Thorizon Introduction

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NRG Webinar – November 24th 2023


Strong demand
for nuclear energy

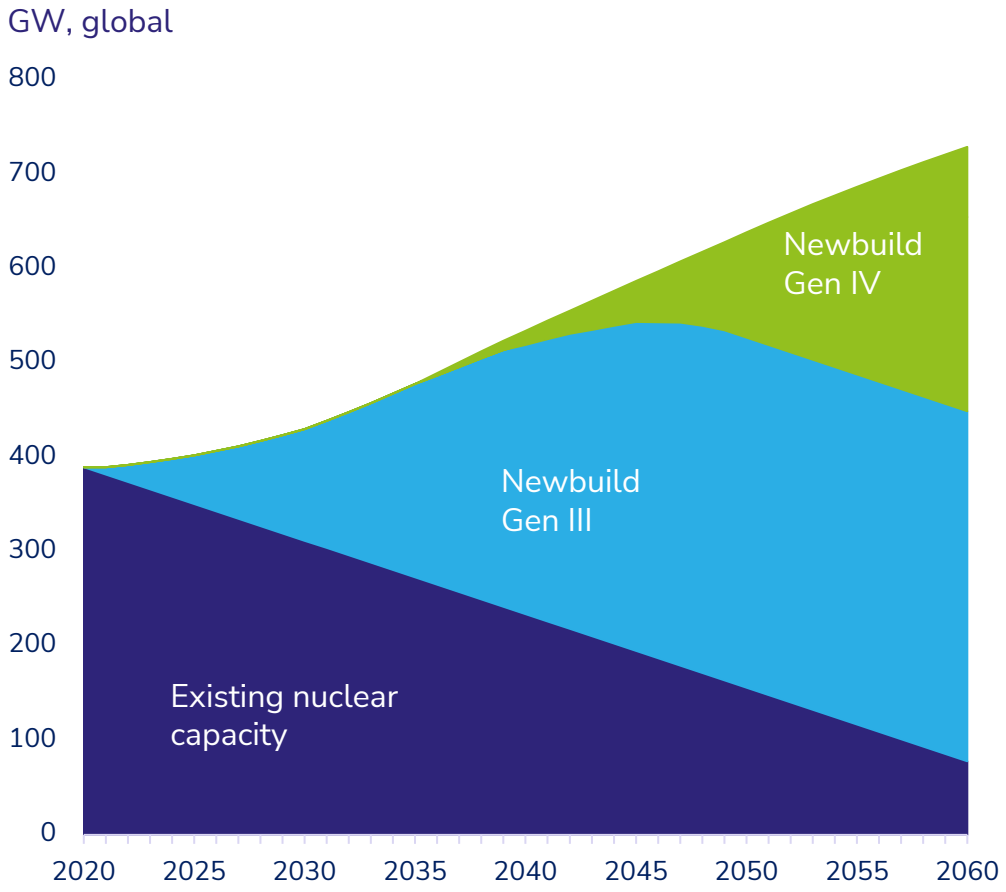

Unique, promising
technology

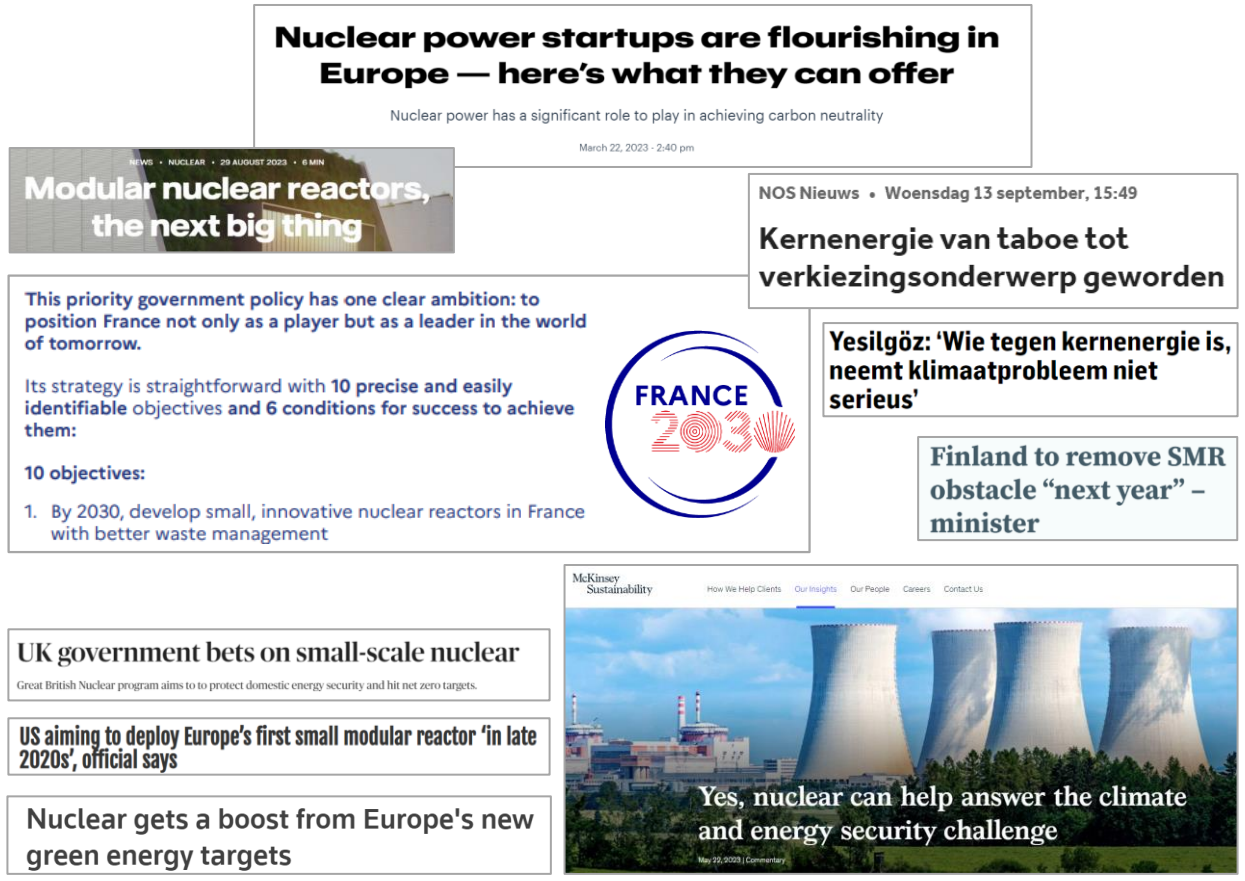

Aiming for partnerships and
ecosystem approach


Experienced and
growing team

Demand and momentum for nuclear energy are increasing …

Trends in nuclear energy market





Source: Energy, Electricity and Nuclear Power estimates up to 2050 (IAEA, 2022) – medium scenario; press clippings

