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Legal aspects of small modular reactors in Polish nuclear law

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Abstract: There is currently urgent need for polish companies to implement new decarbonisation strategies, and introducing nuclear energy might become an essential part of the equation. Small modular reactors, which will be commercially operational in the 2030s might be of particular interest, as they can provide clean, zero-emissional energy. The aim of this paper is to find the answer to question of whether small modular reactors could become an important part of the future energy mix in Polish industry. The analysis was conducted using the legal comparative method. In the course of his analysis the author concludes that small nuclear reactors could indeed be implemented in Poland. In the closing part of this paper author proposes legal and legislative actions to adapt the existing domestic nuclear law to the specificity of small modular reactors, and includes a comprehensive indication of the main directions of activities of the Polish government aimed at the development of small modular reactors.

Prawne aspekty małych reaktorów modułowych w polskim prawie energii jądrowej

Abstrakt: Polskie przedsiębiorstwa pilnie potrzebują przyjęcia nowych strategii w celu dekarbonizacji. Aby to osiągnąć, niezbędne może stać się wdrożenie energetyki jądrowej. W szczególności małe reaktory modułowe, które mają być komercyjnie dostępne w latach trzydziestych XXI wieku mogą dostarczyć czystej, zeroemisyjnej energii. Celem tego artykułu jest znalezienie odpowiedzi na pytanie, czy małe reaktory modułowe mogą stać się ważną częścią przyszłego miksu energetycznego w polskim przemyśle. W artykule zastosowano metodę prawnoporównawczą. W jej wyniku autor doszedł do wniosku, że małe reaktory modułowe mogą być wdrożone w Polsce. W podsumowaniu artykułu autor zaproponował prawne oraz legislacyjne działania, których celem może być dostosowanie krajowego prawa energii jądrowej do specyfiki małych reaktorów modułowych, włączając w to przekrojowe wskazanie głównych kierunków rozwoju działań polskiego rządu w kierunku rozwoju małych reaktorów modułowych.

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Introduction: The international nuclear law regime

In 2021, after combating the major economic recession induces by the coronavirus pandemic, electricity demand in European countries is higher than ever. The rebuilding economy needs stable power sources to operate in the difficult reality of the common market in the European Union. Until 2016, when a postulate to reduce global greenhouse emission was included into the Paris Agreement, acknowledging environmental issues was somewhat less important than covering the electricity baseload in the economies of the Old Continent. However, in the last five years, environmental and climatic aspects have become more and more essential in national policies. The European Union set the ambitious goal for Europe to become the first climate-neutral continent in 2050 with relevant strategic documents and legislative proposals.[1] This means that traditional sources of energy based on fossil fuels, which were fundamental in the previous industrial revolution, are set to be gradually phased out. That approach leads to closing power plants powered with hard and brown coal together with oil and natural gas. Renewable energy sources, mainly onshore and offshore wind farms, coupled with solar panels, are to be the main power sources in this transition to a zero-emission economy due to take place in less than 30 years.[2] Hydropower stations, although being non-emissive, have major environmental issues, so setting the new capacity for hydro could be problematic and dangerous, but facilities of that type that are currently in operation are valuable assets in reaching climate goals for countries where the natural characteristics are suitable for this source type.

However, renewable energy sources are dependent on constantly changing weather conditions, the predictions of which are not sufficiently accurate for the amount of electricity produced over a fixed period. To guarantee satisfying electricity demand in a stable and reliable way, a fundamental need arises to produce electricity in conditions where the sun is not shining and the wind is not blowing. As a result of a comprehensive analysis of the aspects of the Polish energy mix in the current situation and in the 2040 perspective, certain sources can be identified as more important than others. Before that, it is necessary to state that renewable energy sources will have a fundamental role in the future energy mix by providing effective, clean, and economically competitive electricity. Unfortunately, wind and solar-powered sources have to be backed by stable, reliable sources that could diminish the risk of blackouts or brownouts, which pose a serious danger to the economy. The options to produce and store high amounts of energy that are currently available (and will continue to be so in the near future) include coal, natural gas, hydro, batteries, hydrogen caverns, and nuclear reactors. Coal, both hard

[1] European Commission, *The European Green New Deal*, COM(2019) 640 final, Brussels 2019.

