ACEF 2026 spotlight session on nuclear energy - Part II – Advanced nuclear technologies

Lessons learned from France’s nuclear programme and France’s technology solutions for SMRs projects.

10 June 2026

Manilla

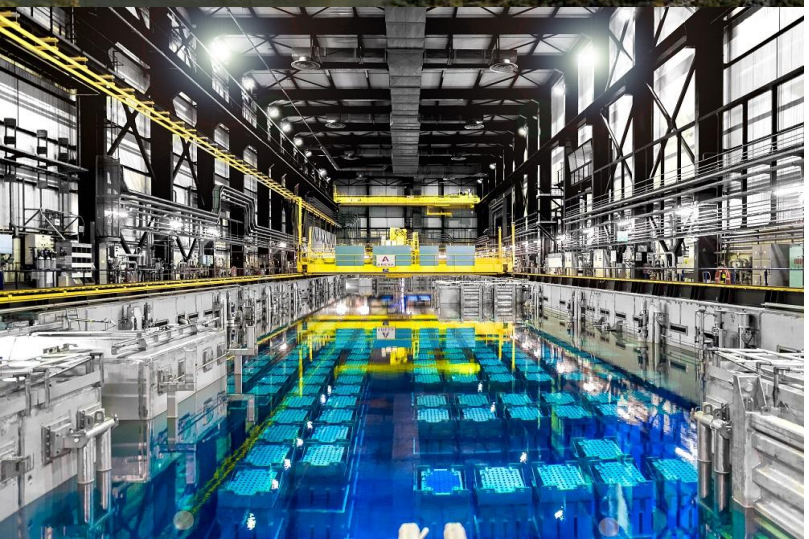
I

Lessons learned from France’s nuclear programme

Timeline and key features of the Messmer plan

The Messmer plan, a bold initiative launched in 1973 to rapidly expand France's nuclear capacity, aimed to build **13 PWRs by 1980** and **58 reactors by 2000**, covering the majority of France's electricity needs. achieving its energy independence goals.

- Key drivers: **energy independence, economic growth, technological prestige, environmental concerns**
- The plan was implemented in **phases**, with a focus on **standardization** and rapid construction. The development of the French nuclear programme can be divided into three main phases:
  - 1970s: **Initial deployment of PWRs**, focus on standardization.
  - 1980s: **Peak construction period**; France became a global leader in nuclear energy.
  - 1990s: **Completion of most reactors;** focus shifted to fuel cycle management and export.
- Over time, the plan evolved to include **improvements in reactor design, fuel cycle management, and safety protocols.**
- **By the end of the 1990s, France had successfully built 58 reactors**, achieving its energy independence goals.



Key outcomes and legacy

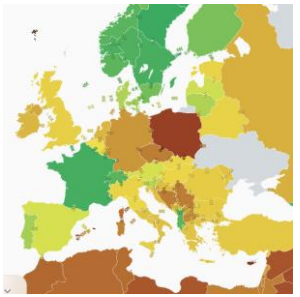
By the 1990s, France had become the second-largest producer of nuclear electricity globally. Approximately 75% of France's electricity came from nuclear power. The French nuclear programme remains a **model of centralised energy planning.** It shaped the country's **energy independence, industrial base, and scientific leadership**. The programme continues to influence EU energy policy and climate strategy.

Significant economic impact, including:

- **Decreasing and stabilizing electricity prices:** In the 90s, France had a one of the lowest electricity prices in the EU, providing substantial competitive edge to its industry
- Creating **tens of thousands of jobs in engineering, construction, and operations**. By the 1990s, the nuclear sector was a major part of the French economy, with a well-established fully self-reliant and independent supply chain and skilled workforce of 220,000 people.
- Enabling France to **export electricity** to neighboring countries.
- **French nuclear expertise** was exported to several countries, including South Africa, South Korea, and China. EDF, Framatome and Areva (now Orano) became global players in reactor design and fuel services.

Development of a comprehensive nuclear infrastructure, including:

- The La Hague reprocessing plant, the largest of its kind.
- Fast breeder reactors like Phénix and Superphénix.
- Waste management and long-term storage solutions.



