



Dr. Hervé BERNARD

November 2024

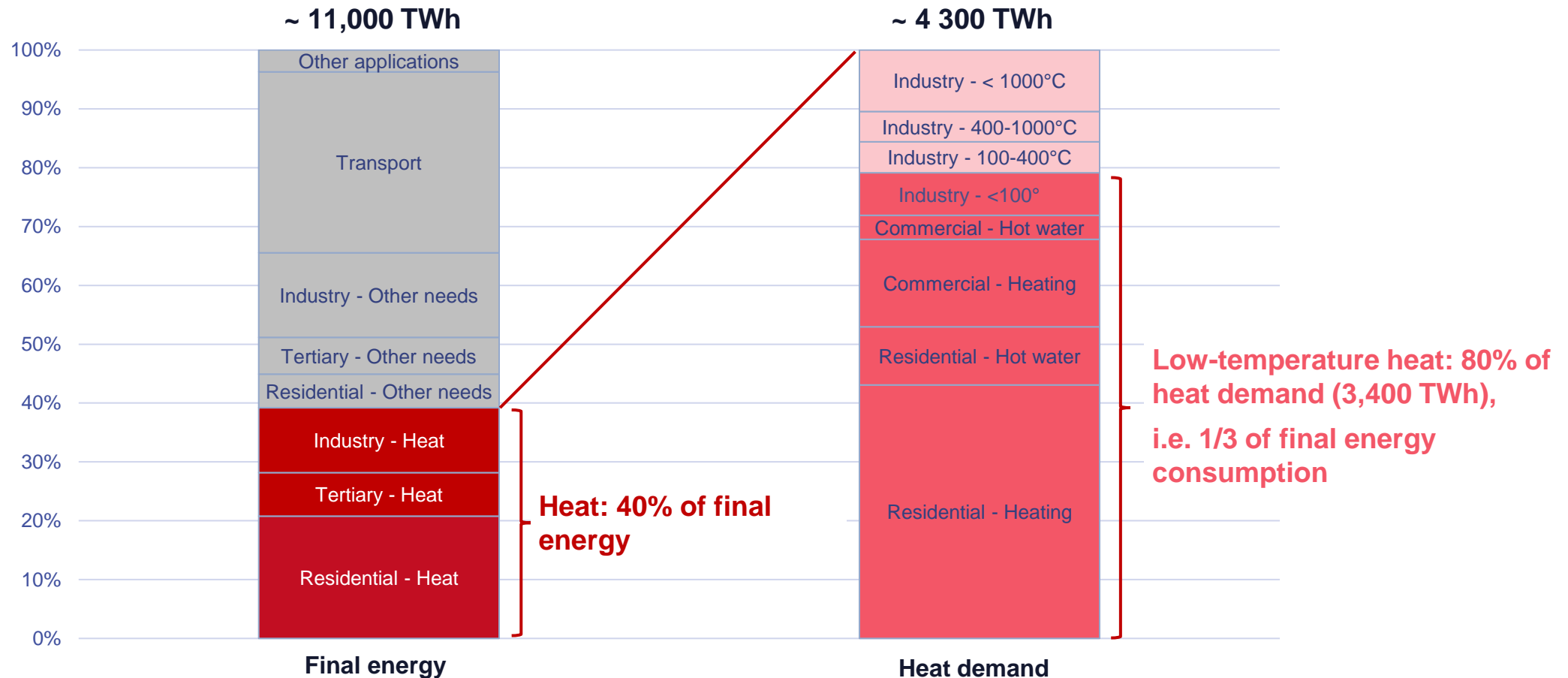


Winner

Calogena
Carbon-free district heating

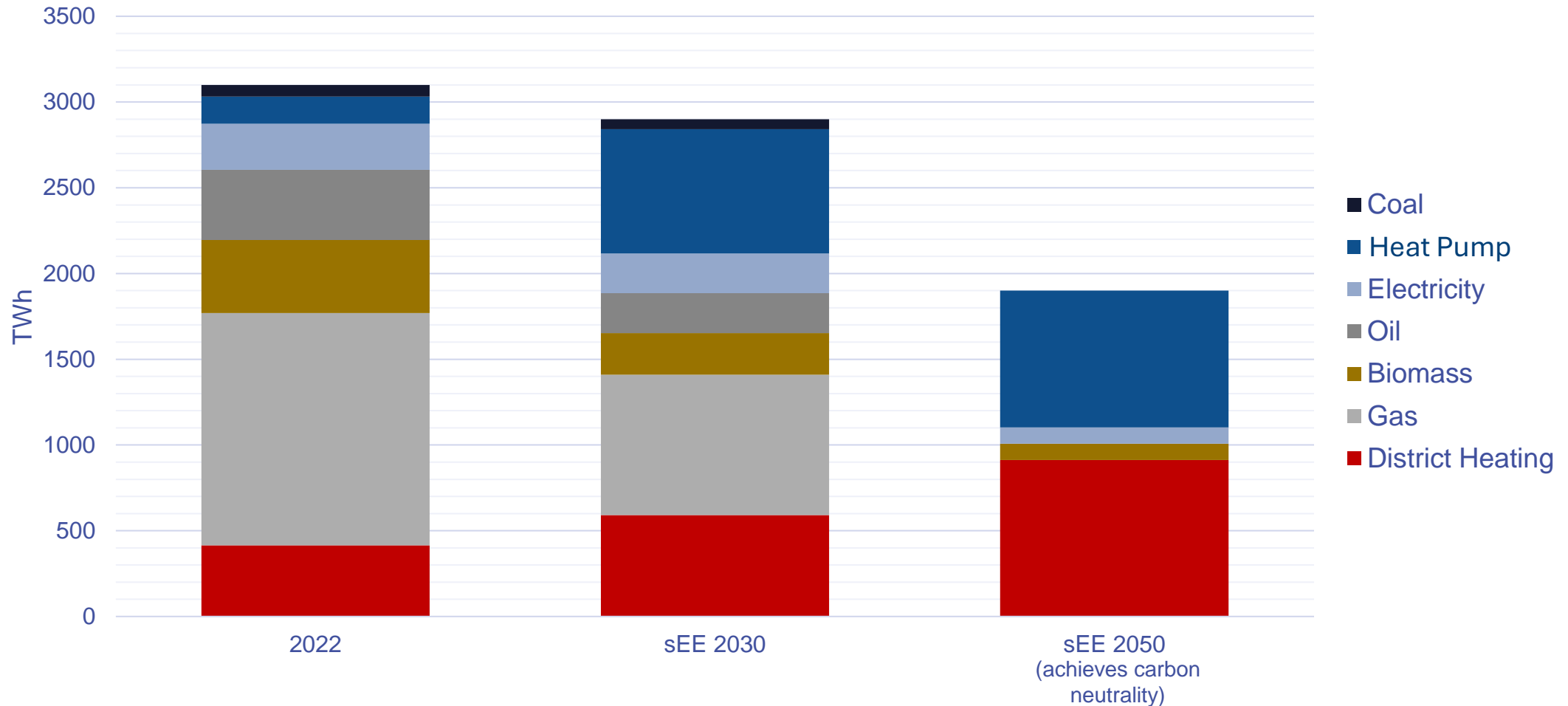
Low-temperature heating accounts for a third of final energy demand in Europe