… and Thorizon’s reactor appeals to multiple users

Applications of Thorizon’s molten salt reactor

One Thorizon molten salt reactor can …

Make nuclear circular

- Use **long-lived radio-active waste** streams by using them as fuel together with Thorium
- Transform into **energy**, only short-lived waste remains
- **Follow-up versions** will be circular and able to convert ~100% of the spent fuel

Generate 100 MW electricity

- Energy for ~**250,000 families**
- A “**private wire**” for companies, avoiding net congestion
- Provide a **balancing base-load** of carbon neutral electricity (flexible between 50-300 MW)

Generate 550° C clean steam

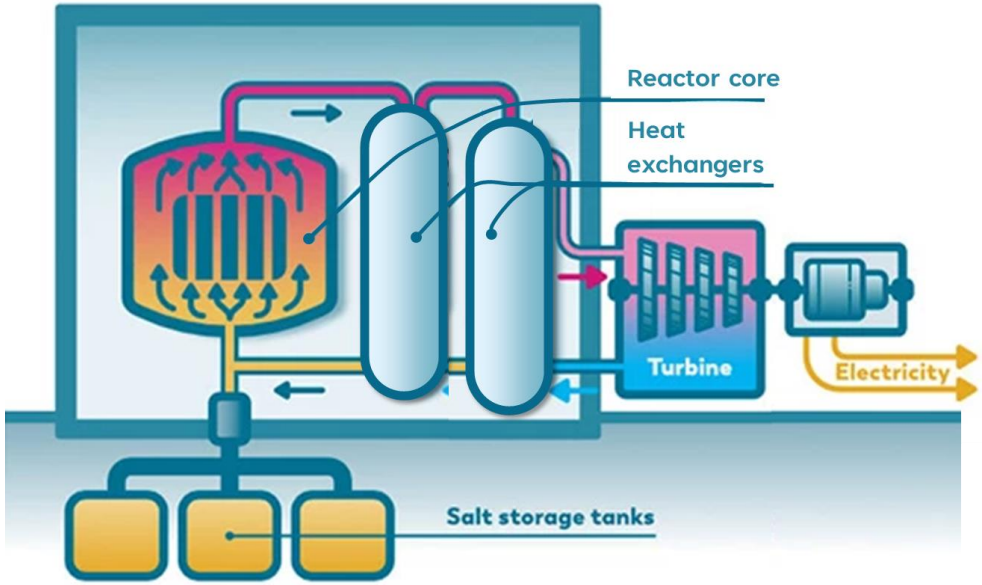
- **250MW** of thermal power
- Used for **production processes** like the chemical industry or hydrogen production
- **Reduce carbon footprint** of current industrial processes

Molten Salt Reactors are seen as a game changer in the nuclear industry

Advantages of molten salt technology

Concept

The fuel is dissolved into a liquid salt mixture at high temperature and low pressure, the fission energy directly heats up the molten salt



« Molten Salt Reactors are seen as a game changer in the nuclear industry »

- International Atomic Energy Agency

Advantages

Molten salt reactors (MSRs) can make nuclear energy cheaper and cleaner, and they will be used in ways that ordinary reactors cannot be used

Walk-away safe
Security is enhanced

Less nuclear waste
Optimal match with reprocessing facilities

Economic
Efficient cycles and reduced capex

Flexible
Electricity, heat, actinide converter, breed & burn

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Source: NRG Molten Salt Reactor FAQs; https://www.iaea.org/fr/themes/reacteurs-a-sels-fondus; https://www.cea.fr; Knowable Magazine; Thorizon business plan

Our modular concept solves a major obstacle in MSR design

The idea of cartridges

The main challenge

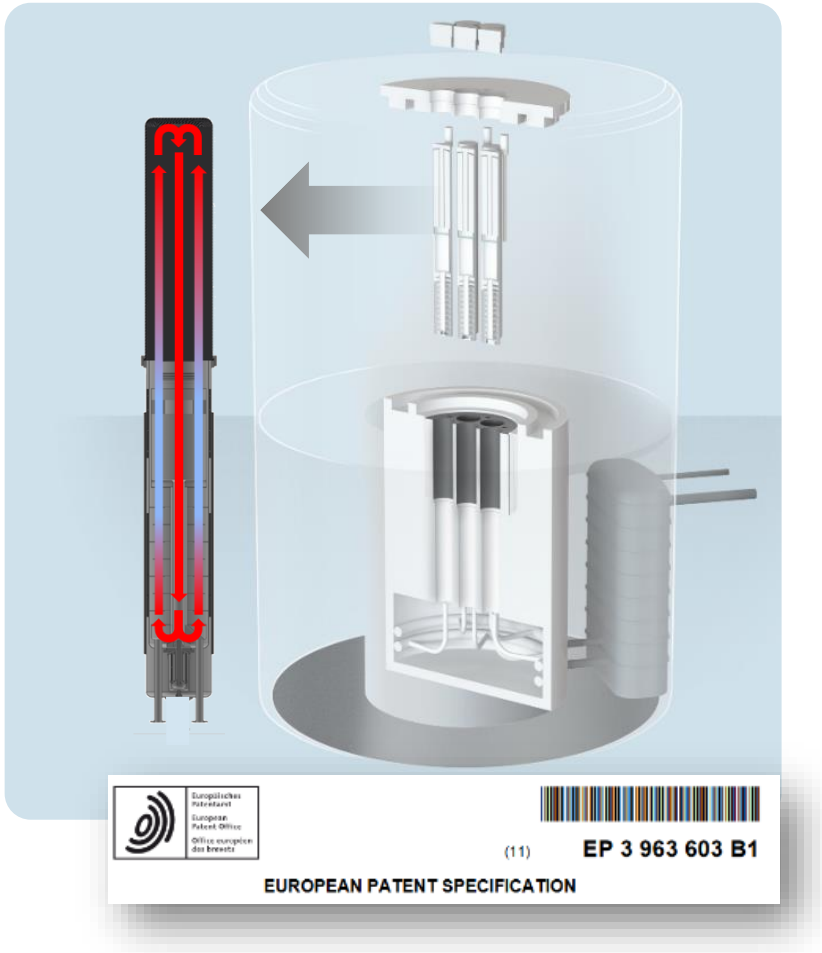
Exposure of materials to extreme conditions