18 May 2026

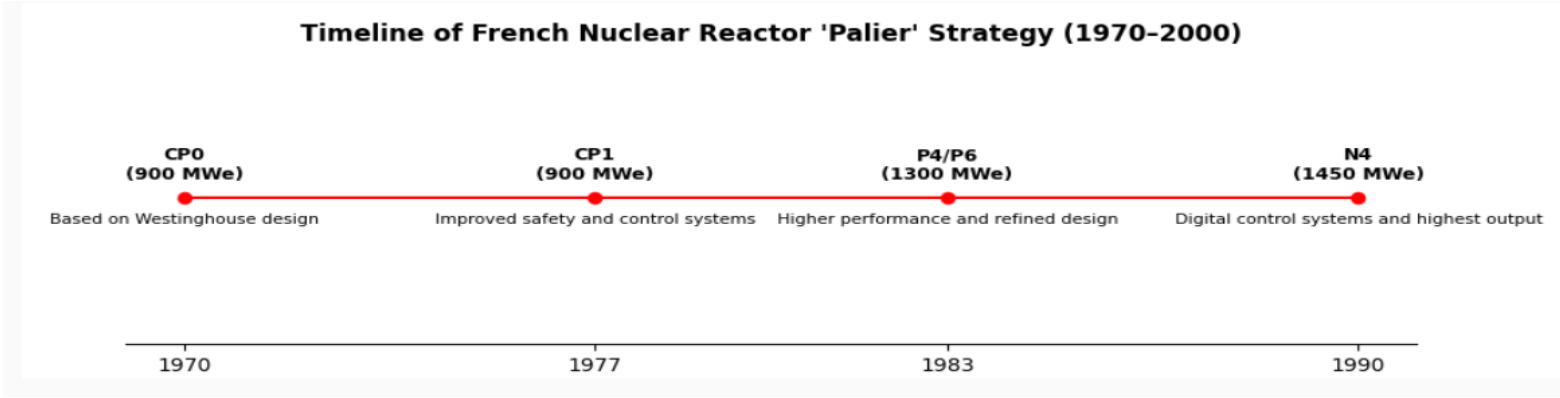
Environnemental performance

- The deployment of 58 reactors in 25 years enabled France to cut its emissions at a rate never observed before. Currently, France boasts one of the lowest-carbon electricity mixes in Europe

Ingredients for a recipe for success & lessons learned (1/2)

Standardisation Strategy implemented through successive phases, each introducing incremental technological and industrial advancements.

- France adopted a **fleet approach**, using the same reactor design across multiple sites. This strategy allowed for lower construction and maintenance costs, easier training and operations, and streamlined safety protocols
- Coupled with a **reactor series strategy**, a step-by-step industrial approach to deploying nuclear reactors, involving in addition to standardization, **incremental scaling**, gradually increasing reactor size and performance with each reactor generation, and limiting technological changes between steps **to reduce industrial and safety risks**



Importance of state-led planning with long-term vision and strong leadership, ambition and continuity as well as clear roles & responsibilities for the execution and delivery with EDF, acting as the architect-engineer of the programme

- Nuclear requires “scale”
- No stop and go
- As an example, a bold decision was made by the government in 1975, to preserve only one kind of reactor, the PWR against the UNGG domestic technology.

Ingredients for a recipe for success & lessons learned (2/2)

Need for public engagement and transparency in nuclear policy.

- Public support for nuclear energy in France was generally strong, but there were pockets of opposition.
- Anti-nuclear movements gained traction in the 1980s, especially after the Chernobyl disaster in 1986. The government engaged in public outreach and education to address concerns and maintain support.

Necessity of long-term waste solutions and decommissioning strategies.

International Collaboration through partnerships with other countries and organizations.

- France licensed American's pressurized water reactor (PWR) technology, which formed the basis for the CP0 “palier”. This allowed rapid industrial deployment while building domestic expertise and ultimately a **fully self-reliant and independent industry**
- France worked with countries like Germany, Belgium, Italy and the UK on (i) **uranium enrichment and reprocessing** through entities like Eurodif and URENCO, (ii) **joint reactors construction projects including Generation IV fast breeder reactors**

Robust Regulatory Framework: strong oversight and regulation ensured safety and reliability. atomic energy development.

II

France’s SMR and AMR technologies

A growing global need for decarbonized energy

In net zero scenarios[1], nuclear power should reach 500-900 GW globally by 2050

	Nuclear Installed capacity	SMR
World	500-900 GW	~700 units

In Europe, demand for heat energy is already strong and in need of decarbonisation

60%

Of current energy demand in Europe is for **heat** applications

70%

Of Europe's current heat supply needs to be **decarbonised**

1. Ambition of the European nuclear alliance; EDF's Ns scenario; Compass Lexecon for NuclearEurope, 2024, "Pathways to 2050: The Role of Nuclear in a Low-Carbon Europe"; IAEA and Enerdata scenarios, 2023. 2. Excluding France

NUWARD, a multi-energy platform serving industries and utilities to accelerate transition to a decarbonised energy future

NUWARD supports the decarbonisation of industry, utilities and datacentres

NUWARD leverage its heritage and innovation to offer Small Modular Reactors (SMRs) as multi-energy solutions.