Final energy and heat demand EU-27, 2019



The share of heating networks will increase strongly

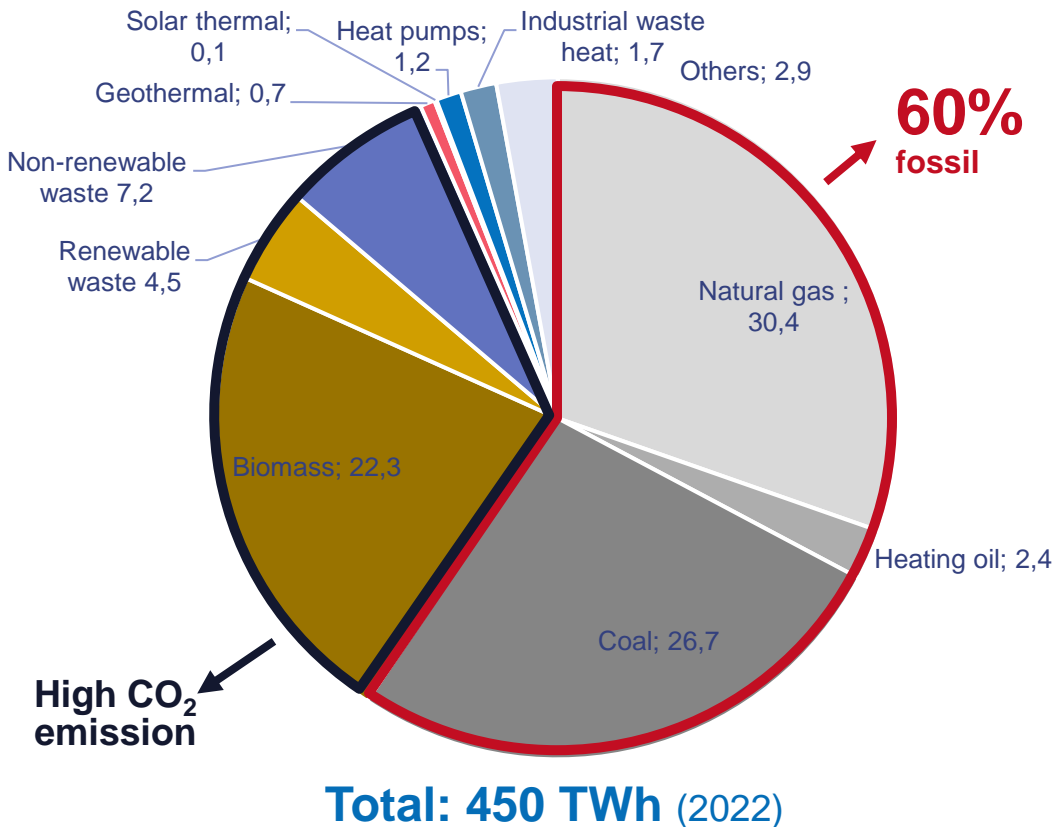
Energy mix for heating and hot water demand, EU28



