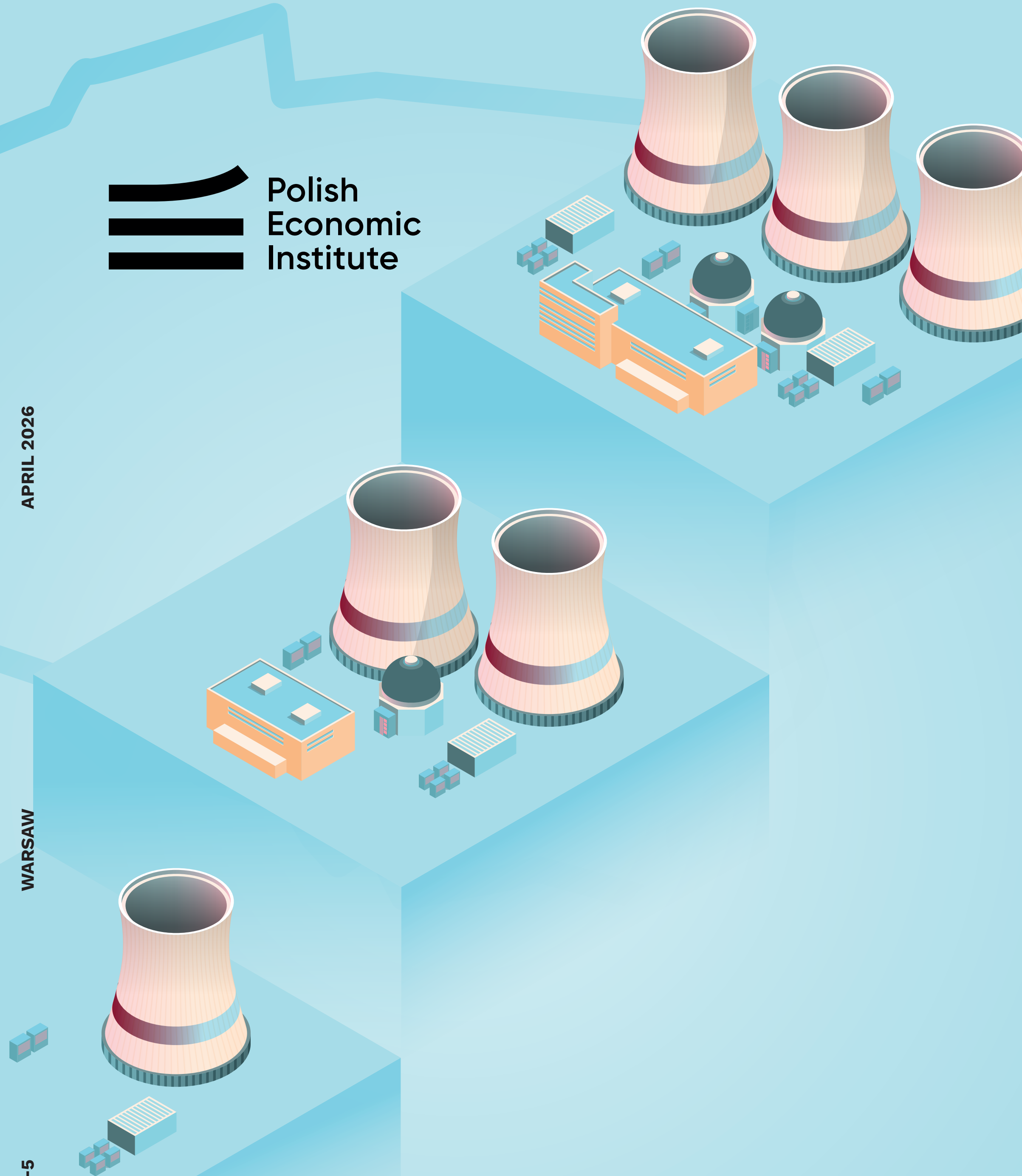
Polish Economic Institute



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Unlocking Nuclear Energy in Poland: Policy, Regulatory and Industry Incentives

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We would like to express our sincere gratitude to all stakeholders and experts who contributed their time and insight to this report. Their openness, practical experience, and thoughtful feedback significantly strengthened the analysis and helped ensure that the conclusions reflect real-world constraints and opportunities. We are particularly grateful to the representatives of government institutions, regulators, industry, and the research community who agreed to participate in interviews and the Delphi study. Their contributions were invaluable to shaping the evidence base for this study.

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Key Findings

- Poland's nuclear pathway is framed by a multi-layered policy architecture (national strategies plus EU planning obligations) and an increasingly complex market reality shaped by rapid renewables deployment, looming coal retirements, rising electricity demand from electrification, and the competitiveness needs of energy-intensive industry.

- Multiple demand projections suggest a **substantial rise in electricity consumption in Poland**, from 169 TWh in 2024 to potentially **240-267 TWh in 2040** and up to **345-471 TWh by 2050** depending on electrification assumptions (electrolysis, EVs, heat pumps, data centers). This growth compounds an already fragile adequacy outlook driven by aging coal capacity and grid constraints which can result in a **possible generation gap in early 2030s**, with reliability metrics such as LOLE (**Loss of Load Expectation**) inceasing in the coming years.

- In interviews – especially with energy-intensive industries – the demand signal is clear and consistent: what industry needs is **stable, predictable, affordable low-carbon electricity and heat**. The technology is secondary to the outcome. This matters because it defines nuclear's value proposition in Poland as **system stability and industrial competitiveness**, rather than "nuclear as an end in itself." It is important to note that most of our Energy Intensive Industries (EII) respondents represented the largest national companies. Only one medium-sized industrial firm agreed to be interviewed; most production companies were not yet interested in SMRs.

- At the same time, interview material highlights a practical asymmetry in today's incentive landscape: many stakeholders perceive current market rules and support structures as **structurally easier to navigate for renewables** than for capital-intensive firm generation. That perception feeds skepticism about near-term SMR economics and timelines – even among actors interested in SMRs for siting flexibility and industrial heat.

- Because nuclear economics are highly sensitive to financing conditions, many of our interviews repeatedly points to the need for **state-enabled risk sharing** but calibrated to project type. However, there is a concern that poorly designed SMR support could be interpreted as indirect industrial aid, triggering European Commission scrutiny and delays. Any incentive framework therefore needs to be both investable and defensible under EU rules from day one.

- According to the interviewed experts scaling up nuclear would help optimize unit costs. Nevertheless, these costs, especially in case of cost overruns for FOAK (First-of-a-Kind) projects still might be prohibitive for investors and demand support from the state side. Most of the interviewed experts preferred **two of the financing models** in the public debate - **contract for difference (CfD)** or **cooperative models such as Mankala or SaHo** model.

- The Delphi study provides **rather carefully optimistic approach regarding nuclear energy future in Polish energy mix**. Experts are not rejecting nuclear; they are mainly discounting **speed and institutional coordination**, especially for SMRs and EU-level accelerators. 56% of the experts feels that the chances of SMRs exceeding 5 GW capacity up to 2050 in Poland are low, very low or nonexistent. Experts are however **moderately optimistic** that nuclear as a technology can reach a meaningful share of Polish electricity – around **20%** – but their central expectation places that outcome **after 2050**.

- The experts believe that **joint purchasing mechanisms**, such as orderbooks are **beneficial** for both buyers (**securing lower prices** and **helping streamlining** project timelines) as well as for producers (**certainty of demand** and **better planning** for production capacities). However, in our interviews they pointed out that even if this idea would be **difficult to implement** in the near future at a multinational level, there is a slightly bigger chance of successfully coordinating it on a national level. One of the ideas would be selecting one or **two preferred SMR technologies for public support**, and encouraging companies that might each purchase one or two reactors individually to pool their orders, enabling the country to place joint orders for a dozen or more units at a reduced price.

- In the Delphi study, experts are **even more cautious**: they show limited confidence that EU-level joint purchasing and orderbook mechanisms will materialize quickly or strongly enough to be a critical-path enabler for Poland. The expert consensus is to treat orderbooks as **upside rather than a base-case assumption as only 20% of Delphi study participants said that in their opinion there is high or very high probability of several EU countries establishing some form of joint purchasing mechanisms**.

- Among the **biggest barriers** for the widespread use of SMRs in Poland that the study participants pointed out are possibly **higher investment costs** than currently declared by the manufacturers, lack of changes in the **EU policy regarding nuclear energy**, and **delays** resulting from lack of experience with **first-of-a-kind projects** that SMRs would be in the early 30s.

- Current legislative framework for nuclear energy - while in general reasonably complete - have some shortcomings that could also be addressed to help in developing nuclear investments (both small and large alike). **First one: construction works beyond basic site preparation** (e.g., levelling, temporary fencing, temporary power supply strictly for construction needs) must wait for the **final building permit** issued shortly after the regulator grants the **construction license**. As a result, no "real plant" works – excavation, foundations, auxiliary buildings – can begin earlier, which **unnecessarily extends the critical path** of nuclear project delivery.

- A second structural issue is the **absence of a structured generic design assessment**: combined with licensing timelines, it means that ordering **long-lead, safety-related items** can only occur **at the investor's own risk**. In practice, the same reactor built at multiple sites would need to undergo a **full licensing review each time**. There are also some smaller operational frictions that could negatively impact the process - one of such commonly pointed out was the documentation burden associated with **Polish-language requirements**.

Key Numbers

10 out of 12

European states with operating nuclear power plants were net exporters of electricity in 2024

More than half (52%)

of the experts believe that there is a very high probability that nuclear energy will cover 20% of Polish electricity demand after 2050

240-267 TWh in 2040 and 345-471 TWh in 2050

projected range for Poland's future electricity demand (from 169 TWh in 2024). 2062 is the median year marked by the surveyed experts as a year of possibly tripling global nuclear capacity (to 1200 GW)

Between 20 to 50%

increase in nuclear capacity will occur in EU countries up to 2050 according to interviewed experts

32%

of the experts believe that SMRs will achieve higher public acceptance than the large-scale reactors

52%

of the experts believe that SMRs built in the large cities will have high (60-80%) or very high (over 80%) acceptance rate among local communities

More than half (56%)

of the experts does not believe that LCOE of SMRs will be lower than 100 EUR/MWh

Introduction

Poland is entering a decisive phase of its power-sector transition.

Electricity demand is expected to rise substantially over the coming decades - driven by electrification of transport and heat, new digital loads, and the emergence of hydrogen production - while the country simultaneously faces the need to replace aging coal capacity and reduce exposure to volatile fossil fuel prices and the EU ETS. In this context, nuclear energy has re-emerged not as a marginal option, but as a strategic instrument: a potential source of firm, low-carbon generation that can strengthen security of supply, support deep decarbonization, and underpin the competitiveness of energy-intensive industry.

The ambition is significant. Poland plans at least six GW-scale reactors across two sites and - in parallel - there is growing investor interest in small modular reactors (SMRs) for industrial applications, district heating, and cogeneration. Yet the scale of this agenda amplifies the consequences of institutional design choices made today. Delivering nuclear at meaningful volume is not only an engineering challenge; it is primarily a question of whether Poland can build a policy, regulatory, and market environment that makes long-lived capital projects bankable and repeatable. Nuclear projects succeed or fail on their critical path: the ability to progress from early siting and licensing through construction and commissioning on a predictable timetable, with credible risk allocation and robust governance.

This report is therefore structured around a pragmatic premise: scaling nuclear energy requires a system designed for delivery, not merely a declaration of intent. It examines how current policy and legal frameworks translate into real project timelines and investment decisions, and where targeted reforms can most effectively reduce schedule risk, lower financing costs, and increase the probability of successful execution. The report considers both GW-scale reactors and SMRs, recognizing that their deployment models, financing needs, and regulatory burdens differ, while still sharing common prerequisites: sufficient licensing capacity, standardized processes, supply-chain readiness, and stable long-term revenue conditions. In several sections, the analysis places greater emphasis on SMRs because their role in Poland's future energy mix remains less certain and more sensitive to commercialization timelines, market design, and the availability of bankable support mechanisms than the GW-scale program anchored in key national documents, including the Polish Nuclear Power Programme.

A central input to this report is stakeholder evidence. Interviews with representatives of energy-intensive industries, developers, and experts consistently emphasize an outcome-driven perspective: industry is less concerned with technology labels than with whether it can secure stable, predictable, affordable low-carbon electricity and heat at the scale required for investment and competitiveness. This lens matters because it ties nuclear policy to industrial strategy: nuclear becomes valuable if it can reliably deliver firm energy services that complement variable renewables and enable emissions reductions in hard-to-abate sectors. At the same time, the interviews highlight persistent concerns around market design and risk allocation - particularly for SMRs, where expectations are high but commercial conditions remain uncertain. To complement the stakeholder interviews, the report draws on an expert Delphi exercise. The Delphi results serve as a reality check on expected timelines and on the likelihood that broader European "accelerators" will emerge quickly enough to shape Poland's critical path.

Against this backdrop, the report focuses on mechanisms that most directly influence delivery. These include: the structure and sequencing of permitting and licensing; tools that improve repeatability and reduce uncertainty for investors (including structured approaches to design assessment and potential benefits associated with standardization and orderbooks); the ability to undertake early works that shorten the construction critical path; and financing and market instruments that stabilize revenues and allocate risk in a way that remains compatible with EU state-aid constraints.

The objective of this report is to draw clear, evidence-based conclusions from the combined system analysis, stakeholder interviews, and the expert Delphi exercise. Across these inputs, a consistent set of messages emerges: scaling nuclear energy in Poland is constrained less by technology choice and more by delivery conditions - specifically the predictability of licensing and permitting timelines, the allocation of construction and market risks, the capacity of institutions to process projects at scale, and the financing terms that follow from these factors. The convergence of views between industrial stakeholders (focused on stable, affordable low-carbon electricity and heat) and expert respondents (emphasizing realistic timelines, the limited near-term impact of EU-level accelerators such as orderbooks, and the need for repeatable processes) supports a unified conclusion: nuclear can become a material pillar of Poland's energy transition only if the domestic framework is built to sustain investable, repeatable project delivery.

On that basis, the report provides decision-makers - government, regulators, developers, and industrial offtakers - with a shared diagnostic of what actions should be taken for nuclear to contribute meaningfully to energy security, decarbonization, and industrial competitiveness. Rather than treating nuclear expansion as a single-project challenge, the analysis frames it as a program challenge: one that requires coherence between institutions and market conditions, and where early choices about process design and risk-sharing will determine whether Poland achieves a credible build trajectory for both GW-scale units and, over a longer horizon, SMRs.

Finally, it is important to state what this report is - and is not. It does not argue that nuclear should replace renewables or that a single technology can solve Poland's transition. Rather, it treats nuclear as one component of a resilient, low-carbon power system - valuable to the extent that policy and market design allow it to be delivered at scale and integrated efficiently alongside renewables, storage, grids, demand response, and flexible capacity.

Existing and Planned Nuclear Energy Policies

Poland

Role of policies and regulations

National nuclear energy policies provide the framework for ensuring energy security, sustainability, and compliance with international safety standards. They define long-term goals for nuclear development, including investment priorities, technological choices, and regulatory structures, while regulations provide specific legal framework for deployment and secure use of the nuclear facility.

Policies

The master document for Polish energy policy is the "Energy Policy of Poland" (pol. "Polityka Energetyczna Polski do 2040", PEP2040). Currently the Polish Energy Law requires updates of the PEP2040 every five years. The official nuclear power programme is called "Polish Nuclear Power Programme" (pol: "Program Polskiej Energetyki Jądrowej", PPEJ) and as of 2025 should be issued every 8 years[1]. Besides those documents developed under national legal framework, Poland as an EU member state is also required to develop a National Climate and Energy Plan under Regulation (EU) 2018/1999 of the European Parliament and of the Council every ten years with a mid-term update[2].

PEP2040

The latest Energy Policy of Poland until 2040 was adopted on 2 February 2021[3]. Following up on the preceding PEP2030[4], it lists "Implementation of nuclear power" as one of eight "Specific objectives". This is to be achieved

[1] Act of 29 November 2000: The Atomic Law [Prawo atomowe] (consolidated text Dz.U.2024.1277 as later amended) [https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20240001277].

[2] Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European nParliament and of the Council (OJ L 328, 21.12.2018, pp. 1–77) [https://eur-lex.europa.eu/eli/reg/2018/1999/oj/eng].

[3] Annex to the Resolution no. 22/2021 of the Council of Ministers of 2 February 2021 (M.P.2021.264), Official English text available at: https://www.gov.pl/web/klimat/polityka-energetyczna-polski.

[4] Annex to the Resolution no. 202/2009 of the Council of Ministers of 10 November 2009 (M.P.2010.2.11)[https://www.gov.pl/documents/33372/436746/DE_Polityka_energetyczna_ost_2030.pdf].

by the “Polish Nuclear Power Programme” updated under the framework of PEP2030. The Policy stipulated that the first nuclear unit of “about 1–1.6 GW” would be commissioned in 2033, with following five units added “every 2–3 years”, reaching totally 6–9 GW by 2043. The nuclear deployment was therefore to be based on large-scale reactors, additionally specified as light water reactors of Generation 3/3+. As for Small Modular Reactors (SMR), the policy only stated that “In the long term, there may be an opportunity to use small nuclear reactors in district heating and industry (process heat)”. Small reactors were not mentioned in any other context, and no investment other than six large-scale units was explicitly envisaged within the time frame of the policy.

It should be noted that PEP2040 is an outdated document in urgent need of an update. While it is not yet legally required, the reality has outpaced assumptions of the policy, especially in the area of renewables. The most striking example is photovoltaics development: PEP2040 prescribed gradual growth up to 10–16 GW in 2040, while in fact in 2025 it is already at 23 GW[5] due to generous state subsidy programmes. Such a major diversion from the policy stipulations creates a threat that there will be no space in the power mix left for stable operation of nuclear plants once they are completed.

A significant concern emerges from Poland's rapid renewable expansion trajectory, particularly the overconstruction of photovoltaics compared to policy targets. If this acceleration continues across solar, wind, and gas-fired capacity without careful coordination with nuclear deployment timelines, there's a substantial risk that nuclear plants will face severely curtailed operations upon completion. With renewables enjoying merit-order dispatch priority due to near-zero marginal costs, and gas plants providing flexible backup, nuclear facilities could find themselves operating at uneconomically low capacity factors, unable to secure sufficient running hours to justify their capital investments. This “market crowding” scenario becomes particularly acute if renewable subsidies and capacity mechanisms continue favouring weather-dependent sources and gas over baseload nuclear. From a strategic perspective, the design of Poland’s future power system must explicitly accommodate high-capacity utilization of stable sources, as nuclear power plants. Ensuring a consistently high load factor for nuclear units is essential not only for their financial viability, but also for achieving long-term cost optimization across the energy sector. In other case, a system combining renewables and gas will prove more expensive than one incorporating nuclear, due to integration and profiling costs that extend well beyond simple LCOE calculations[6].

[5] PSE S.A. update on X, 17.06.2025: https://x.com/pse_pl/status/1934868740564303987.
[6] Juszczak, A. (2024). Exceeding LCOE: Calculating Energy Costs in Energy Policy Design, Working Paper No. 8, Polish Economic Institute, Warsaw. [https://pie.net.pl/wp-content/uploads/2025/03/PEI_Working_paper_08_2024_Exceeding-LCOE-1.pdf].

Polish Nuclear Power Programme (PPEJ)

The Polish Nuclear Power Programme is a roadmap for the Council of Ministers coordinating actions of the Polish Government related to deployment of first nuclear power stations. Originally issued in 2014[7], it was updated in 2020[8] and a draft of another update was published in 2025[9].

From the beginning the PPEJ is specifically aimed at constructing two major power stations based on large-scale reactor technologies. Later iterations specify that other nuclear projects in Poland are possible but they are not covered by the PPEJ as such. Despite this and the fact that a number of Polish investors applied for (and received) Decisions-in-Principle for new SMR projects, there is no other government led nuclear programme though, which means that all actions of the state (in particular preparation of regulatory authorities, education etc.) are based on the assumption that only two plants will be constructed – and may prove insufficient in case more investors launch licencing procedures at the same time. The newest draft does, however, state that a specific SMR Roadmap will be developed by the Government in near future.

Evolution of the Programme goals is presented in the following table.

Table 1. Evolution of Polish Nuclear Power Programme

Specification	PPEJ 2014	PPEJ 2020	PPEJ 2025 (draft)
Plants / units	2 plants	2 plants, 3 units each	2 plants, 3 units each
Output (GW)	6	6-9	6-9
Technology	Not indicated	PWR	AP1000 for 1st plant WCR* for 2nd
First construction start	2019	2026	2028
First unit ready	2025	2043	2036
Programme complete	2035	2043	2043

* water-cooled reactor.

Sources: Polish Nuclear Power Programme. Annex to the Resolution no. 15/2014 of the Council of Ministers of 28 January 2014 (M.P.2014.502), Polish Nuclear Power Programme. Annex to the Resolution no. 141/2020 of the Council of Ministers of 2 October 2020 (M.P.2020.946), Polish Nuclear Power Programme. Draft of 28 May 2025.

[7] *Polish Nuclear Power Programme*. Annex to the Resolution no. 15/2014 of the Council of Ministers of 28 January 2014 (M.P.2014.502). Official English text available at: https://www.gov.pl/web/polski-atom/program-polskiej-energetyki-jadrowej.
[8] *Polish Nuclear Power Programme*. Annex to the Resolution no. 141/2020 of the Council of Ministers of 2 October 2020 (M.P.2020.946). Official English text available at: https://www.gov.pl/web/polski-atom/program-polskiej-energetyki-jadrowej.
[9] *Polish Nuclear Power Programme*. Draft of 28 May 2025. Published at https://www.gov.pl/web/przemysl/projekty-dokumentow-rzadowych3, but as of September 2025 links do not work following Government reorganisation.

National Energy and Climate Plan (KPEiK)

The Polish National Energy and Climate Plan (NECP) for 2021–2030 (pol. Krajowy Plan na rzecz Energii i Klimatu, KPEiK) was duly created in 2019. Under the EU regulation the mid-term update was due in December 2024, but as of September 2025 the update draft has still not been finalised. The initial draft of July 2025[10] since superseded, contained very few references to nuclear power and even though it claimed to take into account the development of nuclear power as prescribed in the PPEJ, the energy mix proposed in it would have left no market space for the second PPEJ plant, not to mention any possible third-party projects.

The updated draft of the NECP was published in December 2025[11]. It sets more ambitious targets compared to the previous version, envisioning the deployment of nuclear energy after 2035 and indicating that by 2040 the capacity from large-scale and small-scale nuclear power plants should reach approximately 5.9 GW, which is consistent with the provisions of the Polish Nuclear Energy Programme (PPEJ), though it remains modest in ambition relative to the programme's target capacity of 6–9 GW.

In this version of the document, nuclear energy is assigned a number of key roles, including ensuring adequate generation capacity for the energy system following the retirement of coal-fired units. The new draft NECP, as essentially the first Polish transformational policy document of its kind, also points to the potential use of nuclear energy in district heating, projecting – in the WAM scenario – that it could account for approximately 10% of heat production volume. The NECP does not distinguish between large-scale nuclear power and SMRs, presenting its provisions in an aggregated manner; it does indicate, however, that SMRs are expected to be deployed in a longer-term perspective following their commercialisation.

As of the publication date of this report, the NECP remains a draft document and has not yet been formally adopted by the Council of Ministers.

Laws

Atomic Law

Polish Atomic Law[12] (adopted in 2000, with multiple amendments since) provides comprehensive rules for safe and peaceful use of atomic energy, and establishes the regulating body for nuclear safety and radiological protection.

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[10] Draft National Climate and Energy Plan 2030 with a perspective till 2040 – version submitted for further proceeding at the level of the Council of Ministers [Projekt Krajowego Planu w dziedzinie Energii i Klimatu do 2030 r. z perspektywą do 2040 r. – wersja przekazana do dalszego procedowania na poziomie Rady Ministrów] [https://www.gov.pl/web/klimat/projekt-krajowego-planu-w-dziedzinie-energii-i-klimatu-do-2030-r-z-perspektywa-do-2040-r-wersja-przekazana-do-dalszego-procedowania-na-poziomie-rady-ministrow].

[11] Projekt Krajowego Planu w dziedzinie Energii i Klimatu do 2030 r. z perspektywą do 2040 r. - wersja opracowana przez ME do zatwierdzenia rządowego [The draft National Energy and Climate Plan until 2030 with a perspective until 2040 - version prepared by the Ministry of Energy for government approval.] https://www.gov.pl/web/energia/projekt-krajowego-planu-w-dziedzinie-energii-i-klimatu-do-2030-r-z-perspektywa-do-2040-r---wersja-opracowana-przez-me-do-zatwierdzenia-rzadowego

[12] Act of 29 November 2000: The Atomic Law [Prawo atomowe] (consolidated text Dz.U.2024.1277 as later amended) [https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20240001277].

With regard to nuclear power stations, it establishes licencing procedures, separately to construct, commission, operate and decommission a facility. The Atomic Law also incorporates certain pre-licencing procedures in form of "general opinions" of the regulator on specific issues. It does not, however, establish any structured design certification process, and every separate nuclear facility (including SMRs) needs to go through exactly identical licencing process, with full verification of safety assessments.

A set of executive regulations issued under the framework of the Atomic Law establishes specific and detailed rules for design of nuclear facilities[13], for safety assessments conducted in the licencing process[14], and for site evaluation[15]. The Atomic Law also regulates liability for nuclear damage issues.

Nuclear Power Investment Act

The Nuclear Power Investment Act[16] establishes a full procedure for development of new-build nuclear power projects in Poland. It specifies all procedures beyond licencing by the nuclear regulator – by establishing new processes (like Decision-in-Principle or site approval) or amending existing non-nuclear processes (for the environmental process, and non-nuclear construction permitting), as well as simplifying some aspects of the investment process (real estate ownership, administrative deadlines).