Our mission is to empower industries, utilities and datacenters to deliver comprehensive low-carbon energy, efficiently meeting both electricity and heat demands for end clients.

NUWARD's value proposition is to take proven technology with three key changes **– simplification, modularisation and prefabrication –** to offer sure, fast and predictable projects to our customers.

NUWARD is pursuing a growth strategy initially focused on the European market

NUWARD is dedicated to becoming a **leading force in the Small Modular Reactor (SMR) market.**

Industry Clusters
Data Centres
Utilities

Relevant industry know-how

Unique supply chain throughout Europe **immediately available**

nuward EDF GROUP
EDF
framatome
arabelle
ansaldo nucleare
ansaldo energia
TRACTEBEL ENGIE

Robust and realistic KPIs to drive NUWARD's success

Up to 400 MWe, and in cogeneration mode up to **290 MWth** and **320 MWe**

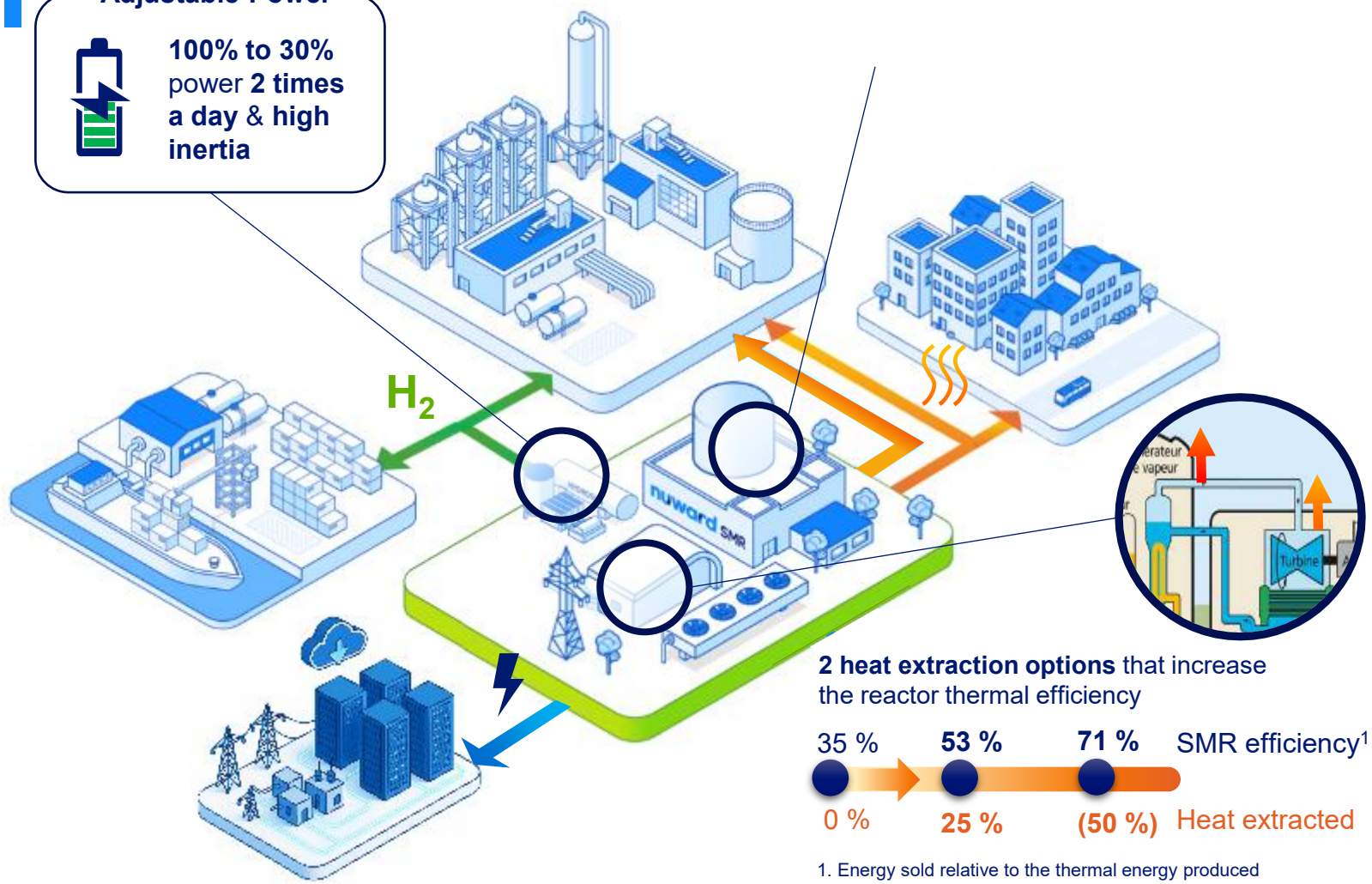
96% of uranium & plutonium **recycled**

Construction in **48 months**

NUWARD, a multi-energy platform designed to meet 2030's demand

Adjustable Power

100% to 30% power **2 times a day** & **high inertia**



2 heat extraction options that increase the reactor thermal efficiency

35 %	**53 %**	**71 %**	SMR efficiency[1]
0 %	**25 %**	**(50 %)**	Heat extracted

1. Energy sold relative to the thermal energy produced

A **Pressurised Water Reactor,** Generation 3+ with an optional high temperature electrolyser

Capable of producing on demand decarbonised **electricity, heat and hydrogen**

Construction in **48 months**

Modular approach and off-the-shelf components

Safety targets that meet the highest international safety standards