Source: Eurostat, Heat Matters: The Missing Link in REPowerEU, 2023

Nuclear power is critical to decarbonize district heating

EU-27 Energy mix in 2018 (%)



District heating still emits a lot of CO₂, with **60% of its energy coming from gas and coal**

In Hungary, 70% is coming from natural gas and 90% in Budapest DH

Potential of **geothermal energy** is constrained due to **limited access** to the resource

Biomass has benefited from governmental support over the last 10 years, but faces **major headwinds**:

- Limited resources
- Significant competition for other needs (biofuel, high-temperature industrial heat, etc.).
- Significant price volatility

Nuclear power can actively contribute to decarbonization goals

Source: Overview of District Heating and Cooling Markets and Regulatory Frameworks under the Revised Renewable Energy Directive, Final Report, EC 2021, FEDENE 2023, District heating and cooling in the European Union, "Quelles perspectives énergétiques pour la biomasse" (Académie des Technologies, 2024)

Our solution: Calogena a 30 MWth Small Modular Reactor for District Heating



Reliable

- Safe and simple design
no Emergency Planning Zone
semi-buried facility
- High availability
- Ability for load-following

Affordable

- Target sell price: 7000 HUF/GJ @60%
(60 €/MWh @60%)
- Low footprint (30mx30m reactor building)

Sovereign

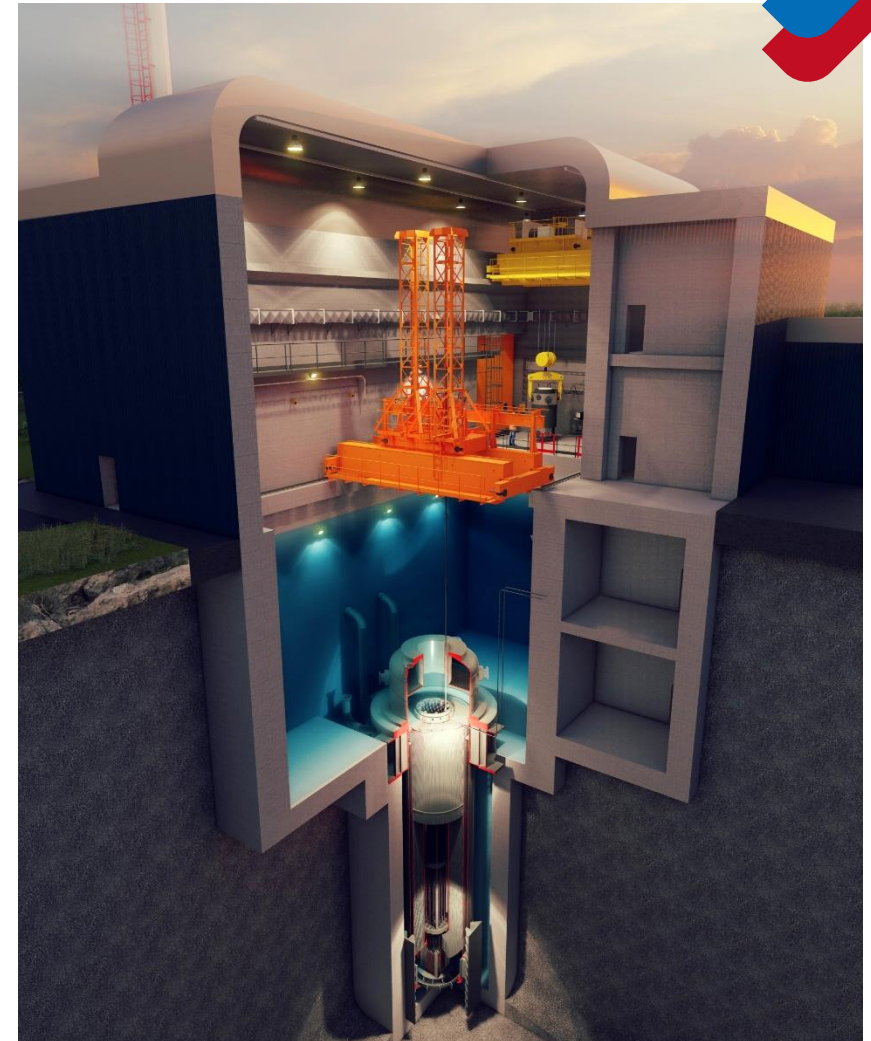
- Independence vs geopolitical changes
- Price stability (fuel <5% of operational cost)

