Empowering competitive industrial decarbonisation and grid stability in the Netherlands through advanced modular reactors

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Brief overview of the company

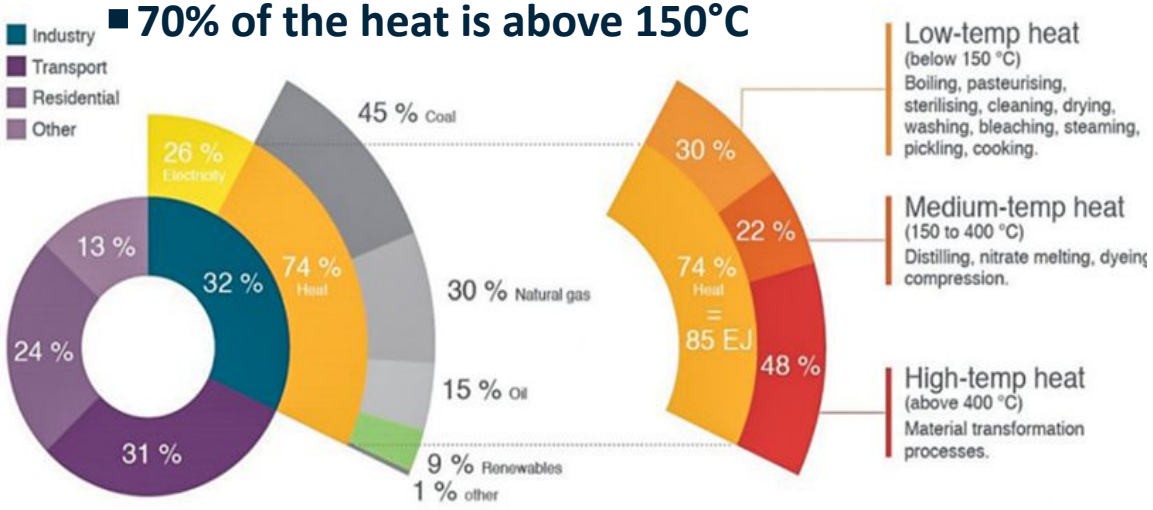
- Founded in 2023
- **Spin-off from CEA**
- **€30M secured** in funding (€20M in equity)
- **+ 70 employees** based in
  - Aix-en-Provence
  - Paris
  - Brussels

Overview of Dutch energy challenges

Today's three core challenges

Decarbonizing industrial heat

- **Heat** represents **75% of global industrial energy needs**
  - 90% of this heat is fossil fuel-based
  - **70% of the heat is above 150°C**



Total global energy consumption (all sectors) is depicted in the circle on the left-hand side. Global industry energy consumption is 26 percent electricity and 74 percent heat.

Source: Renewable Energy for Industry, International Energy Agency

→ Industrial heat remains a key challenge, largely unaddressed

Managing variability & price volatility

- **Rapid growth of variable renewables**
  - Frequent mismatches with demand
  - Price volatility & risk to grid stability

