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DRAFT REPORT

Small modular reactors
(2023/2109(INI))

Committee on Industry, Research and Energy

Rapporteur: Franc Bogovič

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MOTION FOR A EUROPEAN PARLIAMENT RESOLUTION

Small modular reactors
(2023/2109(INI))

The European Parliament,

– having regard to the Treaty on the Functioning of the European Union (TFEU), and in particular to Article 194 thereof,

– having regard to the Treaty establishing the European Atomic Energy Community,

– having regard to the agreement adopted at the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change in Paris on 12 December 2015 (the Paris Agreement),

– having regard to the Commission proposal of 16 March 2023 for a regulation of the European Parliament and of the Council establishing a framework for ensuring a secure and sustainable supply of critical raw materials and amending Regulations (EU) 168/2013, (EU) 2018/858, 2018/1724 and (EU) 2019/1020 (COM(2023)0160),

– having regard to the Commission proposal of 16 March 2023 for a regulation of the European Parliament and of the Council on establishing a framework of measures for strengthening Europe's net-zero technology products manufacturing ecosystem (Net Zero Industry Act) (COM(2023)0161),

– having regard to Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU[1], which is currently being revised,

– having regard to Regulation (EU) 2019/943 of the European Parliament and of the Council of 5 June 2019 on the internal market for electricity[2], which is currently being revised,

– having regard to Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy[3], which is currently being revised,

– having regard to Regulation (EU) 2019/941 of the European Parliament and of the Council of 5 June 2019 on risk-preparedness in the electricity sector and repealing Directive 2005/89/EC[4],

[1] OJ L 158, 14.6.2019, p. 125.
[2] OJ L 158 14.6.2019, p. 54
[3] OJ L 327, 22.12.2000, p. 1.
[4] OJ L 158, 14.6.2019, p. 1.

– having regard to Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088[5] (EU Taxonomy Regulation),

– having regard to Commission Delegated Regulation (EU) 2019/856 of 26 February 2019 supplementing Directive 2003/87/EC of the European Parliament and of the Council with regard to the operation of the Innovation Fund[6],

– having regard to Commission Delegated Regulation (EU) 2022/1214 of 9 March 2022 amending Delegated Regulation (EU) 2021/2139 as regards economic activities in certain energy sectors and Delegated Regulation (EU) 2021/2178 as regards specific public disclosures for those economic activities[7] (Complementary Climate Delegated Act),

– having regard to Council Directive 2009/71/Euratom of 25 June 2009 establishing a Community framework for the nuclear safety of nuclear installations[8], as amended by Council Directive 2014/87/Euratom of 8 July 2014[9],

– having regard to Council Directive 2011/70/Euratom of 19 July 2011 establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste[10],

– having regard to Council Directive 2013/59/Euratom of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom[11],

– having regard to the Commission communication of 1 February 2023 entitled ‘A Green Deal Industrial Plan for the Net-Zero Age’ (COM(2023)0062),

– having regard to the Commission communication of 18 May 2022 entitled ‘REPowerEU Plan’ (COM(2022)0230),

– having regard to the Commission communication of 10 March 2020 entitled ‘A New Industrial Strategy for Europe’ (COM(2020)0102),

– having regard to its resolution of 19 May 2021 on a European strategy for energy system integration[12],

– having regard to its resolution of 10 July 2020 on a comprehensive European approach to energy storage[13],

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[5] OJ L 198, 22.6.2020, p. 13.
[6] OJ L 140, 28.5.2019, p. 6.
[7] OJ L 188, 15.7.2022, p. 1
[8] OJ L 172, 2.7.2009, p. 18.
[9] OJ L 219, 25.7.2014, p. 42.
[10] OJ L 199, 2.8.2011, p. 48.
[11] OJ L 13 17.1.2014, p. 1.
[12] OJ C 15, 12.1.2022, p. 45.
[13] OJ C 371, 15.9.2021, p. 58.