Carbon-free

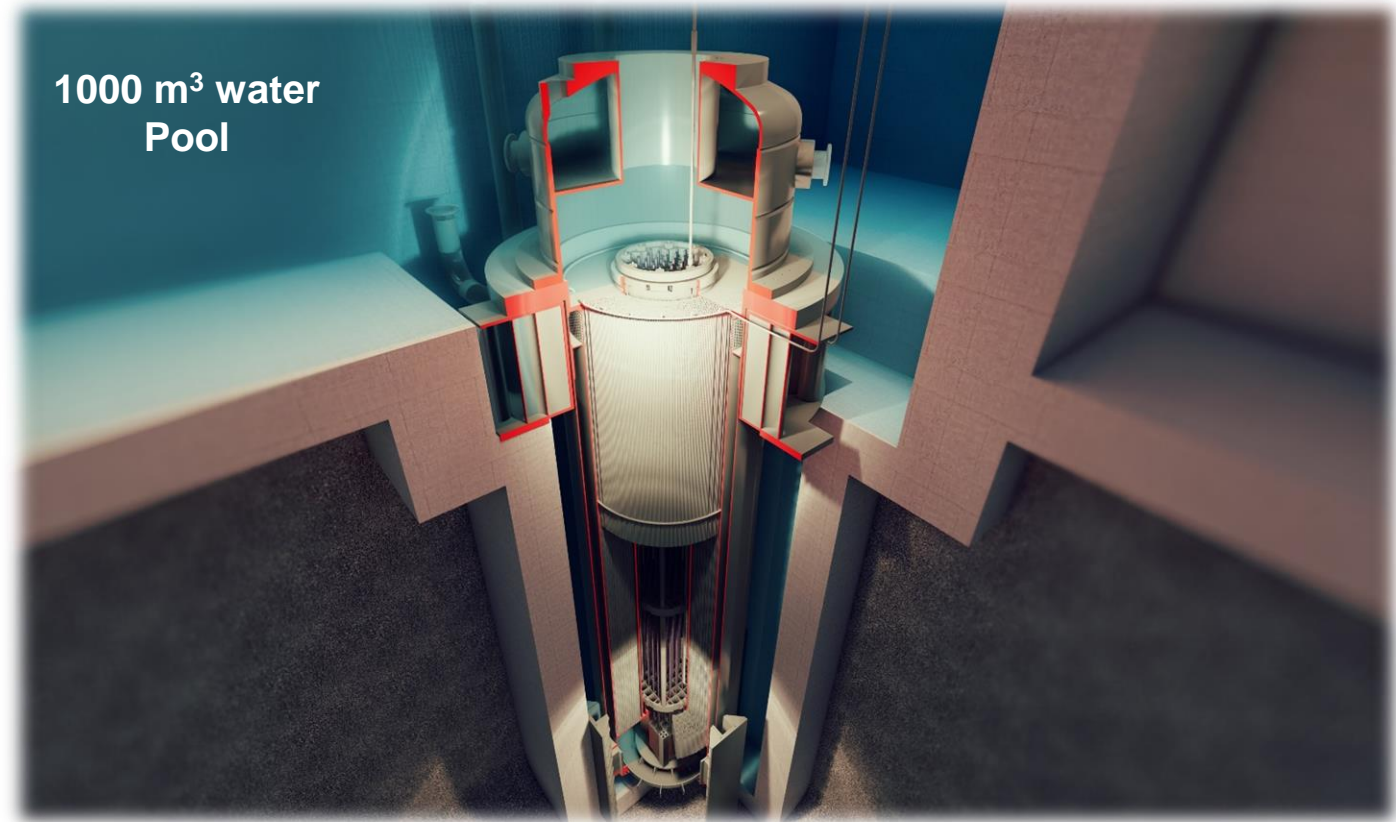
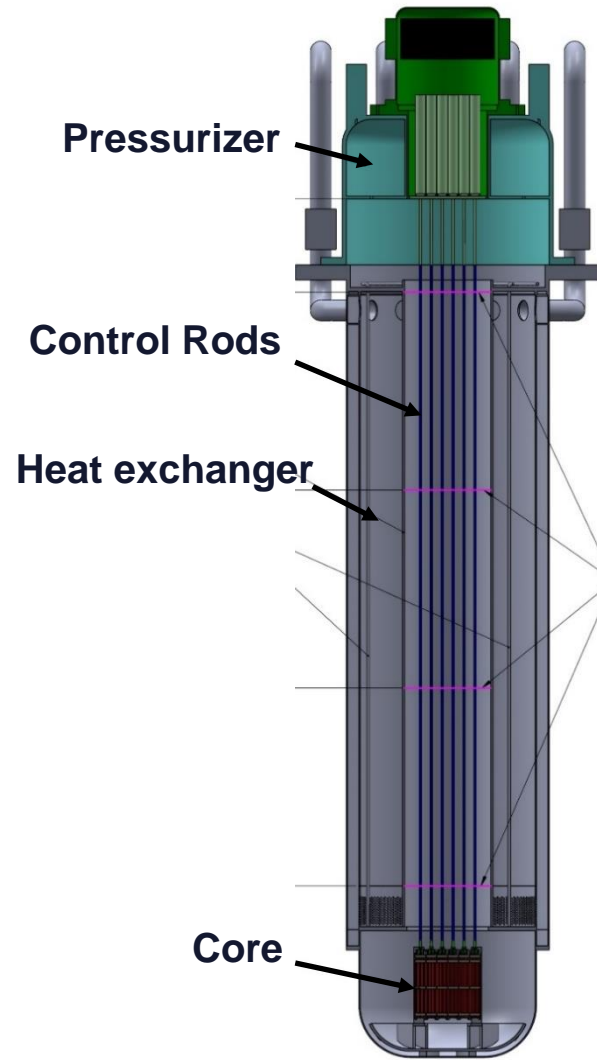
- < 2 g eq CO₂ / kWh

