Renew Europe position paper on Small and Advanced Modular Reactors

To achieve its target of climate neutrality in 2050, the European Union will face a deep transition of its entire economy. While all sectors will have to contribute to the transition effort, the decarbonisation of the energy sector will be of utmost importance.

Shifting away from fossil fuels will require massive electrification of consumption and production and the equivalent increase of carbon-neutral electricity and heat production in Europe. To match the rise of carbon-neutral electricity demand, the European Union must foster the development and scale up of renewable, carbon-neutral and low-carbon production technologies.

The key to a successful electrification will thereby rely in the diversification of the production capacities. The European Union will need both renewable and nuclear production capacities to reach carbon neutrality in 2050 and preserve the competitiveness of its industry.

Moreover, without nuclear energy, it will be very difficult to scale AI and digitalization in Europe without increasing dependency on foreign energy and critical raw materials. In some Member States, data centres already require up to 25% of total electricity consumption and this is expected to rise in the near future.

Conventional nuclear technologies are already an established part of the energy mix in several EU Member States and currently account for around 23% of electricity generation in the EU. They are therefore expected to continue contributing to Europe's future carbon-neutral and low-carbon energy system. But the nuclear ecosystem is at the wake of a significant revolution, as the emergence of Small and Modular Reactors have the potential to transform nuclear production from big to small and from ad hoc projects to standardised factory-assembled production allowing for economies of scale, lowering the investment needs and risks, and requiring lower grids investments. More than 80 designs are being developed worldwide and a competition is going on to build the first SMR in the G7. It is expected that the first SMR to enter in operation will be the GE Vernova Hitachi Nuclear Energy's BWRX-300 SMR in the Province of Ontario in Canada in 2029.

Europe cannot lag behind China or the US in such a strategic technology for its competitiveness and energy transition. It must be at the forefront of the development of European-designed SMR and provide an attractive regulatory and financing environment for SMR and AMR Developers. Some work has already been done to foster their development: the European Parliament adopted a resolution on SMRs in December 2023 and the European Commission launched a European Industrial Alliance on SMRs in February 2024. We welcome the adoption of its first strategic action plan in September 2025.

While these initiatives are more than needed, they are not sufficient to put Europe at the spearhead of SMR development. Too many challenges are facing SMRs and AMRs in Europe and will hamper their quick deployment.

This is why we are pleading for the adoption of an ambitious EU SMR and AMR strategy, laying the ground for an EU SMR-AMR policy package.

The strategy and future policy package should encompass the following objectives:

1. Developing an optional European SMR pre-licensing certification

One of the main barriers to the construction of nuclear reactors is the potential regulatory demand to adapt the design from country to country, which can incur additional costs reaching up to 30% of the total budget of a nuclear reactor.

This will be even more stringent for SMRs. Indeed, as the different designs will need to be licensed and adapted country per country, the modularity of SMRs will be hampered and their economies of scale will be reduced.

This highlights the need for a Europeanised pre-licensing certification for the site-independent part of the pre-licensing process. Such certification could be optional for the developers, coordinated by ENSREG and supported by the European Commission's Joint Research Center (JRC). The design-certificate would then be voluntarily trusted by Member States as a guarantee of safety.

This pre-licensing could include for instance:

- Seismic resistance: A single EU-level study could prove an SMR design's resilience to earthquakes, with countries adding only site-specific checks.
- Passive safety systems: Regulators could jointly review how an SMR behaves in a loss of cooling accident, avoiding multiple parallel assessments.
- Severe accident scenarios: A common European safety review could validate innovative containment concepts (e.g. underground modules), eliminating redundant national studies.

More concretely, if a design is pre-licensed at the European level, Members States could either approve the design "as is" or add proportionate country-specific requirements.

This approach, encompassing both safety and security and based on safeguards by design, would enable the Commission and project promoters to integrate material control requirements from the design stage onwards.

In general, we support any initiative that strengthens coordination between Member States and between national safety authorities. In this respect, SMRs offer a unique opportunity to test better-coordinated review procedures between national authorities. Where designers so wish, joint assessments should be encouraged and fast-tracked licensing should be made possible for designs already approved in other EU Member States.

