg, Malta, Poland, and Portugal do not engage in nuclear electricity production.

In 2021, nuclear energy constituted 13% of the EU's overall energy mix and represented 25% of the total electricity generated.³⁵

The discourse surrounding nuclear energy in the EU revolves around both beneficial opportunities and significant challenges. Small modular reactors (SMRs) are frequently perceived as viable solutions for energy supply challenges and are anticipated to evolve into a commercially viable nuclear option by the early 2030s. These SMRs could potentially be utilized for various purposes such as district heating, desalination, heat treatment for energy-demanding industries, and hydrogen production.

A primary obstacle is the reliance on Russian nuclear technology, uranium, and fuel resources.³⁶

Despite numerous countries making efforts to diversify their fuel sources, recent studies suggest that, in certain instances, this dependency might not diminish.

³² Kiyar and Wittneben, “Nuclear Energy in the European Union after Fukushima,” 11.

³³ Kiyar and Wittneben, “Nuclear Energy in the European Union after Fukushima,” 11.

³⁴ Kiyar and Wittneben, “Nuclear Energy in the European Union after Fukushima,” 13.

³⁵ Monika Dulian, *Nuclear Energy in the European Union*, European Parliamentary Research Service Briefing, PE 751.456 (Brussels: European Parliament, September 2023), 1, [https://www.europarl.europa.eu/RegData/etudes/BRIE/2023/751456/EPRS_BRI\(2023\)751456_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/BRIE/2023/751456/EPRS_BRI(2023)751456_EN.pdf).

³⁶ Dulian, *Nuclear Energy in the European Union*, 6.

Another critical issue is the management of high-level nuclear waste and spent fuel. Proposed solutions indicate that deep geological disposal facilities are expected to become operational within the EU between 2024 and 2035.

Various groupings of nations, referred to as either the 'nuclear alliance' or 'friends of renewables,' consistently debate the significance of low-carbon energy sources generated from nuclear power in relation to the green transition, subsequently impacting diverse energy and climate policies.

5. Conclusions

Numerous factors must be evaluated when considering what the introduction or expanded application of nuclear energy may offer in response to energy challenges, supply fluctuations, and international pressures from suppliers.

Nonetheless, there have been numerous concerns regarding the application of nuclear power over the years.

A significant point of contention lies in the duration required to construct or maintain nuclear facilities.

Its potential to help alleviate current energy challenges is expected to be limited. Issues surrounding radiation and waste management remain persistent problems for the nuclear sector.

Substantial efforts have been undertaken to address these issues.

Safety protocols must be upheld with the utmost rigor since any incidents on the European continent cannot be tolerated. To reduce apprehensions about nuclear energy, the concept of awareness initiatives was mentioned briefly.

Renewable energy alternatives are perceived as the most environmentally friendly, with initiatives aimed at fostering their adoption and reliance being prevalent in the majority of developed countries.

Most worries associated with our energy consumption generally link back to the significant carbon emissions produced.

Hydrogen is being rolled out in several urban areas to fuel vehicles and infrastructures, but its adoption remains limited. Nuclear energy occupies a position that bridges renewable resources and fossil fuel options.

At the same time, the EURATOM Treaty must be reformed, in accordance with the new realities.

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