The solution envisioned

The core contains cartridges that are replaced every 5 to 10 years

Proof that it works

Internal simulations are promising and external audits by Tractebel Engie and CNRS are positive



The cartridge concept was patented by Thorizon in 2020

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Source: Thorizon ; EP 3963603 B1

These cartridges have many additional advantages …

Advantages of the modular cartridge system

Rapid time to market

- Using existing technology and components
- Demonstrator with one or more cartridges

Additional safety

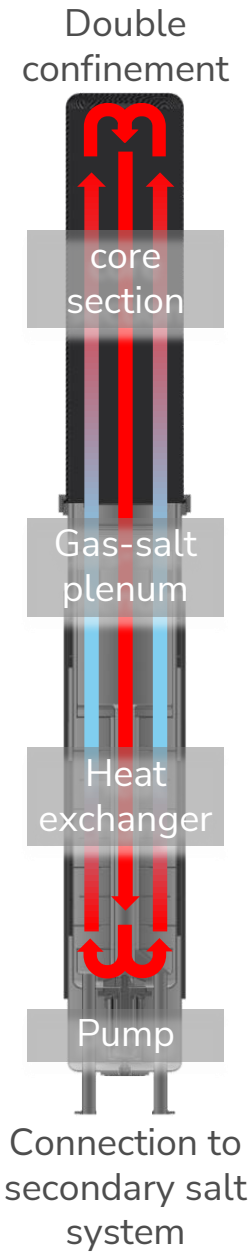
- Without active pumping, the core becomes subcritical
- Closed system with two containment barriers

Additional flexibility

- Different fuels in different parts of the core
- Reactor spectrum may vary

Series production

- Cost reduction
- Continuous improvement and innovation



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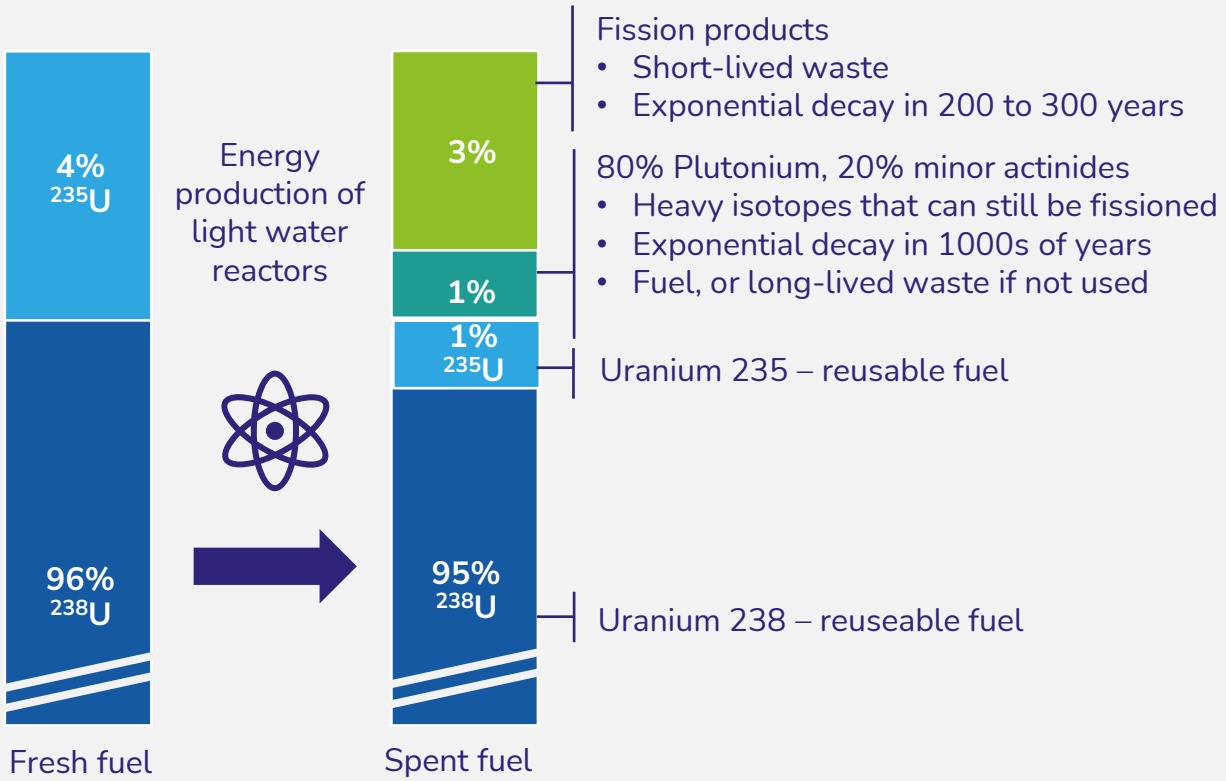
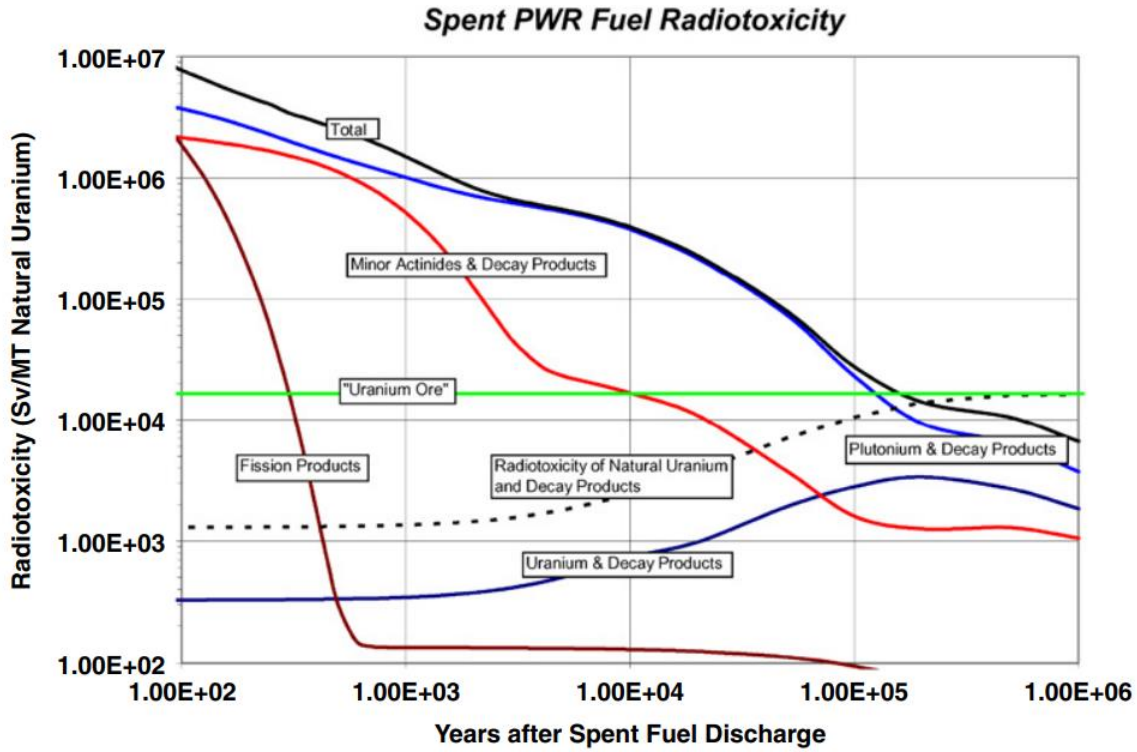
Source: Thorizon - concept de réacteur