→ Need for dispatchable energy sources to provide flexible low-carbon capacities

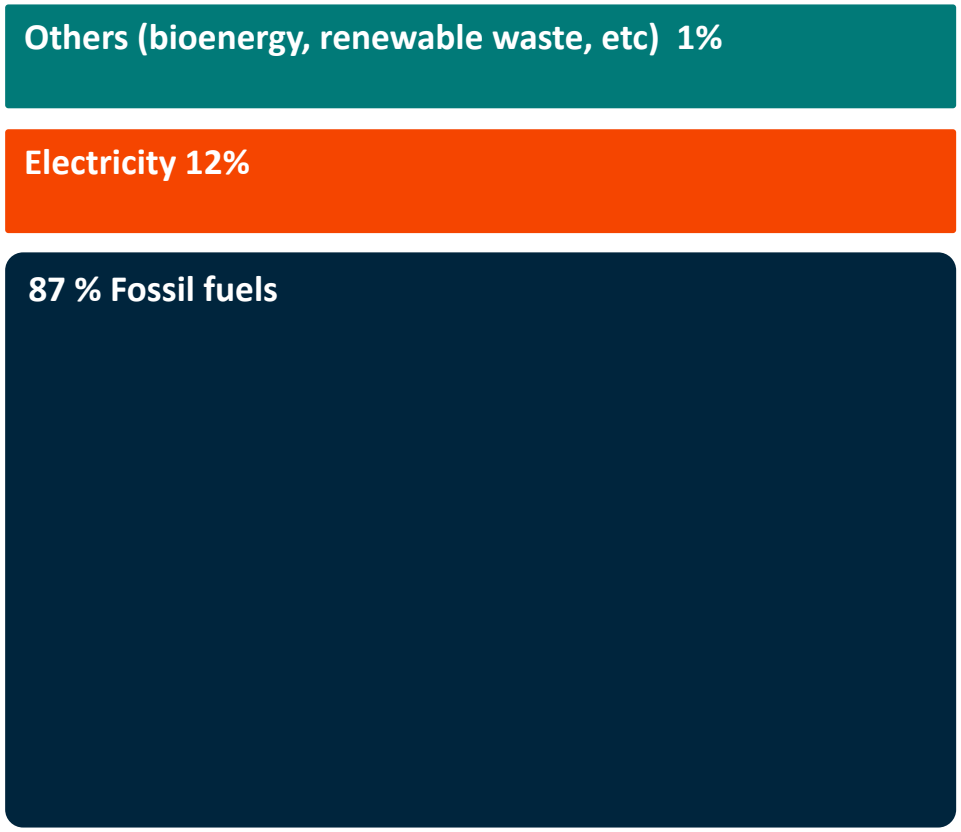
Exposure to geopolitical uncertainty & strategic dependence

- **Strategic dependence threatens our security:**
  - Supply disruption risks → Energy Insecurity → **Economic & social instability**

→ Need for EU domestic & low-carbon resources

Decarbonizing industries: intensive industries are still driven by fossil fuels at 90%