The formal permitting and licencing process begins with obtaining a Decision-in-Principle, which is an expression of approval of the Polish state for development of a nuclear power project at a certain location, by a certain investor and using certain technology. This decision is currently issued by the Minister of Energy.

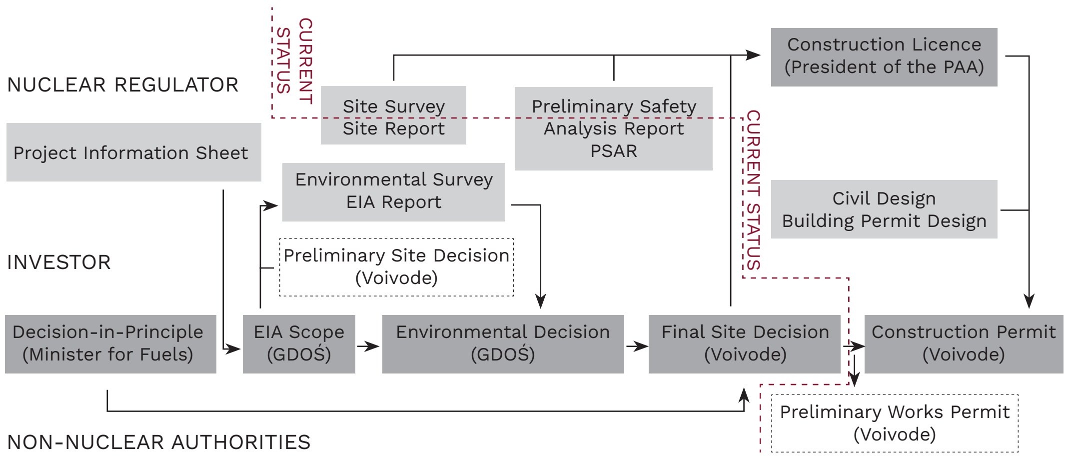
[13] Regulation of the Council of Ministers of 31 August 2012 concerning nuclear safety and radiological protection requirements to be addressed by the design of a nuclear facility [Rozporządzenie Rady Ministrów z dnia 31 sierpnia 2012 r. w sprawie wymagań bezpieczeństwa jądrowego i ochrony radiologicznej, jakie ma uwzględniać projekt obiektu jądrowego] (Dz.U.2012.1048) [https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20120001048].

[14] Regulation of the Council of Ministers of 31 August 2012 concerning scope and method of conducting safety assessments carried out prior to applying for a licence to construct a nuclear facility, and the scope of a preliminary safety assessment report for a nuclear facility [Rozporządzenie Rady Ministrów z dnia 31 sierpnia 2012 r. w sprawie zakresu i sposobu przeprowadzania analiz bezpieczeństwa przeprowadzanych przed wystąpieniem z wnioskiem o wydanie zezwolenia na budowę obiektu jądrowego, oraz zakresu wstępnego raportu bezpieczeństwa dla obiektu jądrowego] (Dz.U.2012.1043) [https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20120001043].

[15] Regulation of the Council of Ministers of 18 August 2012 concerning the detailed scope of evaluation of the site intended for a nuclear facility, cases precluding declaring a site as meeting requirements for a nuclear facility siting, and requirements for a site evaluation report for a nuclear facility [Rozporządzenie Rady Ministrów z dnia 10 sierpnia 2012 r. w sprawie szczegółowego zakresu przeprowadzania oceny terenu przeznaczonego pod lokalizację obiektu jądrowego, przypadków wykluczających możliwość uznania terenu za spełniający wymogi lokalizacji obiektu jądrowego oraz w sprawie wymagań dotyczących raportu lokalizacyjnego dla obiektu jądrowego] (Dz.U.2012.1025) [https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20120001025].

[16] Act of 29 June 2011 on developing and constructing investment projects concerning nuclear power facilities and associated projects [Ustawa z dnia 29 czerwca 2011 r. o przygotowaniu i realizacji inwestycji w zakresie obiektów energetyki jądrowej oraz inwestycji towarzyszących] (Dz.U.2025.1156) [https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20250001156].

Diagram 1. Simplified diagram showing steps and processes leading to obtaining a Building Permit enabling start of actual power plant construction



Source: prepared on the basis of: P. Gorzkowski, *Aspekty prawne projektu jądrowego w Polsce*, Nuclear PL, 2025.

Following the Decision-in-Principle, the investor develops a Project Information Sheet and submits it to the General Director for Environmental Protection (pol. Generalny Dyrektor Ochrony Środowiska, GDOŚ), who then defines the scope of the mandatory Environmental Impact Assessment (EIA). Construction and decommissioning of nuclear power plants is always considered as a project which can have significant environmental impact, therefore EIA is always mandatory. The investor must prepare an EIA Report describing the planned project in detail and including description of project variants with indication of the variant selected for construction, a rational alternative variant, and a variant most favourable for the environment. The Environmental Decision is issued by GDOŚ taking into account consultations with competent authorities, notably the President of the National Atomic Energy Agency (PAA) regarding nuclear safety and radiological protection, findings contained in the EIA Report, and results of public and transboundary consultations.

Once the Environmental Decision is obtained, the investor may apply for the Final Site Decision, which enables land use by the investor. This decision is issued by a local Voivode and defines exact location of the facility, technical, environmental and fire protection conditions, and results for the legal status of affected property.

The Construction Licence is a crucial administrative act issued by the President of the PAA. Its most important function is thorough verification of the project in terms of nuclear safety and radiological protection, being the only mandatory comprehensive review conducted by the nuclear regulator. Prior to applying, an investor must perform comprehensive Site Survey, compile a Preliminary Safety Analysis Report (PSAR), obtain a valid Environmental Decision, and create a Decommissioning Programme. The President of the PAA is entitled to inspect the site, use assistance of external laboratories and expert organisations, and demand conducting studies or expert reviews with costs borne by the applicant.

The Building Permit is the final administrative decision required to start actual construction and is issued by a local Voivode. In order to receive it, an investor must previously receive a Construction Licence.

After completing construction but before commissioning starts, the investor must obtain a Commissioning Licence issued by the President of the PAA.

Upon completion of commissioning, the investor must obtain an Operating Licence from the President of the PAA. Before the Application, an investor must update the safety analysis to the level of Operational Safety Analysis Report. Once issued, the investor is obliged to start contributions to a special waste disposal and decommissioning fund - currently the fee is specified as PLN 17.16 per each generated megawatt of electricity[17].

Grid Connection Requirements and Off-Grid Applications

Polish regulations concerning grid connection do not differentiate between energy sources or types of generation facilities. The Energy Law and associated grid codes apply uniformly to all electricity generating installations that connect to the public grid, regardless of their technology, capacity, or fuel source. This means that nuclear power facilities, whether large-scale reactors or small modular reactors, are subject to the same grid connection requirements as conventional fossil fuel plants or renewable energy installations. The technical conditions for grid connection, including requirements for system stability, voltage control, frequency response, and other grid services, remain identical across all generating technologies. However, for facilities intended for off-grid operation or serving only dedicated industrial consumers without connection to the public electricity system, these grid connection requirements simply do not apply, and no dedicated regulations exist for such arrangements because they are not necessary.

For nuclear power facilities specifically, all permitting and licencing procedures remain identical for both SMRs and large nuclear reactors, with one notable exception related to grid connection approval. While the Nuclear Power Investment Act requires obtaining an opinion from the Transmission System Operator for Electricity or Distribution System Operator for Electricity regarding possibility of plant's interconnection with the power grid, this is merely an opinion that must be submitted as part of the Final Site Decision application process for grid-connected facilities, rather than a separate administrative decision or permit. For off-grid nuclear installations, such as those intended solely for industrial heat production or dedicated power supply to a single facility, this grid operator opinion would not be required, as there is no interconnection with the public grid to evaluate. The substantive technical requirements for grid connection remain unchanged where applicable, but the administrative process is streamlined within the nuclear regulatory pathway, and for off-grid applications, the absence of grid connection simply eliminates this particular procedural requirement without necessitating any special regulatory framework.

[17] Regulation of the Council of Ministers on the amount of payment for the costs of final management of spent nuclear fuel and radioactive waste and for the costs of decommissioning a nuclear power plant by an organisational unit which has been granted a licence to operate a nuclear power plant on 10 October 2012 (Dz.U. 2012.1213).

Nuclear Energy Policies in Other Countries

Czechia

The State Energy Policy[18] was adopted in 2015, currently being in the process of update. According to the binding document one of the strategic priorities of the energy sector in Czechia is balanced energy mix, which shall be ensured by gradual transition from a source mix focused particularly on coal towards a diversified source portfolio with a higher proportion of nuclear energy in electricity generation. Czech government shall focus on "support of the development of nuclear energy as one of the pillars of electricity generation, with the target of nuclear energy comprising approximately 50% of the amount of electricity generated and maximising heat supplies from nuclear power plants". What is specific for Czechia, one of the policy objectives is to support the maximum possible use of heat from nuclear power plants to heat larger agglomerations near those sources.

Document does not refer to specific nuclear technologies (there is nothing about SMRs), although there is a clue that proposed energy mix can bridge the transition period until renewable resources become fully competitive and 4th generation reactors and nuclear fusion are available.

Other document, the National Action Plan for the Development of the Nuclear Energy Sector in the Czech Republic[19], develops the State Energy Policy and defines nuclear power as a key pillar of the Czech Republic's energy security, supply stability, and CO_2 reduction strategy. Its central objective is the preparation and construction of new nuclear units, particularly the third and fourth blocks at existing sites, alongside the creation of legal and financial frameworks, industry participation, and the strengthening of human resources and research capacities. It also stipulates that "small reactors" are units with a capacity below 1,200 MW_e, reflecting the classification used at the time, which differs from today's SMR concept. SMRs (meant by units with electric power lower than 300 MWe or 600–700 MW_e, depending on the definition used) are not mentioned in the wording of the document. Significant attention is given to radioactive waste and spent fuel management, including the preparation of a deep geological repository. The plan further emphasizes research, innovation, education, and public acceptance, setting long-term directions up to 2040 and beyond.

[18] State Energy Policy of the Czech Republic, 2015 [https://mpo.gov.cz/assets/en/energy/state--energy-policy/2017/11/State-Energy-Policy-_2015__EN.pdf].
[19] National Action Plan for the Development of the Nuclear Energy Sector in the Czech Republic, 2015 [https://mpo.gov.cz/assets/en/energy/electricity/nuclear-energy/2017/10/National--Action-Plan-for-the-Development-of-the-Nuclear-_2015_.pdf].

The National Energy and Climate Plan of the Czech Republic[20] for 2021–2030 was originally adopted in January 2020. In December 2024 update of the document was approved by the government of the Czech Republic. In the executive summary of the document the following basic measure to achieve objectives of the Plan was pointed: “The development of nuclear energy is an important element of the decarbonisation strategy. The share of nuclear energy in energy consumption will increase, which will be achieved through the construction of large nuclear reactors and small and medium modular rectors (SMRs). Priority will be given to the construction of additional units on the existing nuclear sites of Dukovany and Temelín, aiming, inter alia, at the partial replacement of existing nuclear resources. In addition, the construction of small and medium-sized reactors is envisaged, with a view to commissioning the first SMR in the mid-2030s”. The Plan stipulates that target share of nuclear energy in the total gross electricity production in 2040 shall be up to 68%, and up to 46% in 2050. The documents provides an assumption that existing coal resource sites shall be explored for the use of SMR and the geotechnical preparation of 3 potential investors takes place at selected sites that are part of the plan for small and medium reactors in the Czech Republic. The first SMR is expected to become operational in the mid-30s, with the total installed capacity of SMRs reaching up to 3 GW depending on the construction of large reactors. Use of nuclear energy (including SMRs) is also considered for existing district heating systems.

SMR roadmap[21] sets out the framework for the usage of SMRs in the Czechia. The source of the document is the governmental policy[22] and the role of the SMR roadmap is auxiliary in relation to other strategic documents, as the Sep and the Spatial development policy of the Czech Republic[23]. Its key assumptions include analysing the country’s energy needs to 2050, assessing electricity and heat capacity gaps, and considering SMRs as a complement to large reactors in the 2030s and 2040s for decarbonization, district heating, hydrogen production, and grid stabilization. SMRs are defined in accordance with the IAEA as reactors with an electrical capacity of up to approximately 700 MW. The document emphasizes the need for clear and non-discriminatory investment conditions, simplified and accelerated licensing procedures, and Czech industry participation in the SMR supply chain. Possible SMR locations include existing nuclear plants, decommissioned coal plants suitable for conversion, and other areas with appropriate infrastructure (in total – 47 potential host sites pointed in Annex E to the SMR roadmap).

[20] National Energy and Climate Plan of the Czech Republic, 2024 [https://commission.europa.eu/document/download/3164cc75-45db-4898-bc63-d5f7d989c9c9_en?filename=CZ%20%E2%80%93%20FINAL%20UPDATED%20NECP%202021-2030%20%28English%29.pdf].

[21] Czech SMR roadmap Applicability and Contribution to Economy, 2023 [https://mpo.gov.cz/assets/en/guidepost/for-the-media/press-releases/2023/11/Czech-SMR-Roadmap_EN.pdf].

[22] https://vlada.gov.cz/en/jednani-vlady/policy-statement/policy-statement-of-the-government-193762/.

[23] According to the point 1.1 roadmap: “The Roadmap analyses the current state of readiness of the Czech Republic and Czech industry for the use of SMR technology and associated opportunities. It makes recommendations based on consultations with the government, industry, the financial sector, and the research and development sector. The Roadmap will form the basis for decisions of the Czech Nuclear Committee and the Government of the Czech Republic on further steps in the area of SMRs with regards to the update of the Sep and the Spatial development policy of the Czech Republic. It recommends creating conditions that will enable the construction of SMRs in the Czech Republic and advance the Czech industry, and setting non-discriminatory conditions for all entities interested in the SMR technology in the Czech Republic”.

France

In 2023 French government revised policy on nuclear energy, moving back to the nuclear energy as an important part of a way of effective decarbonisation and law no. 2023-491[24] on the acceleration of procedures relating to the construction of new nuclear facilities near existing nuclear sites and to the operation of existing facilities was adopted. The document repealed the target of achieving a 50% nuclear share of the electricity mix by 2035, as well as the cap on nuclear generation capacity at 63.2 gigawatts has been removed. Important part of the document is the section with a number of derogations applicable solely to the construction of nuclear power reactors – including small modular reactors – provided they are located either within the boundaries or in the immediate proximity of an existing basic nuclear facility, and on condition that the application for a construction licence is submitted within 20 years from the promulgation of the law. These simplifications mainly refer to urban and land planning, derogation from the prohibition on harming protected species and their habitats due to the "imperative reason of overriding public interest", special expropriation procedure. Part of the provisions of this Law have been removed by the decision of the Constitutional Council, particularly with regard to articles considered as "sensitive" (e.g. provisions relating to the recognition of an imperative reason of major public interest, or those concerning the use of a special expropriation procedure with immediate possession of the property).

The other documents, the French National Energy and Climate Plan[25] supported by multiannual energy programme[26] (which sets out the State's energy priorities for mainland France over 10 years, divided into two 5-year periods), specifies one of the key objectives as decarbonisation of the energy mix by development of renewable energy sources and relaunching the nuclear sector. What is emphasized is that the nuclear energy shall be a strong part of the future French energy mix and shall increase in 2030 and 2035. The nuclear sector shall be recovered and an objective of closing down nuclear reactors eliminated. To achieve this, several measures shall be implemented. First, the operation of existing nuclear power plants shall be continued beyond the previously planned 50-year deadline, as long as all applicable safety requirements are met. Second, the available power of existing reactors shall be increased. Third, new EPR2 units shall be deployed in the 2030s and 2040s, with up to 14 units in total. This includes 6 new EPR2 nuclear reactors at the Penly, Gravelines, and Bugey sites, and up to 8 additional reactors in locations not yet specified. France shall also support EDF to develop Nuward SMR by aiming to achieve the milestone of a first concrete for a first

[24] LOI n° 2023-491 du 22 juin 2023 relative à l'accélération des procédures liées à la construction de nouvelles installations nucléaires à proximité de sites nucléaires existants et au fonctionnement des installations existantes [https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000047715784].

[25] French National Energy and Climate Plan, 2024 [https://commission.europa.eu/document/download/ab4e488b-2ae9-477f-b509-bbc194154a30_en?filename=FRANCE%20%E2%80%93%20FINAL%20UPDATED%20NECP%202021-2030%20%28English%29.pdf].

[26] French strategy for energy and climate Multiannual energy programming, draft March 2025 (2025-2030, 2031-2035) [https://www.consultations-publiques.developpement-durable.gouv.fr/IMG/pdf/02__projet_de_ppe_3_en.pdf].

reference plant in France by 2030 (this goal seems difficult to achieve in light of the complete redesign of this reactor in 2025)[27]. French government also declares continuation of efforts aimed at achieving a first concrete design for a pressurized SMR and launching at least one prototype of an innovative small nuclear reactor using a different technology by the beginning of the 2030s.

Sweden

In 1980 the Swedish Parliament decided to abandon construction of new nuclear power stations (beyond those already under construction) and phase out nuclear power generation in a long term (by 2010). This stance was gradually softened, with a decision to allow replacement reactors (2010), followed after 2023 by legislative amendments permitting new reactors to be constructed in new locations without a country-wide capacity cap. An important symbolic step in the same year was the replacement of the 100% renewable electricity target with a 100% fossil-free target[28,29], thus opening the way of using nuclear as a long-term solution.

In November 2023 the government presented a roadmap for new nuclear[30,31]. A special Coordinator for the programme was appointed in January 2024. The Coordinator's office is to present a detailed report on necessary measures by the end of 2026[32]. According to the current plan, country is to gain 2.5 GW of new nuclear capacity by 2035, and 10 GW by 2045[33].

The government is also working on financial solutions. The governmental aid would be provided in the form of government loans and two-way Contracts for Difference (CfD). Both these parts provide financial support at different stages of a project:

- development phase - government loans are provided for the construction and testing of new nuclear reactors, and for planning and other preparatory measures,

[27] https://www.linkedin.com/posts/nuward_smr-activity-7215987924771684352-dIc6/?utm_source=share&utm_medium=member_desktop.
[28] Yes to the Government's spring amending budget. Riksdag Press Release, 20 June 2023 [https://www.riksdagen.se/en/news/articles/2023/jun/20/yes-to-the-governments-spring-amending-budget_cmsff94b926-2480-4016-a66a-74e624cf4cdden/].
[29] Spring Budget Amendment for 2023 [Vårändringsbudget för 2023] Prop. 2022/23:99 [https://www.regeringen.se/rattsliga-dokument/proposition/2023/04/prop.-20222399].
[30] Sweden's updated National Energy and Climate Plan 2021-2030. Annex to Government Decision KN2024/00362, June 2024 [https://commission.europa.eu/publications/sweden-final-updated-necp-2021-2030-submitted-2024_en].
[31] E. Busch: Färdplan för ny kärnkraft i Sverige. November 2023 [https://www.regeringen.se/globalassets/regeringen/dokument/klimat--och-naringslivsdepartementet/ppt/231116-presentationsbilder-fardplan-for-ny-karnkraft-i-sverige.pdf].
[32] Committee directive A national coordinator for the expansion of nuclear power Decision at the government meeting on 4 January 2024 [Kommittédirektiv En nationell samordnare för utbyggnad av kärnkraft Beslut vid regeringssammanträde den 4 januari 2024] [https://www.regeringen.se/contentassets/364833615c8d415fac8e9300017aafee/en-nationell--samordnare-for-utbyggnad-av-karnkraft-dir.-20241.pdf].
[33] Interim report: The nuclear new-build coordinator's recommendations regarding the expansion of new nuclear power in Sweden – June 2024 [https://www.government.se/contentassets/69254b65d64f46fd866b544d5709108a/interim-report-the-nuclear-new-build--coordinators-recommendations-regarding-the-expansion-of-new-nuclear-power-in-sweden-june-2024.pdf].

- operation phase – two-way CfDs reduce market risk by ensuring both a minimum remuneration to the company during the period reactors are commercially operational, and that any excess profit is transferred to central government[34].

Moreover it is accompanied with a mechanism that governs risk and profit sharing between the company and central government - once a new nuclear reactor has been in operation for a certain amount of time, a review of the company's returns (based on a predefined valuation method) is conducted. The risk and profit sharing mechanism is activated or deactivated depending on returns in relation to a predetermined interval[35].

According to the 2024 update of the National Climate and Energy Plan[36], "Nuclear energy is a prerequisite for reaching climate objectives".

Romania

The Integrated National Energy and Climate Plan for 2021–2030[37] was originally adopted in April 2020 and updated in October 2024. The updated NECP establishes nuclear energy as a cornerstone of Romania's decarbonization strategy, explicitly stating that "nuclear capabilities will provide the base of the generation curve, enabling the safe integration of renewables into the electricity grid". The document recognizes nuclear energy "for the fact that it does not emit greenhouse gases and for its excellent reliability" and emphasizes that "[it is] contributing significantly to the diversity of Romania's energy sources". The NECP sets a target for nuclear energy to reach 16–19% of electricity generation by 2030, increasing to 23–20% by 2050 (WEM and WAM scenarios respectively). Romanian NECP states that "[nuclear large-scale and SMR] investments will contribute to the decarbonization of the energy sector, because the technology of generating electricity from nuclear sources has zero (...) emissions", and sets measurable goals: two new CANDU reactors by 2032 and one SMR by 2030, the latter is present only in WAM scenario.

The Energy Strategy of Romania 2025–2035 with a 2050 Perspective[38], adopted in November 2024, represents the first comprehensive energy strategy in 17 years and positions nuclear energy as central to the country's clean energy transition. The Strategy articulates that "to ensure the country's energy security, Romania must urgently expand the operation of nuclear energy resources" emphasizing "investments in nuclear generation capacities represent one

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[34] Assignment to take preparatory measures to be able to issue government credit guarantees for investments in new nuclear power. [Uppdrag att vidta förberedande åtgärder för att kunna ställa ut statliga kreditgarantier för investeringar i ny kärnkraft] KN2023/04316, November 2023 [https://www.regeringen.se/contentassets/5bf1e1b788074276a39d92461a325589/uppdrag-att-vidta-forberedande-atgarder-for-att-kunna-stalla-ut-statliga-kreditgarantier-for-investeringar-i-ny-karnkraft.pdf].

[35] https://www.government.se/government-policy/nuclear-financing/how-the-support-model-for-financing-new-nuclear-energy-works/.

[36] Sweden's updated National Energy and Climate Plan 2021-2030… .

[37] Romania – Final Updated National Energy and Climate Plan (NECP) 2021–2030 (submitted in 2024), European Commission, 16 October 2024 [https://commission.europa.eu/publications/romania-final-updated-necp-2021-2030-submitted-2024_en].

[38] Strategia Energetica a României 2025-2035 cu perspectiva anului 2050 [Energy Strategy of Romania 2025–2035 with a 2050 Perspective], December 2024, Ministry of Energy, Romania [https://energie.gov.ro/wp-content/uploads/2024/12/Strategia-Energetica-a-Romaniei-2025-2035-cu-perspectiva-anului-2050.pdf].

of the optimal solutions to cover the electricity production capacity deficit forecast for 2028–2035 as a result of reaching the operating life limit of several existing capacities based on fossil fuels”. The strategy explicitly mentions the expansion of CANDU reactors at the Cernavodă NPP, but mentions SMR reactors only by name, without providing construction plans.

Romania is the only country in Europe with CANDU heavy water reactors. Its nuclear expansion plans aim to expand capacity from the current 1,400 MW (two CANDU-6 units at Cernavodă) to approximately 3,200 MW by 2032. The cornerstone project involves completion of the construction of Cernavodă units 3 and 4, for which a €3.2 billion EPCM contract was signed in November 2024[39]. These CANDU-6 (upgraded to EC6 standard) reactors (c.a. 700 MWe each) are partially complete – Unit 3 is approximately 52% complete and Unit 4 about 30% complete[40] – their construction began in 1984 and was suspended in 1991 (after prior mothballing). The project benefits from comprehensive international financing: US EXIM Bank committed $3.0–3.4 billion, Canada provided CAD $2 billion, and Italy's SACE contributed €2 billion, with target commercial operation in 2031–2032[41]. A station for recovering tritium from reactors is also under construction; the element is to be exported and used for thermonuclear fusion research[42].

The Cernavodă unit 1 refurbishment project involves a €1.9 billion EPC contract signed in December 2024 with an international consortium[43]. The comprehensive refurbishment will extend Unit 1's operation for 30 years, with target completion in 2027–2029 and full commercial operation by 2030. Unit 2 refurbishment is planned for after 2037[44].