The creation of joint ventures to support the development of SMR across Member States should be enabled, in a format allowing for continued joint exploitation of the benefits of SMR, beyond the development phase.

Where agreement cannot be found among Member States, using the enhanced cooperation mechanism to enable concrete groundwork serving our energy independence ambitions should be envisaged.

2. Adapting, harmonising and modernising the regulatory environment through a SMR Act

SMRs are not conventional nuclear reactors and need to be treated accordingly in the European regulatory environment. A specific regulatory environment for SMRs is needed to take their size and modularity into account.

An SMR Act would not create a fully centralised EU licensing system and would not weaken safety standards, which are essential. Instead, it would mainly amend and complement existing Euratom legislation to enable faster and more harmonised deployment.

Directives that could be amended by an SMR Act include:

- **Euratom directive 2009/71 on Nuclear Safety**: Adding a specific chapter on SMRs to introduce a definition of SMRs, create a European SMR (pre-)licensing platform coordinated via ENSREG with a voluntary European Design Assessment and introduce simplified procedures for designs approved through the European Assessment. Including an obligation for the fees charged by regulatory authorities to be adapted to the smaller size of the reactors (and not outdated and disproportional flat fees per reactor, which would lead to SMRs bearing proportionately higher licensing costs).
- **Euratom directive 2011/70 on Radioactive Waste and Spent Fuel**: Requiring Member States to take into account the specificities of SMRs such as modular and multi-site waste, streamlining cross-border arrangements for spent fuel and waste handling and clarifying responsibilities for transport and final disposal.
- **Euratom directive 2013/59 on Basic Safety Standards**: Introducing a differentiated and proportional approach for SMRs**,** allowing smaller and proportionate emergency planning zones.

While SMRs share the same Safety Objectives as conventional nuclear power plants, adapting the WENRA Safety Reference Levels to SMRs would help with fostering the harmonisation of national regulations.

While simplifying rules and promoting investments, it is important to build trust in nuclear technology based on the highest international safety standards while updating its regulatory framework to reflect SMRs specificities without blocking innovation. Simplification must not mean weakening nuclear safety for economic reasons. Even if smaller, these reactors are nuclear facilities and require robust, fully adapted safety requirements. Nuclear safety must remain an absolute priority for SMRs and is essential to fostering public acceptance.

Besides, Europe should not rely on technologies from jurisdictions where the independence of the safety authority is not fully guaranteed and foreign licensing cannot replace a full European assessment. This is essential to maintain public trust, protect strategic autonomy, and uphold Europe’s leadership in nuclear safety.

3. Introducing European certification for production of SMR parts and modules

To foster the modularity of SMRs and the production of modules in an efficient manner, an in-factory process of certification at European level is needed. Regulation must evolve from national-based, on-site approval to European-based factory and design-based approval. A specific part, like a reactor pressure vessel or a turbine-generator set, could be approved once in an authorised factory and thereafter produced in series for different SMRs in Europe.

4. Unlocking financing for investing in European SMRs

Private investors remain reluctant to finance first-of-a-kind SMRs because of important upfront costs, still relatively long payback periods, and regulatory uncertainty. The development of SMRs in Europe in a competitive way requires appropriate financing tools and risk-sharing mechanisms between the public and private sectors.

Several mechanisms that already exist for renewables could be opened up to unlock financing for SMRs and a number of new mechanisms could be created:

- **Leverage the EU Taxonomy for sustainable finance:** We call on the European Commission to consider the eligibility of SMRs when reviewing the EU taxonomy in 2026, provided they meet strict safety and waste management criteria.
- **Develop stable revenue models:**
    - Encourage long-term power purchase agreements (PPAs), contracts for difference (CfDs) and combination of both to de-risk revenues, while limiting the impact on the functioning of the market.
    - Promote public–private co-financing models, with Member States covering part of the risk. These could be part of tripartite agreements between Member State authorities, SMR developers and energy-consuming industries.
- Include SMRs in the lists of technologies eligible for **EIB support, based on clear economic, technical and environmental criteria,** focusing on clean tech and low-carbon innovations, such as TechEU and the European Tech Champions Initiative (ETCI).
- **Include SMRs in an Important Project of Common European Interest** to foster massive coordinated public investment and exempt from strict state-aid rules.
- **Issue European low-carbon industrial bonds:** EU-backed bonds dedicated to low-carbon electricity production, transmission and storage deployment could attract institutional investors (pension funds, insurance) by offering a safe, long-term investment vehicle.
- **Launch a SMR Moonshot project** within the future 2028-2034 Research Framework Programme.
- **De-risk projects and attract private investment thanks to Invest EU:** Make sure SMRs are eligible to the ECF InvestEU instrument to benefit from guarantees. The ECF InvestEU Instrument must provide the budgetary guarantee and financial instruments to mobilise additional investment across the Union to support European competitiveness in strategic technologies, such as SMRs and AMRs.
- **Ensure access, where relevant, to EU funds** such as the Innovation Fund, the Just Transition Fund and the future Competitiveness fund and Scaleup Europe Fund. The EU should notably allow the use of such funds to support feasibility studies for SMR deployment and associated fuel cycles, including the conversion of coal sites and the supply of low-carbon power to data centres and industrial clusters.
- **Euratom Research and Training Programme**: Enable strong support for SMRs and AMRs in the new 2028-2032 Euratom Research and Training Programme.
- **Accelerate state-aids procedure:** The procedures for notifying state aid projects for nuclear projects, including SMRs/AMRs, could be accelerated. The European Commission had committed working on this as part of the publication of its strategy for affordable energy in early 2025. We call on the European Commission to introduce the concept of "presumption of compatibility" of SMR/AMR projects with European rules governing state aid, in the same way as renewable energy projects.

- Include SMRs and AMR in the upcoming **Clean Energy Investment Strategy and ensure it adequately reflects the nuclear sector's need for predictability, while ensuring that innovation is not stifled by it.**

The opportunity of making the SMR Industrial Alliance evolve towards a **SMR/AMR Joint Undertaking** under the Euratom Treaty should also be considered in the strategy.

Financing mechanisms should foster optimised return on investment of public resources and include objective assessment criteria.

5. Supporting the European supply chain, European technologies and strategic autonomy

Alike renewable energy, SMRs can contribute to decarbonisation and energy independence. Europe possesses some of the world's most advanced scientific and industrial expertise in nuclear energy, from reactor design to engineering, safety, and the entire fuel cycle. What Europe lacks today is not knowledge, but coordination: our capabilities are fragmented, our R&D funding inconsistent, and no unified strategy exists to scale European SMR and AMR technologies through large-scale demonstration projects. The EU must ensure that its SMR strategy prioritises European technologies, intellectual property, and value creation. Massive imports of non-European designs would undermine European sovereignty and deliver no long-term industrial benefit. With political support, coordinated funding, and a clear strategy, Europe can lead the next generation of nuclear technologies rather than importing it.

The recent EU–US energy agreement, including €300 billion earmarked for US nuclear, is a wake-up call. The US Phoenix Fund already finances feasibility studies in several Member States to deploy American SMRs, something Europe does not yet offer to its own industry. We must not replace past dependencies with new ones.

Europe is to some extent also still reliant on Russian uranium products. While natural uranium supply is not a constraint, with Russia accounting for only five percent of global primary production[1], Europe's remaining dependence on Russian conversion[2] and, to lesser extent, enrichment[3] should be phased out.

Achieving full independence from Russia will require diversification of supplies and increase conversion and fuel fabrication capacities in Europe. A coordinated European approach to diversifying fuel supply would make the SMR value chain more resilient and strengthen European strategic autonomy.

[1] Bruegel (2025). Ending European Union imports of Russian uranium.

[2] Uranium oxide is converted into a gaseous form ready for enrichment.

[3] Uranium is enriched to reach the necessary uranium concentration for a nuclear fission reaction.

