

France's Nuclear Gamble: Status, Challenges and the Road Ahead

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France is doubling down on nuclear energy. Once a symbol of national pride and now the backbone of its decarbonized electricity mix, nuclear power is experiencing a full-fledged renaissance in France. After years of hesitation, political consensus has crystalized around a clear ambition: to make nuclear energy the cornerstone of both climate neutrality and energy sovereignty.

With nearly 70 percent of its electricity still coming from nuclear sources, France stands out globally for its unique energy mix. While other nations have sought to phase out or limit their nuclear capacity, France is investing heavily in its expansion, most notably through the planned construction of 14 next-generation EPR2 reactors and a growing focus on innovative technologies like Small Modular Reactors (SMRs).

This renewed momentum is backed by a supportive legislative and regulatory framework, with reforms aimed at streamlining procedures without compromising safety. However, the scale of the challenge is significant. The sector faces persistent industrial, financial and social headwinds. Whether France can overcome these hurdles will determine not only the success of its nuclear revival but also the future shape of its energy mix as it pursues carbon neutrality by 2050.

A Historic Choice That Still Shapes Today's Energy Mix

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France's reliance on nuclear power is rooted in a bold political decision made in response to the 1974 oil crisis, known as the "Messmer Plan." Today, nuclear power still accounts for more than two-thirds of French electricity production. In 2024, 67.1 percent of French electricity came from nuclear plants, with 57 reactors operating across 18 sites.[1]

With a total nuclear capacity of 62.9 GWe, France is the second-largest producer of nuclear electricity globally. This longstanding commitment to nuclear energy has allowed the country to maintain one of the lowest carbon electricity mixes in Europe.

While nuclear energy has sparked public debate, especially on safety and environmental issues, political support has shifted firmly back in its favor. Plans to reduce the nuclear share to 50 percent were first delayed and then abandoned entirely in 2022, in recognition of the energy transition and security challenges ahead.

A State-Led Ecosystem of Strategic Players

France's nuclear industry is structured around a tightly coordinated group of state-backed entities:

- **Electricité de France** (EDF), fully state-owned, operates all nuclear reactors.
- **Orano**, 90 percent state-owned, manages the entire nuclear fuel cycle, from uranium mining to spent fuel.
- **ANDRA** handles radioactive waste and oversees the controversial Cigéo deep geological repository project in Bure.
- The **Commission for Atomic Energy and Alternative Energies** (Commissariat à l'Énergie Atomique et aux Énergies Alternatives) conducts cutting-edge nuclear and energy R&D.
- The **Nuclear Safety Authority** (Autorité de sûreté nucléaire or ASN) and the **Radiation Protection Institute** (Institut de radioprotection et de sûreté du nucléaire) ensure oversight, transparency, and safety.
- **Framatome**, 80 percent owned by EDF, designs and manufactures nuclear reactors and components.

Together, these institutions manage each stage of the nuclear cycle, from generation to disposal, ensuring full lifecycle control and a high degree of safety and public accountability.

The State of the Nuclear Fleet: Aging Infrastructure and the Need for Renewal

France's nuclear fleet is standardized around Pressurized Water Reactors (PWRs), including 56 second-generation units and one third-generation European Pressurized Reactor (EPR), which is a specific, advanced design that evolved from the PWR technology, at Flamanville, commissioned in December 2024. It was the first new reactor since 1999.

The long gap between new projects resulted from several factors: a temporary overcapacity, a policy shift favoring renewables, and massive delays and cost overruns in existing projects. For example, the Flamanville EPR ended up costing over €23 billion, compared to the initial estimate of €3.3 billion.

Reactors were originally designed for 40 years of operation (60 years for EPRs), but extensions beyond this period are possible with ASN approval. The average age of the current fleet is 39 years, and the oldest still-operating reactors date back to 1979. Coordinating the decommissioning of these older units with the launch of new ones is now a critical challenge. The premature closure of Fessenheim, intended to coincide with Flamanville's start-up, failed to achieve this synchronization.

A Renewed Legal and Regulatory Framework

France's nuclear regulation was consolidated in 2006 with the Transparency and Nuclear Safety Act (TSN),^[2] which created the ASN and set out new obligations on transparency, public information, and environmental protection. This framework was further updated in 2016 to align with EU law through the transposition of three key Euratom directives on nuclear safety, radiation protection, and waste management.