– having regard to its resolution of 14 March 2019 on climate change – a European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy in accordance with the Paris Agreement[14],

– having regard to the Commission communication of 11 December 2019 on the European Green Deal (COM(2019)0640),

– having regard to its resolution of 15 January 2020 on the European Green Deal[15],

– having regard to its resolution of 15 December 2015 on Towards a European Energy Union[16],

– having regard to the proposal for a European small modular rector partnership, resulting from the first EU workshop on small modular reactors, organised by the Commission on 29 June 2021,

– having regard to the Commission's high-level nuclear roundtable held on 15 March 2022,

– having regard to the Commission declaration of 4 April 2023 entitled 'EU Small Modular Reactors (SMRs) 2030: Research & Innovation, Education & Training',

– having regard to the Euratom Work Programme 2023-2025 for nuclear research and training,

– having regard to Rule 54 of its Rules of Procedure,

– having regard to the report of the Committee on Industry, Research and Energy (A9-0000/2023),

A. whereas the EU is a party to the Paris Agreement and has committed to reducing greenhouse gas emissions by at least 55 % by 2030 compared to 1990 levels and to achieving climate neutrality by 2050;

B. whereas the EU must mitigate its own risks of external dependence in terms of energy supplies;

C. whereas the innovative developments in nuclear power technology, particularly small modular reactors (SMRs), represent a promising pathway towards achieving the Union's energy and climate objectives and offer considerable opportunities in terms of electricity production, industrial heat, hydrogen generation and district heating;

D. whereas SMRs offer a lower initial capital investment, greater scalability and siting flexibility for locations unable to accommodate more traditional larger reactors, and now have the potential for enhanced safety and security compared to earlier designs;

[14] OJ C 23, 21.1.2021, p. 116.
[15] OJ C 270, 7.7.2021, p. 2.
[16] OJ C 399, 24.11.2017, p. 21.

E. whereas the deployment of SMRs can help drive economic growth, create jobs and contribute to the EU's global competitiveness in this rapidly developing sphere of technology;

F. whereas the Commission, in its declaration of 4 April 2023 on EU SMRs 2030, welcomed the collaborative efforts of the European nuclear industry and scientific community to achieve the common goal of a modern, resource-efficient and competitive economy and recognised that nuclear, and particularly SMRs, can play an important role even beyond electricity production;

G. whereas the Commission has emphasised that nuclear and radiation protection expertise is needed across the Member States to ensure the safety, security and safeguarding of existing and future nuclear power plants, including SMRs, industrial and medical applications and space exploration initiatives;

1. Welcomes the Commission declaration on EU SMRs 2030, which emphasises the role of research, innovation, education and training in the safety of SMRs in the EU and the need for all sectors to contribute to the transformation of the EU's economy to achieve climate neutrality, energy security and strategic autonomy;

2. Underlines the potential of nuclear power and SMRs in contributing to the EU's clean energy goals;

3. Calls for the development of a comprehensive strategy for the deployment of SMRs in the EU, taking into account the specific needs and circumstances of different regions and sectors;

4. Acknowledges the socio-economic impacts arising from the deployment of SMRs in terms of highly qualified jobs and high added-value companies created in the EU;

The EU as a significant potential market for SMRs

5. Acknowledges that SMRs have the potential to play a significant role in replacing fossil fuels[17];

6. Encourages the use of SMRs for low-carbon hydrogen production;

7. Recognises the potential role of SMRs for industrial heat production;

8. Acknowledges the potential of SMRs for district heating;

Global race for leadership in the future SMR market

9. Emphasises that so far, no SMRs have been commercially operated in the world, but that more than 80 SMR designs are currently at different stages of development and deployment in 18 countries; stresses that the EU should therefore not get left behind in the global race for leadership in the future SMR market;

[17] https://ec.europa.eu/eusurvey/runner/EuropeanSMRPrePartnership.

10. Emphasises that the European nuclear sector is a strong asset and recognises that the EU already has a high degree of expertise and experience in nuclear technologies that can be applied to the development and deployment of SMRs, with a supply chain that could generate most of the added value within Europe;

Partnership on SMRs

11. Recognises that a growing number of Member States are considering nuclear for their energy mix;

12. Recognises that as electrification is a key element in all transition scenarios, nuclear energy, as a low-carbon source of energy with a strong domestic industry, will be a necessary part of the solution;

13. Welcomes the creation of the so-called 'European SMR partnership' in the form of a collaboration scheme involving industrial stakeholders, research and technological organisations, interested customers, European regulators and the Commission;

Adapted policy and regulatory framework: technology neutrality

14. Recognises that a basic condition for SMRs to develop in the EU is to ensure that a conducive policy and regulatory framework is in place;

15. Recognises that the implementation of appropriate contractual and financial mechanisms is needed to provide long-term predictability;

16. Calls on the Commission to launch a specific industrial strategy for SMRs;

Market integration and deployment

17. Emphasises that innovation and adaptation will be key to meet SMR designers' expectations in terms of fuel cycle and waste management;

18. Emphasises that clear support from public authorities to guarantee the competitiveness of the SMR supply chain will be essential in enabling service providers to take a long-term view and accelerate their projects to meet the market window of opportunity;