Calogena's module is specially designed for 3rd and 4th generation district heating networks

Power	30 MWth
Temperature adaptable to network requirements	70-110°C
Module lifetime	> 60 years
Ability for load-following	20-100% P _{nom}
Refuelling frequency	2 years
Land requirement	3 000 m ²
Electricity requirement	3000 kVA
Water requirement	5 m ³ / day
Fuel	UO ₂ 3.4%
Installation	Suburban

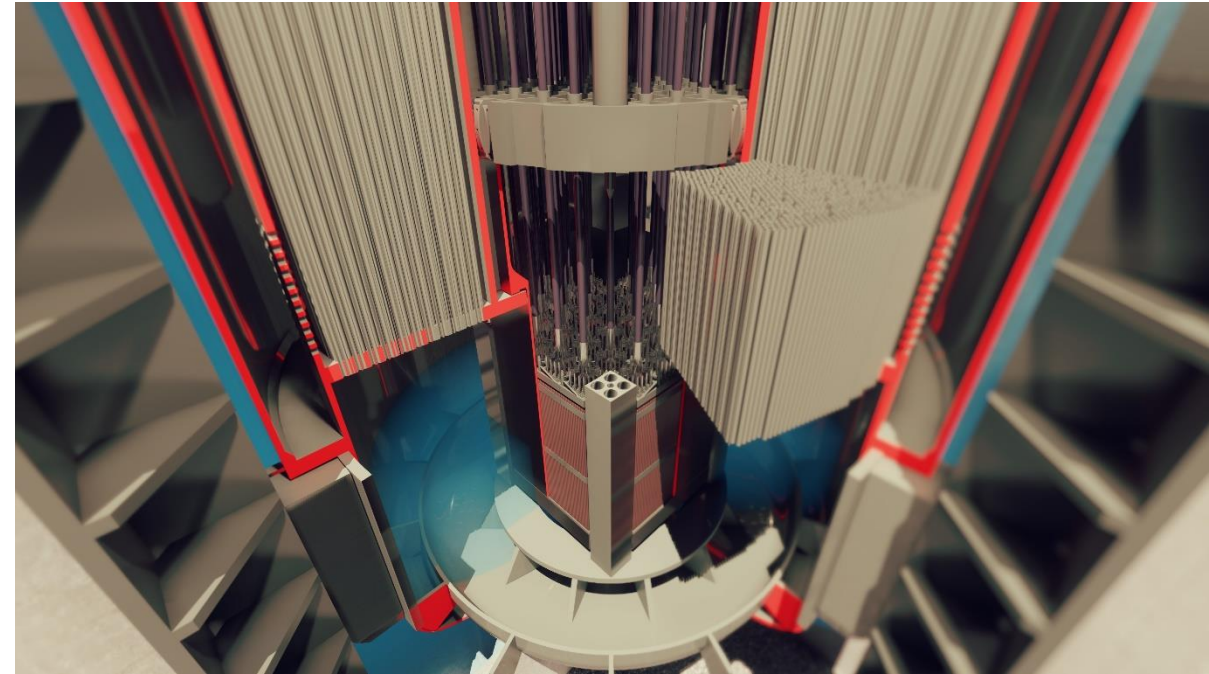


Vessel design



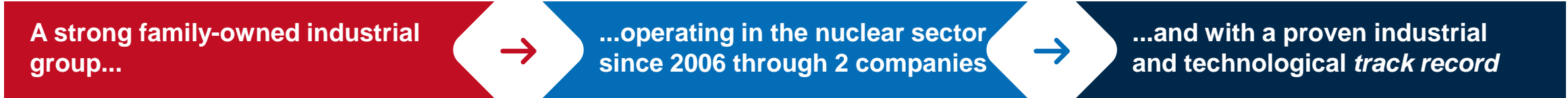
Fuel & core

- PWR-like fuel: UO_2 , 17x17, 3.4% enrichment burnup up to 40 GWd/tU
- Core with **32 fuel assemblies**, height < 1 m
- 4 fresh fuel assemblies refuelled every 2 years
- Fuel assemblies based on Framatome **GAIA** technology (nozzle, grid, guide tubes, etc.)
- 32 control rods (one per assembly)
- Light water without soluble boron



- 1) **High safety margins** with exclusion of core melting
- 2) **High technological maturity** leveraging learning of thousands of reactor-years
- 3) **Established industrial supply chain in Europe/ France**, enabling competitive solution
- 4) **Existing reprocessing solutions** (depending on country strategy)

Calogena is backed by Gorgé group, that has a proven *track record* in developing industrial companies



A strong family-owned industrial group...

...operating in the nuclear sector since 2006 through 2 companies

...and with a proven industrial and technological *track record*

1990 Creation of the group by Jean-Pierre Gorgé

>500 M€ Through industrial and technological activities
income

3 300 Presence in 10 countries
employees



Specialist in risk management and complex systems design

- Nuclear safety
- Operational reliability
- Nuclear security
- Human and organizational factor assessment



900 engineering staff, including 240 in the nuclear sector



Expert in technical doors for the protection of nuclear sites



150 people



World leader in maritime drones (civil and defence), with vertical integration of the value chain