[2] European Commission, *A Clean Planet for All: European Strategic Long-Term Vision for a Prosperous, Modern, Competitive, and Climate Neutral Economy*, COM2018 773 final, Brussels 2018.

and brown, is being withdrawn from the current and future energy policy in the EU due to high emission processing, contamination, and pollution. Hydroelectricity is environmentally unsafe and geographically limited to the countries that have natural indicators for siting this type of source. Batteries, due to losing energy in extended operational time and scalability are unavailable to be sized-up to the national electricity demand level and complexity. Natural gas in the European Union is considered a bridging source, covering baseload during the transition period. However, in the Autumn/Winter 2021/2022 season, the energy crisis caused by unsatisfactory filling of natural gas storage facilities and diminished shipments from suppliers caused a sharp increase in natural gas prices, leading to a dangerous situation for the European Union's energy security. This situation created the necessity for reflection. Natural gas is considerably less emissive than coal, but the amount of carbon dioxide released to the atmosphere is still significant compared with other energy sources. In the cost analysis of the CCGT power plants, the proportion of capital cost of natural gas as a fuel source to the power plant is estimated at 80%.[3]

All energy sources have their advantages and disadvantages. It is important for each country to acknowledge all possibilities and the characteristics of its domestic energy system in order to obtain the most comprehensive and functioning energy mix.[4] In the Polish reality, the current energy mix is determined by high-emission energy production from coal, therefore the starting point to any energy system transformation is difficult and requires a particular approach. Specifically, the primary goal of transitioning to climate neutrality requires a set of actions required to reconstruct the new energy system. This approach, expressed in Polish Energy Policy to 2040, is based on offshore and onshore wind and solar panels with additional stabilization of the energy grid provided by natural gas and nuclear power. Nuclear power is recognized in PEP2040 as a reliable, stable, and non-emissive power source, which could produce energy during an extended period and deliver clean electricity as a constant baseload of the energy system. The programme indicates that nuclear power plants constructed in accordance with PNPP propositions should be constructed according to one reactor technology — specifically with large-scale light water reactors, which are safe and internationally proven. In general, a trend can currently be observed in the European Union which was dubbed the European Nuclear Renaissance — a change of policy direction from the commonly held view that nuclear energy should be graudally phased out into recognizing of this type of energy source as an important part of the future energy mix.[5]

[3] Based on *Polish Nuclear Power Programme*, Warszawa 2020, p. 59. The document can be found as an attachment in "PAA in the Polish Nuclear Power Programme", National Atomic Energy Agency, https://www.gov.pl/web/paa-en/Polish-Nuclear-Power-Program (accessed: _18.04.2023).

[4] *Road to EU Climate Neutrality by 2050: Spatial Requirements of Wind/Solar and Nuclear Energy and Their Respective Costs*, K.M. Brouwer, L. Bergkamp (eds.), Brussels 2021, p. 155.

[5] More about safety of nuclear energy: S. Abousahl et al., *Technical Assessment of Nuclear Energy with Respect to the 'Do Not Significant Harm' Criteria of Regulation EU 2020/852 ('Taxonomy Regulation')*, JRC125953, Brussels 2021.

1. Small modular reactors — nuclear safety and nuclear security aspects

Alongside governmental plans to create a domestic nuclear sector based on *big nuclear*, private investors had announced their plans to introduce their own nuclear power plants. Small modular reactors (also abbreviated as SMRs or SMR) are reactors with an electrical output below 300 MWe that strongly rely on serial, factory-based production of reactor modules.[6] SMRs, being less expensive than large reactors lowers the financial risk of investing a large amount of money, particularly in a market where the cost of energy production by other sources may decrease.[7] The flexibility of siting locations is also favorable to SMRs, as it allows to reduce initial costs. Moreover, small modular reactors are attractive when the financial resources are limited or when self-financing is preferable, and they benefit from "the economy of multiples" when built sequentially.[8] What is also important is the fact that social acceptance for introducing this solution, which plays a fundamental role among the stated goals of the small modular reactors implementation strategy, is much easier to achieve, because the population generally sees SMRs as not as expensive as large-scale reactors, possessing a significantly smaller environmental impact, and as a great addition to renewable energy sources; and overall there is general support for the idea of them functioning as a baseload in the energy system mix. Introducing SMRs in to the national energy strategy is also vitally important for nuclear safety and nuclear security reasons.