Romania is also considering Small Modular Reactor deployment through the NuScale project at the site of the former Doicești coal-fired plant. The project would involve a VOYGR-6 power plant with six modules totalling 462 MW_e capacity. Romania's nuclear regulator CNCAN approved the roadmap for meeting project milestones in August 2023 and in July 2024 received the request for design & siting authorization, and by March 2025, the received 3 general chapters of the Preliminary Safety Analysis Report[45] (out

[39] Key Cernavoda 3 and 4 engineering contract signed, World Nuclear News, 15 October 2024 [https://www.world-nuclear-news.org/articles/key-cernavoda-3-and-4-engineering-contract-signed].
[40] Ibidem.
[41] Nuclearelectrica to sign deal on new Cernavodă reactors, start preliminary works, Balkan Green Energy News, 29 October 2024 [https://balkangreenenergynews.com/nuclearelectrica-to-sign-deal-on-new-cernavoda-reactors-start-preliminary-works/].
[42] First concrete poured for Europe's first tritium removal facility, World Nuclear News, 3 June 2025 [https://www.world-nuclear-news.org/articles/first-concrete-poured-for-europes-first-tritium-removal-facility].
[43] Infrastructure work begins for Cernavoda 1 refurb project, World Nuclear News, 5 September 2025 [https://www.world-nuclear-news.org/articles/infrastructure-work-begins-for-cernavoda-1-refurb-project].
[44] NEA mission to Romania, OECD Nuclear Energy Agency, 21 November 2024 [https://www.oecd-nea.org/jcms/pl_98271/nea-mission-to-romania].
[45] Mădălina Terteci-Drăghici, Plans for Deployment of Small Modular Reactors (SMRs) in Romania, presentation at the IAEA Regional Workshop on Safety Benefits and Challenges in the Development and Adoption of SMRs, Bucharest, 31 March – 4 April 2025, National Commission for Nuclear Activities Control (CNCAN), Romania [https://gnssn.iaea.org/main/ansn/Activity%20Documents%20%20Public/Regional%20Workshop%20on%20Safety%20Benefits%20and%20Challenges%20in%20the%20Development%20of%20the%20Adoption%20of%20Small%20Modular%20Reactors/Presentation/P09.%20Plans%20for%20deployment%20SMR%20in%20the%20Romania%20+.pdf].

of 21 chapters total[46]). Front-End Engineering Design (FEED) Phase 1 was completed in the fourth quarter of 2023. In April 2024, the Romanian government deferred the decision on the continuation of the NuScale SMR project at a Nuclearelectrica shareholders' meeting, stating it needed "a calibrated and integrated vision of the project"[47]. The shareholders ultimately approved the project continuation in July 2024, enabling the signing of the FEED Phase 2 contract. However, the Final Investment Decision has since been delayed from 2026 to 2027[48]. The aforementioned delay means that the SMR construction target set in the NECP for 2030 is no longer achievable.

Lessons Learned and Implications for Poland's Nuclear Strategy

Analysis of nuclear policies in Czechia, France, Sweden, and Romania provides valuable insights for Poland in the context of developing its national nuclear energy sector.

All analysed countries are characterized by coherent, long-term visions of nuclear energy's role in the energy mix. Czechia has set a target of achieving 50% nuclear share in electricity generation, with a perspective of growth to 68% by 2040. Romania has defined nuclear energy as the "foundation of the generation curve", enabling safe integration of renewable energy sources. For Poland, this implies the necessity of developing a clear, multi-year strategy extending beyond the current government's term, with precisely defined quantitative targets and timelines.

Czechia has adopted a balanced approach, planning simultaneously the construction of large units at Dukovany and Temelín as well as SMR development with a total capacity of up to 3 GW. France supports both the EPR2 programme (up to 14 units) and the development of Nuward SMR technology. This supports a view that optimal strategy does not consist of choosing single technology, but rather complementary utilization of differently-scaled solutions. For Poland, this means that parallel to the multiple large reactors project, groundwork should be actively prepared for SMR deployment.

Strategic significance lies in utilizing sites of closing coal-fired power plants (so called Coal-to-Nuclear pathway) – both Czechia (47 potential locations) and Romania (Doicești project) have adopted this solution. This allows for the utilisation of existing grid infrastructure, qualified personnel, and social acceptance. For Poland, facing the challenge of transforming mining regions, this concept holds particular economic and social significance.

A specific element of Czech policy is the emphasis on maximum utilization of heat from nuclear power plants for heating larger cities. When considering

[46] International Atomic Energy Agency (IAEA), Format and Content of the Safety Analysis Report for Nuclear Power Plants, Specific Safety Guide No. SSG-61, STI/PUB/1884, Vienna, 2021, 197 p. [https://www-pub.iaea.org/MTCD/Publications/PDF/PUB1884_web.pdf].
[47] Romania backs SMR nuclear project but needs "more calibrated and integrated" vision to go ahead, Romania Insider, 18 April 2024 [https://www.romania-insider.com/romania-calibrated-vision-smr-nuke-project-2024].
[48] Department of Energy Selects 11 Firms for Advanced Reactor Pilot Program, Neutron Bytes, 17 August 2025 [https://neutronbytes.com/2025/08/17/doe-selects-11-firms-for-advanced-reactor-pilot-program/].

SMR locations in Poland, it is worth accounting for the possibility of their integration with district heating systems, which would increase energy efficiency and will enable the decarbonization of existing district heating systems.

The Swedish example demonstrates the significance of lasting political change – from the decision to phase out nuclear energy (1980) through gradual softening of the stance, to full opening to new locations and removal of capacity limits (2023). The symbolic change of target from 100% renewable energy to 100% fossil-free confirms the permanence of the new course. For Poland, it is crucial to guarantee stability of nuclear policy regardless of government changes.

The Romanian delay of the NuScale project serves as a warning against overly optimistic assumptions. Czechia realistically estimates the commissioning of the first SMR for the mid-2030s. Poland should adopt conservative timelines, accounting for the complexity of licensing processes and technical challenges.

The Romanian financing model for the Cernavodă 3 and 4 project demonstrates possibilities for mobilizing international capital sources. Swedish approach on financial support of the project (government loans, two-way CfD, risk and profit sharing mechanism, and potentially state co-ownership) indicates the necessity of an active state role in facilitating access to capital. Such involvement of the governments in specific cases may simplify business processes and accelerate projects, as it involves the government's willingness to assume more upfront risk to lower the overall cost of capital, and may simplify business processes and accelerate projects.

Synthesis of these experiences indicates that the success of Poland's nuclear program requires combining a clear strategic vision, flexible regulatory frameworks, realistic timelines, and consistent political and financial support.

Other Sectors

Other highly regulated and safety-critical sectors, such as civil aviation and the pharmaceutical industry, provide valuable examples for the nuclear sector due to their complex technologies, cross-border operations, and rigorous certification processes. Their standardized, internationally coordinated approaches to design approval, safety assessment, and market authorization demonstrate models of efficiency and reliability that can be adapted to support safe, predictable, and harmonized development of nuclear projects.

Civil Aviation

Civil aviation is an example of a sector, which combines increasingly complex machinery, mass production, international use, and above-average focus on safety. Modern airliners are manufactured according to standardised designs in hundreds or thousands of examples, and used literally all over the world. Nowadays new designs will not even enter production until orders are received for some hundreds of new aeroplanes, nearly guaranteeing financial feasibility to the manufacturer on one hand and predictable costs to the customers on the other. However, this situation could not exist without international approach to certification.

> The evaluation of aircraft design safety is based on the concept of "type certificates", originally introduced in British law in 1919, and then adopted by other countries (notably USA in 1927). Type certificates are issued for a specific design, upon thorough examination of design documentation and results of prototype tests, performed by a professional regulating body. Initially those institutions were national, but this created obvious challenges, especially in case of smaller countries. This led to increased coordination and cooperation of national regulators, notably in Europe. In 1970 a number of European countries established Joint Airworthiness Authorities (later renamed Joint Aviation Authorities, JAA) to develop common certification codes and standards for large aeroplanes and their engines. This was followed by adoption of joint certification for certain categories of aeroplanes in 1987, and eventually by establishing an EU-wide joint safety authority: the European Aviation Safety Agency (EASA) (reformed and renamed European Union Aviation Safety Agency, also abbreviated EASA, in 2018). EASA has formally taken over a number of functions from national authorities in the interest of European standardisation.

Except for this far-reaching coordination within Europe, EASA closely collaborates with other major authorities, in particular the U.S. regulator – the Federal Aviation Administration (FAA). Under existing Technical Implementation Procedures[49], FAA-issued type certificates are therefore only "validated" by EASA, and upon this process accepted, and full procedure is not repeated (similarly, FAA validates EASA-issued type certificates). Such agreements lead to standardisation of aeroplane designs and rapid international introduction of new types. As an example of relevant timelines:

- American Boeing 787-8 (the initial model of the 787, and also the first entirely new design ever certified by EASA) received both FAA and EASA type certificates on the same day, 26 August 2011, following a joint FAA-EASA process, where FAA was the primary authority, and EASA the validating authority[50];
- European Airbus A350-900 (also the launch model of the A350) received EASA type certificate on 30 September 2014[51], and FAA type certificate on 12 November of the same year[52].

[49] Technical Implementation Procedures For Airworthiness and Environmental Certification Between the Federal Aviation Administration of the United States of America and the European Union Aviation Safety Agency. Revision 7. EASA-FAA [https://www.easa.europa.eu/en/downloads/138781/en].
[50] The Boeing 787 receives EASA certification. EASA Press Release, 26 August 2011 [https://www.easa.europa.eu/en/newsroom-and-events/press-releases/boeing-787-8-receives-easa-certification].
[51] Airbus A350-900 is EASA certified. EASA Press Release, 30 September 2014 [https://www.easa.europa.eu/en/newsroom-and-events/press-releases/airbus-a350-900-easa-certified].
[52] Airbus A350-900 receives FAA Type Certification. Airbus Press Release, 13 November 2014 [archived at: https://web.archive.org/web/20150402175127/http://www.airbus.com/presscentre/pressreleases/press-release-detail/detail/airbus-a350-900-receives-faa-type-certification/].

Pharmaceutical industry

Pharmaceutical industry is also an interesting example of the cross-border approach to the topic of approval of usage of very sensitive type of products. In the European Union, there are three main procedures for drug registration: the centralized procedure, the mutual recognition procedure (MRP), and the decentralized procedure.

The centralized procedure allows an authorization to be obtained for all EU Member States and countries in the European Economic Area through a single application submitted to the European Medicines Agency (EMA)[53]. It applies to specific category of medicaments specified in line with the Resolution 726/2004 of European Parliament and the Council. The EMA's recommendation to grant marketing authorization is approved by the European Commission and applies in all Member States.

The mutual recognition procedure[54] is used for medicines that already have a marketing authorization in one EU Member State, referred to as the Reference Member State (RMS), and the manufacturer seeks to extend the authorization to other Member States (Concerned Member States, CMS). The RMS evaluates the application, prepares a report and scientific opinion, and the CMS review the report. After successful completion of the procedure, each CMS issues a national marketing authorization consistent with the RMS decision. The MRP accelerates market access, avoids duplication of scientific assessment, and ensures a uniform standards across different EU countries.

The decentralized procedure, on the other hand, is used for medicines that have not previously been authorized in the EU; the application is submitted simultaneously to several Member States, one of which acts as the RMS, prepares an evaluation report and coordinates the evaluation, allowing marketing authorizations to be obtained in multiple countries.

The main differences between these procedures relates to the scope of the decision's applicability, requirements for drug innovativeness, and the method of dossier evaluation: the centralized procedure covers all EU Member States, the MRP allows mutual recognition of an existing decision in other countries, and the decentralized procedure enables simultaneous authorizations in several countries.

[53] Regulation (EC) No 726/2004 of the European Parliament and of the Council of 31 March 2004 laying down Community procedures for the authorisation and supervision of medicinal products for human and veterinary use and establishing a European Medicines [https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32004R0726].

[54] Directive 2001/83/EC of the European Parliament and of the Council of 6 November 2001 on the Community code relating to medicinal products for human use [https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32001L0083].

Evaluation of the Existing Regulatory and Financial Framework

Regulatory Framework

As of late 2025, the Polish regulatory framework for nuclear power stations is reasonably complete, although it remains, for the most part, untested. In particular, no investor (project-owner) has yet progressed to the stage of submitting a construction licence application to the regulator, and the current licencing process for power stations has never been used. The same legal framework has been used multiple times for issuing operational permits for the MARIA – Poland's sole research reactor, most recently in 2025.

The Polish Atomic Law is technology-neutral. It establishes, that nuclear power facilities must be based on technologies proven either by actual operation or by properly conducted assessments and studies, and therefore does enable construction of First of a Kind plants, as long as they meet specific requirements set in the Law and associated regulations. The regulations are written mostly with water cooled reactors in mind, and might not cover some issues related to Generation IV designs though.

One notable feature of the Polish licencing and permitting process is a requirement for the investor (project-owner) to interact with multiple authorities at the same time. There are two main work flows. One is related to "nuclear" licencing with the regulator – this one pretty straightforward, basically including only construction licence (then followed by commissioning and operating licences), and only optionally preceded by certain pre-licencing activities. The other involves typical set of permits necessary for a major industrial project: the environmental decision, administrative site approval (which has nothing to do with site safety evaluation, and is performed by state administration) and building permit (administrative, again not safety-related). These are obtained from other authorities. On top of that, in case of some applications, the investor is required to obtain considerable amount of supporting documentation from other authorities (multiple ministries, authorities etc., ranging from the ministry of national defence to local heritage protection authorities). While nothing in regulations discriminates against smaller technologies, plants and investors, it contains no provisions whatsoever facilitating multiple projects deployed using identical technical solutions.

Two shortcomings of the current framework can be singled out already at this stage, affecting both large and small projects alike.

One is the fact that all construction works except for preparation of the construction site (levelling, temporary fencing, power supply but only for the needs of construction processes – these may be carried out based on the preparatory site works permit) must wait until the final building permit issued by the administration shortly after the construction licence is issued by the regulator. This means that no works related to the actual plant – excavations, construction of auxiliary buildings etc. – can start beforehand. This deficiency unnecessarily extends the critical path of project delivery. This problem has been already recognised and the process of updating the law is underway. The proposed solution will provide an optional early construction works permit, which will enable certain works before the licence is granted.

The second one is the fact that lack of any structured generic design assessment process combined with the timeline of permitting and licencing means that **ordering long-lead safety-related items can only be done at investor's own risk**. This means that **the same reactor – if it were to be built in multiple locations – would need to undergo a complete licensing procedure each time – also in the scope already assessed in previous proceedings**. The possibility of certification is only partially replaced by the ability to obtain a "General opinion of the President of the PAA", however, the process of obtaining it is not structured and the scope of pre-licensing depends on the content of the application submitted by the investor.

The introduction of a structured generic design assessment would allow for shortening the licensing procedure for subsequent investments implemented using the same technology and would reduce risk in the scope of Long Lead Item (LLI) orders – although there are no obstacles preventing an investor from obtaining a series of "General opinions" for each LLI separately.

For now, publicly available information suggests that the first investor intends to proceed with procurement of LLIs before receiving the licence and has no intention of obtaining "general opinions" in their scope, although in that case the risk is mitigated by the fact that the AP1000 technology has already been successfully licenced and deployed in two other countries.

Analysis – regulations on SMR vs large-scale reactors

Polish law in general, and Atomic Law in particular, does not recognise a concept of SMR as any special entity. All nuclear reactors other than research reactors are treated in exactly same way and rules for permitting and licencing are also identical (however graded approach principle applies). Any restricted use areas and emergency planning zones around nuclear reactors are designed based on results of safety assessments, so they scale up and down along with the hazards associated with specific reactor type – there are no fixed large zones which would be unreasonable for smaller reactors.

On the other hand, the law does not contain structured, generic design certification procedures. This means, that for every single plant ("nuclear facility" – in practice single power station, although possibly with multiple reactors) the licencing process is exactly the same and includes full evaluation of safety, including all the engineered safety solutions, even if they are absolutely identical to those used in a previously licenced plant.

Of course it can be reasonably expected that each next process would be smoother and easier, as submission of documentation parts identical to previously approved should not raise any new questions, but the results would likely be limited to lack of delays in the licencing procedure caused by a need to clarify or complement submitted documentation, while the formal deadlines would remain the same.

Poland does have certain pre-licensing mechanisms which can be used as substitutes to generic evaluation: the general opinions of the regulator, specified by the Atomic Law. An investor is entitled to submit virtually any piece of documentation, including for example complete safety assessment if they so choose, for a review at any time, and the regulator is required to verify submitted documentation in the context of the same regulations as applied during the actual licencing process. There are two major shortcomings in using this path as quasi-certification. One is that the opinion is formally not binding in the actual licencing process. This is likely not a major disadvantage, because it still can be reasonably expected – under the principle of trust to public authorities – that the regulatory authority would not contradict itself during following licencing processes. The other problem is that the opinion may very well be inconclusive. Unlike in the formal licensing process, where the regulator would call the applicant to submit additional information if finding it insufficient, in case of general opinions at certain stage the authority may issue an opinion that submitted documentation is not detailed enough to rule on its compatibility with local regulations. This has actually happened to several investors who asked the regulator for general opinions on design solutions of certain SMRs, although it needs to be pointed out that at least in some cases this was caused by the fact that the information submitted was indeed not detailed and not tailored to answer specific requirements of the Polish design regulations.

Possible directions

Most Polish regulations do not seem to require any major revisions at this time, provided that early construction works permit is adopted as currently envisaged.

Recommendation

One area which could significantly accelerate and facilitate deployment of new reactors, including SMRs, would be introduction of a structured design certification process. Such a process could be coupled to a joint regulatory review performed together with a foreign authority. In such a case, Polish regulator would retain its power to evaluate the material and issue final ruling, however it would work in tandem with a regulator of another country, for example according to the same principle, as in case of aviation, where EASA works as a validating authority for a foreign regulator (e.g. FAA) who is performing the original process.

Poland could also surely benefit from greater European harmonisation of rules and practices in licensing reactors. Europe has already seen challenges in deployment of theoretically the same reactor design in different jurisdictions – those are apparent in history of EPR projects in Finland, France and UK. Finnish regulator STUK commented publicly on misalignment of regulatory philosophy between France and Finland leading to certain confusion of the French vendor, and subsequently to project delays[55].

At the same time, it is apparent that within Europe itself, path used in aviation or pharmaceutical market cannot be simply copied. The main reason is that not all EU countries are interested in facilitating new nuclear deployments, and some even actively oppose it. This could render establishing a joint EU-wide licencing authority either impractical or even impossible. Any coordination between EU Member States would have to follow a principle of a "coalition of the willing".

It needs to be noted that while design certifications may lead to easier and faster deployment of projects, reducing risks and delays, it is unlikely that even far-reaching coordination and internationalisation of the process could shorten the formal path of permitting in Poland. Currently prescribed period of two years during which the regulator is required to evaluate a construction licence application would still be needed for evaluation of site-specific documentation, including in particular site surveys. It is extremely unlikely that removal of generic design review from the project-specific licencing procedure would shorten the time needed for that. The same applies to environmental procedures, governed not only by local laws, but also by international conventions such as those of Espoo and Aarhus. Chief benefit would therefore lie in making the process smoother and reducing risk of delays, which seem quite likely when local regulator evaluates a new design for the first time, as well as removing any risks associated with ordering LLIs before the regulatory assessment is formally complete (which however can be addressed by obtaining appropriate "general opinions").

[55] J. Laaksonen: *Lessons Learned from Olkiluoto 3 Plant*. Power Engineering, 1 September 2010 [https://www.power-eng.com/nuclear/lessons-learned-from-olkiluoto-3-plant/].

One more issue is that of language. As of now, all the documents which form basis for issuing formal decisions, such as a construction licence, must be submitted in Polish. Only certain supporting documentation can be accepted in a foreign language. This is far from optimal. The greatest challenge is great shortage of nuclear experts in Poland. Those who are available are unlikely to work on documentation translation. Application of modern AI tools for translation will not solve the problem, because in order to work they have to be trained on good quality resources – bilingual texts covering similar topics. Such texts, however, simply do not exist. The only complete set of safety-related documentation ever created for a power reactor in Polish covered old VVER-440 reactors and was made in 1980s. There is no such documentation for any modern reactor, and for many modern safety-related solution no established terminology in Polish language exists. This, combined with volume and complexity of the documents in question, virtually guarantees occurrence of errors and therefore procedural delays once these are being corrected. Issue of low quality of Polish documents has already been brought up by the Polish regulator while it was reviewing some applications for general opinions.

Recommendation

Broader acceptance of English, which is now commonly taught in Poland and broadly used in engineering community could mitigate such risks, although it would require also some effort, not only legislative, but regarding training of Polish personnel.

The possibility of submitting documentation partially in English already exists in the Polish legal framework for other sectors; the Pharmaceutical Law allows annexes to applications for marketing authorization of medicinal products to be submitted in English[56], likewise the Aviation Law similarly permits a range of applications and their annexes to be filed in English[57], although the President of the Civil Aviation Authority may request their translation into Polish[58].

Financial framework

Currently there is very limited financial framework for nuclear projects in Poland, and it is limited to specific plans for the first nuclear power station to be built under the PNPP.

The original state aid package proposed by Poland comprised three instruments: a 60-year two-way Contract for Difference modelled on the UK's Hinkley Point C arrangement (though with an ex-post rather than ex-ante settlement mechanism), a direct equity injection into PEJ covering approximately

[56] Act of 6 September 2001: The Pharmaceutical Law [Prawo farmaceutyczne] (Dz.U. 2001 No. 126, item 1381 as later amended), Art. 10(4) [https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20011261381].
[57] Act of 3 July 2002: The Aviation Law [Prawo lotnicze] (Dz.U. 2002 No. 130, item 1112 as later amended), Art. 21(2) [https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20021301112/U/D20021112Lj.pdf].
[58] Ibidem, Art. 21(3).

30% of project costs, and 100% state guarantees on the debt portion of financing.

The original state aid package proposed by Poland comprised three instruments: a 60-year two-way Contract for Difference modelled on the UK's Hinkley Point C arrangement (though with an ex-post rather than ex-ante settlement mechanism), a direct equity injection into PEJ covering approximately 30% of project costs, and 100% state guarantees on the debt portion of financing.

Following its formal investigation, the European Commission required Poland to revise several key elements of the package. Most significantly, the duration of the CfD was reduced from 60 to 40 years. The remuneration formula was also revised, shifting from an output-based to an availability-based mechanism, designed to preserve PEJ's incentives to respond to market signals and to limit displacement of renewable generation. Additionally, the Commission required the strike price to be strictly calibrated to the project's funding gap using a discounted cash flow model, and introduced a profit-sharing mechanism under which any returns exceeding a market rate would be returned to the Polish state. Finally, Poland committed to selling at least 70% of the plant's annual output on the open power exchange, with the remainder subject to transparent and non-discriminatory auctions. These revisions are consistent with the direction signalled in the opening decision, which had indicated that the originally proposed support scheme was excessively generous and led to an unjustified reduction of investor risk.

While reducing the generosity of the scheme from the Commission's perspective, the changes introduce new risks for the project: the shortened CfD leaves PEJ with 20 years of unhedged merchant exposure, the availability-based mechanism complicates revenue forecasting for lenders and reflects a policy choice by the Commission to explicitly prioritise one zero-carbon source over another – effectively placing renewables above nuclear in the hierarchy of the energy transition, despite both contributing to decarbonisation objectives, and the obligation to sell the majority of output on the open exchange limits access to long-term bankable offtake contracts.

The European Commission approved the state aid scheme in December 2025[59]; however, as of the publication date of this report, the full text of the decision had not yet been made available. Consequently, the above assessment is based solely on the Commission's press release, and may not reflect the full scope or conditions of the approved scheme.

Decision is plant-specific. There are no specific solutions proposed for any other project. Public declarations of the Polish Prime Minister suggest, that the second plant would not be subsidised by the state budget directly[60]. The 2025 draft of the PNPP update mentions that the solution will be chosen in near future.

[59] State aid SA.109707 (2024/C) (ex 2024/N) – Aid measures for the first nuclear power plant in Poland. Invitation to submit comments pursuant to Article 108(2) of the Treaty on the Functioning of the European Union. 4 March 2025 (C/2025/1389) [https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=OJ:C_202501389].

[60] Poland to seek financial partners to build second nuclear power plant, Tusk says. Reuters, 16 October 2024 [https://www.reuters.com/business/energy/poland-seek-financial-partners-build-second-nuclear-power-plant-tusk-says-2024-10-16/].

Identifying Key Policy and Legislative Barriers to Scaling Nuclear Energy

Overview

We conducted thirteen in-depth interviews with nuclear energy experts from various backgrounds, i.e. academia, business, public administration and think tanks. These interviews identify key challenges to scaling nuclear energy in Poland on its path towards climate neutrality in 2050. Our research focused both on the already established across the world – albeit not yet in Poland – large-scale nuclear energy and the emerging technology of small nuclear reactors (SMRs).

Achieving COP28 nuclear energy development goals

Our respondents were skeptical about the possibility of achieving ambitious nuclear energy goals communicated in 2023 at COP28 in Dubai (1200 GW by 2050 globally)[60]. They underlined that current actions are not properly aligned and coordinated with these goals and perceived them unrealistic. Interviewees pointed to two parallel obstacles – phasing-out part of nuclear facilities due to aging and the sheer scale of deployment ramp-up needed to spur nuclear growth. However, they could be partially counterweighted by nuclear plants lifetime extensions – see respondent 4 (R4).

> *"It is no secret that this is quite a major challenge. 60 GW – that is something that might be achievable annually at some point, but given the time horizons of nuclear energy projects, even if we decide today that we want to pursue this and do everything possible to make it happen, we would only be able to reach that pace in about ten years at the earliest. Currently, we are commissioning roughly 10 GW of new nuclear power*

[60] https://netzeronuclear.org/.

worldwide per year, at best. To reach 60 GW annually, the construction pace would have to increase by roughly six times. So, it is a rather ambitious goal." (R4)[61]

However, the interviewees made it clear that there are two distinct paths to nuclear development worldwide. It appears substantially much more probable that countries such as China, India or South Korea will achieve these targets than the EU or the United States. They pointed out that reaching this goal would require strong state involvement, a greater degree of central planning – if not on the scale of China, then at least comparable to France's Messmer Plan in the 1970s – along with a coordination among EU Member States (MS). The following were highlighted as vital conditions to move forward: treating the EU as a single market in terms of securing supply chains (both internal and external), selecting one or two technologies and organizing orderbooks collectively.