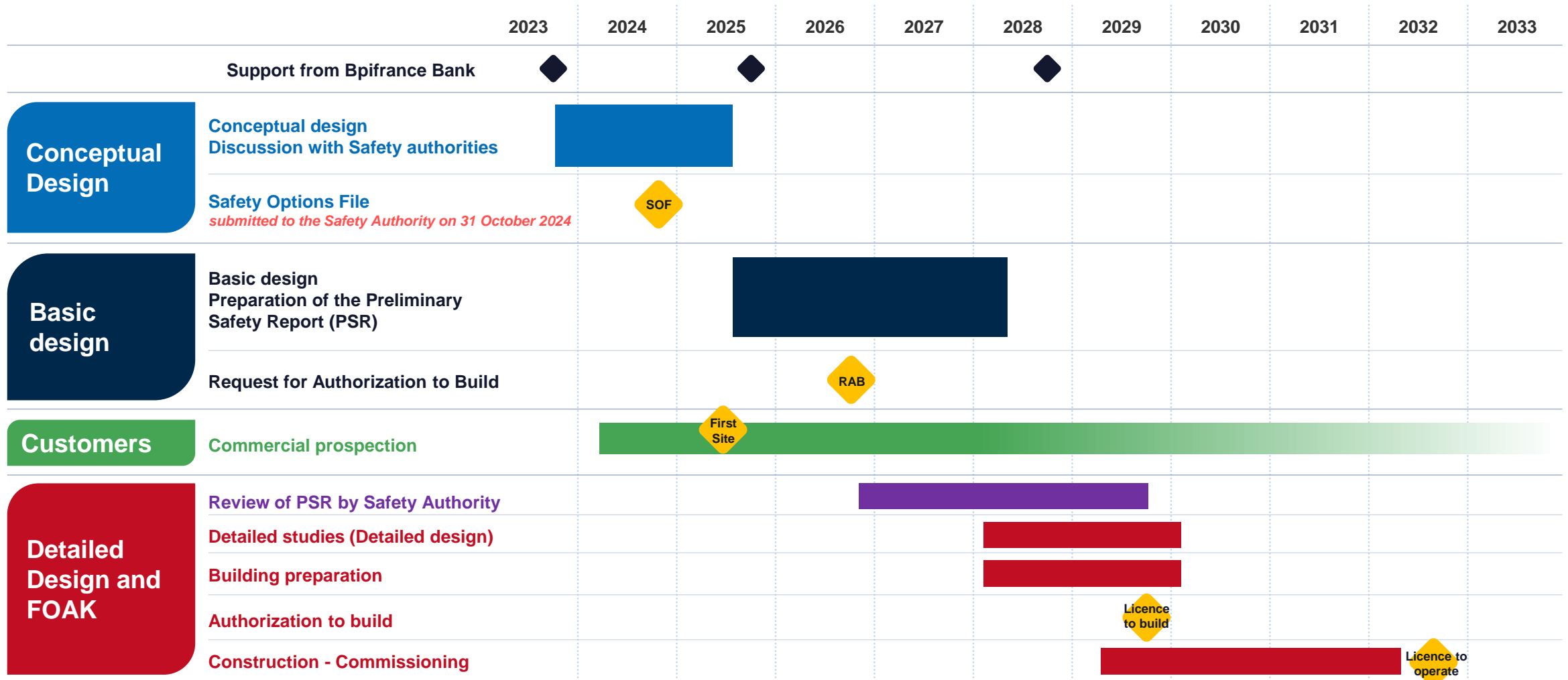
1,800 people



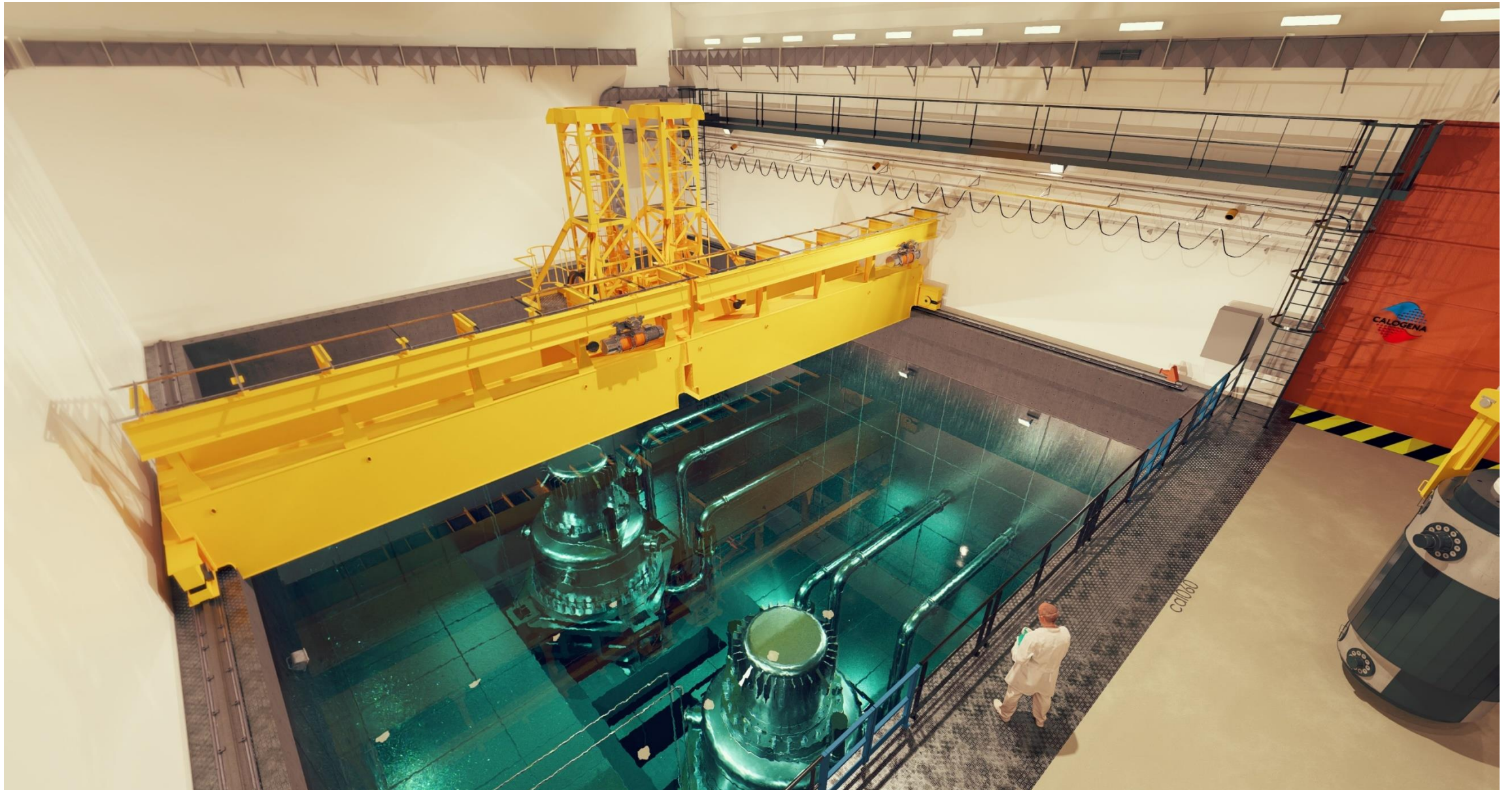
European leader in 3D printing

500 people