Harmonisation of licensing regimes

19. Recognises that the business model of SMR producers will rely on the series effect of building a large number of similar SMRs in different countries; notes that design standardisation is key to unlocking the competitive advantages of mass production;

20. Emphasises the need to identify the elements for establishing a European pre-licensing process based on commonly accepted safety assessments in the licensing of the same SMR design;

21. Emphasises that regulatory bodies should create the conditions to ease the licensing process of SMRs;

Financial support for the domestic production of SMRs

22. Recognises the need to sufficiently explore and identify all possible options for financing European SMR production;

23. Expresses the need to place SMRs among the technologies recognised by the Net Zero Industry Act;

24. Welcomes the fact that the Euratom research and training programme already funds research projects related to the safety and licensing of SMR technologies; emphasises, however, that more coordinated funding is needed;

25. Calls for the establishment of a new joint undertaking for SMRs;

Supply chain adaptation

26. Emphasises that a robust, capable and reliable supply chain is critical for the success of mass-produced SMRs;

27. Recognises the importance of identifying the main challenges in adapting the value chain to the specific characteristics of SMRs compared with high-power reactors and the need for consultations both with vendors and a large number of supply chain suppliers;

Innovation, research and development

28. Recognises the need to define a comprehensive research and development (R&D) roadmap that meets both market expectations and safety requirements and, furthermore, to identify the experimental infrastructure required to implement this roadmap, alongside the necessary training and education programmes;

29. Emphasises that R&D should not only focus on the needs of the first generation of SMR light water reactors, expected by the beginning of the 2030s, but should also further support fourth-generation types of reactors, the so-called ‘advanced modular reactors’;

30. Recognises that increased resources for R&D in state-of-the-art nuclear power are needed;

31. Recognises the need to develop training in key nuclear construction skills;

Waste management

32. Recognises the need to provide uniform rules regarding the responsibility of SMR owners for the handling and storage of radioactive waste, as well as for the recycling of spent nuclear fuel;

Accountability and reporting

33. Stresses the need for an annual report by the Commission assessing progress in the development of SMRs;

34. Calls on the Council to demonstrate a firm commitment to contributing to the successful development of SMRs in the EU;

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35. Instructs its President to forward this resolution to the Council, the Commission, the European Economic and Social Committee, the European Committee of the Regions and the Member States.

EXPLANATORY STATEMENT

Introduction

The EU's ambition to reach net-zero emissions by 2050 is the major challenge that lays ahead of us. This objective requires a very low carbon energy system, based on both renewable and nuclear energies, the two backbones of the future energy mix.

Currently 12 out of 27 EU Member States (Belgium, Bulgaria, Czechia, Finland, France, Hungary, Netherlands, Romania, Slovakia, Slovenia, Spain, and Sweden) host nuclear power plants on their territory. Furthermore, other countries such as Poland are proposing to develop nuclear energy for the first time. In 2021, nuclear energy made up 13.1% of the EU energy mix and accounted for 25 % of all electricity produced.

The debate on nuclear energy in the EU focuses on both opportunities and challenges. Many Member States see potential in solutions offered by extending the operating of existing large nuclear power plants and the construction of new ones, alongside the development of Small Modular Reactors (SMRs). Likely to become a commercially viable nuclear product by the early 2030s, SMRs could be used for electricity production, district heating, desalination, process heat for energy-intensive industries and production of hydrogen.

Small modular reactors

Small modular reactors (SMRs) are nuclear reactors in a range of power between 10 and 300 MW. They are based on existing technologies and designed to be built in factories in a standardised modular form. They have a reduced power capacity compared to large nuclear power plants, but a major advantage is they can be factory-assembled and then shipped and installed on site. SMRs could be used inter alia for power generation in remote areas with limited grid capacity or in areas where the use of large traditional nuclear power plants may not be possible. SMRs offer savings in cost and construction time, and have reduced fuel requirements. SMRs use nuclear fission reactions to generate heat to produce energy.

One of the most important advantages of SMRs is design simplification and standardization, which can have a positive effect on the overall price of investment and can be incrementally expanded given increasing energy demand. The main challenge of SMR deployment is the uncertainty coming from the fact that designs are not yet at the advanced stage of maturity. The scientific community still needs to test and prove the expected advantages. This affects the risk perception and limits the potential size of the market. Another challenge would be establishment of a robust supply chain.