"I think this can be divided into two parts: the so-called western world and the rest. And by the rest, we mean countries such as China, Russia, and their affiliated states. There, we can clearly see that the expansion of nuclear energy – and in fact, of the entire energy sector – is very strong. The development pace is high, and it is happening across many different technologies and variants. It is not just one single stream of development: they are building both large reactors and small modular ones. There are simply many large-scale projects underway, all aimed at constructing nuclear reactors in various formats. As for the Western world – that is, the countries that have signed this agreement – if we are to achieve the net zero 2050 targets, then action in this area must begin as soon as possible." (R10)

Nuclear renaissance in the EU

Interviewed nuclear energy experts were pessimistic about the chances of nuclear renaissance happening in the EU. They saw a distinct positive change in the perception of nuclear energy and its recognition as a vital decarbonization tool by policymakers. Nevertheless, they claimed that several barriers outweigh any step forward. Participants were apprehensive that the EU would not make up for its current technological stagnation and the loss of competencies in nuclear energy and that it would lead to importing resources from abroad. To prevent this from happening, they agreed that the EU should build more manufacturing facilities for nuclear components and fuel (such as centrifuges) as only such steps would allow for greater capacity of constructing new reactors in the Member States.

[61] According to the IAEA, the peak in new nuclear capacity added occurred in 1984 and 1985, with 31 GW added each year. On average, 20.5 GW of new capacity was connected to the grid annually between 1980 and 1989, compared to an average of 6.8 GW annually between 2015 and 2024.

"The European Union practically does not exist on the technological development front. All progress is taking place beyond its borders. I believe that, by 2050, the delay we are already facing will be impossible to make up for. I do not know how much money would have to be invested in nuclear development in Europe for us to be able to contribute anything technologically. From an investment perspective, I also do not think we are capable of doing so." (R1)

Our respondents also brought attention to the lack of coordination and political will of MSs to act together against issues hampering their nuclear investments. According to the experts, this problem stems from growing national sentiments in the MSs and their desire to shape their energy policy independently. In theory, collaboration in nuclear energy deployment could help overcome two significant barriers – cost overruns and delays. However, our participants did not consider it to be a viable option for the MSs to synchronize their efforts for the sake of optimized deployment at the EU level. They saw potential cooperation possibilities in case the MSs decide to choose particular reactor technology, which is somewhat likely only for SMRs.

"It seems to me that Europe has been dividing rather than integrating in recent years. As a result, I would be more concerned about the risk of increasingly aggressive competition among Member States than hopeful about any prospects for joint action. I do not see much potential for multiple countries to participate in common projects aimed at improving the efficiency of nuclear investment deployment within the Union." (R7)

Nuclear energy experts we interviewed called for levelling the playing field between nuclear and renewable energy. In their view, nuclear would benefit from shifting its role in the energy mix from being the renewables-complementing source to equally important one, treated as a base for reducing GHG emissions. In their opinion, the solution is to reform the electricity market in the EU so that it would no longer favor renewables. In addition to this, they proposed implementing more regulations supporting and welcoming nuclear energy scale-up.

"First, the European Union's approach to the role of nuclear sources in the energy system needs to change. The merit order mechanism should be reformed, or at least adjusted, to ensure that nuclear power plants can operate in a manner consistent with their technological purpose and technical characteristics." (R1)

Nuclear energy in Poland

Our participants stressed that it is hugely important to finish the first Polish nuclear power plant, Choczewo NPP, as much on time and in budget as possible by learning from experiences of other nuclear projects in Europe (e.g., from Flamanville, Olkiluoto 3, Hinkley Point C). They see this unit as a catalyst for the development of energy-intensive industry in Poland, which suffers from increasing costs of covering its electricity and heat demand.

"I believe the priority should be to complete the construction of three reactors at the first site. All available resources should be devoted to this investment, and it should be treated as a top priority by everyone, as it will potentially have a positive impact on everything else. Through this project, regulators such as the PAA and UDT, as well as the entire industry, will gain experience and adapt to the quality requirements of the nuclear sector. Once we see how this project goes, it will be easier to anticipate whether anything beyond it can realistically follow." (R2)

Nuclear energy experts also found several barriers that may prevent Poland from achieving its nuclear goals. Firstly, they regarded Poland's energy policy as poorly coordinated and managed, since its shape strongly depends on the vision of the currently ruling political party. In other words, the support for specific energy sources, including nuclear, does not constitute a non-partisan issue[62]. Beyond energy policy, there was agreement that clarifying the place of nuclear energy in the national energy mix, given the planned expansion of renewables, is essential to derisk the investment in the Choczewo NPP. Secondly, our respondents said that big infrastructural projects, such as building a nuclear plant, are subject to long and complex administrative procedures, which is why they proposed their streamlining to the needs of nuclear energy development in Poland. Thirdly, they made it clear that increased credibility of the current and future nuclear projects would facilitate safeguarding of necessary nuclear resources (skilled workforce, supply chain components, financing) and help maintain high social support for nuclear energy in Poland.

"I would say there are three main barriers that can be observed. First, there is a political and psychological barrier. While this may not be a politically correct statement, it might actually be easier to overcome it in more authoritarian countries than in democratic ones with a developed public opinion and strong civil society. Second, there is an organizational barrier, which, as mentioned earlier, is largely about coordination. And finally, there are human resource and financial barriers, the latter perhaps being the most significant one, as it is typically addressed mainly through loans." (R6)

Role of small nuclear reactors (SMRs)

Our respondents viewed SMRs as a possible decarbonization solution (e.g. in heating) but – as this technology is not yet commercially implemented – several issues remain unclear. They doubted that the energy-intensive industry has the financial capacity to invest in SMRs given the predicted capital and operational expenditures, also the decarbonization-related ones. The experts told us that regulatory demands for first-of-a-kind reactors (regardless of

[62] Even though general support for nuclear energy is widespread across the entire political spectrum, specific parties differ on the details of nuclear policy.

whether small or not) should be maintained on a current level as this would ensure their safety and profitability. In parallel, they highlighted that SMRs must not follow the same process of acquiring all necessary approvals and administrative documents as large reactors.

> *"For me, it is just as likely that SMRs will collapse at some stage, that they will build a demonstrator in Canada, but it will turn out not to make financial sense, and we will say: let us wait until it gets cheaper; let others play with it for now. That could very well happen at some point." (R1)*

Interviewees pointed out that SMRs would be especially fit for scalable energy systems, industrial companies in need of stable zero-emission energy source (e.g. in the steel sector), and in small-scale investments as they assume that the effect of economies of scale might not be as big as in the case of large reactors. To minimize the cost of deploying SMRs, the experts recognized the potential benefits of coordinating orders at the EU level once the leading reactor projects had emerged.

> *"If we are aiming for a sufficiently large scale, such as a threefold increase in capacity, then it would be large enough that the clearly better technical solution would be to focus on large reactor units and build them in series. For example, from the perspective of production bottlenecks, the pressure vessel in an SMR is often not significantly smaller than in a large reactor." (R12)*

The absence of a single, officially recognized definition of SMRs is a key point to note. Hence, our interviewees found it problematic as related to creating effective regulatory framework for these units. According to the experts, SMRs should be regulated in a bottom-up approach, meaning that law is adjusted as these reactors are gradually introduced to the market.

> *"There is undoubtedly a definitional issue whether it is about size alone or rather about scalability, and how to ensure the modularity of the design. Many manufacturers want to position themselves under this label. Out of roughly eighty concepts, we estimate that perhaps five or six distinct models may actually reach the market within the next few years." (R6)*

Financing nuclear energy

Our participants remarked that cost overruns for first-of-a-kind reactors are unavoidable. In their view, scaling up nuclear would help optimize unit costs, nevertheless these costs still might be prohibitive for investors and demand support from the state side. At the same time, some experts said that the state should not be financially engaged in every nuclear project, which confirms the opposing views in that matter.

> *"Financing is a significant bottleneck, as is, of course, the state's participation in future investments, particularly in SMR projects. The question is to what extent external investors will become involved to support the state in developing new nuclear generation capacity." (R7)*

As for safeguarding the needed capital for nuclear projects, our respondents had mixed feelings. They recognized a warmer approach towards nuclear energy in EU's financial institutions but at the same time they did not see it transformed into concrete financial commitments to support this energy source. Moreover, they saw no progress in simplifying and fostering the process of approving state aid by the European Commission for nuclear projects.

> *"The World Bank is opening up to the possibility of financing nuclear projects. Reportedly, discussions are also taking place within the European Investment Bank. The financial world began shifting in this direction with commercial banks, which announced last year that they were considering financing such investments." (R5)*

Interviewed experts thought that two financial models would be suitable for coming nuclear projects, namely a contract-for-difference (CfD) or a cooperative model (e.g. SaHo model[63]). The former was pinpointed as simple yet capital-hungry for public finances whereas the latter as a risk-reducing vehicle for each party involved in a nuclear project.

> *"The contract for difference has both a fundamental advantage and a disadvantage. Its advantage is that it is simple, although not necessarily when it comes to nuclear investments. Its biggest drawback, however, is that it is very expensive, both for the state budget and potentially for the final electricity price as well. I look favorably on cooperative models, as I see significant benefits in them. I am not sure whether they would be applicable under Polish conditions. Their main advantage is that they distribute the financial burden more evenly and ensure a guaranteed market for the generated electricity." (R1)*

One of the proposals put forward by the experts was to implement a coal-to-nuclear initiative, i.e. locating nuclear reactors on the areas previously utilized by the coal sector. They underlined that it would reduce costs not necessarily for the investor (although it is possible) but rather for local economies since this can help them relatively smoothly transition from the current dependence on income from coal.

> *"It is hard to imagine a better story: we are moving away from coal, which for decades was the foundation of the region's strength, and transitioning to nuclear power, which will define the region's and Poland's economic strength for decades to come. So, in terms of the initiative itself, it is difficult to have any objections. It is an attractive response to Poland's specific circumstances." (R1)*

[63] SaHo is a Polish financial model created by dr Bożena Horbaczewska and Łukasz Sawicki. In SaHo, the state (as the initial investor) establishes a company to build and operate a nuclear power plant, then sells its shares to energy consumers during construction. Shares are sold on market terms, in tranches for different consumer groups. Once the plant begins operation, shareholders are entitled and obliged to offtake electricity at production cost, proportional to their ownership. The project functions as a state-initiated, quasi-cooperative of energy consumers rather than a profit-driven enterprise. See more: https://sahomodel.com/about-model/.

When asked about the EU's IPCEI financial mechanism, the experts were not particularly convinced of its usefulness for nuclear energy, except potentially for SMRs. They thought that its weakness lies in lengthy procedures, applicability to nuclear energy and the possibility of its inclusion, and the difficulty in fulfilling the mechanism's requirements.

> *"I would use the IPCEI for development-oriented issues, for example, more towards SMRs and new applications of nuclear energy. That would provide an impulse situated somewhere between research and development and the commercialization of various solutions." (R5)*

> *"I have been involved in preparing IPCEI applications for few years, and what has shaped my rather negative view of this support mechanism are the extremely lengthy procedures that tend to drag on for a very long time." (R7)*

Nuclear energy legislation

Interviewed experts remarked that nuclear regulations in the Member States do not significantly differ, although there is little chance of fully harmonizing them. In their opinion, each regulator appreciates their decision-making autonomy and understands nuclear safety distinctly, which translates into their more or less strict nuclear requirements setting. On the contrary, they advised that nuclear regulatory bodies (such as Polish Atomic Agency) work together towards common regulations, excluding those concerning the reactor technology. According to our participants, such collaboration would be exceptionally beneficial for SMRs given that creating regulations for them is bound to be an uncharted territory for the aforementioned bodies.

> *"My point is not to deprive Poland or any other nuclear regulatory authority of the right to conduct its own assessment of a technology. However, I would certainly strengthen the regulations to allow for the use of other regulators' experience and conclusions when evaluating a given technology in order to potentially simplify the process. It is not even about shortening it, but rather about ensuring that the nuclear regulator is not overburdened by the licensing process." (R1)*

As for introducing any major changes, the experts proposed that administrative procedures should be simplified and accelerated, whereas nuclear energy itself gains a status of a special investment. They did not find any drastic regulatory modifications necessary, as they claimed that Polish nuclear law is satisfactorily prepared for the demands of future projects.

> *"Polish regulations allow for the construction of a nuclear power plant regardless of the chosen technology, size, or reactor type. In other words, they are simply technology-neutral. Of course, certain targeted amendments may be justified, as in any legal system. However, the overall legal framework is favorable enough that a nuclear power plant can, in principle, be built under Polish law." (R1)*

> *"It seems to me that the solution would be for the state to clearly define the status of such investments. In other words, to recognize them as projects of strategic importance, which could then be granted certain facilitations or preferential treatment." (R2)*

Our experts did not find it necessary to expand International Atomic Energy Agency's competences outside of current ones, like providing recommendations and supervising nuclear facilities.

> *"They already have a lot of authority and conduct extensive training, so I would say there is no need for them to have even more power. They are doing a good job at what they do." (R3)*

Nuclear energy workforce

Our participants emphasized that the shortage of skilled specialists will hinder the Polish nuclear project. They highlighted the need to create proper education programs, both at the university and post-university level, encompassing broad scope of specializations, outside of more typical ones such as nuclear engineers. They also pointed out that nuclear jobs ought to be attractive enough to prevent experts from seeking other employment opportunities. Our respondents said that it is especially crucial for government institutions, which suffer from outflux of workforce towards private companies able to offer better working conditions and compensation.

> *"When we analyze not only the nuclear sector but infrastructure projects in Poland in general, and consider our demand for labor, or, to put it more precisely, for construction-site competences, we are currently lacking around 30-40% of the skilled workforce needed to carry out ongoing investments. This is because there are roads being built, the Solidarity Transport Hub is under development, and other projects are happening as well. As a result, we are essentially cannibalizing our own domestic labor market." (R2)*

> *"Postgraduate studies are a major area of activity that still has not really developed in Poland. Only a few institutions offer such programs. There is great potential here, as many companies are very interested in this type of complementary education." (R7)*

> *"I think that if the five main universities in Poland were able to reach a really strong agreement on how they want to educate students, that in itself would already be a major success. Each university has its own autonomy, and subconsciously that makes coordination difficult — although it does seem to be improving somewhat. It works very well in the Czech Republic. They have several universities that are formally associated with one another. Of course, there are always human factors at play — everyone naturally feels more attached to their own institution — but they still manage to cooperate effectively." (R3)*

Constructing nuclear power plants

Our respondents claimed that the construction process of Polish nuclear power plant may face numerous barriers. Apparent nuclear renaissance in the EU as seen by more and more announced nuclear projects might end in competition to acquire needed resources, both between these projects and between them and other large infrastructural ones. This may be amplified by already limited number of companies in the nuclear supply chain, which have set capacity and can serve a particular number of projects at the same time. Moreover, countries able to deliver the reactor technology for Poland – France, USA, South Korea – might be more interested in reviving their own nuclear sectors. In the view of our experts, some degree of central planning by the state would be beneficial to supervise the process of providing enough quality workforce, components, and materials for the Choczewo NPP.

> *"There are very few nuclear power plant components available on the market, so Poland is now somewhat competing with countries like Slovakia for their supply. We want to place our orders before them so that they are behind us in the queue." (R1)*

> *"These challenges are related, for example, to the supply chain and the number of subcontractors. In Europe, we are limited by the small number of technology providers, essentially the Americans, the Koreans, and the French. Westinghouse will be developing its own projects in the United States, while EDF will be doing the same in France, and both may face difficulties in carrying out additional projects elsewhere in Europe, for instance due to workforce shortages." (R5)*

Interviewed experts suggested that Poland should create its domestic manufacturing base for nuclear energy so as to increase the share of local content in the Polish nuclear project. In their opinion, such base would help establish a network of companies able to collaborate in future NPPs, both in Poland and abroad, thus constituting a strong supply chain.

> *"If we manage to build a competence base for the nuclear sector that will be willing to carry out subsequent projects on its own, it will have a positive impact on the cost of each following project, as well as on overall interest, public support, and the ability to implement such projects efficiently." (R2)*

> *"Poland should simply invest millions, if not more, in creating a domestic manufacturing hub for various nuclear components, because there is significant potential here. The nuclear supply chain is limited, as projects have been few and far between and there has been no continuity." (R5)*

Introducing Orderbooks

The surveyed experts expressed highly divergent opinions regarding the idea of establishing order books and purchasing clubs in the nuclear energy sector.

On one hand, several respondents viewed this concept as highly desirable, emphasizing the need for greater coordination if Europe is serious about developing nuclear power on a large scale. They pointed out that such an approach would benefit both buyers and suppliers:

- For buyers, it could help streamline project timelines and secure lower prices through economies of scale.
- For producers, it could provide long-term contractual certainty and better planning for production capacities.

On the other hand, experts expressed serious doubts about the feasibility of implementing this idea in the near future. The most common concerns included the lack of coordination across other energy market sectors and the observation that European entities have become increasingly competitive with one another in recent years.

> *“If, say, two countries are moving at the same pace and need the same reactor vessel at the same time, there will inevitably be a race.” (R1)*

As examples, respondents cited the conflict between Czech Republic and EDF, price competition for CCGT turbine purchases, and the difficulties in designing a joint EU gas procurement policy. They also referred to competition for resources during the COVID-19 pandemic, when some medical-sector order books failed to deliver because products were sold at higher prices to other buyers once the crisis began.

> *“We barely managed to reach an agreement in Europe on joint gas purchases – and even then, the final list of countries or companies actually using that mechanism is very limited.” (R1)*

Several respondents further feared that, in a collective purchasing mechanism, wealthier and more influential EU member states would likely receive priority access to supplies, reflecting the persistent lack of mutual trust within the EU – a theme that surfaced repeatedly in the interviews.

> *“I think we could secure financing – we are quite an attractive partner. But if we were to end up on some kind of European order book, meaning a joint procurement scheme, I do not believe we would be first in line. In fact, I doubt we would even be second.” (R5)*

Beyond political and trust-related challenges, respondents highlighted asynchronous project timelines as a major obstacle. Coordinating a joint order book would be extremely difficult when, among several potentially cooperating countries, some have not yet selected reactor technology, while others are at entirely different stages of project development.

Experts expressed a marginally elevated degree of optimism regarding the feasibility of organizing and coordinating orderbooks for Small Modular Reactors (SMRs). They particularly saw potential for coordination at the national level – for example, by selecting one or two preferred SMR technologies for public support, and encouraging companies that might each purchase one or two reactors individually to pool their orders, enabling the country to place joint orders for a dozen or more units at a reduced price. Such coordination could be crucial for industrial users, for whom cost per unit is a decisive factor in determining the economic viability of SMR deployment.

> *"This will have to happen one way or another, for a simple reason: there just are not that many technologies on the market that can be built. If you look at the SMR landscape – go through the logos on something like the SMR Industrial Alliance – you will see all kinds of concepts like Nucleo, high-temperature fast reactors, molten-salt-cooled systems, and so on. Everything at once, right? And the reality is, those will simply never be built. But there are a few technologies that might eventually make it to deployment. Once projects begin, that process itself will create natural repetition in how the units are built, and automatically lead to some level of consolidation – for example, around the supply of specific components. That consolidation will happen organically. What is critical right now, though, is to make strategic decisions – to determine exactly which technologies we want to invest in." (R12)*

Common regulations

Interviewed experts agreed that a certain degree of standardization and unification among nuclear regulators in different countries is necessary, especially for SMRs, if they are to be deployed on a large scale. They pointed out that there are several initiatives aimed at ensuring this – both at the European level (such as the European Nuclear Safety Regulators Group[64] and the European Industrial Alliance on SMRs[65]) and at the international level (the Nuclear Harmonization and Standardization Initiative[66]).

> *"It is always welcome – especially now, as we have been observing for months the ongoing discussions about the differences between American and European standards. Greater alignment is definitely desirable, since this is one of the factors that prolongs the investment process." (R7)*

> *"ACER is actually a good example in this context. I think that enabling standardization at the level of EU law, supported by an institution that could formally approve and coordinate such efforts, would be a step in the right direction, as it would certainly help. Of course, there are some risks. Greater alignment is definitely desirable, we have never discussed such*

[64] https://www.ensreg.eu/.
[65] https://single-market-economy.ec.europa.eu/industry/industrial-alliances/european-industrial-alliance-small-modular-reactors_en.
[66] https://nucleus.iaea.org/sites/smr/SitePages/Nuclear-Harmonization-and-Standardization-Initiative.aspx.

an idea openly, but there is always the concern that the approach could become too rigid or – conversely – too flexible, and that these differences could pose challenges." (R2)

However, achieving full harmonization would be difficult. Certain steps – such as geological assessments or site-specific adjustments for projects located near borders – are inherently unique to each site. The experts also noted that safety standards can vary between countries. Harmonization may be easier within the EU but more challenging across the Atlantic – one of the reasons mentioned was the lack of a common system of measurement.

"Because in the nuclear field, there is this issue of safety – and each country understands nuclear safety a bit differently. Plus, there is the matter of public trust. Take our own example: if we were to tell citizens, "Look, we are not checking everything thoroughly because the American regulator has already done it and it works," well, from the perspective of nuclear safety, that would not really go over well." (R2)

"If we cannot even align basic measurement units across transatlantic projects, I am not sure we could harmonize the regulations either. So, it might get complicated. Especially since there is still this ongoing element of economic competition." (R8)

Evaluation of Existing Financial and Economic Incentives for Nuclear Energy in Poland

Overview

We conducted ten in-depth interviews with representatives of energy-intensive industries. The interviewees came from the steel, chemicals, copper and coke sectors. We also spoke with SMR developers and climate and energy experts from Polish think tanks. Our aim was to assess the financial and economic incentives for deploying nuclear energy in Poland from the perspective of energy-intensive industries.

An important finding worth highlighting is the high number of interview refusals among energy-intensive companies. Most of these enterprises – particularly those with fewer than 1,000 employees – were not interested in discussing nuclear energy or SMRs. These companies often stated that although they support the technology, its timeframe is far too distant to be relevant for them at this stage.

Energy-intensive industries in the Poland's and EU's economy

Energy-intensive industries are a core pillar of the EU economy and underpin multiple strategic value chains. The most energy-intensive sectors include basic metals (iron, steel and non-ferrous metals such as copper and aluminum), non-metallic minerals (glass, ceramics and cement), pulp, paper and printing, and chemicals. They generate around 16% of manufacturing gross value added (about 2% of EU GDP) and provide roughly 13% of all manufacturing jobs[67]. Energy-intensive products are used across a wide range of industrial processing sectors, from automotive and construction to the defense industry.

[67] European Parliamentary Research Service, Energy-intensive industries (2025).

Poland is more industrialized than the EU average. In 2024, the share of Polish industry in the total value of industrial output sold in the EU was 6%, exceeding Poland's 4.7% share of EU GDP. Gross value added at current basic prices in Polish industry accounted for 22.9% of total gross value added in the Polish economy, compared with the EU average of 19.1%[68].

Challenges of energy-intensive industries in Poland

From the perspective of EU climate policy targets, emissions from energy-intensive sectors are mostly hard-to-abate[69]. These EU-wide decarbonization challenges are demand-related (i.e., demand for low-carbon products), supply-demand-related (i.e., financial investments), and supply-related (i.e., energy costs, energy resources, and ensuring a capable and skilled workforce).

While the transformation of energy-intensive industries is necessary, it presents Poland with distinct challenges within the EU. The main obstacle to decarbonizing these sectors in Poland is the high cost of electricity, driven by coal-dependent, ETS-exposed power generation and reliance on imported fossil fuels. Other challenges stem from EU climate policy, including the gradual phase-out of free emission allowances under the EU ETS and risks related to carbon leakage. In addition, energy-intensive firms face decarbonization spending that exceeds their capacity to finance emissions-reducing investments on their own, compounded by difficulties in securing grants and funding from EU and national sources, as well as in obtaining debt financing on financial markets[70].

The role of nuclear for energy-intensive industries in Poland

From the perspective of energy-intensive industries, nuclear energy is secondary to their main need: affordable, decarbonized and stable energy in the form of both electricity and industrial heat to conduct their core business. When discussing nuclear energy with EIIs, it is important to distinguish between large-scale nuclear power plants, such as the Lubiatowo-Kopalino Power Plant under construction in Poland, and small modular reactors (SMRs). Expectations for the latter are high, because once the technology is mature, standardized units are expected to be easy to order and install close to energy-intensive industrial sites. However, most projects around the world are still in the licensing, siting, or construction phase rather than full commercial operation. And even once the technology is ready, securing all the necessary permits in Poland will still take considerable time.

[68] M. Sobkiewicz, K. Krawiec, Polishing the Pathway to Net-Zero Energy-Intensive Industries (2025), Polish Economic Institute, Warsaw.
[69] M. Draghi et al., The Future of European Competitiveness (2024), European Comission.
[70] M. Sobkiewicz, K. Krawiec, Przemysł net-zero. Dekarbonizacja bez utraty konkurencyjności (in Polish) (2025), Polish Economic Institue, Warsaw.

Large-scale nuclear from the perspective of EIIs

Large-scale nuclear power could play an important role for industry, provided it offers competitively priced energy. If large-scale nuclear power can meet these conditions and help stabilize or lower energy prices, industry would be prepared to buy both electricity and heat from it – see respondent 22.

> *"From the company's perspective, it is important that this electricity is relatively cheap and stable. And it is secondary whether it comes from nuclear energy or not. Especially if we are talking about a Polish nuclear programme, which rather envisages some, not marginal, but quite small capacities in the context of decarbonization." (R22)*

It is also worth noting that, given the current timetable for Poland's first nuclear power plant, any benefits would come only after 2035. At the same time, challenges related to the availability of low-carbon and reasonably priced energy had been already visible and intensified after Russia's full-scale invasion of Ukraine. As a result, while industry sees nuclear power as a promising option for the future, its immediate focus is on managing present energy crisis.