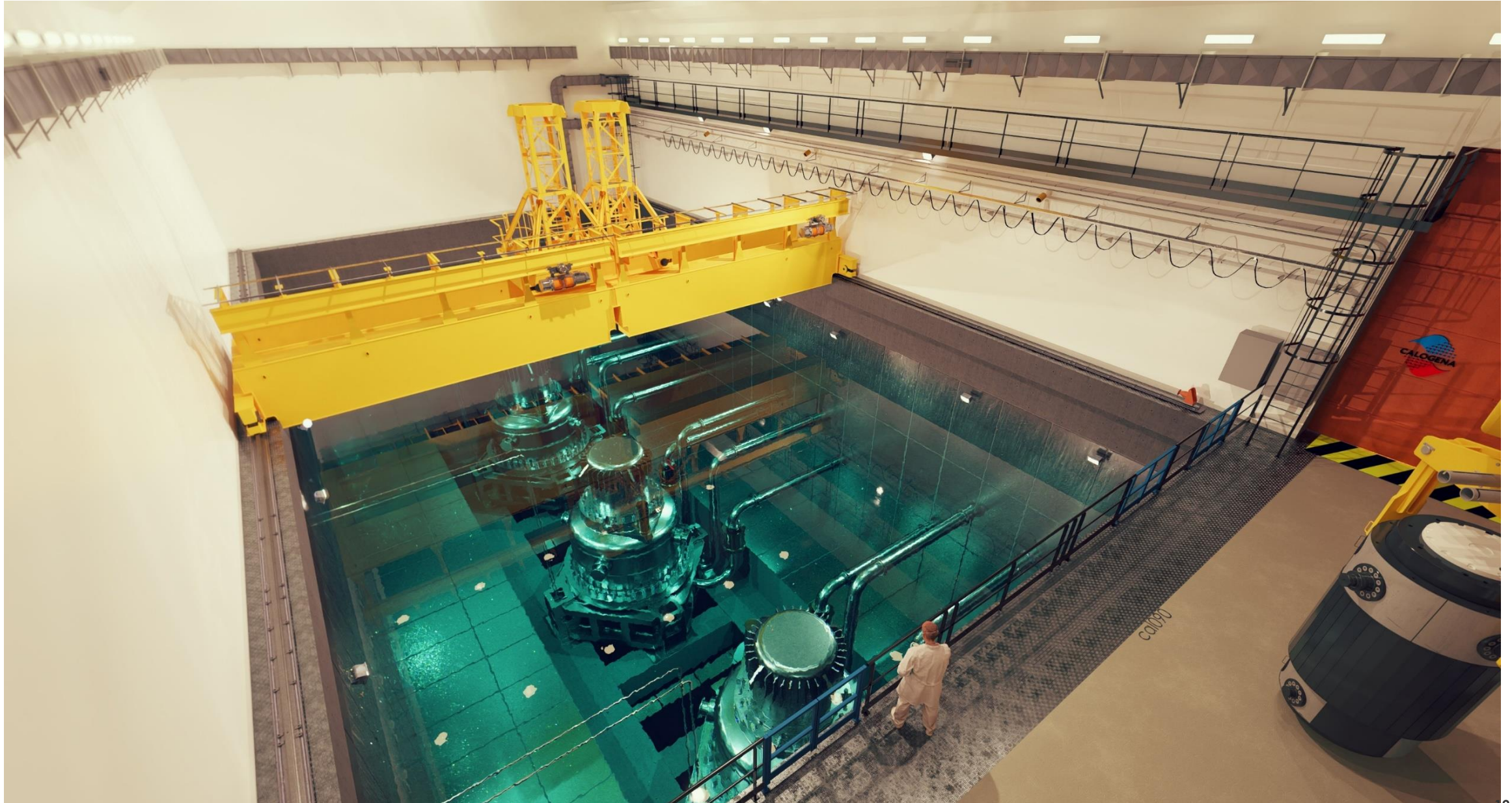
A realistic development schedule aiming to start building the first Calogena module before 2030



Illustrative view of CAL 60



Illustrative view of CAL 90



City Heat project: a European base for Calogena



City Heat Project





Carbon-free district heating

h.bernard@calogena.com