Ref. Ares(2025)8545051 - 08/10/2025

Electrification is one of the most powerful tools at the EU's disposal to reach its decarbonisation objectives. However, electrification in the EU has stagnated in the last decade. Nuclear, which remains the largest single source of decarbonised electricity, is ready to contribute towards driving forward electrification.

Europe needs the upcoming electrification action plan to be ambitious and therefore nucleareurope recommends the following:

- Technology neutrality, both in terms of electricity generation and electrification technologies, should be applied throughout the plan.
- Presenting a fiscal framework favourable to homegrown technologies and electricity sources.
- Ensuring robust financial support for CAPEX and OPEX.
- Promoting PPAs and CfDs for nuclear power.
- Proposing ambitious electrification targets based on in-depth impact assessments of users' needs and capabilities. This would create confidence in investments and allow energy intensive industries to adopt pragmatic electrification plans.

Electrification and the role of nuclear

As the largest single source of decarbonised electricity in the EU, nuclear power is particularly suited to enabling electrification efforts across the region by providing affordable and clean energy 24/7. In 2024, nuclear was the leading source of electricity, accounting for 24% of the electricity produced in the EU. The firm and dispatchable characteristics of nuclear power provide the predictability that businesses depend on in terms of security and reliability of supply and, very importantly, price. Beyond electricity, nuclear technologies also offer the potential to produce high-temperature heat and clean hydrogen—critical solutions for industrial processes where direct electrification is not feasible, practical, nor cost-effective. Flexible co-production of electricity and heat and/or hydrogen can also contribute to grid stability through load following. By enabling both electrification and alternative decarbonised energy vectors, nuclear power plays a vital role in building a resilient and climate-neutral European energy system. For more information, please refer to Annex 1 which highlights the role that nuclear can play in supporting the decarbonisation of different sectors.

Unlocking electrification

As highlighted by the European Commission, over the past decade, electrification has stagnated, currently accounting for around 23% of final energy demand in the EU. Without a swift and ambitious uptake of electrification, the EU risks missing key opportunities in terms of strengthening its competitiveness, enhancing energy security, and achieving its decarbonisation objectives. Decarbonised electricity is key to meeting these objectives, and this goes hand in hand with stimulating demand for such electricity.

To unlock its full decarbonisation potential, the Electrification Action Plan (EAP) should focus on the demand side: industry, transport, and buildings. It should provide new tools to accelerate electrification in all sectors of the economy and aim to address the problem of CAPEX and OPEX (especially in the case of industry) through targeted schemes, such as the Clean Industrial Deal State Aid Framework (CISAF) and the establishment of an Industrial Decarbonisation Bank.

The primary focus when pushing for electrification should remain on the CO2 content of the electricity generated, rather than the technology used to produce it. Nuclear has a significant role to play and not recognising this runs the risk of blocking electrification efforts and delaying the benefits.

Furthermore, the plan should consider the specificities of the various industrial sectors, in terms of their readiness to electrify, availability of better options, etc. As such, it should be implemented in parallel with other decarbonisation programmes such as the use of decarbonised heat and hydrogen. Demand-side response can be a good addition as it provides services to the energy system and can bring a financial gain, but only for those consumers that are able to operate flexibly in a cost-efficient way. It should not become a condition to electrification: it must remain voluntary, appropriately incentivised and never penalise market participants with less flexibility potential. The constraints faced by the energy system due to its inability to cover for periods of peak demand when variable energy sources are not available should not be pushed onto consumers who cannot operate in flexible mode, either for technical of economic reasons. In some cases, electrification is not at all possible. Here, the nuclear sector is ready to support industries and others with whatever alternative decarbonisation solutions are found, such as carbon capture which is an alternative that requires significant volumes of electricity that nuclear can provide.

Finally, to ensure a resilient and cost-effective future for the European energy system, both electricity generation and consumption must be addressed at EU level in a coordinated way. Achieving balanced and sustained growth in supply and demand is essential to tackle current and emerging challenges—such as negative price periods, system stability, and the need for greater flexibility.

What the electricity system truly requires is a holistic strategy that harnesses the strengths of each energy source: net zero and dispatchable technologies like nuclear for stable and flexible generation, alongside storage solutions and renewables, with the goal of delivering clean, scalable and affordable electricity.