Respondent 20 (R20) points to another limitation, which is the very location of the power plant in northern Poland near the Baltic Sea:

> *"Large-scale nuclear energy is not suitable for industry – at least not in this country – for a very simple reason. This is because it requires much greater water resources than SMRs. As a dry country, we only have sufficient water resources in the north – which is why this large nuclear power plant is located there. I am afraid that when Polish industry, which is mainly located in the south or center of the country, were to rely solely on large-scale nuclear power located exclusively in the north, the transmission costs would be prohibitive." (R20)*

In fact, the proposed location for the second nuclear power plant is in central Poland. It will likely be situated on the site of a lignite power plant that is still operating today but will have been decommissioned by then, either in Konin or Bełchatów. The site is not located near any major energy-intensive industries.

Small Modular Reactors from the perspective of EIIs

The technical characteristics of SMRs make it reasonable to locate them in the vicinity of large industrial plants with stable and significant energy consumption as soon as the technology and permitting will be ready. The map below shows six locations for SMR projects for which the Ministry of Climate and Environment has made fundamental decisions regarding the construction of nuclear power plants using SMR modular reactors. These sites are positioned to supply low-carbon electricity and industrial heat to energy-intensive sectors, including steel and metal processing in Dąbrowa Górnicza and Kraków, the chemicals industry in Stawy Monowskie and Włocławek (the latter also for the petrochemicals), heavy manufacturing in Tarnobrzeg and

Stalowa Wola, and district heating in Ostrołęka. The map also shows a nuclear power plant under construction by the sea, as well as two potential sites for a second large-scale nuclear power plant.

Figure 1. Planned and potential locations of nuclear power plants in Poland

▲ NPP 1 under construction ▲ NPP 2 locations under consideration ● SMR locations with the decisions of the Ministry

Source: PEI based on Polish government and OSGE information.

The industry has high hopes for SMRs in the medium and long term, both in terms of electricity and industrial heat – see respondent 19 (R19).

> *"If the opportunity to use this technology (author's note: SMRs) arises and it is economically viable, we absolutely do not rule out such a possibility." (R19)*

> *"SMRs have the advantage that their EU definition includes reactors of up to 300 megawatts – from about 10 to 300 MW, with 10 MW being the range of certain micro-reactor projects. A 200- or 300-megawatt unit fits perfectly, almost like Lego bricks, into the scale of our existing coal-fired CHP plants, which have very similar capacities. That is the first advantage of SMRs. Second, they do not require such large volumes of water as large-scale nuclear plants do. And third, because of the first two reasons,*

they can potentially be located almost anywhere in the country - provided that all the necessary regulatory and safety requirements for nuclear installations are met. They can be placed close to energy consumers, and in some cases, they can even be built as off-grid installations." (R20)

Small reactors offer some cogeneration potential[71]. This positions them to contribute both to electrification – by helping to close the emerging power gap[72] in the Polish electricity system – and to the provision of industrial and communal heat.

Energy intensive industries on nuclear energy

Risks (legislation, regulations, merit order, technology development)

The main risk factor concerning SMRs is that this technology is still not commercially available. Although they are now seen as a much more realistic and viable option than just a few years ago, representatives of energy-intensive industries pointed out that there have been numerous delays in SMRs development in recent years:

"Of course, large companies consider and explore many decarbonization options before choosing exact pathway – they sign memoranda and various agreements, engage in cooperation, and get involved in different initiatives. So there is interest in SMRs in that sense, but we are still, in my view, at the stage of very distant plans, that won't necessarily translate into real projects. One of the questions was about the time perspective, right? And, you know, that perspective seems to be moving further away each year. People used to say that the first SMRs would appear in Poland around 2030[73] – to me, that sounds unrealistic, given what is currently happening with SMR projects." (R22)

"Based on my experience, it will take at least 10-15 years. I remember that back in 2018 there was talk that SMR certification would be possible within ten years. Well, seven years have passed, and that certification still does not exist." (R21)

[71] Some of the SMRs are suitable for producing both heat and electricity. It might be useful both in industry (such as petrochemical sector, https://www.sciencedirect.com/science/article/pii/S0196890425010921) as well as for district heating. For example, according to Think Atom 300 MWe (900 MWt) CHP reactors could provide up to 81% of annual heat demand of Warsaw (estimated for 14 TWh in 2040) as well as provide additional electricity, https://thinkatom.net/wp-content/uploads/2019/04/nuclear-district-heating-in-finland_1-2_web.pdf.
[72] See chapter 3.
[73] In 2024 Orlen admitted that original strategy and timelines for the SMRs deployment that included FOAK reactor construction up to 2030 might have been too ambitious. Current target for first BWRX-300 deployment was moved to 2032: https://biznes.pap.pl/wiadomosci/firmy/orlen-ocenia-ze-uruchomienie-pierwszego-smr-w-2030-r-moze-byc-zbyt-ambitnym-celem.

Among the risks that need to be considered, experts noted that during the construction of FOAK reactors we are likely to face licensing and permitting challenges, as well as potential requirements for additional safety measures that will need to be addressed.

> *"We are talking about a technology that is only just entering the market and has not yet been fully proven. So naturally, there are technological risks associated with investing in a first-of-a-kind installation. Everything you mentioned fits into that category. [...] The key risks, as I see them, are financial and technological, in the sense that when you build something entirely new, various unforeseen problems can emerge during the investment process, construction, and installation, and these issues will have to be resolved as they arise. And if they do appear, it is obvious that they will affect costs, timelines, and so on."*

There are many unknowns surrounding SMR technologies – including their final costs[74] – and, at the same time, several other decarbonization options are available that may prove less risky[75]. This combination could result in limited demand for SMRs[76].

> *"In my view, the biggest bottleneck will be the demand for this technology. There are so many other decarbonization options that are perhaps less risky and potentially cheaper. In some cases, private companies may even opt to simply scale back production and/or redirect investments offshore, rather than engage in such large and complex projects. Therefore, critical challange is to effectively derisk SMRs and establish competitive position relative to these alternative options" (R22)*

Finally, representatives of the EIIs we interviewed noted that current energy-market regulations, which tend to favour renewables over nuclear, combined with limited state support mechanisms, may hinder the success of SMR technologies in the EU.

> *"As you know very well, in Europe we all pretend that we have a free energy market, while in reality it is one of the most manipulated and, so to speak, manually controlled markets among all industrial sectors. Politics interferes constantly... [...] We need less politics and more physics in nuclear energy." (R16)*

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[74] Final LCOE is still unknown. Estimates provided by the developers change over time – for example in 2021 NuScale estimate rose from 58 USD/MWh to 89 USD/MWh (including Inflation Reduction Act – without IRA subsidy the estimate rose to 119 USD/MWh), https://ieefa.org/resources/eye-popping-new-cost-estimates-released-nuscale-small-modular-reactor.

[75] While the SMRs final costs is still unknown prices of battery storage dropped on average by 20% per year over the last decade, https://ember-energy.org/latest-insights/how-cheap-is--battery-storage/.

[76] After the rise of SMR companies stock related to data centers announcements by biggest IT companies stock prices of Nuscale Power, Oklo and Nano Nuclear Energy nearly halved from its 2025 peak, https://www.ft.com/content/567a1cbc-5030-4e7f-854f-b7eb9ca6b762.

Energy prices from SMRs

The main issue with SMRs, according to our interviewees, is that it is currently impossible to predict the final cost of NOAK reactors. There are simply too many unpredictable variables, not only related to design but also to the prices of basic components on the global market. In their opinion for SMRs to become attractive to energy-intensive industries, the cost of their electricity would have to remain below 50-60 EUR/MWh.

> *"Theatre tickets have doubled in price over the past three years. We are not even talking about rare earth metals or critical materials, and yet everything keeps getting more expensive. So what is the value of making predictions ten years ahead when even simple things are slipping out of control?" (R16)*

Heat generation

Heat should be treated as an integral part of nuclear energy production. Some of the SMR technologies planned for deployment in Poland have the capability to produce steam for both industrial and district heating purposes. However, it is important to remember that the most advanced SMR projects currently available[77] (Generation III+ reactors) cannot produce high-temperature heat (they typically reach around 300°C[78,79]), which limits their applications[80,81]. Generation IV reactors could, in theory, deliver much higher temperatures, even up to 800-900°C, but these designs are still at earlier stages of development[82].

> *"If we speak purely hypothetically at this point, these kinds of solutions would be of greater interest to us, considering the nature of what we produce and, more broadly, the areas in which we currently operate. This is also where we are looking for various sources of both heat and electricity." (R18)*

State support and financing of the nuclear investments

The representatives of the EIIs agreed that some form of state support is necessary not only for large-scale reactors but also for SMRs.

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[77] This is not the case with molten salt reactors which could potentially achieve the temperature exceeding 700 degrees Celsius, https://world-nuclear.org/information-library/nuclear-power-reactors/other/molten-salt-reactors.

[78] In comparison – coal and gas power plants can produce industrial heat with temperatures up to 500-600 degrees Celsius. Higher temperatures are available through other technologies like direct-fired furnaces: https://gasturbineworld.com/hrsg/.

[79] There are also some low carbon technologies that are possible to use in the future for high temperature industrial heat such as solar thermal power generation (https://www.mdpi.com/1996-1073/18/8/2120), hydrogen combustion [https://www.sciencedirect.com/science/article/pii/S135943112402773X].

[80] Industrial heat above 300 degrees is necessary for some of the applications in metallic industry, non-metallic minerals (glass, ceramic, concrete), chemical and petrochemical sectors.

[81] According to EHPA 37% of final energy demand for process heating in Europe is below 200°C and another 11% between 200 and 500°C, https://www.ehpa.org/wp-content/uploads/2025/03/20250304-EHPA-Industrial-Heat-pumps-position-papeR221.pdf.

[82] https://www.ansto.gov.au/news/small-modular-reactors-can-be-built-generation-iv-reactor-designs.

"Should the state be financing SMRs? In my opinion, since we already finance renewable energy sources and other decarbonization technologies, I see no reason why we should not also support another decarbonization technology, namely nuclear energy." (R22)

"At such an early stage of SMR fleet development, the projects will require financial support. Loan guarantees are a fairly natural element of securing debt financing. They are definitely a tool that facilitates investment while not placing an excessive burden on the state budget." (R15)

The proposed forms of support varied. Respondents suggested that the state could potentially cover all the licensing costs for SMRs, which would make the technology more affordable for industry. SMRs could also be co-financed as an element of capacity market. However, these mechanisms alone are not enough: state support should also focus on securing access to technology, helping the projects to be delivered on time and within budget. As they pointed out, SMRs will face competition on the market (renewable hydrogen, renewables with battery storage, integrated power plants).

"When you think about the costs – the price of energy from SMRs compared to other alternatives available in Europe, or even compared to imports – we need to remember that, for instance, an SMR used for hydrogen production will have to compete with electrolysers powered by renewables in Europe, and potentially also from other regions with advantageous conditions for cheap renewables such as Africa. Even if not directly in terms of hydrogen, Africa could produce derivatives such as ammonia for fertilizers and export it here." (R22)

They also noted that financing models used in some European countries, such as Finland's Mankala system, or the RAB and CfD mechanisms, could be beneficial. One of the experts also mentioned the SaHo model as a possible alternative. In addition to these forms of support, experts expressed enthusiasm for power purchase agreements (PPAs) for nuclear energy, as well as for co-financing SMR projects within shared industrial or economic zones by multiple companies as form of cluster agreements.

"There is a range of other mechanisms, including CfDs, PPAs, but also other, more hybrid models, that could facilitate progress with SMR investments. Poland already has access to such instruments; they are known and used in different energy sectors." (R15)

"A joint investment with an industrial or economic zone located nearby would be a more rational approach. If the right conditions were created, I would say it could even be highly beneficial." (R21)

Experts expressed doubts about the possibility of fully harmonizing nuclear regulations across the EU. They also noted that, although the European Commission and the European Investment Bank have become somewhat more open to nuclear energy, it remains excluded from most support schemes.

“It should be kept in mind that the European Commission has been very consistent in sidelining nuclear energy from its regulations. This has created a highly uneven approach, with strong support for renewables and a conspicuous neglect of nuclear power in many regulations, which means that the position of these two energy sources is far from equal.” (R19)

Some experts also expressed concerns that state support for SMRs intended for EIIs companies could be perceived as preferential treatment. Thus, a European Commission assessment of this support might be necessary and could be declined.

“If public aid is granted for the construction of a nuclear unit, and the resulting energy is then sold to, for example, energy-intensive industries, a question arises as to whether this might constitute a form of indirect state aid for those companies by reducing the overall cost of the investment project, and consequently lowering the cost of producing electricity or heat, particularly if the source is located close to those industrial sites.” (R19)

Orderbooks

Similar to the experts interviewed for the previous chapter, industry representatives expressed mixed opinions regarding orderbooks.

“It would be excellent if such cooperation were possible and if we could do this jointly, because in that case the opportunities – negotiation-wise, volume-wise, and in every other respect – would simply be much greater. However, I’m not sure whether this would actually be feasible, whether it would truly work.” (R21)

On the one hand, some agreed that this could be a viable solution for both big scale nuclear and SMRs. They pointed out that similar mechanisms had worked in the past, for instance, in the joint procurement of COVID-19 vaccines, or through initiatives such as AggregateEU or Sweden’s Industrikraft platform. Such an approach could strengthen investors’ positions in negotiations by improving both pricing and purchasing terms.

“Conceptually, it makes sense – like AggregateEU mechanism, it was not exactly joint gas purchasing yet, but more of a matching platform. We already have some initial experience with that. We know that the European Commission has already launched something similar for critical raw materials, and there will also be one for hydrogen. I do not see why there could not be a similar mechanism for nuclear energy.” (R22)

On the other hand, several industry representatives noted that competition within the European Union often leads member states to prioritize their own national investments. As a result, this type of mechanism might struggle to withstand political differences and lobbying pressures favoring domestic suppliers. Moreover, it would likely require focusing on just one or two technologies – a strategy that, while offering some advantages, could also be risky due to reduced diversification where one technical flaw, as in case of France, could end up requiring to temporarily shut down and repair multiple reactors[83].

> *"It is neither feasible nor particularly sensible. Up to a certain point, EU member states will all be competing for the same things, but sooner or later, national interests will take over, everyone will start fighting for their own. Each country will want to have it as soon as possible, and every government will pursue slightly different policies. At that stage, various companies will also get involved. Each will try to sell its own solution as the best, fastest, and most cost-effective. Inevitably, lobbying will play a role in all of this." (R17)*

It is worth emphasizing that both proponents and opponents of orderbooks agree that it is still too early to draw firm conclusions. For now, the priority should be to develop a long-term policy framework for SMRs, both in Poland and across the EU, and to ensure the successful implementation of the first FOAK projects.

[83] In 2021 EDF detected a stress corrosion crack in one of its reactors. The further investigation found out that this issue affect most of N4 – series reactors and P'4 series reactors. 16 nuclear reactors had to be shut down for maintenance, https://www.nucnet.org/news/edf-has-found--corrosion-crack-at-penly-1-nuclear-plant-says-regulator-3-3-2023.

Assessment of Poland's Energy Mix and the Role of Nuclear Energy in Achieving Its Transition Targets Under the EU Energy Policy Goals

Analysis of Poland's Electricity Demand in 2040 and 2050

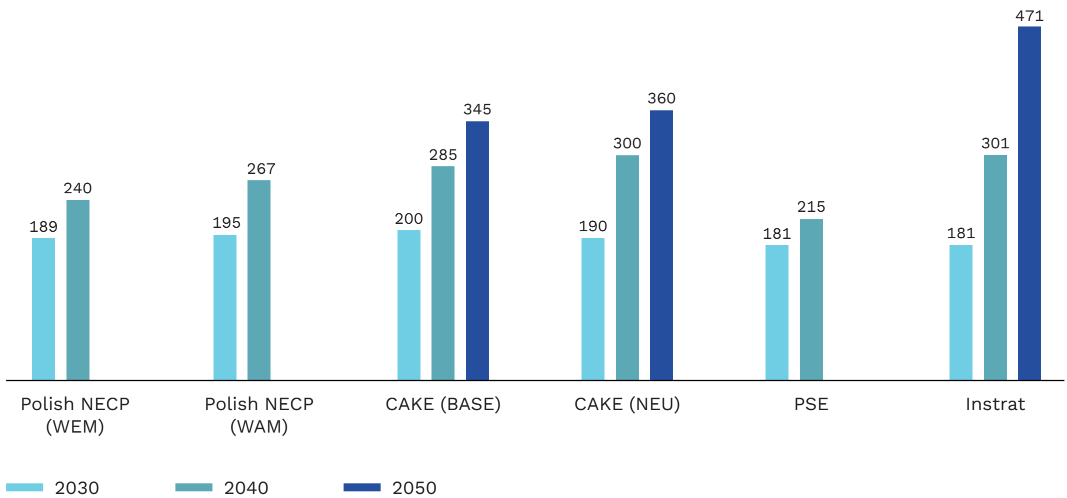
Selected electricity demand projections for 2030-2050

Electricity demand in Poland will rise considering ongoing electrification of its economy in line with the EU's climate policy. Emerging electricity end uses, such as heat pumps, electric vehicles, water electrolysis, and data centers necessitate the roll-out of new low-emission generation capacity in the Polish electricity system, in which nuclear energy is set to play an increasingly important role.

The electricity use in Poland is projected to increase substantially from its 2024 value, 169 TWh[84], in 2040 and 2050 – even up to 345 – 471 TWh (see Figure 2 for the selected electricity demand projections). Differences in future demand estimates result from diverging assumptions for the pace of the energy transition and corresponding GHG emissions reduction in various sectors of the Polish economy. The important source of uncertainty – apart from the mentioned emerging end uses – is also the future of the Polish energy-intensive industries (e.g. steel, chemicals), which now relies on the conventional energy sources.

[84] https://www.pse.pl/dane-systemowe/funkcjonowanie-kse/raporty-roczne-z-funkcjonowania-kse-za-rok/raporty-za-rok-2024.

Figure 2. Projected electricity demand in Poland in 2030, 2040 and 2050 [in TWh]



Note: the Polish NECP refers to the version published in December 2025.

Source: PEI based on the Polish Ministry of Energy (NECP), KOBiZE-CAKE, PSE and Instrat.

The most recent version of the Polish National Energy and Climate Plan (NECP), which was published in December 2025, assumes that the electricity demand in Poland will range between 187 TWh (WEM[85]) and 195 TWh (WAM[86]) in 2030, and between 240 TWh (WEM) and 267 TWh (WAM) in 2040. Regarding the industrial sector, this strategic document forecasts that renewables (PV, bioenergy, renewable hydrogen and waste) can cover 17-21% of the projected energy demand in 2030, and 21-49% in 2040.

Another trajectory is envisioned in energy system modelling by the National Centre for Emissions Management's Center for Climate and Energy Analyses (CAKE)[87]. According to the CAKE's scenarios, the Polish electricity demand will reach between 190 TWh (NEU) and 200 TWh (BASE) in 2030, where lower and higher end assume 90% and 60% GHG emissions reduction[88], respectively. In 2050, these scenarios estimate the electricity demand in the range of 345 TWh to 360 TWh. The additional demand from water electrolysis and district heating amounts to 0 and 77-84 TWh in 2030 and 17-31 TWh and 67-77 TWh in 2050.

[85] WEM – with existing measures – is a scenario of the sustainable energy transition in the current legislative and investment framework.
[86] WAM – with additional measures – is a scenario of the accelerated energy transition, which can help achieve some of the EU's Fit for 55 goals.
[87] https://climatecake.ios.edu.pl/wp-content/uploads/2022/06/CAKE_Energy-transformation-2050_Summary_EN.pdf.
[88] Emissions reduction in 2050 vs 1990, excluding the LULUCF sector.

The Polish TSO, Polskie Sieci Elektroenergetyczne (PSE), estimates a more conservative path. In its NRAA[89] (National Resource Adequacy Assessment), PSE assumes that the electricity demand will reach 181 TWh in 2030 and 215 TWh in 2040. These values include emerging uses, such as heat pumps, EVs, data centers, water electrolysis and industrial electrode boilers and heat pumps.

More ambitious estimates than those of public institutions (CAKE, PSE) appear in independent energy system modelling by Polish think tanks, including Instrat[90] or Forum Energii[91]. Instrat's main scenario, depicting the electricity needs of the Polish economy driven by its achieving climate neutrality in 2050, estimates a modest 181 TWh in 2030, but even 301 TWh in 2040 and 471 TWh in 2050. The domestic electricity demand in 2040 and 2050 comes in a large part from water electrolysis (60 TWh and 164 TWh), EVs (20 TWh and 47 TWh) and residential heat pumps (22 TWh and 25 TWh). Forum's projections show 203 TWh of the electricity demand in 2030 and 255 TWh in 2040. In the latter, 161 TWh constitutes a base demand, 22 TWh demand for EVs, 34 TWh for electric heating and 24 TWh for water electrolysis.

Electrification of the Polish industry

The industry sector will receive part of the clean electricity from the presented estimates, as decarbonizing this sector is critical to reach the climate neutrality by 2050. Emissions reductions will be achieved by transitioning from fossil fuels to electricity, both directly and indirectly – through low-emission energy carriers such as RFNBO hydrogen (produced mainly by water electrolysis) and heat generated by electric boilers and heat pumps. For instance, the steel sector will depend on clean electricity for electric arc furnaces (EAFs) and low-emission hydrogen for direct reduction of iron (DRI), whereas the cement sector for carbon capture and storage (CCS) facilities.

The current industrial electricity consumption amounts to 64,1 TWh[92], 39% of the direct domestic demand. On the one hand, it will fall due to the gradual phase-out of coal mining in Poland, which constitutes around 5% of the Polish electricity demand, and implementing energy efficiency measures in industrial processes. Moreover, there is a risk that the energy-intensive industries will no longer be able to remain competitive and relocate its production in search of cheaper energy outside Poland[93]. On the other hand, the growing Polish economy and the emerging uses in the steel, cement and chemical sectors may counteract this trend. Nevertheless, as pointed out in the Polish NECP and expert modelling exercises, the Polish industry will need

[89] https://www.pse.pl/documents/20182/20580197/National+Resource+Adequacy+Assessment+2025+%E2%80%93+2040.pdf/6b5c6d34-a3fe-4893-8cac-51d2b27ecdd9?safeargs=646f776e6c6f61643d74727565.
[90] https://instrat.pl/wp-content/uploads/2024/11/Instrat_Modelowanie-2025_web.pdf.
[91] https://www.forum-energii.eu/czas-inwestycji-wnioski-z-modelowania-systemu-energetycznego-polski-do-2040-r.
[92] Electricity consumption for 2024, includes sections B (mining and quarrying) and C (manufacturing) of the NACE Rev. 2 statistical classification of economic activities.
[93] Similar issue could be observed in some other EU countries. For example BASF – one of the biggest chemical sector company, is closing some of their facilities in Germany while investing in China.

significant amounts of clean electricity to decarbonize. In the short term (2030), it can be supplied from the electricity grid, while in the long term (2050) it can come from industry-dedicated low-emission capacity, including renewables coupled with battery energy storage (BES) and small modular reactors (SMRs). For example, KGHM – a Polish copper and precious metals producer – estimates that the electrification of the steel sector would increase its electricity demand to 12 TWh and the full decarbonization with renewable hydrogen even to 42 TWh[94], which is roughly a quarter of the current Polish electricity demand.

However, the sheer scale of clean electricity needed for decarbonizing the industry in Poland is not the only challenge ahead of reducing GHG emissions in this sector. Among those barriers, we underlined the following[95]:

- high industrial electricity costs,
- high EU ETS emissions allowances costs[96] and suboptimal spending of the EU ETS income by the government[97],
- low technological maturity of some decarbonization solutions in the hardest-to-abate subsectors (e.g., CCUS in cement),
- underdeveloped hydrogen supply, transmission and storage infrastructure,
- underdeveloped CO_2 capture, transmission and storage infrastructure,
- difficulty in sourcing finance for necessary investments,
- high seasonal differences in electricity generation from renewables (particularly from PV),
- risk of relocating facilities abroad due to CBAM (by possibly increasing the price of imported semi-finished goods and the gradual phase-out of free EU ETS allowances).

[94] https://orka.sejm.gov.pl/opinie9.nsf/nazwa/650_20211029/$file/650_20211029.pdf.
[95] https://pie.net.pl/wp-content/uploads/2025/06/Point-Paper_Przemysl-net-zero.Dekarbonizacja-bez-utraty-konkurencyjnosci-1.pdf.
[96] Although the government compensate part of the costs of purchasing the EU ETS allowances for some industrial entities, see: https://www.nik.gov.pl/en/news/state-aid-for-energy-intensive-industries-not-always-effective.html.
[97] In 2024, the Supreme Audit Office (NIK) underlined that only 1.3% of the income from January 2013 to May 2023 from selling allowances was dedicated specifically to the reduction of GHG emissions, see: https://www.nik.gov.pl/en/news/managing-proceeds-from-the-sale-of-emissions-allowances.html.