Conceptual design	2026	Basic design	Detailed design	Erection & Commissioning	2035

The Joint Early Review, an innovative initiative aiming at anticipating the regulators' expectation

Main objectives

- **Foster exchanges** with several **European regulators** on the NUWARD SMR design and its safety approach
- **Identify key enablers** and conditions to meet licensing expectations in participating countries
- Enable all participants **to increase their respective knowledge** of each other's **regulatory practices**

Phase 1 completed with three European nuclear safety authorities

06/2022 – 06/2023

Summary Reports published in September **2023**

Phase 2 completed with three more EU nuclear safety authorities

12/2023 – 04/2025

Summary Reports published in December **2025**

Phase 3 scheduled with two more EU nuclear safety authorities

01/2026 – 12/2026

Summary Reports to be published in **2027**

A pressurised water SMR fully relying on proven technologies, an established industrial sector, and a sustainable fuel cycle

Proven technologies

Architecture and systems based on proven technologies used on the existing EDF fleet and EPR2 reactor technology.

A **primary circuit** to deliver a thermal power of 1150 MWth, that can be manufactured with existing industrial facilities.

Established industrial sector

NUWARD SMR relies on the **EDF Group's** technical and industrial expertise and **Framatome's and Arabelle Solution's** industrial infrastructure,

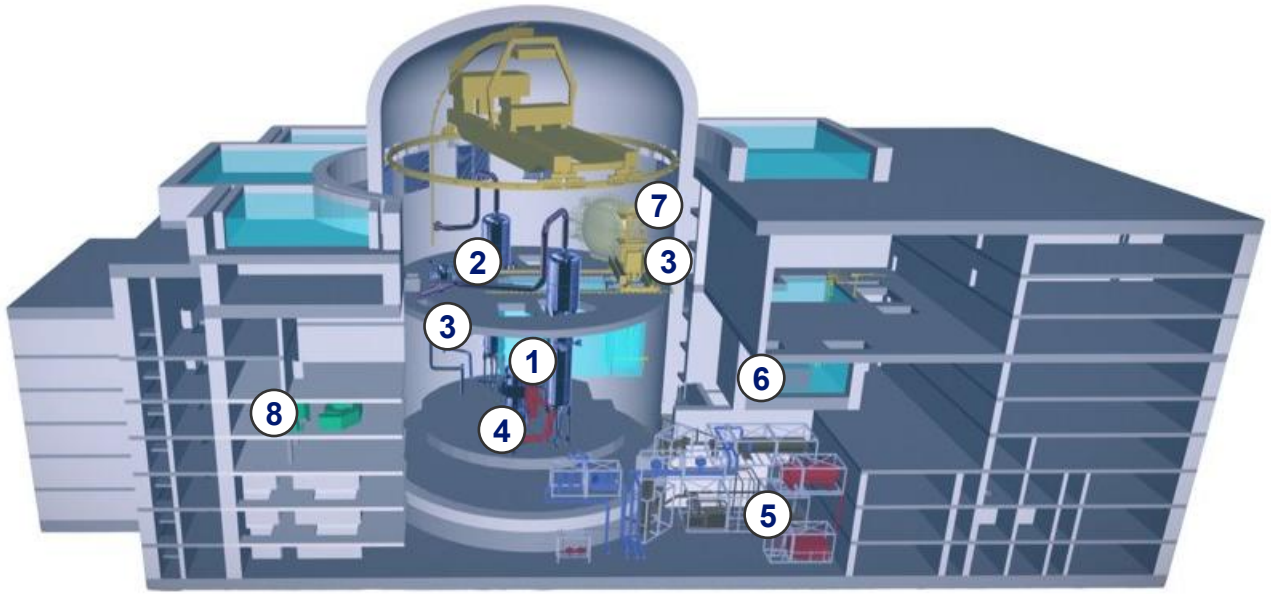
and integrates **partners** to enhance its construction and modularity skills, such as **Tractebel** and **Ansaldo Nucleare.**

Proven and sustainable fuel cycle

Fuel assemblies similar to those currently used in the French nuclear fleet.