Recommendations

In order to ensure that nuclear can fully contribute towards enabling electrification the EAP must:

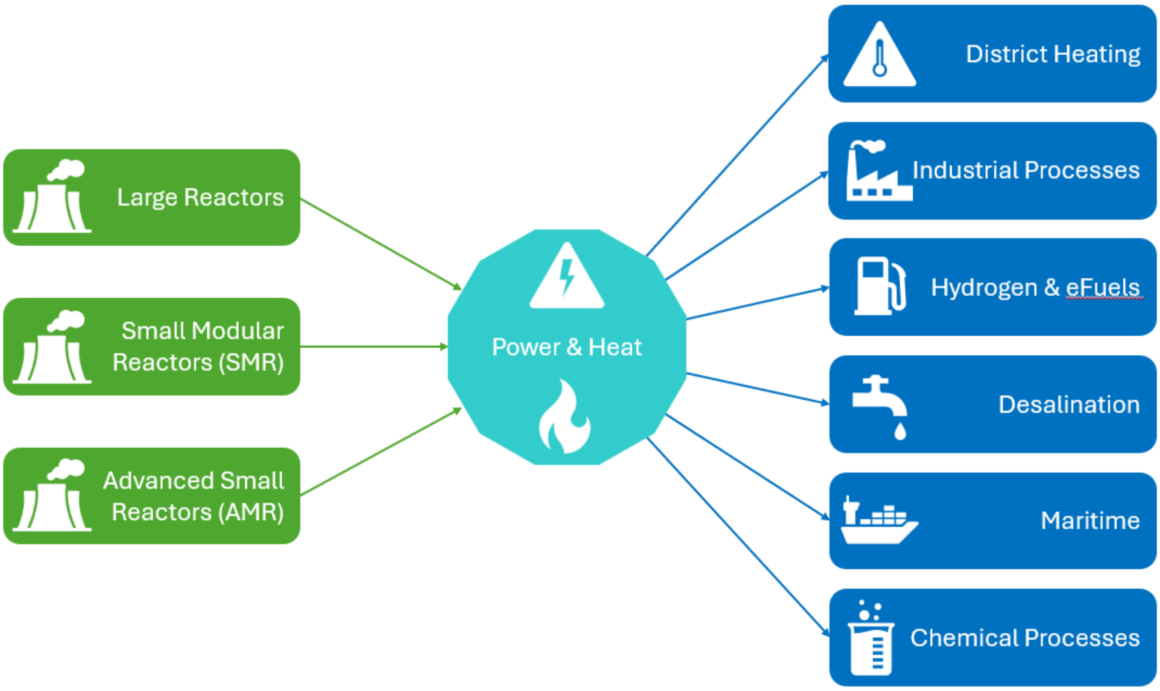
- Be technology neutral and economically optimised at a global system level. It must not favour one technology over another, both in terms of electricity generation and electrification technologies.
- Prioritise electrification in all new public energy and infrastructure investments. This can be achieved by revising the Public Procurement Directives.
- Set a framework that allows Member States to designate an Electrification Entity, tasked with promoting and financing electrification as a public good. This entity would:
    - Raise awareness among customers of the benefits of electrification, in terms of competitiveness, energy security and decarbonisation.

    - Aggregate small-scale loans, reducing risk for banks and enabling lower interest rates.
    - Pre-finance electrification investments with repayments spread over time.
    - Encourage customers (which have the ability to do so) to become more flexible.
- Implement a monitoring and forecasting framework for electrification at EU and national level, considering the NECPs and supported by sector-specific indicators and objectives. In this regard, the KPI of 32% of electrification by 2030 is welcomed and should be extended in 2040 and 2050. It is imperative that efforts among Member States are coordinated to avoid infrastructure imbalances and ensure coherent development of electric infrastructure, while respecting the choice of their energy mix.
- Establish a fiscal framework that favours electricity and net zero domestic energy sources, lowers taxation on electricity by removing levies that are not energy-related, treats all clean technologies on an equal footing and shifts levies that finance energy policies to the general budget. Given the objectives pursued by the EU, it does not sense that electricity remains, on average, taxed more heavily than fossil fuels in the EU. The Commission and the Council need to move forward with the revision of the Energy Taxation Directive or find a solution to this blockade.
- Create the conditions for robust financial support towards industrial electrification, both for CAPEX and OPEX.
- Promotes Power Purchase Agreements (PPAs) for nuclear projects with a duration of up to 60 years, matching the entire operating life of the reactor so that the energy produced can be sold under stable, long-term contractual conditions. This would mirror practices in the renewable energy sector, where PPAs typically span 15–20 years, reflecting the conventional operating life of wind and solar installations before repowering. For capital-intensive sectors such as the nuclear, lifetime PPAs provide predictable post- commissioning revenues, reducing market risks during operation and supporting the long-term economic sustainability of projects.
- Enable bilateral contracts for difference (CfDs) ensuring that contractual revenues will remain secure for the entire duration of the agreement. This would strengthen

investor confidence and create the conditions for nuclear projects to secure financing and contribute towards Europe’s net-zero objectives.