Analysis of the economic impact of nuclear energy for the national energy system, energy security, and industrial competitiveness

The deployment of nuclear energy in Poland will provide numerous benefits for its national energy system. In 2025, this system depends on aging coal power plants, most of which are planned to be decommissioned by 2040, around the same time when first nuclear units will start generating electricity in the Choczewo NPP. The Polish energy system also relies on the expanding fleet of gas power plants fueled by imported natural gas, which is suboptimal for the domestic energy security. The deployment of renewables, although dynamic in recent years (especially rooftop PV), is hindered by the underinvestment in electricity grids and batteries (for PV) and the legislative gridlock (for onshore wind). In parallel, emerging electricity uses – data centers, heat pumps, electric vehicles – will drive the demand for this energy carrier. Nuclear energy may mitigate these issues and strengthen the domestic energy system given that it is developed at a large enough scale.

Nuclear energy and national energy system

The decarbonization of the energy system requires large capital (CAPEX) and operating (OPEX) expenditure given the emission-intensive characteristic of the Polish economy. One of the factors, which influence the final energy transition costs and its viability, is the role of nuclear energy, because a serious delay in the commissioning of nuclear power plants can increase them.

Selected Polish energy system modeling exercises, such as that done by Instrat[98], point out that the successful energy transition in Poland depends on the deployment of nuclear energy. Instrat's analysis shows that the lack of nuclear would necessitate additional 40 GW in onshore wind and 50 GW in PV, which exceed the domestic technical potential of these energy sources making the transition unachievable.

Another Instrat's report[99] stresses that the decarbonization scenario featuring both nuclear energy and renewables would result in smaller costs for the energy system as well as smaller electricity production cost compared to the scenario based only on renewables.

In addition to this, nuclear energy can broadly benefit the Polish economy. Polish Economic Institute (PEI) estimates[100] that its deployment may result in over 1% growth in GDP, create up to almost 40 thousand jobs and involve the Polish companies, which could invest up to 130 billion PLN.

98 https://instrat.pl/wp-content/uploads/2024/11/Instrat_Modelowanie-2025_web.pdf.
99 https://instrat.pl/wp-content/uploads/2023/12/Instrat-Policy-Paper-06-2023-Polska-prawie-bezemisyjna-Cztery-scenariusze-transformacji-energetycznej-do-2040-r.pdf.
100 https://pie.net.pl/wp-content/uploads/2022/08/PIE-Raport_Ekonomiczne-aspekty-inwestycji-jadrowych-w-Polsce.pdf.

The newest PEI's report[101] notes that to take advantage of the benefits of nuclear energy, it should be commissioned without major delays or cost overruns. The costs of delays can reach 290-667 million PLN per month depending on the construction phase and the debt interest rate. This illustrates that each month of delay shrinks the cost effectiveness of nuclear energy development.

Nuclear energy and electricity supply security

Due to the aforementioned issues, such as the coal phase-out, barriers to the deployment of renewables and rising electricity consumption, the Polish electricity system may experience a generation gap as early as before 2030, threatening the security of the domestic electricity supply. PSE – the Polish TSO – shows in its NRAA[102] that the LOLE[103] and EENS[104] indicators, which illustrate the reliability of this supply – may considerably increase in the next few years. For example, the former is set at below three hours, but is expected to exceed this value considerably and reach from 5.8 to even 50.2 hours per year. In consequence, the electricity system in Poland is at risk of the undersupply of electricity. Despite the planned broad development of renewables in view of decarbonization efforts, the domestic electricity system, as illustrated by the LOLE and EENS, will need operational capacity during the transition towards cleaner energy sources. The first reactor in Choczewo NPP is scheduled to start up in 2036 (followed by second and third reactor in 2037 and 2038), therefore it is unlikely that it will help alleviate the immediate issues created by the generation gap. At the same time, this nuclear power plant, potentially along with some SMR units and second NPP (scheduled for early 2040s), may positively affect the stability of the domestic electricity system in the long run.

Another key factor which influences the domestic energy security is that Poland is a net importer of electricity. In the last decade (2015-2024), exports outweighed imports only twice, including in 2022 when other EU members suffered greatly from the natural gas price spike. The electricity balance improved volume-wise, since the import fell to 2 TWh in 2024, yet it remains negative due to high wholesale electricity prices in Poland driven by the ETS-burdened coal power plants.

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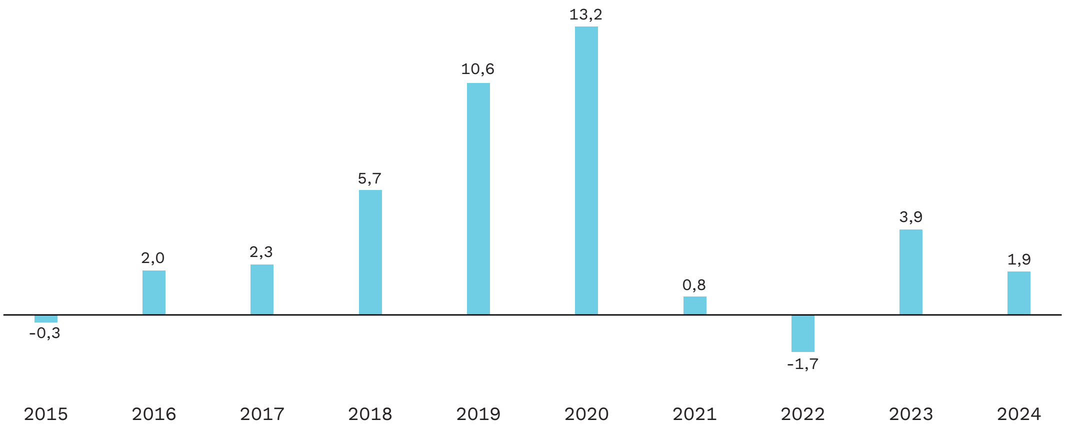
[101] https://pie.net.pl/wp-content/uploads/2025/12/PIE_Raport_Renesas-jadrowy-w-obliczu--kosztow-opoznien-i-zakloconych-lancuchow-dostaw.pdf.
[102] https://www.pse.pl/documents/20182/20580197/National+Resource+Adequacy+Assessment+2025+%E2%80%93+2040.pdf/6b5c6d34-a3fe-4893-8cac-51d2b27ecdd9?safeargs=646f776e6c6f61643d74727565.
[103] LOLE – loss of load expectation – is the expected total duration (in hours per year) of power shortfalls in a particular period during which capacity resources are insufficient to meet the demand.
[104] EENS – expected energy not supplied – the expected volume of energy (in GWh per year) not supplied due to power shortfalls in a particular period.

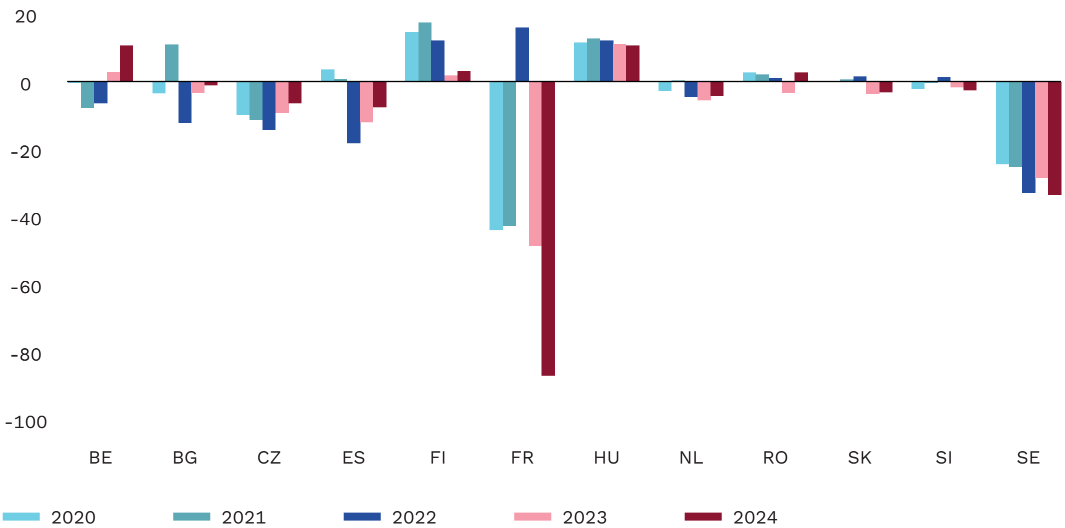
Figure 3. Net electricity import in Poland in 2015-2024 [in TWh]



Source: PEI based on PSE.

Nuclear energy may positively affect the electricity balance in Poland. Almost all the 12 EU countries[105] with operating[106] nuclear power plants (excluding Finland and Hungary) noted a negative net import of electricity, which means that their exports exceeded imports, in at least one year in the last 5 years (2020-2024).

Figure 4. Net electricity imports in EU countries with operating nuclear power plants in 2020-2024 [in TWh]



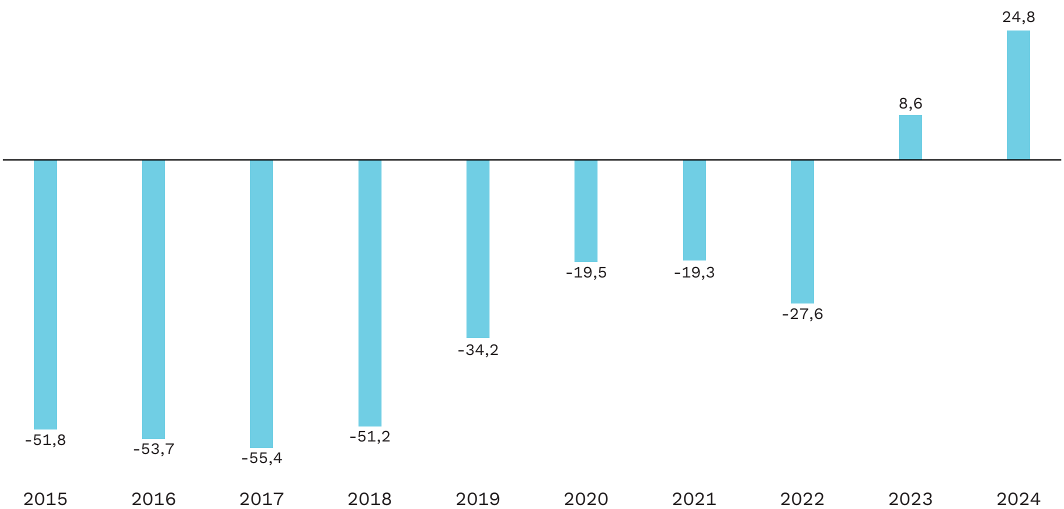
Note: country codes are as follows: BE – Belgium, BG – Bulgaria, CZ – Czechia, ES – Spain, FI – Finland, FR – France, HU – Hungary, NL – the Netherlands, RO – Romania, SK – Slovakia, SI – Slovenia, SE – Sweden.

Source: PEI based on ENTSOE.

[105] Selected countries: Belgium, Bulgaria, Czechia, Spain, Finland, France, Hungary, the Netherlands, Romania, Slovakia, Slovenia, Sweden.
[106] Operating as of 31th December 2025.

Germany is the notable example of how nuclear energy can influence the electricity balance. This country phased out its nuclear fleet in 2023, which led dramatically to an increase in electricity imports. Before the phase-out (up to 2022), Germany exported between 19 and 55 TWh of electricity per year, whereas in 2023 and 2024 it imported 4 and 24 TWh, respectively. This lack of dispatchable capacity[107] had visible consequences for Germany's electricity trade with its neighbors, especially during periods with low renewables generation, which became apprehensive of constructing or upgrading interconnectors with Germany[108].

Figure 5. Net electricity import in Germany in 2015-2024 [in TWh]



Source: PEI based on ENTSOE.

Nuclear energy and fossil fuels imports

Nuclear energy can improve energy security beyond electricity, as Poland heavily relies on imported fossil fuels. In 2024[109], Poland imported 16% of domestically consumed steam coal, 18% of coking coal and 84% of natural gas, which are used in the industrial sector. Technically, nuclear power plants, especially SMRs, have some potential to provide clean heat and facilitate the phase-out of steam coal and natural gas from the Polish industry, as well as clean electricity to substitute natural gas in the power sector and coking coal in the steel sector (by means of low-emission hydrogen production).

[107] According to the German Federal Network Agency – Bundesnetzagentur – the electricity system in Germany will require up to 22-35 GW of additional dispatchable capacity by 2035. See: https://www.bundeswirtschaftsministerium.de/Redaktion/DE/Publikationen/Energie/versorgungssicherheit-strom-bericht-2025.

[108] Norway is considering abandoning the upgrade of a 500 MW HVDC interconnection with Denmark, and Sweden has blocked the construction of a new 700 MW interconnector with Germany.

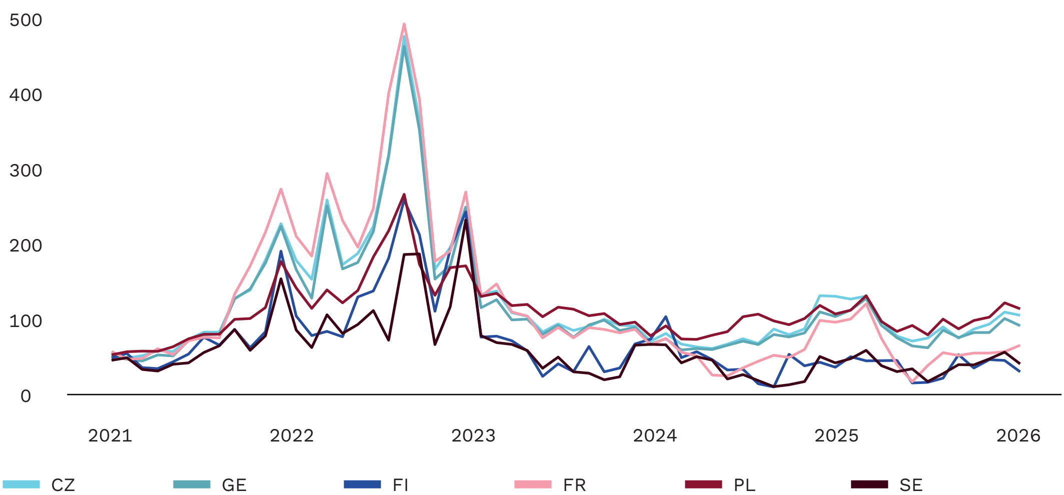
[109] https://stat.gov.pl/obszary-tematyczne/srodowisko-energia/energia/gospodarka-paliwowo-energetyczna-w-latach-2023-i-2024,4,20.html.

However, the selected location of the Choczewo NPP does not use this potential, as it will focus only on electricity generation. This may change with SMRs – see Chapter 3.

Nuclear energy and wholesale electricity prices

The heavy reliance on coal and natural gas for electricity generation causes Poland to have one of the highest wholesale electricity prices in the EU electricity market. This is driven, among others, by the high cost of domestic steam coal and the elevated EU ETS allowance prices associated with coal and natural gas combustion. The average wholesale electricity price in Poland in 2025 was 103.9 EUR/MWh, with a minimum value in June (81.5 EUR/MWh) and a maximum value in February (133.8 EUR/MWh). The price in Poland was significantly higher than in other EU countries: 7% than in Czechia (96.9 EUR/MWh), 16% than in Germany (89.7 EUR/MWh), 160% than in Finland (40 EUR/MWh), 64% than in France (63.2 EUR/MWh), 145% than in Sweden (42.4 EUR/MWh).

Figure 6. Wholesale electricity price in selected EU countries in 2021-2025 [in EUR/MWh]



Source: PEI based on PSE.

Nuclear energy can play a role in stabilizing the wholesale electricity price in Poland as there appears a risk that it may rise due to the increasing cost of purchasing EU ETS allowances and the capital demands of the energy transition, especially for strengthening the electricity grid. The strike price of the Choczewo NPP amounts to 470-550 PLN/MWh[110] (111-130 EUR/MWh), but it may change in light of shortening the CfD from 60 to 40 years[111] and the conditions under which debt financing will be secured.

[110] https://ec.europa.eu/competition/state_aid/cases1/20258/SA_109707_92.pdf.
[111] https://ec.europa.eu/commission/presscorner/detail/en/ip_25_2963.

Nuclear energy and industrial competitiveness

The competitiveness of the Polish industry hinges on the secure and affordable supply of electricity, which – as discussed above – can pose a challenge to the domestic electricity system. In consequence, some Polish companies turned to nuclear energy as a possible solution in the form of developing on-site SMRs or purchasing electricity from the Choczewo NPP and SMRs in bilateral contracts, e.g. power purchase agreements (PPAs). Most notable partnerships are those established by Orlen Synthos Green Energy (OSGE) and GE Vernova Hitachi Nuclear Energy and by Industria and Rolls-Royce SMR. In each example, these companies plan to develop a fleet of SMRs to utilize them for clean electricity, heat and hydrogen production, aiding in decarbonizing the Polish industrial sector. They intend to commission SMRs as soon as early 2030s. As for the indirect use of nuclear energy, it will be possible for the domestic industrial entities to procure electricity from Choczewo NPP, since up to 30% of its output may be sold via auctions[112], e.g. PPAs. Such option to cover electricity demand can turn out to be attractive, because it would shield the industry from the volatility of electricity prices and better answer its need for the stable supply of electricity than the weather-dependent generation from renewables.

[112] https://ec.europa.eu/commission/presscorner/detail/en/ip_25_2963.

Polish Nuclear Sector Foresight

Overview

We conducted a survey of Polish energy experts from various backgrounds, i.e. academia, business, public administration and think tanks. Our aim was to better understand their opinions on the future of nuclear energy, with an emphasis on its deployment in Poland and the EU.

Our questionnaire was divided into two parts. The first one consisted of Delphi theses. For each thesis, we asked the experts to:

- indicate the likelihood of its realization,
- choose the timeframe in which it is the most likely to be realized (for selected questions),
- provide a comment (optional).

The second one contained other questions beyond Delphi theses. The experts were asked to select an answer and give a comment for two questions, and for the third – to rate the given statements about nuclear energy on a scale of 1 to 5.

We conducted the survey in two rounds. In the first one, we asked the experts to complete a questionnaire. Then they were presented with the results of the survey. In the second round, they responded again to the same Delphi theses from the questionnaire. The second part of the questionnaire was only shown during the first round of the survey.

Methodology

The research in this chapter is based on the Delphi method, a type of expert survey where experts' experience-based opinions are treated as a legitimate contribution to formulating a vision of the future for the research subject. The method is used to predict the development of long-term phenomena amid the uncertainty, especially when: (I) the predicted phenomena do not lend themselves to analytical techniques characteristic of forecasting, (II) there is no reliable data on the anticipated processes, or (III) external factors have a decisive impact on the predicted phenomena[113].

[113] Nazarko J. (2013), Regionalny foresight gospodarczy. Metodologia i instrumentarium badawcze, Association of Employers of Warsaw and Mazovia, Warsaw.

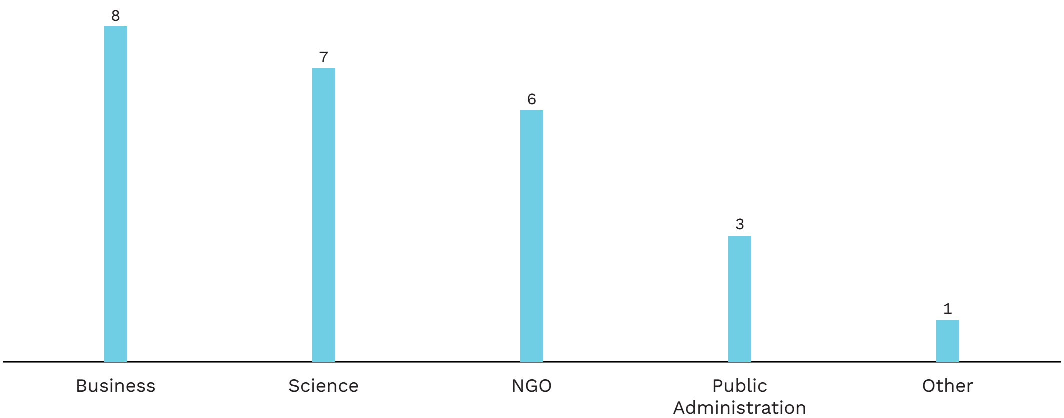
The questionnaire was used to conduct the first round of the assessment of the Delphi theses (stage four) by 25 experts in the form of a CAWI (Computer Assisted Web Interviewing) survey. The selected technique has many advantages. The most important ones include:

- the logical correctness of the data is automatically verified,
- the test results are automatically saved on the server,
- research is possible to be carried out among groups of respondents scattered across a large geographical area.

The experts for the Delphi study were chosen by purposive sampling. The group would consist of eminent representatives from science, business, NGOs, and the public administration.

From these groups, nearly 100 experts were selected and invited to participate in the study; 25 of them agreed to take part. Taking part in a study conducted using the Delphi method requires a considerable time commitment and work from experts. These factors were often the reason that some declined to participate in the study.

Figure 7. Sector represented by survey respondents



Source: PEI based on own survey.

Only 11 participants of the 1st round took part in the 2nd round. Therefore in this chapter we present only the results of the 1st round. We present the comparison of the 1st and 2nd round (limited only to matched 11 participants of both rounds) in the appendix.

For the purposes of the report and data analysis, we presented some of the questionnaire variables in the form of indicators that synthesize and organize the results of a larger number of detailed observations.

To determine the individual theses probability, we suggest Probability Indicator (PI) with the following formula:

$$PI = \frac{100 * n_{VH} + 75 * n_H + 50 * n_M + 25 * n_L + 0 * n_{VL0}}{n - n_{HTS}}$$

Where:

n_{VH} - "very high" - number of responses,

n_H - "high" - number of responses,

n_M - "medium" - number of responses,

n_L - "low" - number of responses,

n_{VL0} - "very low or zero" - number of responses,

n_{HTS} - "hard to say" – number of responses.

Moreover, in question 11, indicators relating to the impact of barriers (BI – barriers indicator) on the widespread use of SMRs in Poland were also determined. The indicators were calculated using the formula:

$$BI = \frac{100 * n_{VS} + 75 * n_S + 50 * n_M + 25 * n_L + 0 * n_{VL0}}{n - n_{HTS}}$$

Where:

n_{VS} - "very significant" - number of responses,

n_S - "significant" - number of responses,

n_M - "moderate significance" - number of responses,

n_L - "low significance" - number of responses,

n_{VL0} - "zero significance" - number of responses,

n_{HTS} - "hard to say" – number of responses.

Part 1. Delphi theses

The global installed capacity of NPPs will triple to around 1,200 GWe (December 2025: 377 GWe)

Our respondents were cautiously optimistic about the dynamic deployment of nuclear energy in the future. Nearly half of them assessed that chances for the tripling of global nuclear capacity to roughly 1,200 GWe are "high" or "very high". This reflects the opinions of energy experts and policymakers predicting a nuclear renaissance[114] driven by energy security concerns and a race to net zero. Nevertheless, a fifth of respondents did not believe in such high nuclear ambition.

The experts remarked that the tripling of nuclear capacity is more realistic after 2050 as it necessitates the development pace similar to that observed globally in the 70s and 80s. In fact, it must increase fourfold when accounted for the replacement of the current reactor fleet.

> *"Such a significant expansion of capacity would require a drastic increase in both industrial and human resources potential, which today is sufficient to deliver only a limited number of projects, particularly in the Western world. A multiple increase in capacity, which in practice means building four times the current capacity, since the existing facilities would need to be replaced by then, would therefore require an expansion of industrial capabilities comparable to what took place between roughly 1960 and 1980."*

They pointed out that the demand for new NPPs may come from the electrification of the global economy, especially in emerging economies such as China and India, which are likely to drive the nuclear capacity growth. In their opinion, this broad deployment depends mostly on access to finance, strong supply chain, availability of workforce and political will. The experts underlined that SMRs can largely increase the possibility of attaining the tripling goal.

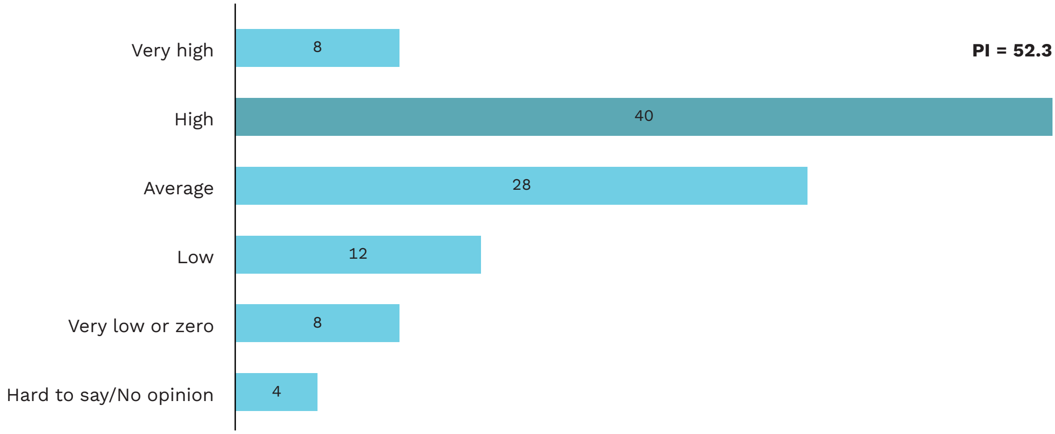
> *"This thesis is true on the assumption that nuclear energy will receive adequate funding, for which it competes mainly with renewable energy sources."*

> *"Tripling the installed capacity in nuclear energy requires significant development of supply chains, which will be difficult given the current development trends among global leaders."*

> *"Highly dependent on the development of SMRs (whether they will be able to compete with alternatives)."*

[114] https://iea.blob.core.windows.net/assets/b6a6fc8c-c62e-411d-a15c-bf211ccc06f3/ThePathtoaNewEraforNuclearEnergy.pdf.

