

Unlocking the potential of Small Modular Reactors in the EU

Eurelectric position paper

Eurelectric represents the interests of the electricity industry in Europe. Our work covers all major issues affecting our sector. Our members represent the electricity industry in over 30 European countries.

We cover the entire industry from electricity generation and markets to distribution networks and customer issues. We also have affiliates active on several other continents and business associates from a wide variety of sectors with a direct interest in the electricity industry.

We stand for

The vision of the European power sector is to enable and sustain:

- A vibrant competitive European economy, reliably powered by clean, carbon-neutral energy
- A smart, energy efficient and truly sustainable society for all citizens of Europe

We are committed to lead a cost-effective energy transition by:

investing in clean power generation and transition-enabling solutions, to reduce emissions and actively pursue efforts to become carbon-neutral well before mid-century, taking into account different starting points and commercial availability of key transition technologies;

transforming the energy system to make it more responsive, resilient and efficient. This includes increased use of renewable energy, digitalisation, demand side response and reinforcement of grids so they can function as platforms and enablers for customers, cities and communities;

accelerating the energy transition in other economic sectors by offering competitive electricity as a transformation tool for transport, heating and industry;

embedding sustainability in all parts of our value chain and take measures to support the transformation of existing assets towards a zero carbon society;

innovating to discover the cutting-edge business models and develop the breakthrough technologies that are indispensable to allow our industry to lead this transition.

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A Eurelectric paper

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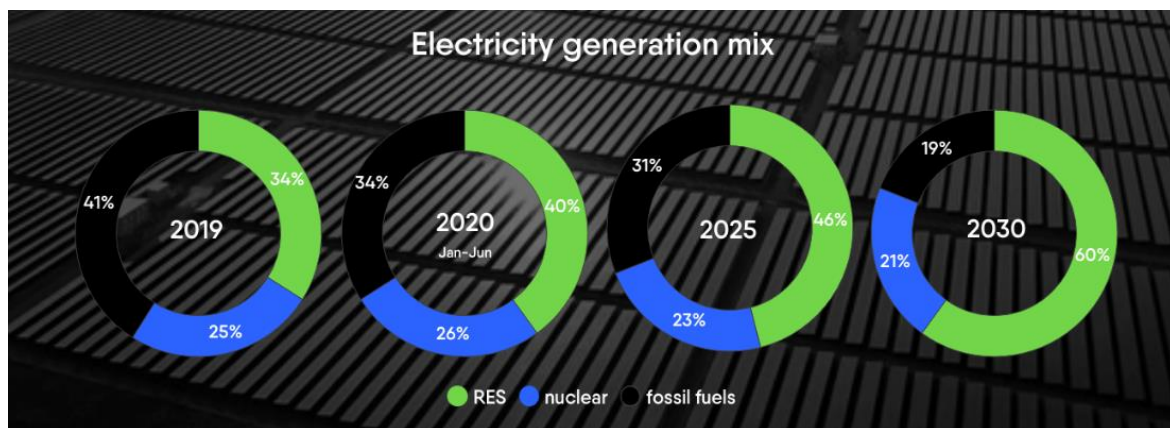
KEY MESSAGES

- Nuclear is currently the largest source of carbon free electricity generation in many Member States that use the technology and it is also included in the National energy and climate plans of most of these countries to meet the 2050 target. Other Member States that are working on introducing nuclear in their energy mix, planning and building new capacities and preparing for long-term operation of current units.
- As we move towards a system with increasing RES share coupled with fossil fuel phase-out, nuclear, and specifically SMRs offer flexibility and scalability to the grid. SMRs can provide rapid power ramping upward or downward. Modules can be added over time to adapt to market needs and provide power to regions of the EU where the deployment of other sources of energy may be technically challenging.
- Eurelectric calls for coordination of all stakeholders to foster the development of SMR specific requirements in the EU and to integrate SMRs into the ongoing energy transition in time in those Member States that opted for use of nuclear.
- The SMR technology option should be incorporated as a source of carbon-free electricity in the strategic planning of the European Commission in the field of energy, climate and transport policies as an alternative solution to substitute fossil fuels in different parts of our economy, including heating and transport.

Introduction

Eurelectric strongly welcomed the Paris agreement as a major landmark in addressing the global climate change challenge. The power sector has a big responsibility to ensure that electricity is an important part of the solution. To achieve this goal, our members are committed to provide a carbon-neutral electricity mix in Europe well before mid-century, providing a decarbonise path for those energy using sectors that will need to decrease their emissions as well.

Our sector envisions a very low carbon energy system in 2050, where renewable and nuclear will form its backbone, as also stated in the EC's strategic long-term vision¹ (2018). Eurelectric's Decarbonisation pathways² concludes that - in its most ambitious decarbonisation scenario - the bulk of electricity is provided by renewables, with nuclear playing a strategic complementary role in terms of system reliability and flexibility. In Eurelectric's Power Barometer (2020) this trend is already visible for the decade 2020-2030.