Global industrial energy mix



Industries : Cement, chemicals, steel & iron

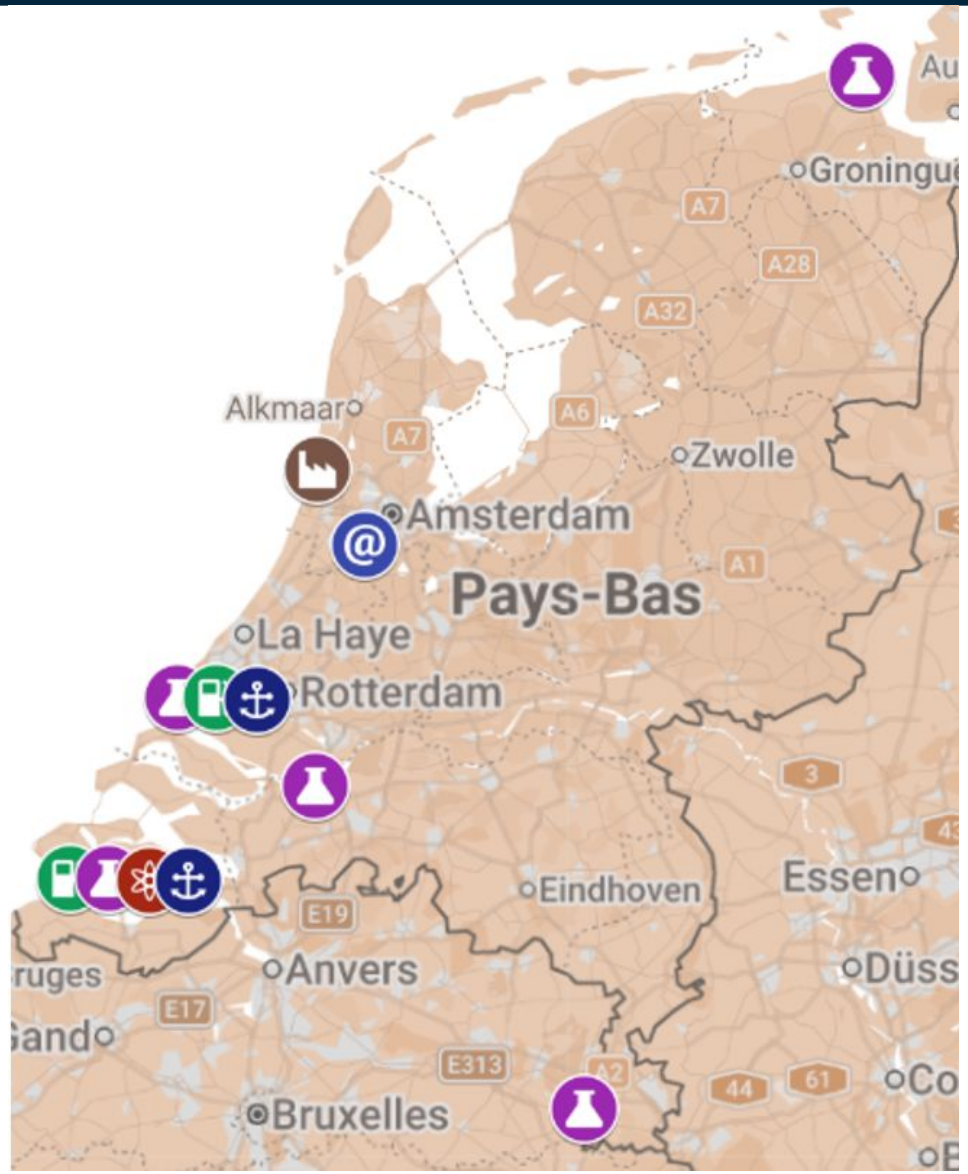
Source: IEA

Why is it so difficult to replace fossil fuels?

- Meeting current & future energy demand requires **abundant**, **sustainable** and **scalable** energy resources
- Decarbonisation goes **beyond electricity** → e.g heat, hydrogen
- Economic **competitiveness** is key to achieving large-scale deployment and impact

The challenge is not technical feasibility, but achieving decarbonisation at scale while maintaining affordability, competitiveness, and resource sustainability

Main energy intensive industries in the Netherlands



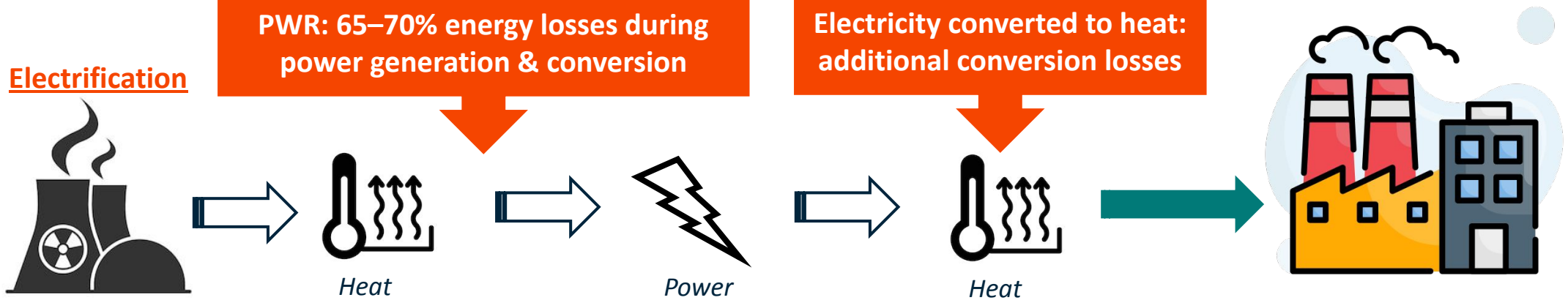
- Chemicals
- Steel
- Refinery
- Data centre
- Port
- Borssele NPP