Figure 8. Thesis 1.1 results: percentage share of answers [in %]

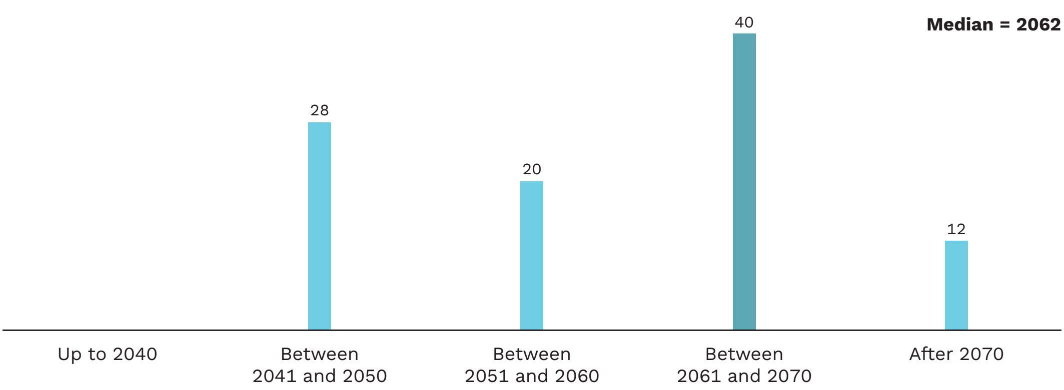


Source: PEI based on own survey.

As for the timeframe in which such ambition can be realized, our experts were divided: nearly half of them (48%) thought that the goal would be achieved before 2060 and more than 1/4th (28%) believed that the tripling of global nuclear capacity would take place between 2041 and 2050 (28%) which would be a major assistance in achieving climate neutrality goals up to 2050. The other half (52%) believed that this goal would be achieved no sooner than between 2061 and 2070 (40%) or even after 2070 (12%). The results underline the ambiguity concerning the possible ramp-up of nuclear energy development, which strongly hinges on the well-functioning supply chain[115].

"The often-stated target of 2050 is unrealistic. In the longer term, yes, although difficult."

Figure 9. Thesis 1.2 results: percentage share of answers [in %]



Source: PEI based on own survey.

[115] https://www.iaea.org/topics/management-systems/management-of-the-nuclear-supply--chain.

Nuclear energy will be treated equally with other low-carbon energy sources in the EU (e.g., access to financing, inclusion in climate targets and definitions such as RFNBO, change in merit order)

Our respondents believed that nuclear energy stands at least a small chance of competing on equal terms with other low-carbon energy sources in the EU. As to how big of a chance nuclear has, almost two thirds (64%) assessed that it is "low" (32%) or "medium" (32%), doubting that the current EU stance[116] on nuclear would significantly differ in the future. On the contrary, over a third (36%) found this more possible: the share of answers labelled "high" and "very high" was 24% and 12%, respectively.

The experts indicated that there is currently little movement towards changes to the treatment of nuclear. They also seem critical to the EU's competitiveness. Along these lines, the experts thought that any adjustments to approach to nuclear energy would be gradual, just as they were in the case of renewables.

> *"At present, however, no concrete steps in this direction are visible, apart from largely symbolic initiatives such as a nuclear IPCEI or the establishment of the SMR Alliance."*

> *"Certainly, the first equalization, e.g. inclusion in targets and financing, will take place before 2030. However, it should be noted that the extensive RES support system currently in place has been built up over two decades. The same assumption should apply to nuclear power. Support will be built up gradually."*

> *"This will happen under the pressure of global tensions. Europe's competitiveness depends heavily on the development of nuclear energy."*

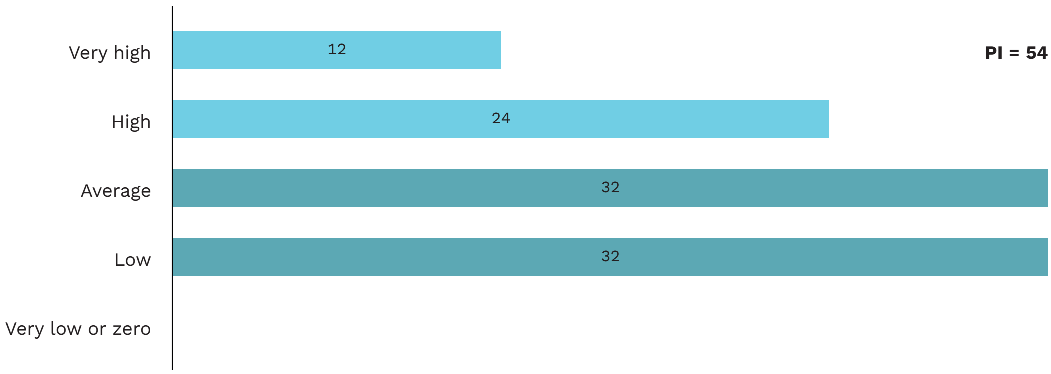
The respondents highlighted that the most realistic changes include facilitating access to finance (particularly for SMRs) and greater role in climate goals, possible to make even as early as this decade. In their view, the deep modifications of energy market, for example regarding merit order, are unlikely to happen. They concluded that leveling the playing field for nuclear and renewables can happen by maintaining pressure on the EU energy policy by pro-nuclear countries and other non-EU superpowers.

> *"Access to financing and inclusion in climate targets are realistic, changes in merit order, not yet."*

> *"Maintaining political pressure leading to a reduction in the anti-nuclear camp may result in changes in the law, including an amendment to the RED Directive, which could put nuclear energy on a par with renewable energy as zero-emission energy sources."*

[116] https://world-nuclear.org/information-library/country-profiles/others/european-union.

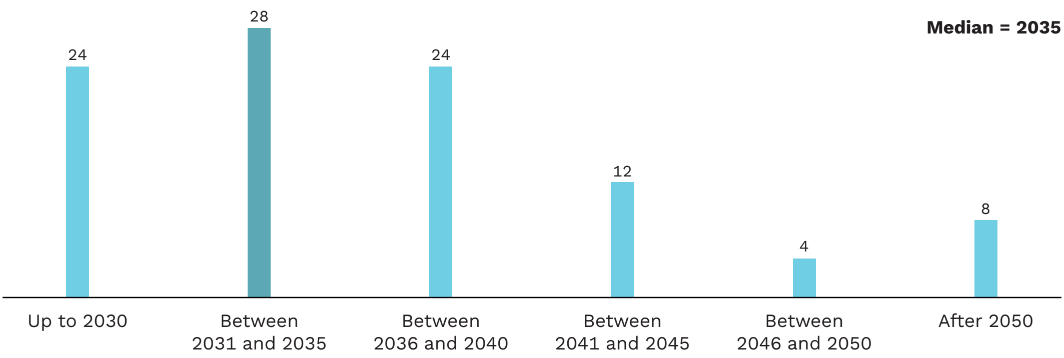
Figure 10. Thesis 2.1 results: percentage share of answers [in %]



Source: PEI based on own survey.

Nearly a fourth (24%) of the experts thought that such level playing field would be achieved after 2040: between 2041 and 2045 (12%), between 2046 and 2050 (4%) or after 2050 (8%). The other timeframes were similarly popular among our respondents. They most often pointed to 2031-2035 (28%), but some also found it possible before 2030 (24%) or between 2036 and 2040 (24%).

Figure 11. Thesis 2.2 results: percentage share of answers [in %]



Source: PEI based on own survey.

At least 20% of Poland's annual electricity demand will be covered by nuclear power

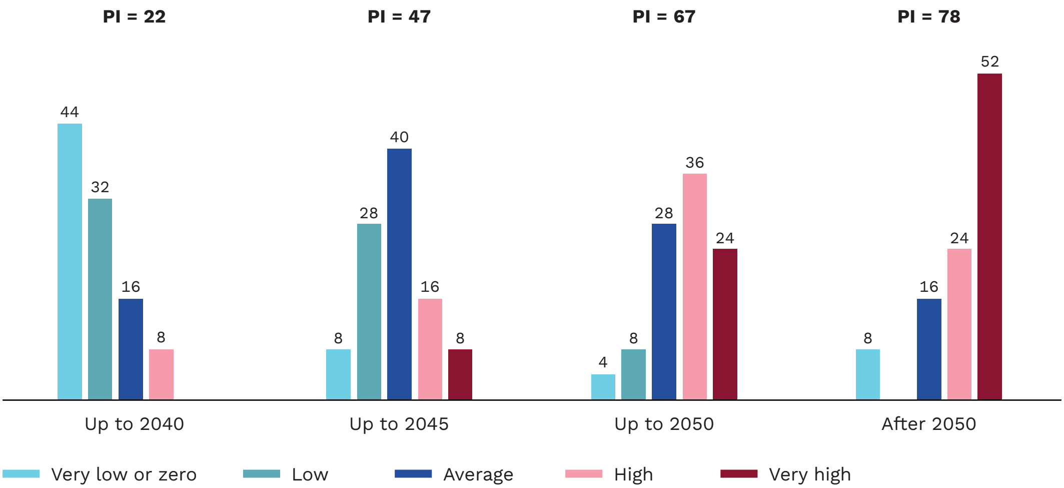
Our experts expected that nuclear energy would most likely produce at least 20% of electricity in Poland between 2045 and 2050 (36% of answers as “high” and 24% as “very high” likelihood) or after 2050 (24% and 52%, respectively). Only 8% claimed with such certainty that this would happen before 2040 and 24% leaned towards before 2045. Their responses were more or less in line with the trajectory presented in the Polish National Energy and

Climate Plan[117] (NECP), which envisions 15% of nuclear in the electricity production mix in 2040.

Some experts said that the share of over 20% of nuclear in electricity generation is a matter of time. At the same time, they did not believe in it to happen before 2050 and indicated two possible factors: the delays in the Choczewo NPP project and the dynamic growth of domestic electricity demand.

> *"The Polish Nuclear Power Programme and the construction of the first power plant are already delayed, but the general assumption regarding the use of nuclear energy remains in place; therefore, it is primarily a matter of the time horizon."*

Figure 12. Thesis 3 results: percentage share of answers [in %]



Source: PEI based on own survey.

The installed capacity of SMRs in Poland will exceed 5 GWe

Our respondents doubted in the large-scale deployment of SMRs in Poland: 44% of them assessed chances of over 5 GWe of SMRs capacity as "low" and 12% as "very low". As little as 16% were optimistic (8%) or very optimistic (8%) about the prospects of SMRs. These results reflect the skepticism towards this energy source as it is yet to be commercialized and financially proven with regards to final capital and operating costs. Little data about these costs and low technological maturity made it difficult for our experts to predict how many SMRs might be constructed in Poland.

> *"The problem with SMRs is primarily related to technological immaturity and, despite everything, high installation costs."*

[117] https://www.gov.pl/web/energia/projekt-krajowego-planu-w-dziedzinie-energii-i-klimatu--do-2030-r-z-perspektywa-do-2040-r---wersja-opracowana-przez-me-do-zatwierdzenia--rzadowego.

The experts noted that the large portion of domestic SMR capacity may be built for district heating as a replacement for aging coal CHPs or for industrial purposes.

> *“The SMR momentum in Poland has slowed down, and the strategies of major energy companies indicate that they will only become interested in the subject around 2040.”*

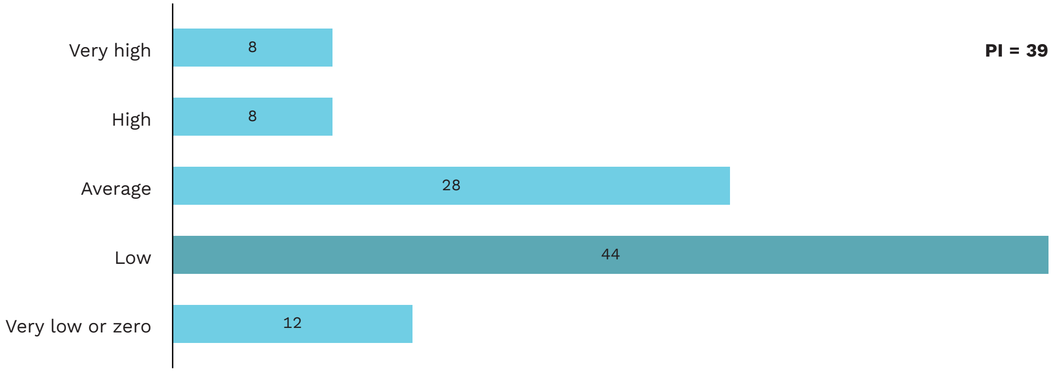
> *“Only the heating sector, several GWt by 2050.”*

The respondents emphasized that the deployment of SMRs in Poland can be accelerated on the condition that the private sector would have enough capacity to invest capital in them and the construction of large-scale NPPs would face serious obstacles.

> *“In Poland, PPEJ focuses on large-scale reactors, so investments in SMRs will primarily come from the private sector/companies, which may limit interest in this technology, especially in the face of competition from renewable energy sources.”*

> *“A larger number of SMRs will only have a chance to develop if Polish investors are unable to agree on joint investments in larger projects or if large-scale technology suppliers are unable to present credible offers.”*

Figure 13. Thesis 4.1 results: percentage share of answers [in %]



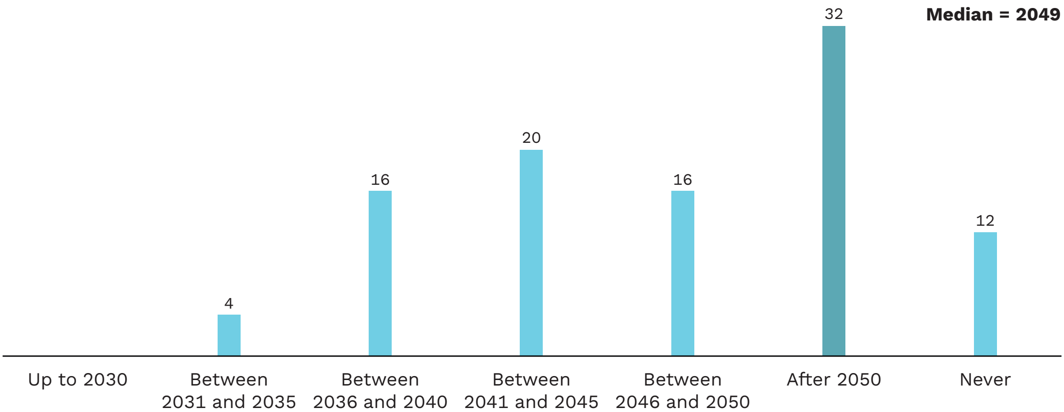
Source: PEI based on own survey.

Large part (32%) of the all the experts believed that the SMR capacity would exceed 5 GWe later than in 2050. Over half (52%) thought that this would take place in 2036-2040 (16%), 2041-2045 (20%) or 2046-2050 (16%). In contrast, 16% of them were either highly optimistic or highly pessimistic: 4% claimed that SMRs would reach the 5 GWe mark as soon as before 2035, whereas 12% that it is virtually unattainable. These answers highlight the uncertainty about this technology as it has many roadblocks to overcome[118], which may lengthen the development process over the timelines predicted by companies developing such reactors.

[118] https://www.oecd-nea.org/upload/docs/application/pdf/2021-03/7560_smr_report.pdf.

"Difficult to determine due to a lack of data on the possible price, but it will be hard to compete with a price based on renewable energy sources. If so, then after 2050."

Figure 14. Thesis 4.2 results: percentage share of answers [in %]



Source: PEI based on own survey.

At least several EU countries will establish joint purchasing mechanisms (e.g. in the form of order books) for SMRs or components for the construction of large or small nuclear reactors

Our respondents were not particularly convinced that joint purchasing mechanisms would be created at the EU level for either large- or small-scale reactors. Roughly half of them (48%) thought that there is a "low" (32%) or a "very low or zero" (16%) chance for it to happen, whereas almost another third (32%) assessed it as "average". This skepticism may stem from the fact that each Member State might have differing preferences with regard to supply chain. The respondents reminded that the choice of a nuclear technology does not depend solely on objective metrics but is also impacted by geopolitics and energy policy targets.

"Unfortunately, this does not make sense/is not possible due to the choice of different technologies in different EU countries."

The experts underlined that establishing such mechanism is more likely in smaller countries or for a group of companies with relatively weak individual influence and with regard to components which do not require substantial modifications in each NPP project.

"Applies only to components that will not require design changes in individual countries. Other elements of a SMR may be subject to change in accordance with national requirements."

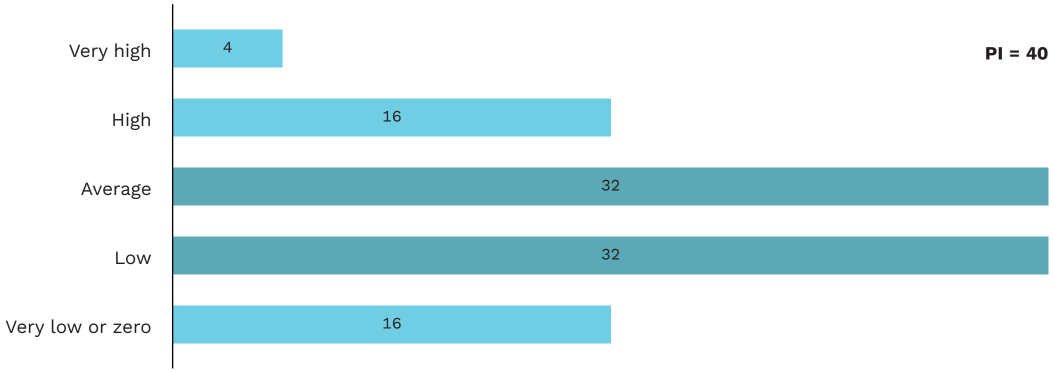
"This topic does not come up in the discussion at all. What is more, pro-nuclear countries are primarily focusing on large-scale reactors. Any orders could be fulfilled by smaller countries or companies."

Nevertheless, they pointed out that there is little discussion and political will on the EU level to make this mechanism a reality. In addition, they saw side effects of coordinating nuclear purchases as seen by possibly less competition among nuclear technology providers and favoritism of some countries. Finally, they said that countries do not constitute direct investors in nuclear projects, which is why it would be complicated to arrange nuclear purchases, e.g. on the model of military ones.

> *"Such EU coordination may restrict competition between technology providers and may favor certain countries."*

> *"To date, no real political action has indicated even a declarative willingness to pursue such goals. The situation is further complicated by the fact that, as a rule, countries in the European Union are not direct investors, which will make it difficult to transfer mechanisms known, for example, from defence procurement."*

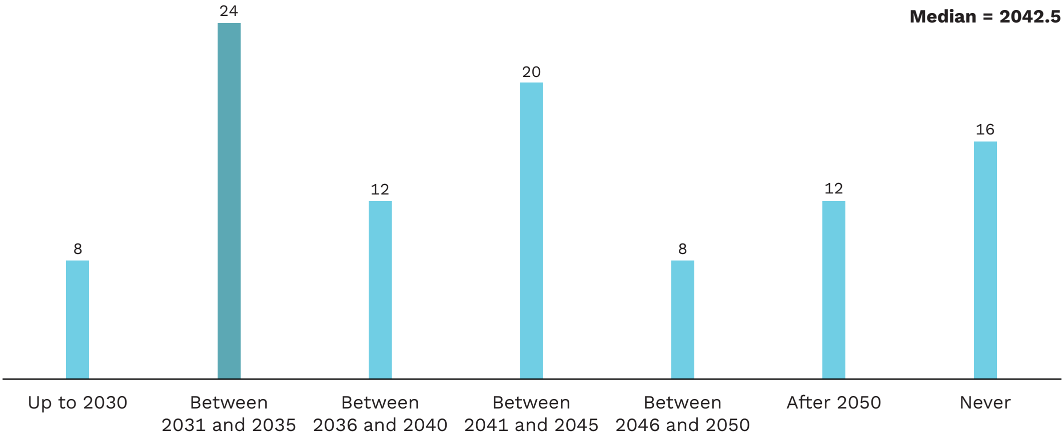
Figure 15. Thesis 5.1 results: percentage share of answers [in %]



Source: PEI based on own survey.

The experts were not unanimous when it comes to the period of potential implementation of a joint purchasing mechanism. A group of them pointed out that this is realistic between 2031 and 2035 (24%), another bet on a decade later, 2041-2045 (20%), whereas some found it impossible (16%).

Figure 16. Thesis 5.2 results: percentage share of answers [in %]



Source: PEI based on own survey.

The cost of electricity (LCOE) from future SMRs will fall below EUR 100/MWh (in 2025 prices)

Significant part of our experts (56%) believed that there is little probability of SMRs reaching levelized cost of electricity (LCOE) below 100 EUR per MWh: 32% labelled it as "low" and 24% as "very low or zero". There are only two commercially operating land-based SMRs in the world[119], which is why some respondents (12%) found it difficult to say with conviction whether SMRs capital and operating costs will turn out to be low enough to reach this level of LCOE. They stressed that this is complicated because of the benefits from economies of scale in nuclear energy, which may be less visible in SMRs. For this reason, SMRs might generate more expensive electricity than large NPPs in the future.

> *"No realistic information on the costs of such installations (other than non-binding declarations by suppliers in the early stages of project development, gradually revised as prototype implementations approach) indicates such a possibility."*

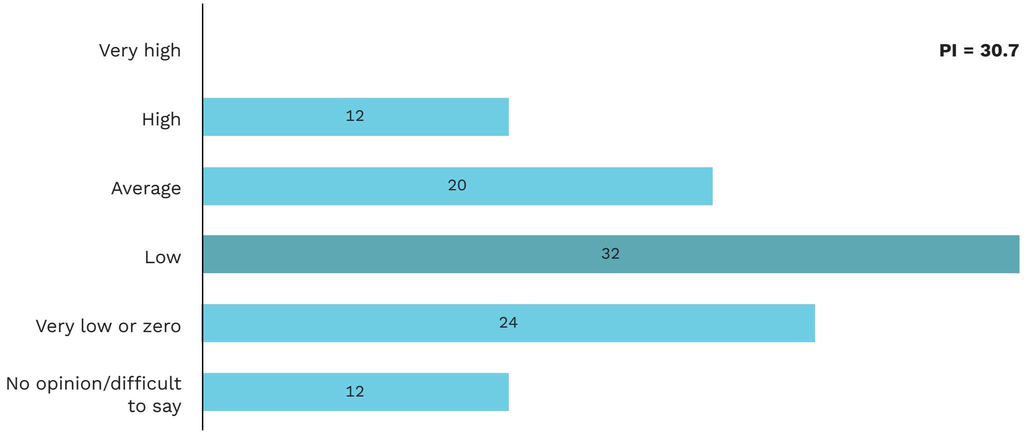
> *"The economies of scale in nuclear energy are practically impossible to overcome."*

The respondents found it futile to predict the electricity cost from SMRs as this technology is not yet fully commercialized. They said that SMRs investment costs may turn out to be lower if produced on a big enough scale.

> *"The CAPEX of SMR investments can definitely be lower compared to a "full-scale" power plant if the entire supply chain is negotiated for a fleet/series of projects (otherwise, prices are set for X projects rather than for a single project, which requires costly adaptation of the enterprise) and if competition among suppliers develops."*

[119] https://publications.jrc.ec.europa.eu/repository/handle/JRC144653.

Figure 17. Thesis 6.1 results: percentage share of answers [in %]

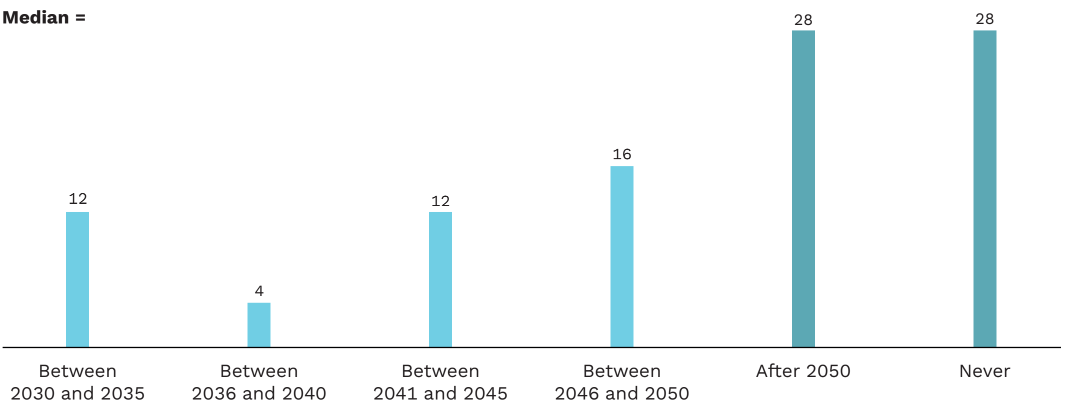


Source: PEI based on own survey.

The respondents were unsure when SMRs could achieve LCOE below 100 EUR per MWh. Three clusters of answers are particularly interesting: 12% thought that this would come into fruition as early as 2030-2035, 28% after 2050 and another 28% said this would never happen. It is evident that while some experts were confident in a rapid fall of SMRs costs, others predicted a long road ahead of this technology towards full market maturity.

> *"There is no reason for this to be the case; the LCOE of small units will be higher than that of large ones."*

Figure 18. Thesis 6.2 results: percentage share of answers [in %]



Source: PEI based on own survey.