More recently, the 2023 Nuclear Acceleration Act^[3] simplified permitting procedures to speed up the construction of new reactors. Key reforms include the separation of nuclear permits from land development approvals, streamlined environmental assessments and shorter litigation timelines. Meanwhile, the EU's inclusion of nuclear energy in its green taxonomy in 2022 confirmed its status as a sustainable energy source, subject to stringent safety and waste management criteria.

A New Economic Model for Nuclear Power

For over a decade, France operated under a unique regulatory scheme known as ARENH (Regulated Access to Historic Nuclear Electricity), introduced in 2010 to open the electricity market to competition. Under this system, EDF –

France's state-owned utility – was required to sell a portion of its nuclear output (up to 100 TWh per year) at a fixed low price (€42/MWh) to alternative suppliers.

While initially intended to foster competition and benefit consumers, the mechanism became increasingly unsustainable for EDF, especially during periods of high market prices, such as the 2022-2023 energy crisis. It also drew growing criticism from the European Commission, which considered it a distortion of competition and incompatible with EU internal market rules. In response, the French government decided to phase out ARENH by the end of 2025. The phase-out of the ARENH mechanism marks a turning point in the sector's financial regulation. From 2026 onward, EDF will operate under a new regime based on revenue-sharing and consumer protection.

This post-ARENH model introduces:

- **A tax on excess nuclear revenues**, with a 50 percent levy above a set threshold and up to 90 percent above a higher “capping” threshold.
- **A universal nuclear rebate**, funded by this tax, to reduce electricity bills for all consumers.
- **An oversight from the Energy Regulation Commission**, France's independent regulatory authority overseeing the electricity and gas markets, ensuring that the system remains transparent and effective.

The new framework is designed to ensure EDF's financial stability, attract investment, and maintain competitive energy prices for end users.

Industrial Revival and Strategic Investment

France's nuclear renaissance is anchored in two main projects: the construction of six EPR2 reactors (with the potential for eight more) and the development of SMRs like the NUWARD project. Delays have already pushed the first EPR2 commissioning from 2035 to 2038, while the estimated cost of the program has risen to nearly €80 billion.

Financing is expected to come from state-backed loans, a regulated CfD model offering EDF a guaranteed price of €100/MWh, and private investments through initiatives like the France Nuclear Fund 2, aimed at supporting SMEs in the supply chain.

These projects are also embedded in the forthcoming Multiannual Energy Program (PPE 3), which will reaffirm nuclear power's central role while encouraging innovation in reactor design, fuel reprocessing, and fusion research. Notably, the CEA's WEST tokamak set a world record by maintaining plasma for over 22 minutes, a key step in the pursuit of fusion energy.

France's Position on the European Stage

France's pro-nuclear stance also extends to EU negotiations. In April 2025, Paris formally opposed efforts to raise renewable energy targets without parallel recognition of nuclear energy. It advocates replacing the current Renewable Energy Directive with a broader, "decarbonized energy" directive that includes nuclear on equal footing. Germany's recent shift in stance toward nuclear power, despite its historical opposition and the closure of its last nuclear plants in 2023, marks a significant step toward recognizing nuclear energy as a long-term low-carbon asset. In May 2025, Germany announced that it would no longer oppose French efforts to incorporate nuclear power into European legislation.

This reflects a broader effort to secure regulatory parity for nuclear energy, emphasizing France's uniquely low-carbon electricity mix. As the EU works toward its 2040 climate goals and prepares its roadmap for COP30, France is positioning itself as a leader in pragmatic, diversified decarbonization.

Conclusion

In conclusion, France's bet on nuclear energy is bold but calculated. Its success depends on mastering complex industrial projects, securing sustainable financing and maintaining public and political support. If successful, France will not only preserve its unique energy model but may also set the standard for a low-carbon, resilient electricity system in Europe and beyond.

In this context, navigating the legal, financial, and regulatory framework will be critical for investors, suppliers and stakeholders across the nuclear value chain.

[1] RTE, *Bilan Electrique 2024*.

[2] Law No. 2006-686 of 13 June 2006 on transparency and safety in nuclear matters.

[3] Law No. 2023-491 of 22 June 2023 on accelerating procedures related to the construction of new nuclear facilities near existing nuclear sites and the operation of existing facilities.