Industrial direct heat supply: a more efficient path to decarbonisation

Electrification

PWR: 65–70% energy losses during power generation & conversion

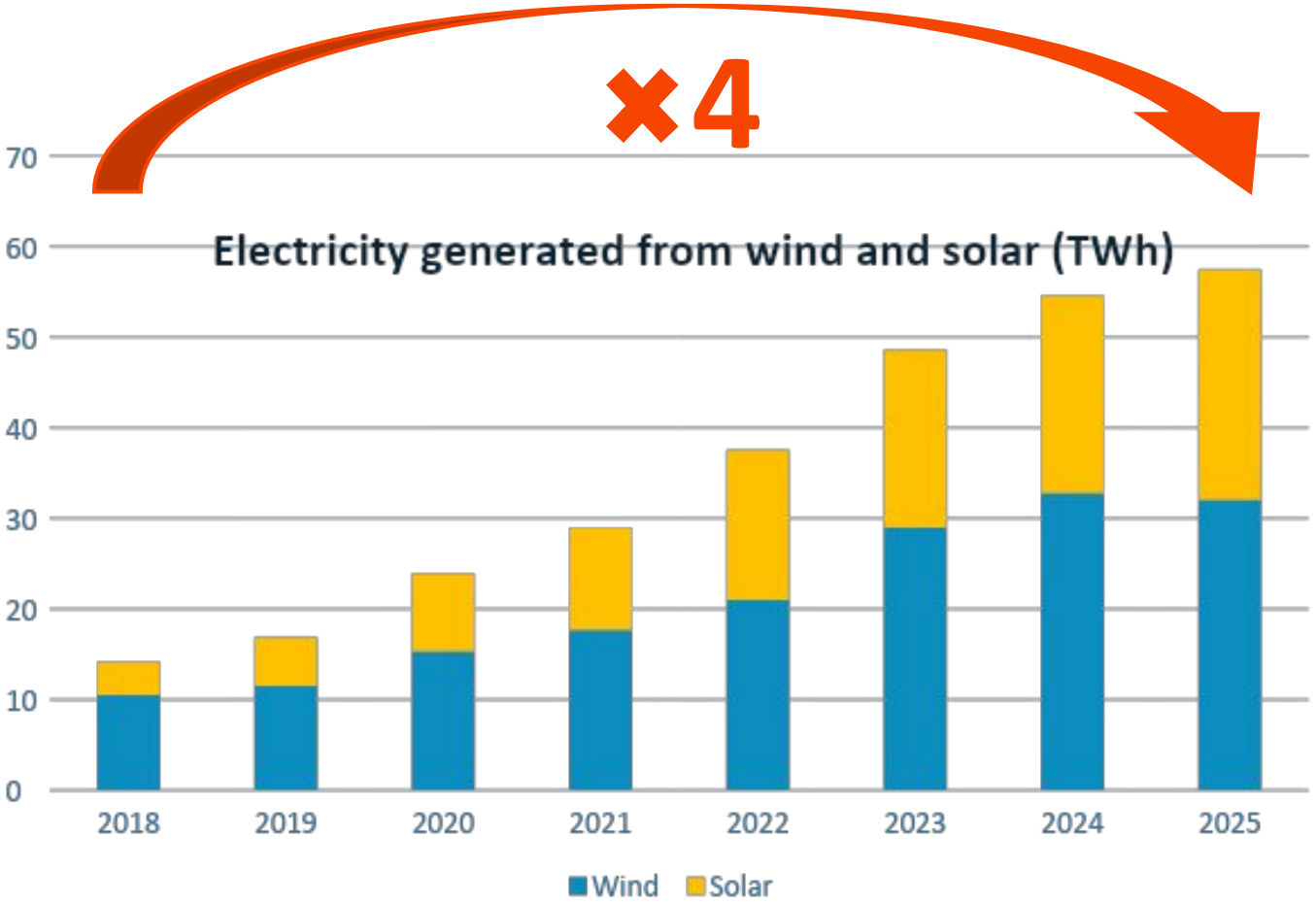
Electricity converted to heat: additional conversion losses



Direct heating to avoid large upstream conversion losses

KEY POINT: electrification is part of the solution but is not always the most **energy-efficient** option...