The most important area in industry where SMRs can be extremely important as the answer to decarbonization strategy principles is the cover of a base-load electricity demand.[9] In the present day big companies which operate in chemical production or manufacturing of raw materials require a source of electricity that can be adjusted to the demand of operating in a stable timeframe regardless of weather conditions and provide energy when it is needed without fluctuation. This role is currently fulfilled by fossil fuel-powered energy plants. These energy power sources produce a significant amount of carbon dioxide emissions and require great amounts of coal. However, coal-powered plants can be scaled down to meet the electricity needs of the companies that are below 1000 MWh, which is the common

[6] NEA OECD, *Small Modular Reactors, Nuclear Energy Market Potential For Near-Term Deployment*, NEA no. 7213, Paris 2016, p. 15; IAEA, *Advances in Small Modular Reactors Technology Developments, in International Atomic Energy Agency*, Vienna 2020, p. 1.

[7] E.M.A. Hussein, "Emerging small modular nuclear power reactors: A critical review", *Physics Open* 5, 2020, art. 100038; G.A. Black, F. Aydogan, L.C. Koerner, "Economic viability of light water small modular reactors: General methodology and vendor data", *Renewable and Sustainable Energy Reviews* 103, 2019, pp. 248–258.

[8] G. Locatelli, C. Bingham, M. Mancini, "Small modular reactors: A comprehensive overview of their economics and strategic aspects", *Progress in Nuclear Energy* 73, 2014, pp. 75–85.

[9] G. Locatelli et al., "Cogeneration: An option to facilitate load following in small modular reactors", *Progress in Nuclear Energy* 97, 2017, pp. 153–161.

electrical output of large-scale nuclear power plants. Small modular reactors can be seen as the most suitable option for major industry companies in Poland. Executive authorities of Synthos S.A., one of the country's biggest producers of raw chemical materials came to similar conclusions. Michał Sołowow, CEO of Synthos, will be the first private investor engaged in the implementation of SMR technology in the world.[10] The company has already achieved the most important steps that are currently attainable to introduce and develop nuclear power in Poland. Moreover, this entity conducted research and economic studies, which point to the BWRX-300, the boiling water reactor with an electrical output in the range of 300 MWe, as the most suitable choice. Electricity and heat generated by the BWRX-300 are seen as comparedable to gas-based power plants and energy produced from renewable energy sources. This electrical output, about 300 MWe, could be recognized as comparable with energy sources and meet the needs of major industrial companies in Poland. Moreover GEH, the producer of BWRX-300 expects it to require up to 60% less capital cost per megawatt when compared to other water-cooled SMR with an estimated cost of construction about one billion dollars.[11]

On the other hand, a solution also exists for smaller Polish companies that don't have such high electricity needs or cannot make such great expenditures as the major players in the market, but also want to be climate neutral, be less emissive or have a smaller environmental impact. Small modular reactors operate in various types of electrical output that can be sized down to a few MWe. Their biggest issue is that according to publications by the International Atomic Energy Agency there are over 70 types of SMRs worldwide.[12] To extend the scale effect and lower the cash outlays in the projects this excess of options has to be narrowed down to the few most promising technologies. The private sector in Poland aims to be in the forefront of small nuclear reactors technology, and with that objective

[10] In 2019 Synthos S.A. announced the signing of Memorandum of Understanding and in 2020 the Study Assessing of Feasibility. The company is currently working on the roadmap to the whole project. All information is provided from press releases, for more studies see "SGE and Exelon Generation completed the works on deployment feasibility study", Synthosgroup.com, 11.12.2020, https://www.synthosgroup.com/en/synthos-group/news/news/synthos-green-energy-wraz-z-exelon-generation-zakonczyli-prace-nad-studium-wykonalnosci-dla-reaktora-bwrx-300 (accessed: 18.04.2021). See also "Study completed on BWRX-300 deployment in Poland", Nuclear Newswire, 22.12.2020, https://www.ans.org/news/article-2497/study-completed-on-bwrx300-deployment-in-poland/ (accessed: 18.04.2021).

[11] B. Godusławski, "Michał Sołowow postawi elektrownię atomową w Polsce [NEWS DGP]", Dziennik.pl, 21.10.2019, https://gospodarka.dziennik.pl/news/artykuly/610825,elektrownia-atomowa-polska-michal-solowow-synthos-ge-hitachi-nuclear-energy.html (accessed 18.04.2021). The economic studies depend on many varying factors, so the final cost will be known after the construction of the nuclear power plant with the first-of-a-kind reactor will be finished.

[12] "Small nuclear power reactors", World Nuclear Association, https://www.world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-power-reactors/small-nuclear-power-reactors.aspx (accessed 18.04.2021).

in mind it started to work with international partners on the development of micro modular reactor technology.[13] This type of SMR is estimated to produce under 5 MWe of electrical output with 15 MWth of thermal output. The estimated lifespan of a nuclear power plant is 20 years, compared to the commonly estimated time of 60 years with an extension option. Most importantly, the basic operational temperature of the reactor at this output should be about 630 Celsius degrees,[14] which is sufficient for cogeneration purposes.