- Not shift undue grid development related costs onto consumers (notably industry and households), undermining competitiveness, and welfare.
- Ease access to grid connections for electrification projects.

Annex 1 - Where can nuclear step in

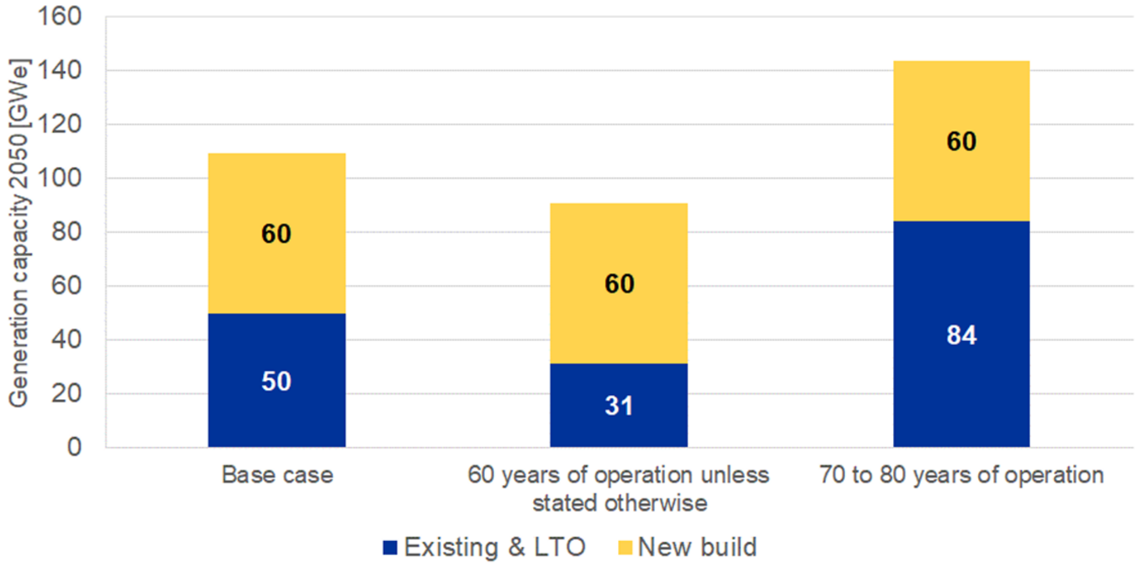


Existing EU nuclear capacity:	Forecast of EU nuclear capacity by 2050[1]:

• Number of reactors in operation: 100
• Installed capacity of the existing fleet: 100 GW
• Electricity production in 2024: 656 TWh
• Capacity factor: over 90%
	• Large reactors
	  ○ New build: 60GW
	  ○ Lifetime extension: up to 84GW
	• New build SMRs / AMRs: up to 55GW

[1] European Commission, Nuclear Illustrative Programme, June 2025

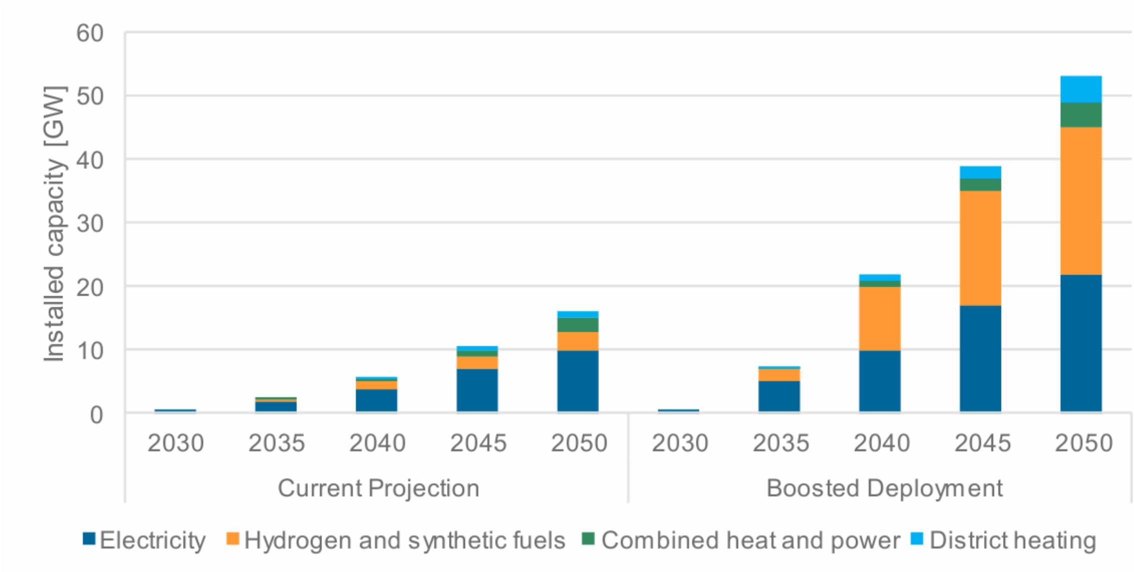
Figure 3 – Sensitivity of 2050 installed large-scale reactor capacity to LTOs



Source: European Commission.