Source: Eurelectric Power Barometer (2020)

In this context, a variety of low carbon technologies should be available to provide flexibility and choice for Member States, governments and local communities, to find the best way towards decarbonisation. These technology options include nuclear, as underlined by the European Council³.

The advantages of deploying SMRs in the EU

Eurelectric considers that small modular reactors (SMRs)⁴ have significant potential across the EU as a future low-carbon technology, complementing large nuclear power stations and renewables as we decarbonise the power sector. Both large and small-scale nuclear power stations can support a diversified low carbon energy mix.

The International Atomic Energy Agency (IAEA) defines 'small' as under 300 MWe. Very small reactors (vSMRs) are units under about 15 MWe which can be used for remote communities. There

¹ COM (2018) 773, p. 9.

² Eurelectric (2018), <https://cdn.eurelectric.org/media/3558/decarbonisation-pathways-all-slideslinks-29112018-h-4484BBOC.pdf>

³ European Council meeting (12 December 2019), <https://www.consilium.europa.eu/media/41768/12-euco-final-conclusions-en.pdf>

⁴ SMRs are nuclear reactors generally 300MWe equivalent or less which can be basically classified into light water reactors, fast neutron reactors, graphite-moderated high temperature reactors and molten salt reactors. Their main feature is that they are manufactured at a factory, shipped to the end location and assembled there.

is a difference in technical maturity between SMRs and Generation IV advanced Reactors using modular systems which are relatively unproven technologies.

SMRs have a number of anticipated design benefits including smaller space and lower capital cost requirements, modular construction, reduced construction time & risk, together with simpler safety systems and smaller emergency planning zones. These features might ultimately lead to a lower overall cost per MWh compared to larger reactors. SMRs are also suitable to be constructed in locations not fit for larger nuclear plants and can offer distinct safeguards, security and non-proliferation advantages. Many of the potential light water SMRs use fuel technology, which is already familiar from the existing large PWR/BWR reactors. The vast majority of projects does not assume to exceed the current conventional fuel enrichment limit (5%) and thus there is no major impact on fuel cycle process.

Due to lower outputs, longer fuel cycles and frequent omission of boric acid from the project, radioactive waste production will be smaller in absolute amounts. Radioactive waste (low-level, intermediate-level and high-level) and spent fuel management will be similar to large reactors for most SMR technologies and subject to implementation of national law and programmes for the management of these materials. The potential of nuclear energy to contribute to the framework for facilitating sustainable investments as climate neutral energy is being assessed with respect to Do No Significant Harm-criteria (DNSH) and the Commission will report on the results in the context of the review of the Regulation (EU) 2020/852.

SMRs can play a role in helping industrial sectors decarbonise. Besides producing carbon-free electricity, SMRs can provide an alternative solution for fossil fuel heating production and combined electricity-heat (co-generation) as well. They can also support the electrification of some segments of transport as well as district heating for some existing centralised heating systems and production of hydrogen from electrolyzers.

Eurelectric shares the opinion of NEA/OECD that there is a large potential for these technology. A very significant amount of new low-carbon capacity needs to be built and all new opportunities should be explored. In a system where about 80% of electricity comes from intermittent source of energy like RES, SMRs can be both a source of firm (baseload) power as well as provide another flexible generation opportunity. Larger nuclear reactors can be operated flexibly but SMRs could provide an enhanced flexible nuclear option that could provide for a decrease of total system cost. They therefore represent an important innovation opportunity as a technology which can contribute to the system resilience and overall security of supply of the EU electricity system.

Given the development based on 'fleet economics' comprehensive and the design-to-cost approach, Eurelectric believes that SMRs can represent an alternative to the existing technologies for the Member States which decide to use nuclear energy to meet the growing demand for affordable, clean, emission-free energy.

Progress but no EU integrated approach yet

The European Commission considers in its 2017 Nuclear Illustrative Programme the absence of a licensed SMR design in the market to be a major challenge.⁵ Meanwhile, major progress has been made, especially in the USA where the regulator has already provided its safety certification for one SMR design and is working on several others.⁶ There is already an established North American SMR regulatory cooperation between Canada and the USA working together to cross-regulate designs to essentially the same standards. Demonstration units of SMR (HTGR) are in operation in

⁵ SWD (2017) 158, p. 20.

⁶ NRC (2018), <https://www.nrc.gov/reactors/new-reactors/design-cert/nuscale.html>

Japan and China, construction of SMR (PWR) are in progress in Argentina and China. In Europe, a consortium formed by CEA, EDF, Naval Group and TechnicAtome announced in September 2019 the joint development of the NUWARD SMR design⁷.

