

OTRERA NEW ENERGY is a spin off from CEA (Atomic Energy Commission) co-founded in 2024 by Frédéric VARAINE, Grégory CHERBUIIS et Jean-Éric LUCAS and winner of the France 2030 Call for Proposals on Innovative Nuclear Reactors. OTRERA designs and develops a range of **4th generation sodium-cooled SMR** (Small and Modular) nuclear reactors.

At OTRERA NEW ENERGY, we are redefining nuclear power to meet decarbonization goals by 2050, the greatest challenge of our century.



We are developing a small innovative 2x300 MWth (2x110 MWe and 2x180 MWth) sodium fast neutron reactor (SFR) that produces low-carbon electricity and heat between 100-150°C up to 500°C, to power cities and industry. The challenge for these stakeholders is to achieve Net Zero Emissions by 2050.

Our objective is to make sodium technology as competitive as possible, with a market launch in 2032, by building on the 50-year scientific and technical history of this industry of excellence and tens of billions in investments.

To achieve this, we have changed the paradigm in line with today's challenges by re-examining the historical specifications for SFRs, and without disrupting the technology.

Drawing on our experts' experience, most of whom also worked on the ASTRID SFR project, we are proposing a simplified, modular, safer architecture already in pre-industrial phase, enabling competitive energy production and accelerated time-to-market. To power its reactor, OTRERA has designed a new-generation core allowing: optimal use of fissile material, a 10-year fuel cycle, an optimized cycle integration, and the ability to use both MOX and UO₂ HALEU fuel.

OTRERA innovative SFR

OTRERA brings major innovations to fast neutron reactors, supported by a proactive patent strategy with 15 patents already filed, some of which are applicable to other sectors such as chemistry, energy, and industry. OTRERA stands out from the competition in five key points:

Innovative, compact and economical architecture



OTRERA plant located near suburban areas.

The innovative architecture of the OTRERA reactor makes it highly compact. With a 2.5-meter-diameter vessel, compared with the 12-meter diameter of the ASTRID reactor (150 MWe version), this compactness is also reflected in the site, which has a footprint of 4 hectares. OTRERA reduces the amount of concrete required by a factor of three, drastically cutting construction costs and environmental impact.

Its Brayton thermodynamic cycle enables the recovery of low-medium temperature heat, enhancing overall energy competitiveness.

Long-lasting, high-performance core with cycle integration

OTRERA has designed a high-performance, long-cycle core that produces twice as much electricity for a given quantity of MOX (Mixed Oxide) fuel compared to classical SFR and PWR reactors. OTRERA is the only SMR able to recycle fuel material (plutonium and reprocessed uranium) from used MOX assemblies, which are currently not reprocessed and stored in pools at La Hague. This means more efficient management of nuclear materials, preservation of finite uranium resources, and a reduction in waste by a factor of two.

SFR reactors built between 1960 and 1980 (in France, Russia, Germany and the USA) made extensive use of MOX, with positive feedback. The manufacture, transport and reprocessing of this type of fuel are well known and fully managed. This makes MOX by far the most mature fuel for SFR.

OTRERA is also the only European reactor to be able to operate with two other fuel types:

- Unused fuel assemblies from earlier sodium reactors, saving time and reducing costs.
- UO₂ HALEU fuel for export (plutonium-free, whose status differs from country to country). This fuel opens up new opportunities as it is a less proliferating and easy-to-use product, ideal for many countries in terms of safeguard. Moreover, it benefits from extensive industrial feedback from FNR around the world and is easy to manufacture and transport.

OTRERA's technology associated with these fuels lead to reactors that produce twice as much energy as thermal reactors such as the HTR and third generation ones, and to extended fuel cycles of up to 10 years, versus 18-24 months for current reactors. OTRERA's fuel availability and cycle advantages are contributing to accelerating the deployment of its reactors.

Modular design ready for industrialization

The New Space-inspired modular design ensures short manufacturing times and low costs, while maintaining industrial scalability. OTRERA's 50 MWth primary heat exchange loops are standardized, one-time qualifiable, manufacturable and factory pre-assembled. Key components such as the vessel, control rods and heat exchange modules will be manufactured by OTRERA on a non-nuclear industrial site.