Light water reactor spent fuel, contains a lot of energy, especially in the longlived elements (actinides)

Recycling of spent fuel – schematic overview





Current reprocessing strategy has limitations

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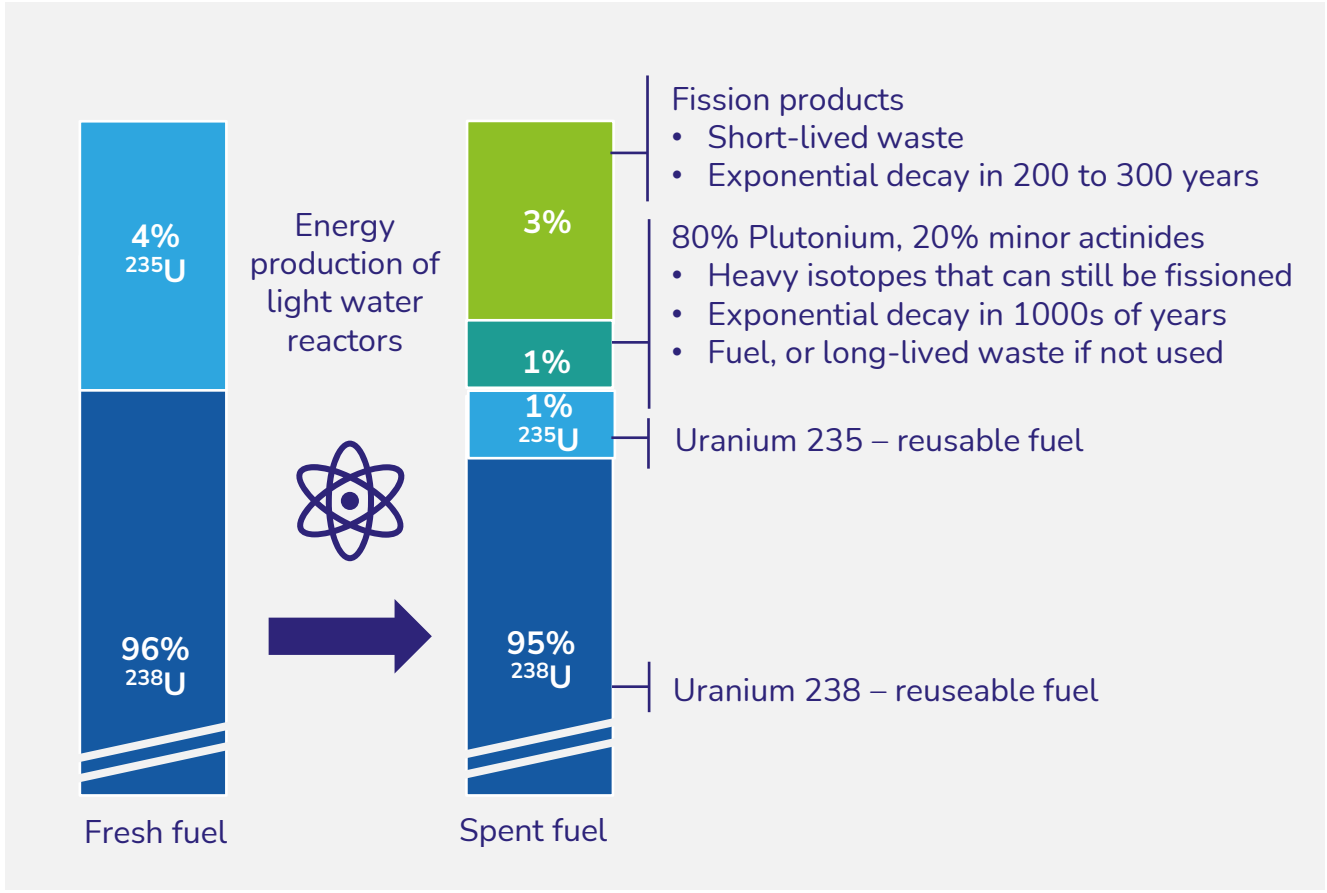
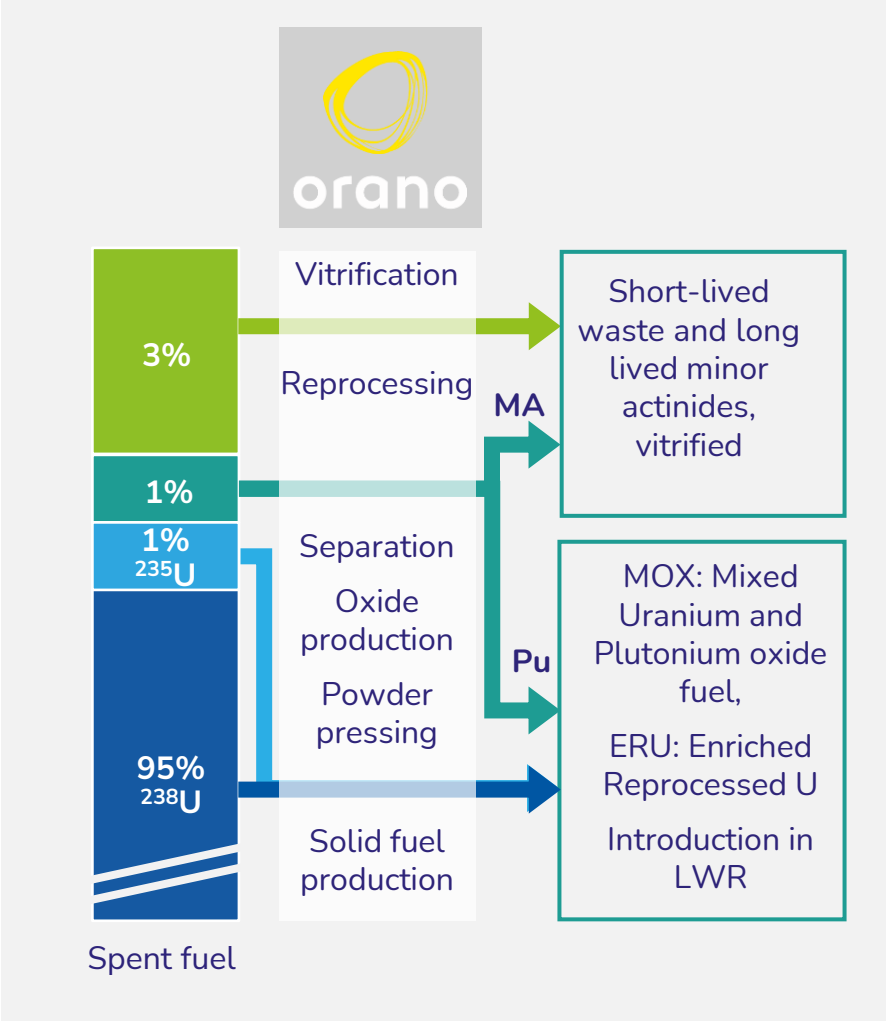
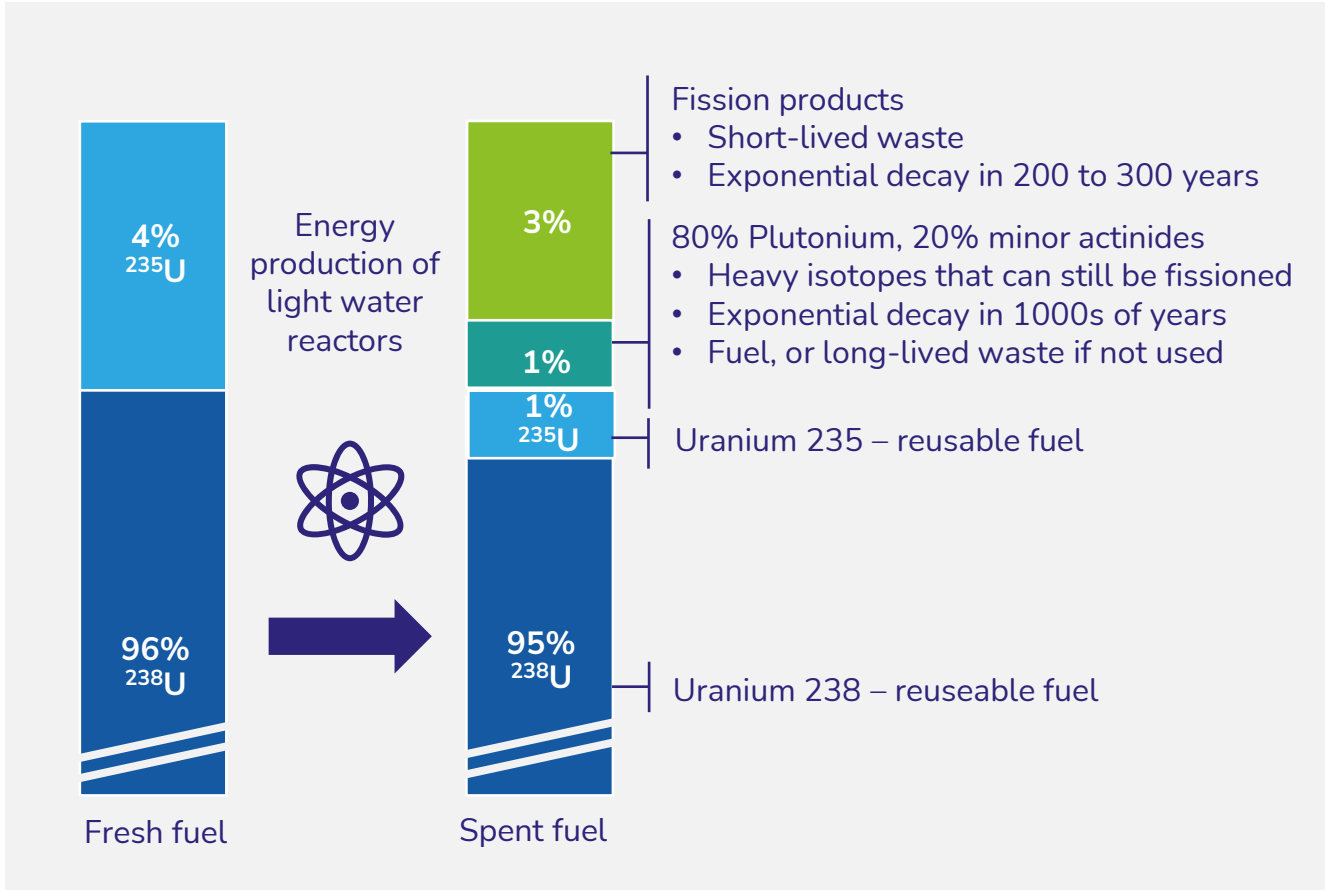