It is worth pointing out that there exists a high possibility of SMRs attracting investment interest from other entities (both private and public). These companies could simply have the resources, standing, or internal strategies to make financial efforts to cooperate with international partners in technological aspects.[15] In that case, every nuclear power plant project has to fulfill one key fundamental rule of the international nuclear energy law regime — nuclear safety and nuclear security, first and foremost. After Fukushima Daiichi, basic norms in these two standards became stricter than before, putting pressure on constructors of nuclear reactors to prevent a similar nuclear accident from happening in the future. This safety regime raises the entry threshold for future nuclear power plants, which in the case of Poland means that the rules can only be met by the state. However, the rules can be changed without compromising the adherence to maintaining the highest possible level of nuclear safety and nuclear security.

> While all safety features of SMRs generally could be addressed within the existing regulatory framework, there are issues that must be resolved. In particular, current regulatory practices might not be fully compatible with a factory assembly mode, especially if the assembly mode process is automated. Regulators must adapt their work to test the units to the greatest extent possible at the assembly stage and reduce the potential for rework.[16]

However, it is important to indicate significant differences of certain technological aspects in the small modular reactors sector. SMR is the common framework name for over 70 propositions of nuclear reactors currently under development or in earlier stages around the world. Therefore, these projects are different from each other in areas such as electrical output, type of coolant, temperature output, size, and many more. In this article, the author indicates several technologies of nuclear reactors relevant to near-term deployment in Poland, based on the current policy strategies of public and private companies. As such, the current plans amount to introducing two types of reactors: light water reactors with an estimated installed

[13] "Ultra safe nuclear corporation partners with Synthos Green Energy", Synthosgroup.com, 4.11.2020, https://web.archive.org/web/20210301153424/https://www.synthosgroup.com/en/synthos-group/news/news/ultra-safe-nuclear-corporation-nawiazala-wspolprace-z-synthos-green-energy (accessed 18.04.2020).

[14] IAEA, *Advances in Small Modular Reactors Technology Developments*…, pp. 303, 323.

[15] P. Zawadzki, "Nowy jedwabny szlak — szanse czy zagrożenia?", [in:] *Bezpieczeństwo Azji w XXI wieku — wybrane aspekty*, W. Śmiałek, Ł. Kominek (eds.), Poznań 2021, pp. 142–153.

[16] NEA OECD, *Small Modular Reactors, Nuclear Energy Market Potential*…, p. 66.

power capacity around 300 MWe in a single BWRX-300 unit or in the currently acquired 77 MWe NuScale reactor in a single unit. The second type of reactor is a highly-specialized micro modular reactor in high-temperature gas-cooled reactor technology with an electrical output of around 5–10 MWe. Micro modular reactors are treated as a sub-category of SMRs due to their lower electrical output and simplified technological aspects, which translates to smaller dimensions. In accordance with current information, there are no plans for introducing Poland's floating nuclear power plants or transportable nuclear power plants. This information will be relevant in a later part of this article.

2. Small modular reactors — a new challenge to nuclear law

Small nuclear reactors are significantly different from currently existing large-scale reactors in terms of exploitation. Moreover, the fundamental technical and construction characteristics of SMRs require tailor-made legal approaches to various types of actions in all stages of its lifetime in various environmental and regulatory aspects. However, before these legal challenges will be addressed in this article, it is necessary to state that the relationship between international and domestic nuclear law has a unique character compared to other fields of law. In general, the development of international nuclear law is inevitably connected with nuclear accidents such as the Three Mile Island accident, the Chernobyl disaster, or the Fukushima Daiichi incident. These situations have been resonating into nuclear law for decades, and therefore fundamentally determined the current focus on nuclear safety and nuclear security. However, this approach resulted in a situation in which international nuclear law can be described as "reactive" rather than "proactive". It is importand to recognize, however, that in the area of nuclear law there is a constant need for improving nuclear safety and security, and that only incidents or stress-tests are able to realistically verify the essential adjustments needed for improving accident protection.[17]