The European Nuclear Energy Forum reminded in 2018 that Europe has traditionally been in the forefront of nuclear research, and there exists an ambition among some in Europe to maintain technological leadership, in particular in nuclear technologies like SMRs.⁸ In 2019, it recognized the importance to increase efforts in the fields of R&D in particular on safety of SMRs and underlined the need to harmonize licensing and regulation.⁹

In 2018, the Small Modular Reactor Regulators' Forum, open to IAEA Member States, was established¹⁰ based on a pilot project to identify, enhance understanding and address key regulatory challenges that may emerge in future SMR regulatory and licensing discussions to inform changes, if necessary, to their requirements and regulatory practices. Finland and France are members, the EU an observer.

In 2019, the Western European Nuclear Regulators Association (WENRA) incorporated SMRs into the priority lines derived from the 2018 strategic plan.

In 2019, the ELSMOR (European Licensing of Small Modular Reactors) project, funded by the Euratom, was launched. This project should aim at defining future uniform European requirements for SMR licensing and should be closely linked to the work of the EUR Organization which is currently preparing a position paper for implementing SMR-specific requirements to current EUR Revision E document. The Small Modular Reactors Task Force (SMRTF) by CORDEL will also consider suggesting the development of dedicated safety standards for SMRs. Meanwhile, some regulators such as STUK¹¹ already expressed their views regarding the licensing system and regulatory control required for SMRs.

However, co-operation between authorities and industry should be increased. This in view to create a harmonized approach for European countries with plans to build SMRs, so that national regulation will allow SMR licensing by Member states without significant changes. European guidelines should follow IAEA safety standards and be consistent with the regulations in other OECD countries. Guidelines should be based on the minimization of societal risk by required level of safety, allowing freedom for the designer on how to achieve these. Adopting these approaches would create a common European market and allow fair competition between various design solutions.

The EU has the experience and expertise within the nuclear sector (including significant research and development capabilities) to play a key role in developing SMRs. They can provide additional jobs and global export potential, linking to the EU industrial strategy and providing significant local economic value. For example, SMR development can create valuable additional intellectual property leading to high-end skills and jobs in the EU. There is the opportunity to leverage the economies of those EU MSs who support nuclear energy and their respective nuclear industries to help deliver this opportunity. Pre-feasibility work already undertaken has confirmed the benefits of the technology at a high level and has suggested potential global demand for SMRs could be hundreds of units by 2040 worldwide.

⁷ <http://www.cea.fr/english/Pages/News/Nuward-SMR-CEA.aspx>

⁸ ENEF (2018), https://ec.europa.eu/info/sites/info/files/2018_10_01_enef2018conclusionsfinal.pdf

⁹ ENEF (2019), https://ec.europa.eu/info/sites/info/files/enef2019conclusions_0.pdf

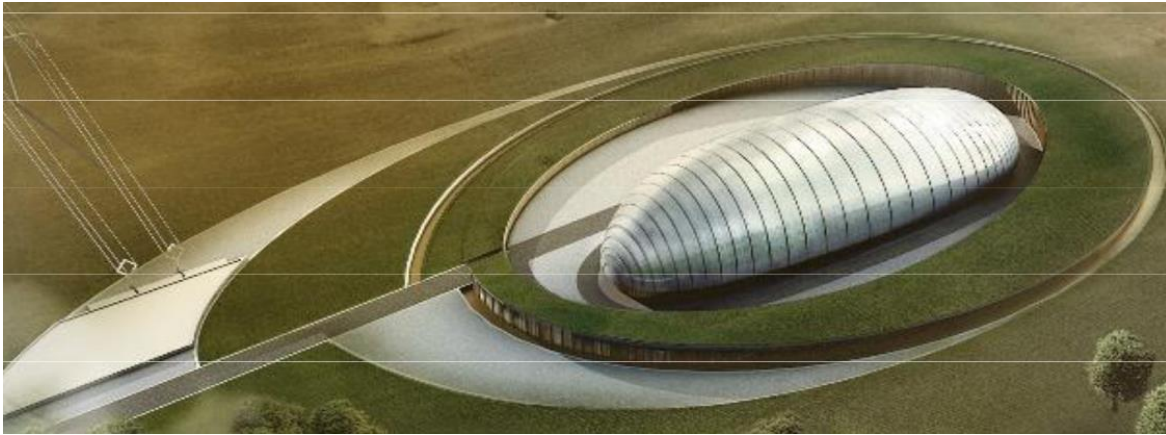
¹⁰ SMRRF (2018), https://www.iaea.org/sites/default/files/19/03/smr_rf_tor_october_2018_0.pdf

¹¹ [Preconditions for the safe use of small modular reactors](#) – STUK – March 2020