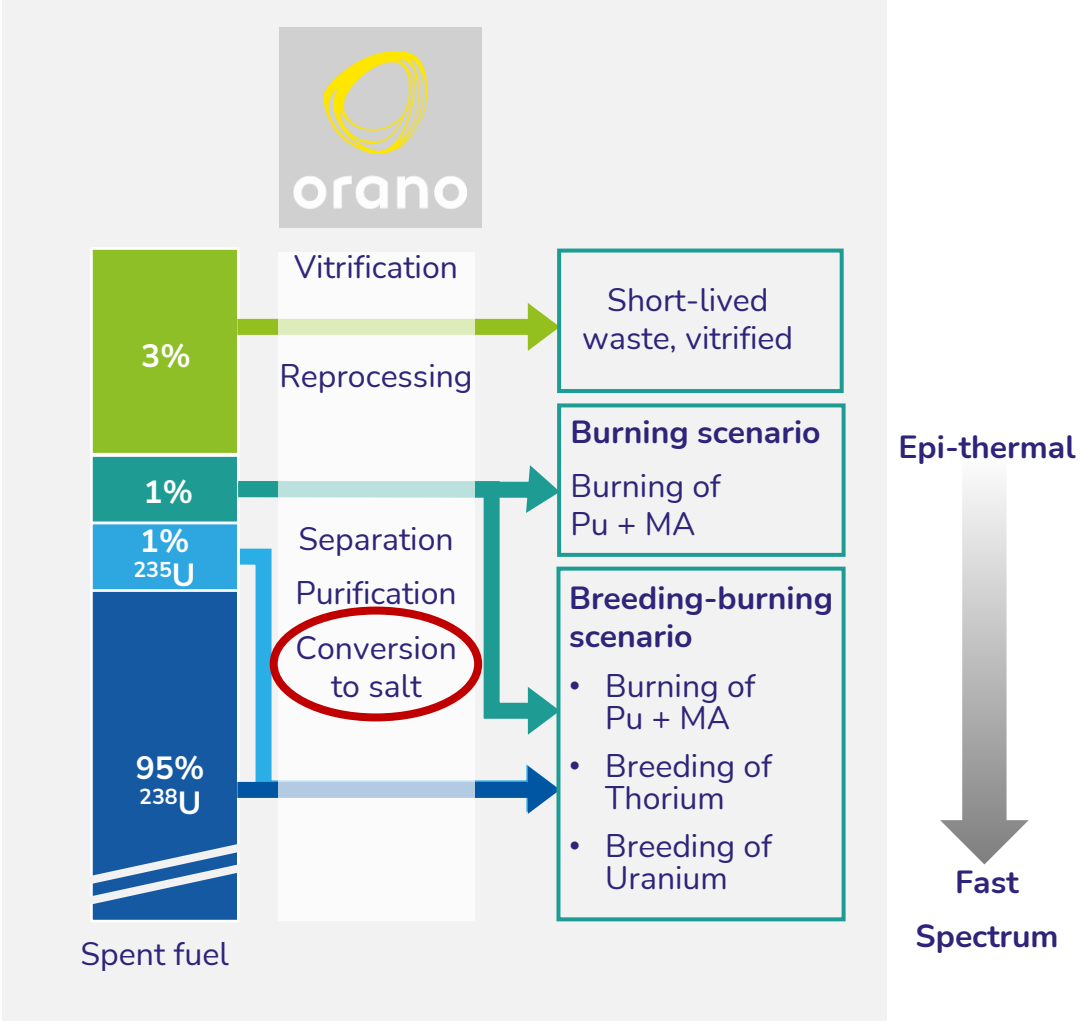


Current reprocessing strategy has limitations

Light water reactor spent fuel reprocessing combined with molten salt reactors

Recycling of spent fuel – schematic overview





Efficient actinide conversion avoids waste of valuable resources and reduces long-lived waste

Demand for nuclear waste reduction is high and expected to increase

Market analysis

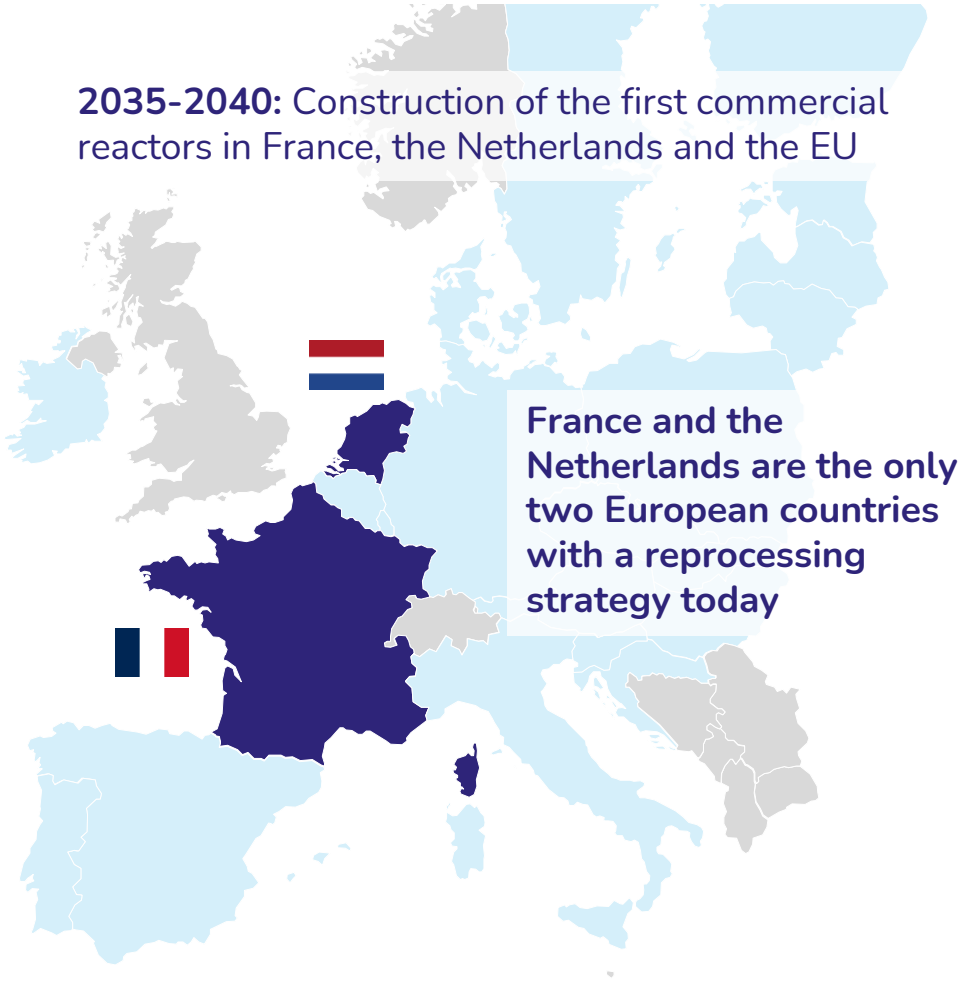
Reactors required to process **spent fuel** produced by nuclear **power plants in operation** in the EU today — **75 reactors**