The last three years have been particularly busy in this field. Numerous initiatives have been launched: in R&D to develop new concepts, and in industry with the emergence of various designs. Public players have also been mobilised to devise a favourable financial and regulatory framework; safety authorities have invested in the field. A whole ecosystem is therefore emerging, which still needs to be consolidated, in a context of strong international competition.

The development and deployment of SMRs require a comprehensive strategy that takes into

account the specific needs and circumstances of different regions and sectors. This includes continued research and development to ensure the safety, efficiency, and cost-effectiveness of these technologies. It is also crucial to promote public awareness and understanding of the benefits and challenges of nuclear power and SMRs, ensuring transparent and inclusive decision-making processes. EU efforts in education, training, research, and innovation are key to managing radioactive waste and spent fuel and developing the technologies of tomorrow.

The OECD states that SMRs could become a commercially viable nuclear product by the early 2030s. SMR's expected use is for electricity production, district heating, desalination, process heat for energy-intensive industries (steel, ammonia, etc.) and production of hydrogen. They could support decarbonisation of hard-to-abate applications in power generation, industry, and transport sectors. To maximise the economic advantage of SMRs, it would be crucial to establish an almost global market for one design of reactor to be manufactured via mass production. That would require higher levels of regulatory harmonisation and market consolidation than exist at present.

Importance of Small modular reactors

For electricity production, SMRs present some key benefits such as a reduced initial capital investment compared to large power plants, both in terms of volume and timeframe for construction, simplified design due to their smaller size, and an industrial series effect associated with the repetitive production of SMRs in factories, thereby lowering costs. SMR also have a potential to open new markets for supply of low carbon electricity, such as isolated or remote areas, and they are adapted to small and medium sized electricity grids. In their range of power, SMRs could potentially substitute medium-sized fossil fuel power plants, such as coal-fired power plants in the EU.

In addition to low-carbon electricity production, the hybridisation capacity and size of SMRs make them a beneficial option for decarbonising certain uses or industries that, until now, rely on fossil fuels. Furthermore, SMR use can be complementary to high-power reactors (existing nuclear power plants and new build) as well as renewable energies, thanks to their small size. SMRs could alleviate grid constraints, reuse former industrial sites and thus help to limit land artificialization. They are also less demanding in terms of water-cooling systems, which, in the context of climate change, is an ever-pervasive issue.

In industry, the chemical, paper and food industries are potential outlets for the heat produced by the SMR. Other industrial sectors, such as the steel industry in combination with hydrogen production, or the production of e-fuels for the aviation and maritime sectors, are other potential market applications for SMRs. In the hydrogen sector, coupling both SMR and AMR with high-temperature electrolysers would make it possible to meet a demand for hydrogen that is set to grow by 50% between now and 2050, with excellent energy efficiency.

Declaration on EU SMR 2030 in April 2023

In June 2021, the European Commission organised first EU workshop on SMRs[1] to engage EU industrial actors and to consolidate the industrial value chain. Its tangible outcome was the proposal for the creation of the so-called 'European SMR Partnership'[2], a collaboration scheme involving industrial stakeholders, research and technological organisations, and

[1] https://www.nucleareurope.eu/wp-content/uploads/2022/12/2022-10-14_ESMRP_WorkshopPresentation.pdf.
[2] https://snetp.eu/wp-content/uploads/2022/06/SNETP-TS1-P1-Foratom.pdf#page=3.

interested customers. As a preparation phase 'European SMR pre-Partnership'[3] strives to identify conditions and constraints of safe design, construction and operation of SMRs in Europe and, once in place, its compliance with the EU legislative framework. Its Steering Committee was established in 2022 and is tasked with overseeing the drafting and rolling out of a roadmap of SMR development in Europe.

With a signature of Declaration on EU SMR 2030[4] in April 2023, the European Commission has reiterated its commitment to support research, innovation, education and training with an aim to deploy SMRs in Europe by 2030. The declaration highlights the importance of an improved regulatory framework and stakeholder involvement. It presents the SMR as 'an opportunity to further improve nuclear safety and increase the stability of the grid, complementing the higher penetration of renewables.

Challenges

Since Russia invaded Ukraine in February 2022, the European Union has focused on decreasing its dependence on imported fossil fuels. However, EU's major dependencies on Russian nuclear technology, uranium supplies and handling of spent nuclear fuel have remained largely below the sanctions radar. According to data from the World Nuclear Association[5], an industry organization, the EU sources 20 % of its natural uranium from Russia.

Another challenge are costs stemming from adapting reactors for the authorization of new fuel suppliers. These costs create an obstacle, but diversification of supply resulting from them is a way to ensure continuous operation of facilities.