The abovementioned unclear dichotomy of approaches in international nuclear law are revealed in relation to small modular reactors. As was said before, SMR is only a technical, abstract name for many different technologies grouped together under the same general description and title. There are two legal regimes in international nuclear law that strongly affect the domestic frameworks of the Member States. First and foremost, there are several international, legally binding conventions which regulate fundamental principles of nuclear law. Secondly, certain soft law documents can be pointed to as, so to speak, being "in the regime" of international nuclear law. These non-binding proposals, safety guidelines, assessments, expert mission reports, technical documents, and codes of conduct are generally

[17] S.G. Burns, "The impact of major nuclear power plant accidents on the international legal framework for nuclear power", *Nuclear Law Bulletin* 101, 2018, no. 2, pp. 7–30.

adopted under IAEA auspices. Moreover, the *Nuclear Law Bulletin* published under the umbrella of the OECD Nuclear Energy Agency hold considerable sway in the field and provide useful insights and influential expert point of view. Soft law norms can be described as relevant to legal-binding certainty of hard law. Therefore, soft law could have significant value to provide fundamental obligations and non-binding liability compliance in nuclear safety and security area.

As was stated before, international nuclear law in the last 50 years can be viewed as a combination of both soft law and hard law legal systems, which created a comprehensive nuclear law regime. The aforementioned accidents resulted in new conventions, treaties, and soft law documents. The conclusions listed above can be summed up thusly — international nuclear law is reactive, not proactive, and is created as a response to the insufficient development of certain aspects of nuclear technology.

However, the current situation presents a once-in-lifetime opportunity to revise this trend and adopt several non-binding documents and adjust existing binding conventions to create a legal framework before new technology can be commercially developed. As described above, the unique characteristics of international soft law and its relation with domestic nuclear law regimes allow the establishing of national regulatory and legal frameworks before small modular reactors will be commercially available. These actions would bring two significant advantages. Firstly, the establishment of enhanced domestic law could result in the certainty of law and therefore set a clear framework of rules in which public and private investors are potentially able to cooperate and act with a decreased level of investment risk that could arise from uncertain legal provisions. The second advantage of these actions is the setting of exemplary precedent provisions, which other countries could recognize as reference points for their nuclear law regimes.

Particularly with regard to small modular reactors, there are significant legal aspects where the current legislative framework is not comprehensive enough or is extensively bloated. These difficulties originate in the current dichotomy existing in international nuclear law, especially the binding conventions, of which the Convention on Nuclear Safety is the most comprehensive.[18] The scope of this act includes "nuclear installations" defined as any land-based civillian nuclear power plant under its jurisdiction.[19] It is therefore important to distinguish the second part of the abovestated dichotomy in international nuclear law — soft law documents. International organizations are able to publish non-binding documents, which nonetheless have a significant influence on the interpretation of particular legal norms.[20] For example, there are discussions in the doctrine on whether all

[18] Convention on Nuclear Safety (1994), IAEA doc. INFCIRC/449, 1963 UNTS 293, entered into force 24 October 1996 (CNS).

[19] Article 2(i) of the CNS.

[20] H. Blix, "The role of the IAEA in the development of international law", *Nordic Journal of International Law* 48, 1989, no. 3–4, pp. 231–242.

types of SMRs are covered by these conventions, or if specific small modular reactors should be excluded from under scope of the CNS.[21]

Moreover, the Polish nuclear law regime shows a signficant influence of legally binding EU norms, which comes from transposition of relevant EU and Euratom directives. Two directives in particular address the issue of small modular reactors, both of which define the term *nuclear installation* similar to the CNS convention: the 2009 Euratom Safety Directive[22] and its 2014 amendment.[23] The main problem with the current nuclear law regime in Poland is the fact that the requirements in the area of nuclear safety and security area, the licensing process, and a number of different permits and licences that investors have to obtain are tailored to large-scale energy reactors in nuclear power plants that provide baseload electricity demand in the national level of the energy mix. However, small nuclear reactors have fundamentally different characteristics than large-scale reactors, would be deployed for different purposes, and on the the investment process level, will be implemented by private and public entities, not a governmental company. Therefore, a unified approach to small modular reactors should be established in the Polish legal framework.

The nuclear law legal framework in Poland, in which the Atomic Law Bill is the most important act, currently distinguishes between "nuclear facilities" and "nuclear energy facilities".[24] Therefore, as a result of the analysis of the legal norms in comparison with policies that were already introduced, a strong connection between established legislation and a strategy to introduce nuclear power plants in Poland can be observed. However, the NCBJ utilize research reactors which are excluded from CNS convention and only quasi-regulated by a non-binding Code of Conduct on Research Reactors.[25]

Small modular reactors will generally be constructed in factories, and after that located in nuclear power plant sites. This approach is fundamentally different from the current licensing practice of regulatory organs, according to which every nuclear power plant project has unique characteristics, and the technical aspects

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[21] In particular see: NEA OECD, *Small Modular Reactors: Challenges and Opportunities*. Currently, legal problems on classification floating nuclear power plants and transportable NPPs can create some difficulties, these options are not discussed in this article due to the lack of probability of deployment of these types of nuclear power plants in Poland.