Notes: Section 5.1 treats SMRs separately.

Figure 35 – SMR deployment scenarios



Source: European SMR pre-Partnership Report, Workstream 1 – Market Analysis, 2023.

Notes: In GWe for electricity and hydrogen; in GWth for industrial heat and district heat.

Electricity and heat supply capabilities of nuclear reactors:

	Direct Electrification	Indirect Electrification (Grid)	Direct Heat	Waste Heat
Large Reactors	-	⚡	-	🔥
Small Modular Reactors (SMR)	⚡	⚡	🔥	🔥
Advanced Modular Reactors (AMR)	⚡	⚡	🔥	🔥

Power production capabilities of nuclear for the different sectors (non-exhaustive):

	Electricity	Heat
District Heating & Cooling	⚡ (via heat pumps)	🔥 Primary
Food	⚡ (motors, refrigeration, processing)	🔥 (low–mid temperature process heat)
Pulp & Paper	⚡ (pumps, drives)	🔥 (steam drying — major demand)
Desalination	⚡ (reverse osmosis)	🔥 (thermal desalination e.g. MSF/MED)
Chemical Processes	⚡ (electrochemistry, compressors)	🔥 (process heat — wide temperature range)
Refineries	⚡ (electrified steam generation, pumps)	🔥 Primary (high-temp heat, furnaces)
Non-ferrous Metals	⚡ Primary (electric furnaces, electrolysis)	🔥 (melting & annealing)
Ceramics	⚡ (electric kilns)	🔥 Primary (thermal kilns — gas or hydrogen today)
Glass	⚡ (electric melting furnaces scaling up)	🔥 Primary (high-temp heat)
Steel	⚡ (EAFs, hydrogen-based DRI, electrolysis routes)	🔥 (traditional blast furnaces)
Cement	⚡ (emerging — plasma, electric calcination)	🔥 Primary (kilns 1400°C+)
Hydrogen & e-fuels	⚡ Primary (electrolysis)	🔥 (for high-temp synthesis, e.g. Fischer–Tropsch)
Data Centres	⚡ Primary	—
Maritime Propulsion & Power	⚡ (batteries, fuel cells)	🔥 (steam turbines, thermal engines)

Examples of industrial decarbonisation projects that can take advantage of nuclear's decarbonised electricity and heat.

- **Steel Industry -** Direct Electrification via Electric Arc Furnaces (EAFs)
    - **ArcelorMittal (France):** Replacing blast furnaces with EAFs powered by nuclear electricity, e.g. the Dunkerque site in France plans to combine hydrogen-based DRI with electric furnaces by 2030.
    - **Vargön Alloys (Sweden):** Fortum and Swedish ferroalloys producer Vargön Alloys AB have signed a five-year power purchase agreement (PPA) with progressive pricing for delivery of approximately 0.4 TWh of electricity and Guarantees of Origin for nuclear power per annum in Sweden.
- **Cement and Lime -** High-Temperature Electric Kilns and Plasma Heating
    - **CemZero (Sweden):** Cementa and Vattenfall are testing plasma-based electrified kilns for cement production. Stable nuclear electricity from one of Vattenfall's facilities can be key to achieving this.
- **Chemicals and Refining -** Electrified Steam Cracking and Electrochemical Processes
    - **Dow Terneuzen (Netherlands):** Using heat pumps and electric boilers to electrify process heat in ethylene oxide and glycol production. This could also be achieved by direct heat from SMRs or AMRs or by taking advantage of waste heat from existing reactors.
- **Pulp and Paper -** Electric Dryers, Heat Pumps, and Biomass-Electric Hybrid Systems
    - **UPM (Finland):** Electrifying pulp drying and black-liquor evaporation stages with high-temperature heat pumps and direct electric heaters.
- **Industrial Heating and District Systems -** Large Heat Pumps and Electrified Steam Networks
    - **Rotterdam Port Industrial Cluster (Netherlands):** Electrification of industrial steam supply through e-boilers and grid-connected high-voltage heat pumps.