6. Developing all technologies in a technology neutral manner

The European SMR strategy should embed the principle of technology neutrality and avoid discriminating amongst different SMR designs. Europe hosts a wide diversity of innovative designs, including PWR, BWR, fast sodium and lead reactors, high-temperature reactors, fast molten salt reactors, Calogena reactors and other advanced concepts, many of which are technologically mature and backed by decades of European expertise. The European SMR strategy should fully embrace and support the development of a wide scope of small and advanced modular reactor technologies, taking into account transparent, fair and objective criteria such as project maturity, safety, costs, feasibility, etc...

Yet strategic and promising technologies developed in Europe have not been selected under the first call of the European SMR Alliance. Future calls should sufficiently reflect the diversity of European projects.

7. Going beyond electricity generation

SMRs offer a wide portfolio of applications that the EU should recognise and actively support. They will be essential for powering ports, industrial and chemical clusters, data centres and remote regions and cities. They will provide more flexibility than conventional reactors and will be a prerequisite for the EU's digital ambitions and the rapid expansion of AI and cloud infrastructure.

But SMRs can go beyond electrification and contribute to the energy transition as a whole by enabling hydrogen production, industrial heat generation, district heating, e-fuel production, desalination, particularly in industrial clusters, remote regions, or areas with limited grid capacity. It is essential that the SMR Strategy promotes and supports their full potential, beyond their role in power generation.

Industrial heat

Several SMR technologies can provide high-temperature industrial heat (over 400 °C), a key requirement for decarbonising sectors still reliant on fossil fuels, which represents nearly 90% of Europe's industrial heat today.

Hydrogen

Moreover, SMRs and AMRs will also be essential enablers of clean hydrogen. Coupled with high-temperature or conventional electrolysers, they could deliver continuous, low-carbon hydrogen for energy-intensive sectors such as chemicals, refining, steel, and fertilisers. A multi-SMR plant of 300–600 MW could supply the hydrogen demand of an ammonia production facility or a refinery. Such potential could help the EU close the gap between its current output and future needs. For instance, the EU produces only 1 million tonnes of SAF today but needs to reach 20 million tonnes by 2035 to decarbonise aviation fuels.

To unlock these projects, nuclear PPAs should be recognised in the EU's methodology for defining low-carbon hydrogen.

8. Encouraging EU-wide participation, fostering training and developing skills

Wide participation of EU Members states to SMR projects, collaboration and consortia should be encouraged. Sharing technology, data, IP, and supply chains could support deployment in new EU Member States and maximize economies of scale.

A concrete knowledge agenda and sector-specific training should strengthen the industrial capacity of the European SMR sector. This should include sustained support for reactor design, fuel cycle innovation, advanced materials and modelling and simulation tools, building on existing programmes such as the Euratom Research Programme, Horizon Europe, the Joint Research Centre and national research infrastructures.

The EU should also support the development of a stronger nuclear skills and competencies pipeline by encouraging the launch of dedicated education and training pathways, from technical training to university programmes and advanced post-graduate curricula. Europe needs a strong pool of engineers to lead the development of SMRs and AMRs. Strong nuclear education and research is thereby essential to ensure the long-term competitiveness and resilience of Europe's SMR ecosystem.

To ensure the success of new nuclear projects, including SMRs and AMRs, the EU must launch dedicated, large-scale skills initiatives such as *Skills4Nuclear*, the *NZIA Academy*, and a new network of *European Nuclear Valleys*.

These "Nuclear Valleys" could mirror the model of Hydrogen Valleys under the Clean Hydrogen Partnership, as well as the French Nuclear Valley, by bringing together the entire ecosystem in one coordinated territorial hub: industry, SMEs, research centres, regulators, universities, training institutes, start-ups, and supply-chain actors. Their mission would be to develop curricula, deliver hands-on training, accelerate certification, and build strong regional specialisations that directly serve industrial deployment.

The NZIA Academies should work hand-in-hand with these Valleys to design training content with industry and ensure the availability of skilled workers across the full value chain.

The need is urgent: the European nuclear sector alone will require around 100,000 new qualified workers over the next decade. Without a coordinated European skills strategy, Europe will not be able to deploy its nuclear ambitions at scale.