[22] Council Directive 2009/71/Euratom of 25 June 2009 establishing a Community framework for the nuclear safety of nuclear installations, Official Journal of the European Union (OJ) L 172 (2 July 2009) (2009 Safety Directive).

[23] Council Directive 2014/87/Euratom of 8 July 2014 amending Directive 2009/71/Euratom establishing a Community framework for the nuclear safety of nuclear installations, OJ L 219 (25 July 2014) (2014 Amended Safety Directive).

[24] For more information see: J. Gierszewski, et al., "Nuclear power in Poland's energy transition", *Energies* 14, 2021, art. 3626.

[25] For the full text of the Code of Conduct see: IAEA, *Code of Conduct on the Safety of Research Reactors*, IAEA doc. IAEA/CODEOC/RR/2006, Vienna 2006, p. 1.

of which should be tailored to the specific regulations and conditions of the state where the nuclear energy reactor will be built. There is, however, a discussion of a slightly different approach to the SMR field — one which would require a new licensing process. Regulatory organs would have to adjust their actions at an earlier stage of the licensing process.

There are currently three options on the table, all of which have their advantages and disadvantages. The first option is that the licensing process will be conducted separately with regard to every single factory-made nuclear reactor, as things currently stand in the Atomic Act Bill. This option requires an unproportionally extensive number of actions and a substantial amount of permits granted for investors, which could be either private or public entities (but not state-owned companies), and could result in significant delays in the investment process. The schedule to combat climate change and to secure a decrease of emissions is essential in Polish coal-powered reality.

The second option is to transfer the bulk of the licensing process to the vendor — the company where small modular reactor modules are produced — and then, in cooperation with the regulatory authority of the country of origin, establish a common pattern of actions, which could potentially result in permit licensing for a technology provider company. This approach requires a highly effective cooperation with another regulatory authority to obtain the maximum possible level of safety and certainty in peer-reviewed quality control mechanisms. Moreover, this approach could potentially accelerate the construction of small nuclear reactors in Poland, where an investor would have to obtain fewer approvals and licensing than in the first option.

The last option is to transfer the entirety of small modular reactors licensing process to Euratom. This is a variant of the bilateral approach described above and is determined by the trans-national level of cooperation and unification. The European Atomic Energy Agency could potentially establish a multinational common legal framework for small nuclear reactors and with the unification of approaches on the national level, ensure a high standard of nuclear safety and nuclear security. A current trend in the European Union to reintroduce nuclear energy as a reliable, stable, and low-emission source of energy could go two ways. One is to provide a vast amount of clean energy from large-scale nuclear reactors. The second approach is to create a comprehensive, unified code of conduct to deploy a fleet of small modular reactors to the specialized purposes, for example in industry, or to produce clean hydrogen, recognized as a future source of energy.

Conclusions

Commercial deployment of small modular reactors is expected around 2030. In Poland, the governmental strategy objective is to build 6–9 GW of installed

power capacity in nuclear energy. However, nuclear energy could resolve problems in other sectors of Poland's economy, in particular, the high-emission heavy industry sector, private energy producers, the district heating sector, and many more.[26] There are entities in these sectors that do not have the ability to construct large-scale reactors, because in most countries this type of investment is realized at the national level. Small modular reactors are thus revealed as a cost-effective solution to the issue of carbon dioxide emissions. SMRs could be affordable for large entities and act as an economic incentive. Nevertheless, in the current nuclear law framework, commercial deployment and licensing process is highly ineffective in the area of small modular reactors due to a lack of legal procedures on the national level. Moreover, there are currently no existing comprehensive guidelines and codes of conduct on an interpretation of international conventions and soft law documents (which could be a point of reference to the national authorities) in international nuclear law. We are currently facing an unprecedented opportunity to create an international nuclear law framework tailore-made for small nuclear reactors and enhance the development of this type of reactors and act proactively instead of reactively.

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[26] K. Värri, S. Syri, "The possible role of modular nuclear reactors in distric heating: Case Helsinki region", *Energies* 12, 2019, art. 2195, p. 19.

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