\+ — \+

Reactors required to **process existing stocks of heavy metals** from spent nuclear fuel in the EU — **135 reactors**

Demand for recycling in the EU only based on existing nuclear capacity and stockpiles — **210 reactors**

2035-2040: Construction of the first commercial reactors in France, the Netherlands and the EU



France and the Netherlands are the only two European countries with a reprocessing strategy today

Source: Analysis of the Thorizon team based on company websites, conferences and presentations, IAEA and Nuclear Europe.

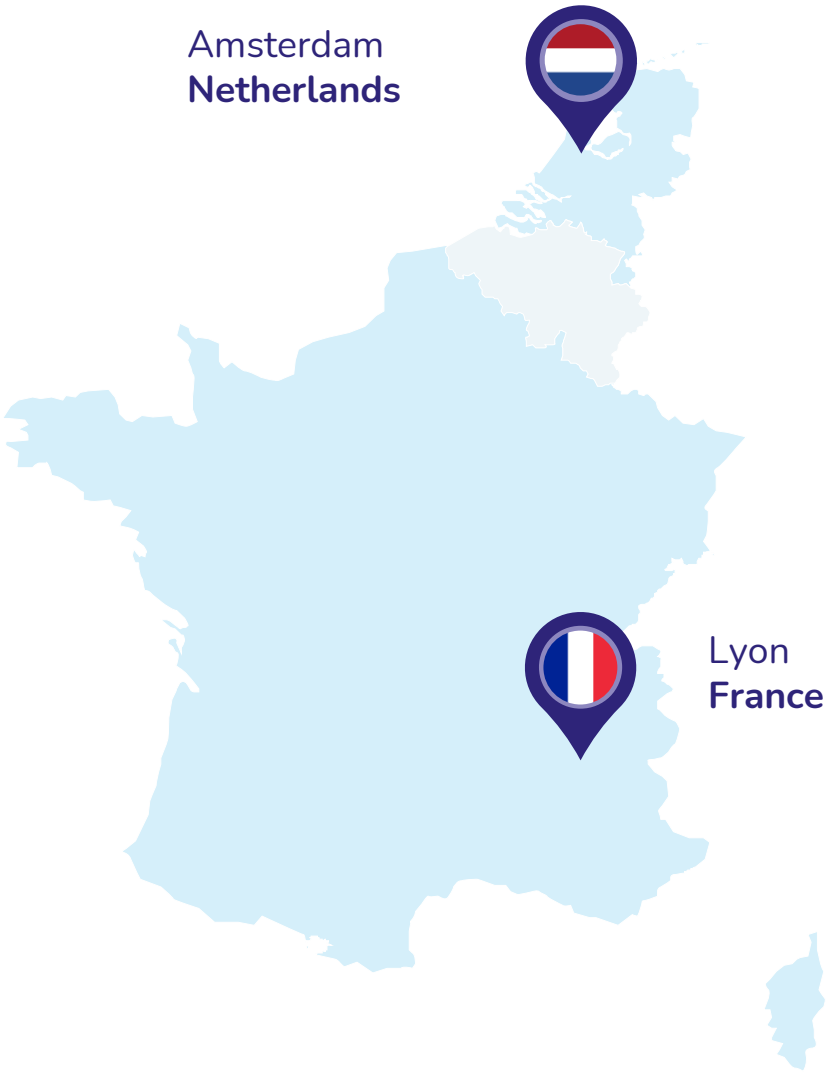
We are applying for France 2030 funding

France 2030 application

- Large investment plan of € 54bln to support the “sectors of **France’s industrial future**”
- Nuclear technology is **priority number one**
- - € 1 bln will be invested to develop **“small, innovative nuclear reactors with better waste management“**
- Together with e.g., Orano and Université de Lille we are applying for **€ ~10mln funding**
- RfP for 3 development phases with **total potential of € 390mln support**
- This would offer us the opportunity to **speed up our reactor design**, molten salt fuel and material research, fast spectrum focus (French fuel cycle connection)
- Currently Thorizon is in the last phase of negotiation.