Policy recommendations

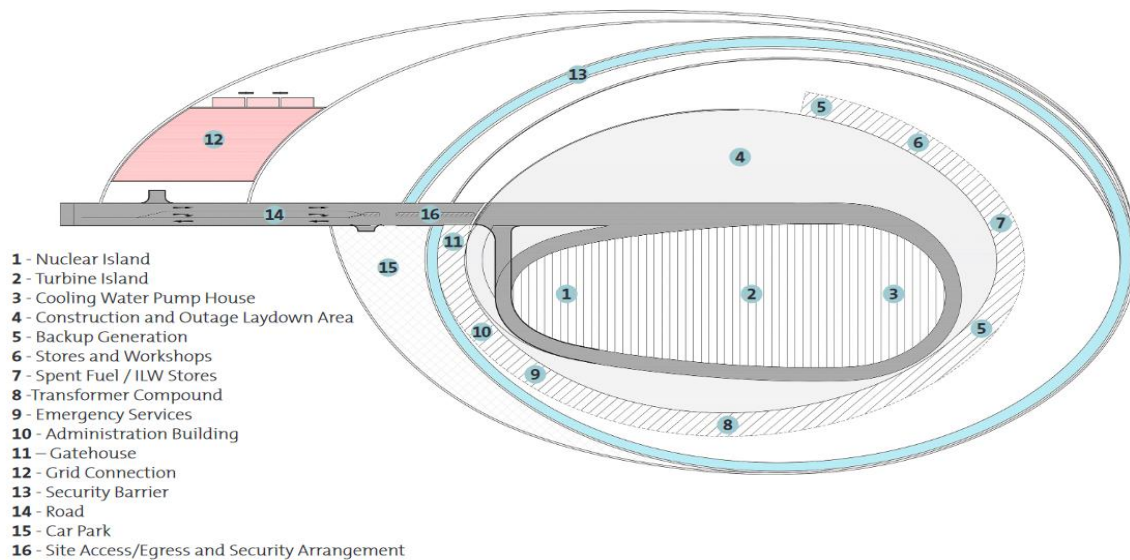
- Support a technology-neutral approach which ensures equal conditions for all sources of carbon-free electricity;
- Undertake a fully informed assessment of nuclear energy by recognised experts for the use of the Taxonomy Regulation as part of the delegated acts
- Support the EU development of SMRs as a carbon-free technology which can help replace fossil fuel fired power plants, grow EU power supply to meet the demands of electrification and decarbonisation of other sectors and integrate flexibility into a EU power system that has renewables and large scale nuclear as its backbone;
- Incorporate the SMR technology option in 2020 updated Reference Scenarios;
- Promote and enhance R&D in SMRs to become a technology leader;
- Set up properly the business environment to attract the EU industry into the SMR production to increase its share on the world production of nuclear components/SMRs to gain economic benefits;
- Involve all stakeholders to foster the development of SMR specific requirements in the EU;
- Foster strongly the progress towards standardisation and harmonization to enable greater and faster deployment of nuclear technologies (both SMRs and large scale nuclear) and leading to significant cost reductions;
- Enhance activities and programmes such as U.S.-EU High-Level Industrial Forum on SMRs.

Small Modular Reactor – a visual example



Aerial view of a UK SMR project, by Rolles Royce¹²

Functional arrangement of the same plant as above



Technical specifications of Small Modular Reactors according to iaea

Small modular reactors, which are defined as advanced reactors that produce electricity of up to 300 MW(e) per module, are deployable either as single or multi-module plant. They offer the possibility to combine nuclear with alternative energy sources, including renewables. They also display an enhanced safety performance through inherent and passive safety features, offer better upfront capital cost affordability and are suitable for cogeneration and non-electric applications. They are deployable either as a single or multi-module plant, and are designed to be built in factories and shipped to utilities for installation as demand arises. There are about 50 SMR designs and concepts globally. Most of them are in various developmental stages and some are claimed as being near-term deployable. There are currently four SMRs in advanced stages of construction in Argentina, China and Russia, and several existing and newcomer nuclear energy countries are conducting SMR research and development.

¹² "This specific project was included with the sole purpose of showing how SMRs can look like. Projects from other manufacturers may follow slightly different designs". Full prospect can be found [here](#)

Eurelectric pursues in all its activities the application of the following sustainable development values:

Economic Development

- Growth, added-value, efficiency

Environmental Leadership

- Commitment, innovation, pro-activeness

Social Responsibility

- Transparency, ethics, accountability



Union of the Electricity Industry - Eurelectric aisbl
Boulevard de l'Impératrice, 66 – bte 2 - 1000 Brussels, Belgium
Tel: + 32 2 515 10 00 - VAT: BE 0462 679 112 • www.eurelectric.org
EU Transparency Register number: [4271427696-87](https://ec.europa.eu/transparency/regexpert/?s=participations&id=4271427696-87)