In addition, some challenges still exist in validating the business case for SMRs, assuring predictable and streamlined licensing processes and frameworks, developing global supply chains to ensure profitability, identifying suitable nuclear sites and achieving a transparent dialogue model between the concerned stakeholders.

Waste management

Radioactive waste is a result of the production of electricity in nuclear power plants or the non-power-related use of radioactive materials (medicine, research, industry and agriculture). Although radioactivity decreases over time (radioactive decay), these materials can remain dangerous for thousands of years.

Radioactive wastes coming from the production of electricity in nuclear power plants is uranium mill tailings, spent (used) reactor fuel, and other radioactive wastes. Most of the waste (by volume)[6] resulting from nuclear power has a relatively low level of radioactivity. The spent fuel is considered high-level radioactive waste. Today two dominant options to manage it are reprocessing and direct disposal in deep geological repositories, or a mixture of both.

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[3] https://snetp.eu/european-smr-pre-parnership/.
[4] https://research-and-innovation.ec.europa.eu/system/files/2023-04/ec_rtd_eu-smr-declaration-2030.pdf.
[5] https://www.world-nuclear.org/information-library/country-profiles/others/european-union.aspx.
[6] https://www.eia.gov/energyexplained/nuclear/nuclear-power-and-the-environment.php#:~:text=Nuclear%20energy%20produces%20radioactive%20waste,health%20for%20thousands%20of%20years.

'Nuclear revival'?

The decision to use nuclear power lies with the Member States, while the European Commission repeatedly has committed itself to technological neutrality. When taking a decision on including nuclear in their energy mix, Member States must analyse not only the needs of the energy market but also public perception. The last Eurobarometer on nuclear energy production conducted in 2008 showed that public opinion in the EU was strongly divided, as almost identical shares of respondents expressed support (44%) and opposition (45%) to nuclear energy. The poll showed that citizens in countries with operational nuclear power plants were more likely to support nuclear energy. Recent studies[7] show that since 2019 there has been a gradual rise in support and the war in Ukraine has become a focal event increasing support for use of nuclear power in the EU.

Some Member States have been vivid supporters of nuclear energy. Apart from France, a dedicated advocate of these solutions, a strong commitment towards nuclear energy comes from Eastern Member States: Bulgaria, Czechia, Poland, Romania and Slovakia. Those countries see nuclear as a way to phase out coal and other fossil fuels. Furthermore, also Sweden recently announced it would build new nuclear power plants.

Debates on the use of nuclear became more intense in light of Russia's invasion on Ukraine. The sudden reduction of fossil fuel supplies from Russia and the rapid rise of energy prices became something of a turning point. Some countries hesitant towards the nuclear energy have turned to it out of pure necessity.

Innovation, know-how

Although SMR opportunities are developing quickly, some uncertainties remain. Therefore, clearer global support is needed to incentivize European actors to go ahead and mobilize their skills and technological know-how. This necessary global approach towards SMR deployment requires an industrial strategy in which European expertise can be focused on its areas of excellence. There is a need to structure this emerging sector at the European level to preserve the EU industry's competitiveness.

Financial support for the domestic production of small modular reactors

There is also a clear need for significant European financial support to foster innovative solutions for new reactor concepts, new fuels, an increasingly circular spent fuel management through the development of new recycling processes, and a safe and competitive logistics base.

Positive developments have been observed these recent years in the Euratom research and training programme, but many issues remain to be tackled, especially for advanced SMR concepts. The Euratom programmes only focuses on R&D activities, and its budget is very limited compared to other strategic technologies that will also play a role in decarbonizing the energy system. It is thus important for the successful development of SMRs to increase funding for the Euratom research and training programme and to give access to other European funding programmes that currently are not available for nuclear projects.

[7] https://www.robert-schuman.eu/en/european-issues/0662-a-return-to-grace-for-nuclear-power-in-european-public-opinion-some-elements-of-a-rapid-paradigm.

ANNEX: LIST OF ENTITIES OR PERSONS FROM WHOM THE RAPPORTEUR HAS RECEIVED INPUT

The following list is drawn up on a purely voluntary basis under the exclusive responsibility of the rapporteur. The rapporteur has received input from the following entities or persons in the preparation of the draft report:

Entity and/or person
CEA (French Alternative Energies and Atomic Energy Commission)
EDF (Électricité de France)
EGE (Ecole de Guerre Economique)
European Commission
Euratom
ENSREG (European Nuclear Safety Regulators Group)
Foratom
Naarea
nucleareurope
NEA (Nuclear Energy Agency)
Nuward
OECD
Orano