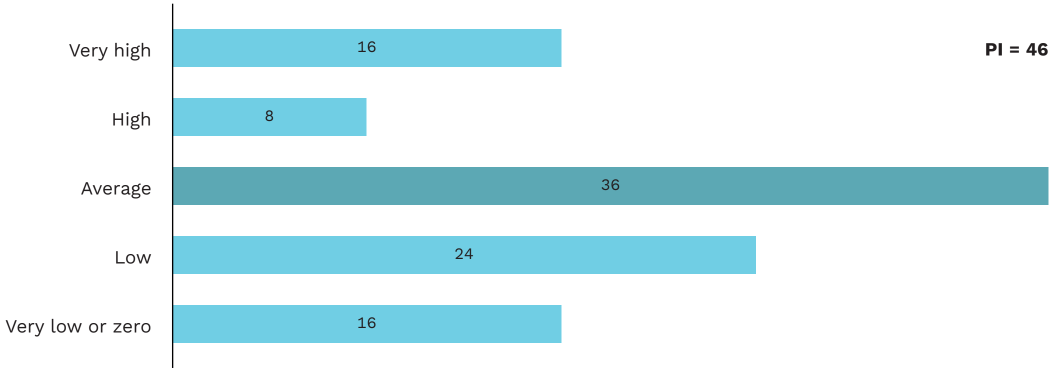
Energy-intensive industries (metallurgy, chemical sector, etc.) will cover at least 20% of their annual electricity demand from SMRs (on-site or through contracts, e.g. PPAs)

There was no consensus among our experts on whether energy-intensive industries (e.g. steel) will be able to source at least 20% of their electricity from SMRs (directly or indirectly). Large part (36%) claimed that there is an "average" chance for this to materialize. There were also two groups with the same share of 16%: one which assessed possibility to "very low or zero" and another to "very high". These results underline broader uncertainty among the representatives from energy-intensive industries, which seem to need more data (about real-life costs etc.) before deciding if including SMRs in their strategies is reasonable.

The experts said that the application of SMRs in the industry depends on their investment attractiveness, availability and technological maturity. They added that realizing such ambitions might prove difficult as the industry is currently not particularly convinced whether SMRs would be the right fit for them.

> *"This could follow in the footsteps of nuclear power construction if we were talking about large-scale units (although the industry does not seem interested in this anyway). For SMRs, the opportunity is minimal due to the uncertain time frame for their construction and the incalculable cost."*
>
> *"It is, in principle, a priority recipient of energy from SMRs."*

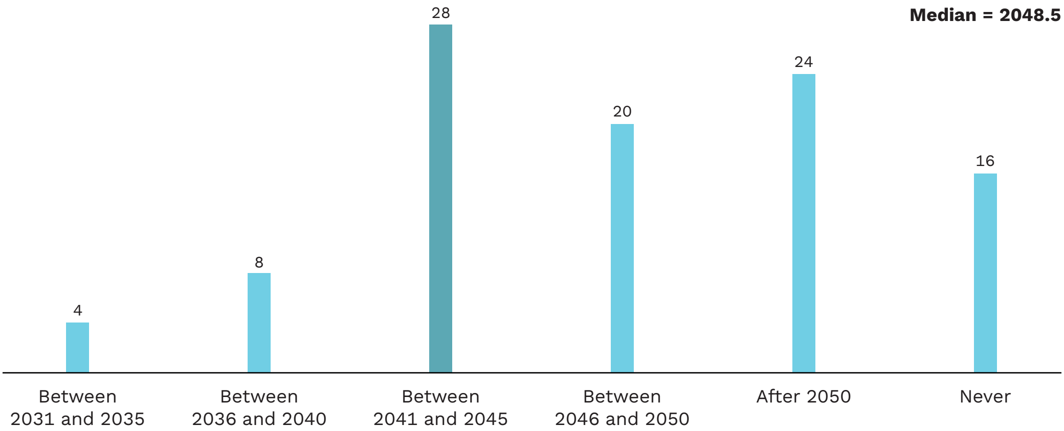
Figure 19. Thesis 7.1 results: percentage share of answers [in %]



Source: PEI based on own survey.

The majority of respondents (88%) believed that energy intensive industries in Poland would cover at least 20% of their electricity demand no sooner than after 2040. When it comes to the exact period of achieving this goal, they were divided: 28% answered "between 2041 and 2045", 20% "between 2046 and 2050" and 24% "after 2050". There is also a considerable share of respondents (16%), who did not believe in SMRs in the industry whatsoever.

Figure 20. Thesis 7.2 results: percentage share of answers [in %]



Source: PEI based on own survey.

Currently, the installed capacity of nuclear reactors in the EU-27 is approximately 98 GWe. Please indicate to what extent you agree with the following statements regarding the installed capacity of nuclear reactors in the EU-27 in 2050

The experts were rather skeptical about the large increase in nuclear capacity in the next 24 years. The most probable scenario in their opinion would be additional 20 to 50 GW in nuclear capacity. Many of the future nuclear investments will be merely a replacement of aging nuclear power plants build in the 70' and 80' in EU's western countries (mainly France).

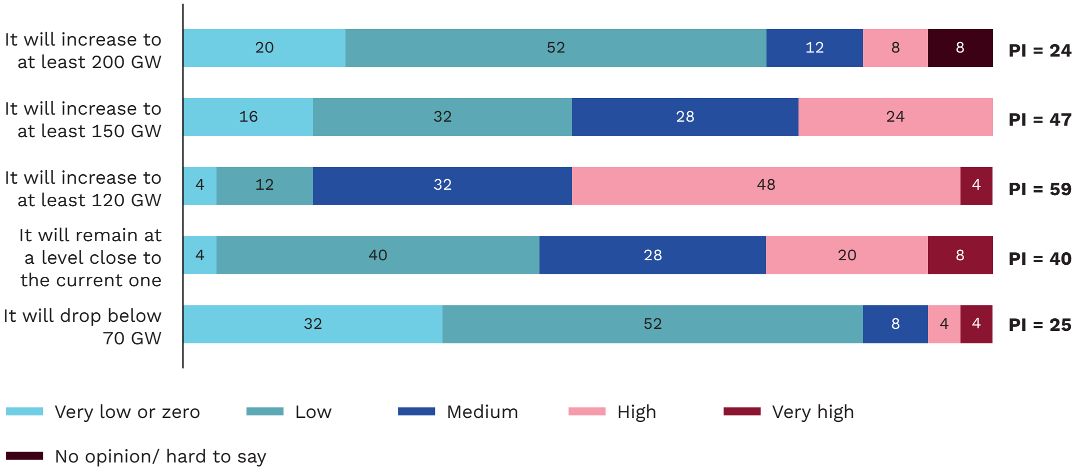
> *"It seems that in the medium term, the EU will merely (and in the best case scenario) rebuild its nuclear capacity, as is currently the case in the United Kingdom. In particular, the French nuclear program will be based on this and at the same time will drain nuclear personnel from the rest of the Member States."*

> *"However, the development of nuclear energy will be hampered by the development of renewable energy sources, which is why the increase in capacity – rather small in absolute terms – will be spread over a long period of time."*

The experts accentuated that the deployment scale of nuclear capacity may be hampered by the priority for renewables in EU energy policy, the need to replace the current aging fleet of reactors and the underinvested European nuclear industry.

> *"The current capacity of the Western nuclear industry is insufficient even to replace existing capacity. Even assuming a rapid restoration of this capacity, its effects will only be felt in several years' time, during which capacity will continue to decline."*

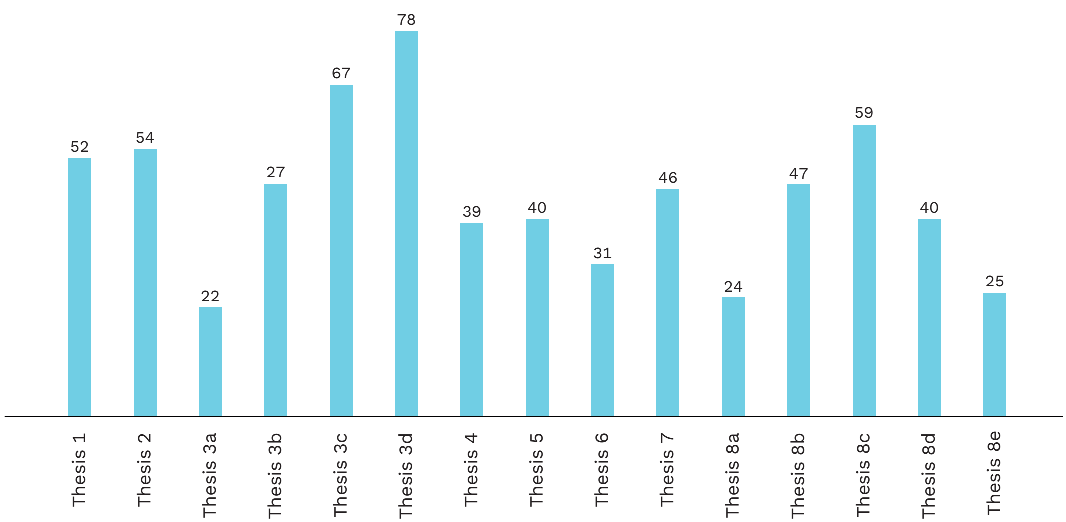
Figure 21. Thesis 8 results: percentage share of answers [in %]



Source: PEI based on own survey.

Our survey shows that the experts found it especially unlikely that the share of nuclear energy in the electricity production mix would reach at least 20% before 2040 (PI = 22), but strongly believed that it would happen just before (PI = 67) or after 2050 (PI = 78). They also fairly confidently thought that the nuclear capacity in the EU would probably rise slightly to at least 120 GW (PI = 59) and doubted in its both exceptionally high (over 200 GWe, PI = 25) or low (below 70 GWe, PI = 24) level. Other theses were assessed as somewhat likely (PI around 50) or somewhat unlikely (PI around 30).

Figure 22. Probability indicators of Thesis 1 to 8



Source: PEI based on own survey.

Part 2. Other questions

Public acceptance of SMRs will be higher/similar/lower than of large-scale NPPs

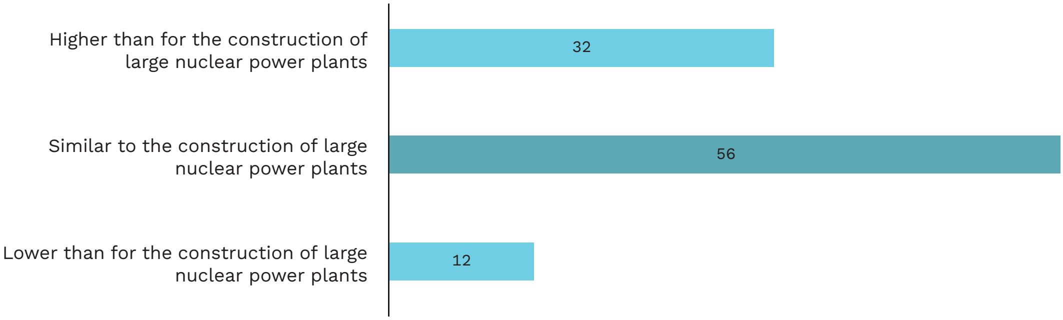
Most of our respondents presumed that public acceptance of SMRs would be high. Over half of them (56%) thought that it would be at least similar to the acceptance of large-scale nuclear, whereas almost a third (32%) that it is going to be even higher. The latest survey, conducted in November 2025 and commissioned by the Polish Ministry of Energy, showed that roughly 92% of Poles were in favor of nuclear energy[120]. Moreover, almost 80% of them would welcome such energy source in their neighborhood. Maintaining high acceptance would immensely help with the construction of SMRs in industrial and district heating applications located close to cities.

> *"Much depends on how communication is conducted. Furthermore, acceptance is highly sensitive to various events, such as even minor nuclear accidents or changes in the perception of the costs of nuclear power."*

The experts noted that the acceptance may depend on the location and the communication strategy from the investor side. The latter is particularly vital since its lack can create conflict between local communities and the stakeholders of a SMR.

> *"Large-scale nuclear power plants are quite "abstract" facilities for the average citizen. They are located in only a few places in the country, so their potential negative impact does not affect most citizens. SMRs, on the other hand, when located on the site of, for example, a former municipal coal-fired combined heat and power plant, may face challenges similar to those faced by waste incineration plants."*

Figure 23. Thesis 9 results: percentage share of answers [in %]



Source: PEI based on own survey.

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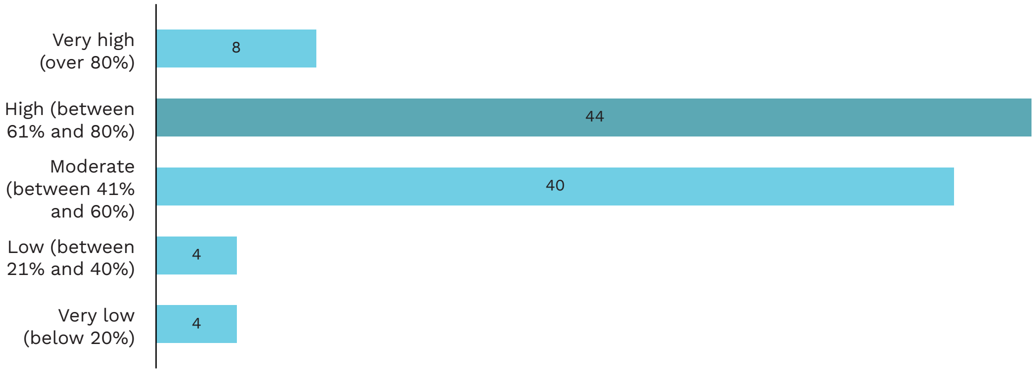
[120] https://www.gov.pl/web/energia/energetyka-jadrowa-z-niezwykle-silnym-mandatem-spolecznym-ponad-90-proc-polek-i-polakow-stawia-na-atom.

SMR construction in large cities (e.g. for district heating) will benefit from very high/high/moderate/low/very low social acceptance

The majority of our experts (84%) thought that constructing SMRs in large cities would be moderately (41-60%) or highly (61-80%) accepted by local communities. The NIMBY (not in my backyard) attitude may play a role here just as much as it played for renewables, especially wind, which in Poland suffered from opposition.

Figure 24. Thesis 10 results: percentage share of answers [in %]



Source: PEI based on own survey.

What are the biggest barriers to the widespread use of SMRs in Poland in the future?

Out of several barriers to the development of SMRs in Poland, the experts indicated that some are more critical than others. Among them they assigned "significant" or "very significant" importance to the risk of investment costs overrun (84%), lack of changes in EU policy towards nuclear (68%), lengthy licensing and safety assessment processes (64%) or project delays resulting from no experience with this technology (60%). On the contrary, they highlighted that such obstacles as the number of suitable sites for construction (72%), nuclear fuel supply (72%) or public opposition (48%) have "no" or "low" significance. Other barriers, such as lack of investor interest or competition for resources, seemed to be more contentious with no single clear answer.

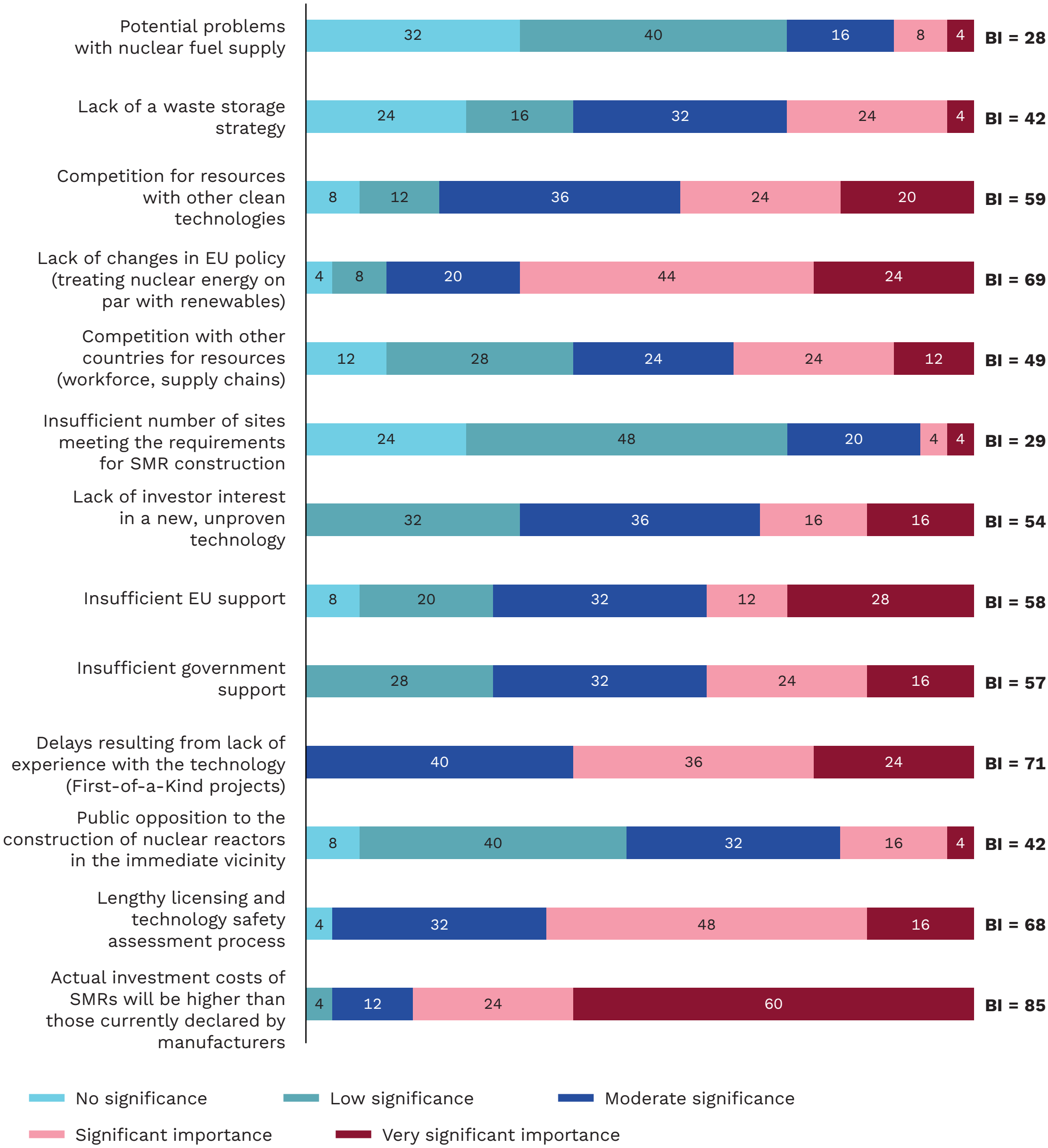
> *"Lengthy process of obtaining licences and assessing technology safety: moderate [effect], as many supervisory authorities take steps to engage in early dialogue with technology providers. This allows for the exchange of information and highlights any issues that may require further discussion."*

> *"Public opposition to the construction of nuclear reactors in the immediate vicinity: always – public acceptance is fickle, and although there is currently support for nuclear power in Poland, it is unclear what the situation will be in a few years' time."*

"In my opinion, price competition will be the most important factor. Resources in terms of materials are of little significance in my view."

"EU policy will have no practical significance if the technology is truly competitive."

Figure 25. Thesis 11 results: percentage share of answers [in %]



Source: PEI based on own survey.

Recommendations

1) **Make Choczewo NPP the national "learning curve" project and prioritize on-time, on-budget delivery.** The highest-value action is to treat the first large-scale project not as a standalone plant, but as the institutional foundation for the entire Polish nuclear program. Effective delivery of key milestones will be critical not only for maintaining public opinion support for subsequent investments and establishing good practices in local content and supply chain development, but also for ensuring a reliable contribution of nuclear power to Poland's electricity mix in the late 2030s and early 2040s.

2) **Ensure that the future energy mix scenario fully reflects the role of nuclear energy. It is crucial to design a forward-looking energy mix scenario that takes into account both the benefits and limitations of different generation technologies.** This should translate into a more explicit and consistent inclusion of nuclear energy within Poland's strategic planning framework. Currently, some key policy documents remain outdated (e.g. PEP2040), while others are not fully aligned. Continued expansion of renewables and gas-fired capacity - particularly under lower electricity demand scenarios - may, if not properly coordinated, lead to a market crowding effect. This could result in nuclear units operating at persistently low capacity factors or facing low capture prices, ultimately undermining their economic viability.

3) **Build a repeatable financing framework for projects beyond the first plant - particularly for FOAK SMRs.** Financing conditions are a critical determinant of nuclear project economics. This is especially evident given that many stakeholders express concerns regarding first-of-a-kind (FOAK) investments. For SMRs, Poland should define a clear and stable framework for state support - such as co-financing, state guarantees, or other risk-sharing mechanisms - that can enable investment while remaining compliant with EU state aid rules. In practice, this should prioritize instruments such as loan guarantees, CfD-style revenue stabilization mechanisms where justified, and cooperative financing models (e.g. Mankala/SaHo) tailored to industrial off-takers. Tailoring the support schemes to a coalition of companies (such as special economic zones) could ensure that SMRs would not be limited to the participation of a few of the biggest nationwide companies.

4) **Treat SMRs as a strategic option, but not as a near-term capacity solution.** While experts do not reject SMRs, they remain skeptical regarding their deployment speed, economic viability, and institutional readiness. Survey results indicate that 56% of respondents assess the probability of Poland exceeding 5 GWe of SMR capacity by 2050 as low or very low, and industry stakeholders consistently highlight uncertainty

around actual costs and delivery timelines. Moreover, SMR technologies have historically faced delays in the first-project deployment that for most projects is currently announced for late 20s and early 30s. For decision-makers, this implies that national adequacy planning for the 2030s should not rely on SMRs as a primary capacity source. Instead, SMRs should be advanced through a market development strategy - focused on a limited number of credible technologies, with a clear roadmap for industrial and district heating and cogeneration applications, and site selection driven by proximity to real demand clusters.

5) **Introduce targeted upgrades to the regulatory framework.** Even though the current national regulatory framework is considered quite well adjusted to nuclear investments, selected, well-defined regulatory adjustments could materially accelerate nuclear project delivery without compromising safety standards. In particular, the following measures should be considered:

    a) **Broader use of English in technical documentation**, with controlled translation requirements where necessary, to reduce bottlenecks and better reflect the realities of the international nuclear supply chain;

    b) **Enhanced cooperation between the Polish regulator and experienced foreign regulatory authorities**, enabling joint or parallel review processes for new technologies - drawing on models used in the aviation sector;

    c) **Introduction of early works permits**, allowing construction of auxiliary infrastructure to begin prior to the issuance of the final building permit, thereby shortening the overall project timeline.

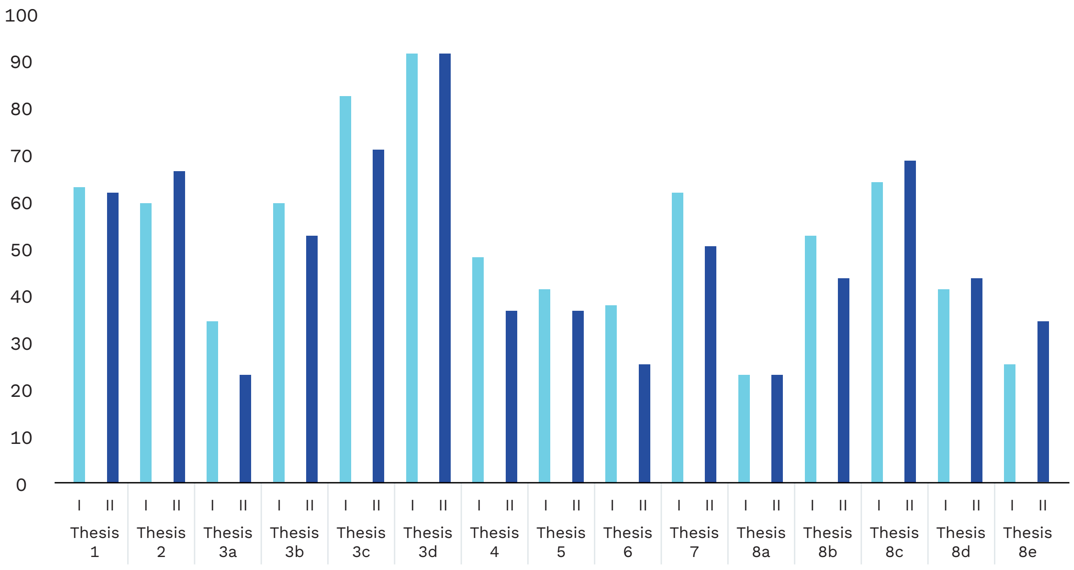
6) **Consider orderbooks, primarily at the national level.** Coordinated procurement through orderbooks could offer cost and standardization benefits. However, EU-level implementation remains uncertain and should be treated as an upside rather than a base-case scenario. Poland should not rely on EU-wide initiatives or multinational buyer coalitions to address cost and deployment challenges. Instead, a national coordination approach could be pursued - potentially involving the selection of one or two preferred SMR technologies for public support once sufficient technological maturity is achieved. In parallel, Poland may engage in “coalitions of the willing” to advance regulatory harmonization and supply chain cooperation. However, the domestic program should be structured to remain viable even in the absence of EU-level orderbooks.

7) **Closely monitor and mitigate risk regarding workforce constraints**, including shortages in construction and engineering competences, as the nuclear sector will compete for talent both internationally and with other domestic sectors, notably renewables.

Appendix

Only 11 participants of the 1st round took part in the 2nd round. Comparison of this group shows that the results of 1st and 2nd round were quite similar. Interesting exceptions were thesis 3a (At least 20% of Poland's annual electricity demand will be covered by nuclear power up to 2040) where the probability indicator fell from 34 to 23, thesis 3c (At least 20% of Poland's annual electricity demand will be covered by nuclear power up to 2050 – drop from 82 to 70), thesis 8b (EU nuclear capacity will remain at the similar level to current's one – drop from 52 to 43) and 8e (the EU nuclear capacity will achieve at least 200 GW – increase from 25 to 34).

Figure 26. Probability indicator comparison between both rounds participants



Source: PEI based on own survey.

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