High level of maturity for an accelerated deployment, First Of A Kind starting in 2032

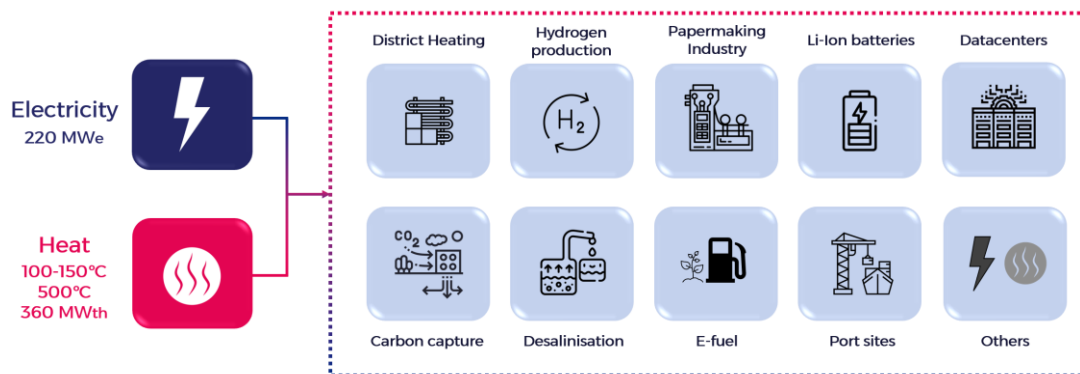
OTRERA therefore relies on mature technology, as demonstrated by its designation as an "Industrial Reactor" in the [classification issued by the French Nuclear Safety and Radiation Protection Authority \(ASNR\)](#). OTRERA is based on pre-industrial components, some prototypes of which can be seen at CEA Cadarache (electromagnetic pump, sodium/gas exchanger). The innovative design does not involve a disruptive technology, but rather overcomes the bottlenecks identified in previous sodium reactors. This guarantees fast, reliable implementation. Thanks to its high level of maturity and the French regulator ASNR's in-depth knowledge of this technology, OTRERA can directly propose an industrial reactor without the need for a demonstrator. This first reactor will provide France and Europe with a fast neutron source and will serve as a qualification tool for the key technologies of OTRERA. The reactors will be deployed in European countries, benefiting from French feedback and working with local authorities.

Enhanced safety and security

OTRERA's optimized design and operating conditions (made possible by the physical properties of sodium) guarantee maximum safety and security, as described by the French High Commissioner for Atomic Energy (HCEA) in July 2024. OTRERA features a 4th containment barrier, operates in an inert, non-pressurized atmosphere, and is in a semi-underground building. By design, this eliminates the risk of sodium reacting with air and water. In addition, fuel handling steps are reduced as the fuel cools down in its own core after reactor shutdown, unlike other technologies requiring an adjacent storage pool. OTRERA reactors can therefore be deployed close to suburban areas. OTRERA is currently under review with the French regulator (ASNR), in the Preparatory Review phase.

Market and use cases

OTRERA's energy users include high-consumption areas, such as industry (datacenters, hydrogen and e-fuel production, Li-ion battery manufacturing, etc.), which can be grouped together in clusters, and heating networks. Here are some examples of final customers for the decarbonized electricity and heat:



The objective is to supply them with electricity and heat (between 100 and 150°C, up to 500°C) at controlled and predictable costs to contribute to their decarbonization roadmap. Among the various aspects of decarbonization, heat production is a major challenge with nearly 90 % of commercial heat worldwide derived from fossil fuels. Heat accounts for half of the world's total energy consumption and two-thirds of industrial energy demand. Globally, heat production emitted 1.3 billion tons of CO₂ in 2021.

As an example, OTRERA can produce over 30,000 tonnes per year of low-carbon hydrogen by high-temperature electrolysis (HTSE/SOEC). The use of heat to vaporize the water reduces the electricity required for electrolysis and improves overall efficiency. The OTRERA reactor can also power a 200 MWe hyperscale datacenter, a type of datacenter that is responding to the exploding demand for cloud services, particularly for AI. As they are now compelled to valorize their waste heat at around 40°C, coupling with OTRERA heat enables them to reach a more suitable temperature for the market, i.e. around 120°C (for instance for district heating).

The OTRERA's LCOE of electricity depends on that of heat, with values ranging from about 60 to 90 €/MWh for electricity and 50 to 20€/MWh for heat. The electricity price rises when the heat price decreases. The market's main need, particularly for industrial companies, is to hedge against variations in the price of decarbonized energy (electricity and heat), using medium/long-term contracts such as PPA or futures. Moreover, the ability to supply energy to industrial companies with electro-intensive production could be included in the price of futures contracts.