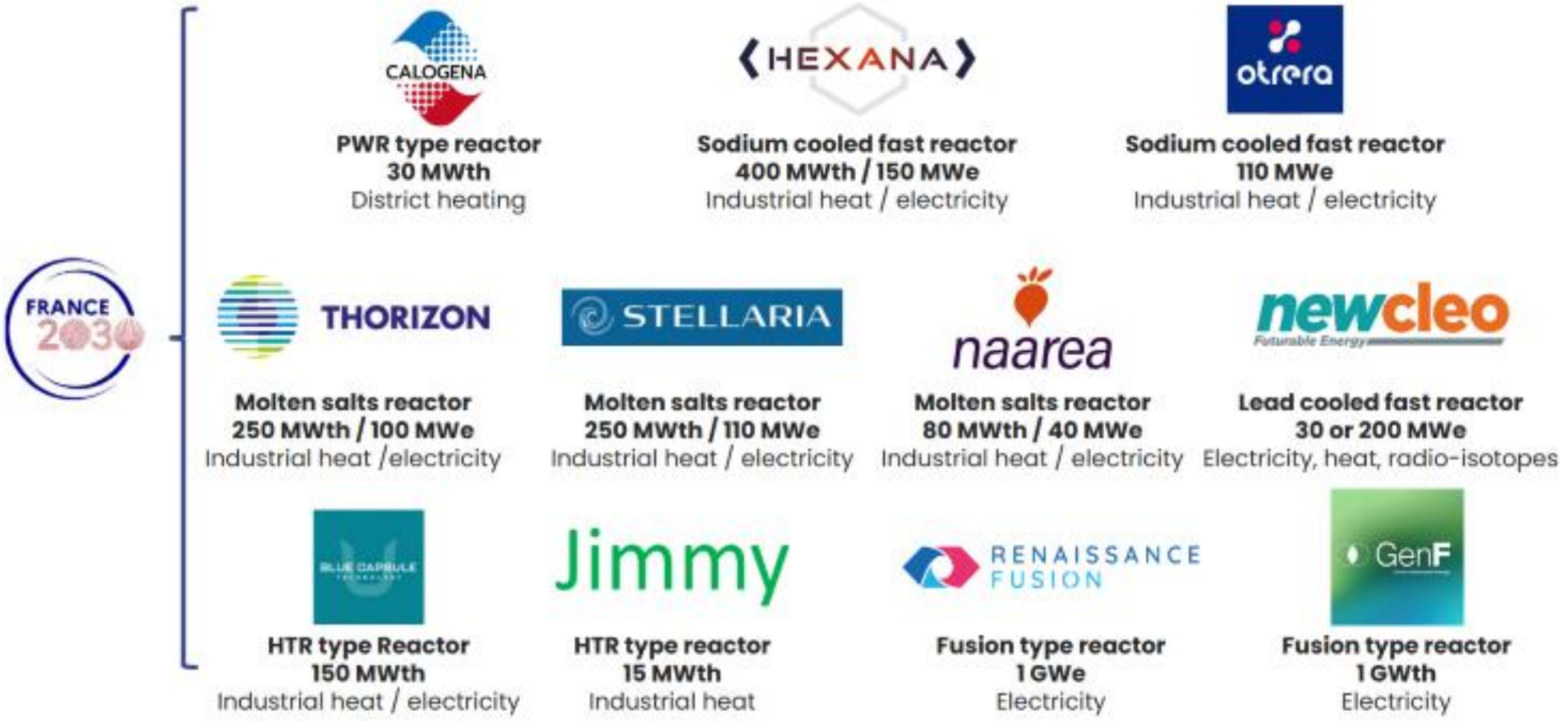
A reactor designed to operate with **MOX fuel** and enriched reprocessed uranium (**ERU**).

NUWARD SMR: the only SMR that helps **reducing the natural uranium consumption** and **spent fuel volumes**.



1. Reactor core
2. Steam generators
3. Pressuriser
4. Primary pumps
5. Safety system module
6. Fuel pool
7. Fuel charging & discharging system
8. Control room

In addition to NUWARD, 11 SMR & AMR projects benefiting from the support of France 2030 initiative



Thank you

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