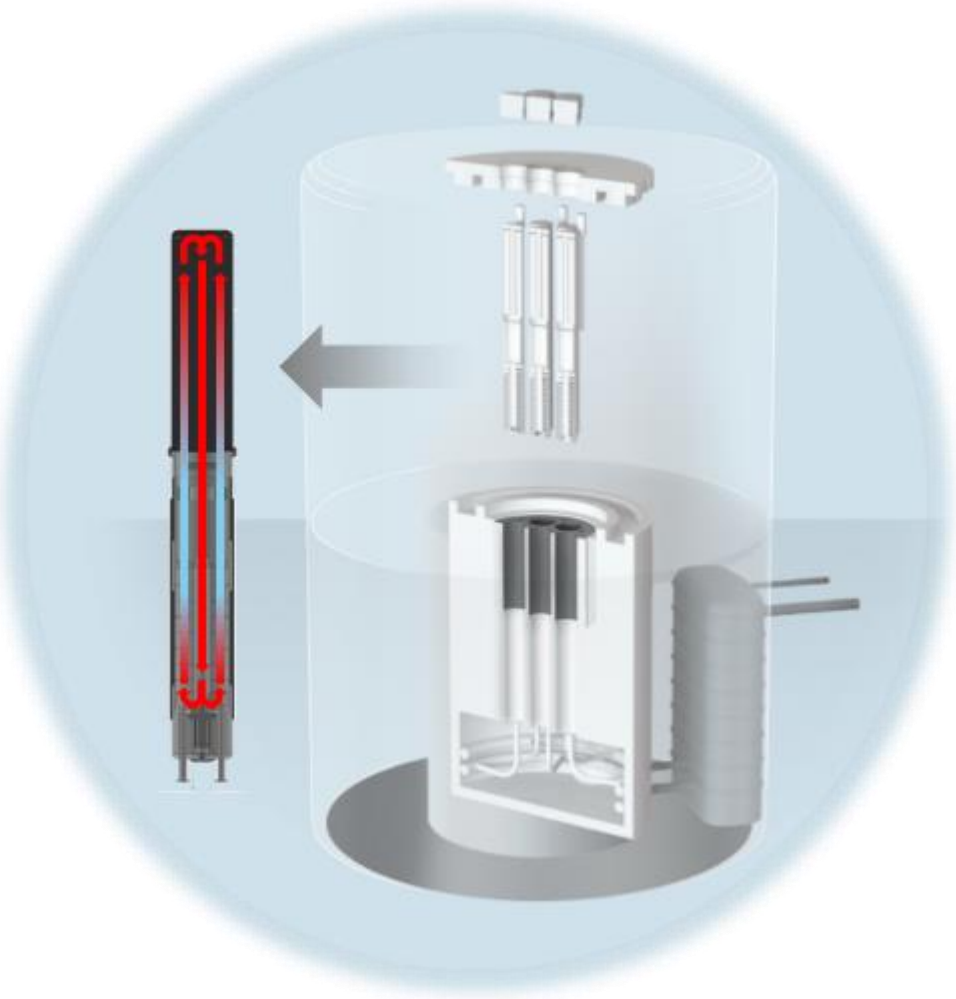
We have the right experience and continue to grow

Thorizon team, 20 Amsterdam, 5 Lyon, and growing.



Summary: our patented reactor concept resolves material degradation issues and accelerates time to market

Thorizon cartridge technology



Concept

- Core consists of cartridges containing molten salt fuel
- Salt is circulated in each cartridge by a pump
- Fission energy is only generated when the pump is operational and there is salt at the top side of all cartridges
- When the pump shuts down, the salt drops, and the nuclear reaction stops (not critical anymore)

Modular design

- Cartridges are replaced every 5-10 years
- Solves material degradation issues for containment material
- Extends the plant's lifetime
- Enables continuous improvement and adjustment to need
- Reduces costs through standardization and off-site series production of the primary system
- Facilitates and accelerates design qualification

Fast spectrum reactor or epi-thermal molten salt reactor concepts can be realized with the same technology basis

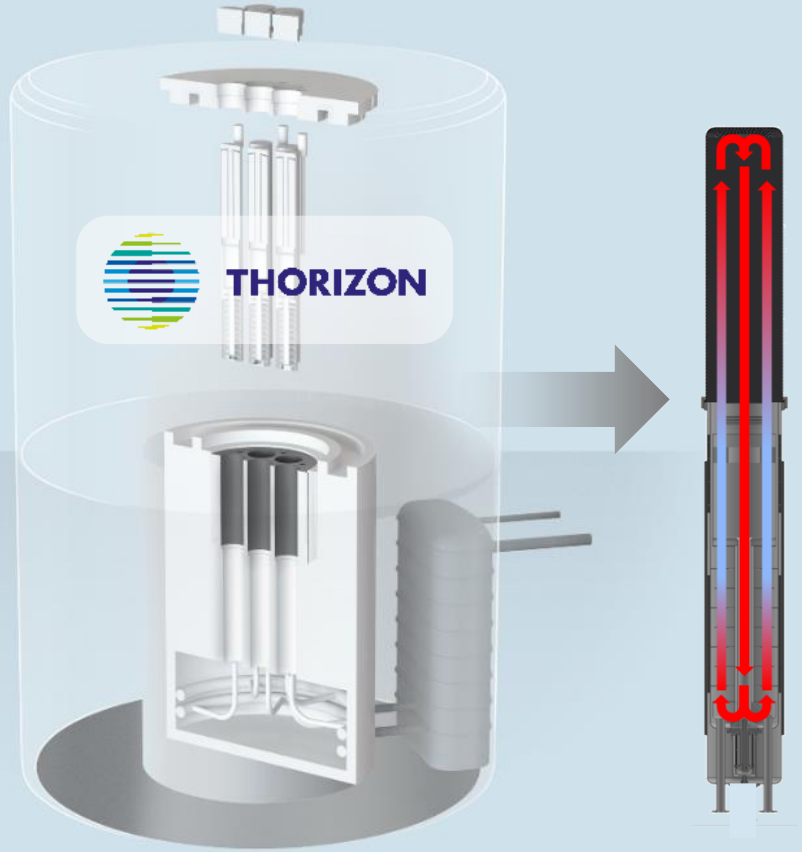
Your support can help us to realize our mission

The challenge is large, acceleration of development by collaboration

100MW of electricity or
250MW of process heat

Recycling of spent
nuclear fuel

Intrinsically safe



Disruptive nuclear technology

Molten salt reactor

Patented concept of modular cartridges

The optimal route for rapid implementation

Recurring business model

Source: Thorizon team; EP 3963603 B1

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Start-up Pavilion

We contribute to a clean planet by developing a reliable nuclear reactor that makes more efficient use of fuel and minimizes waste.

In the future, we foresee several clean energy technologies that function in synergy. This mix will provide affordable and accessible energy for all, fulfilling a basic human necessity.

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