Strengthening the grid: A growing expansion of renewables in the Netherlands…

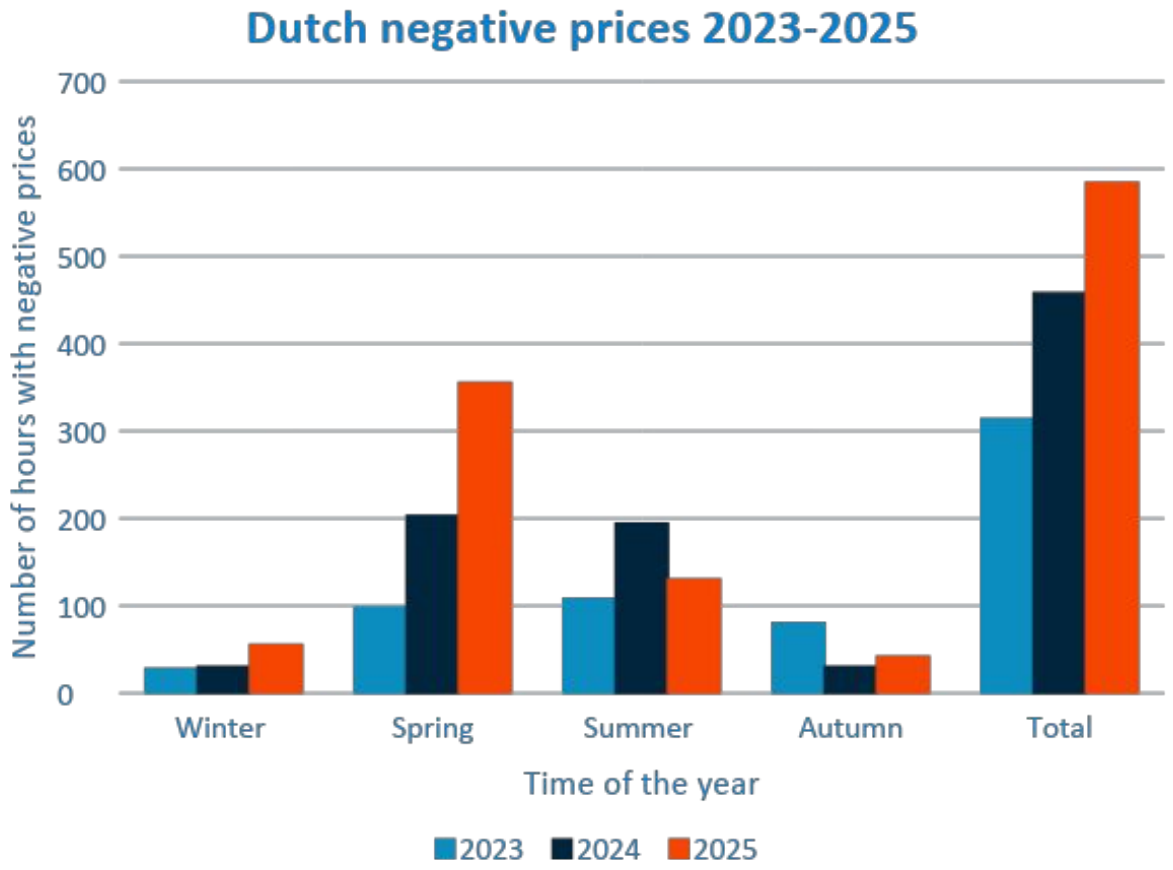


Source: *CBS*

Domestic electric production

- 57% low-carbon **43% still to decarbonize**
  - **Renewables (wind, solar and biomass) are dominant and expanding rapidly** (54%)
  - **Gas is the 2nd energy source in the domestic power production** (36% in 2025)
  - **Nuclear remains limited** (3%).

… that is driving an increasing price volatility on the grid



Source: *Aggregation of data from Electricity map and ComCam*

High price volatility:
116 days in 2025 with negative prices
Most negative price:
€-350/MWh
Average daily price swing:
€124/MWh
Maximum single-day swing:
€477/MWh (from €40 to €518)

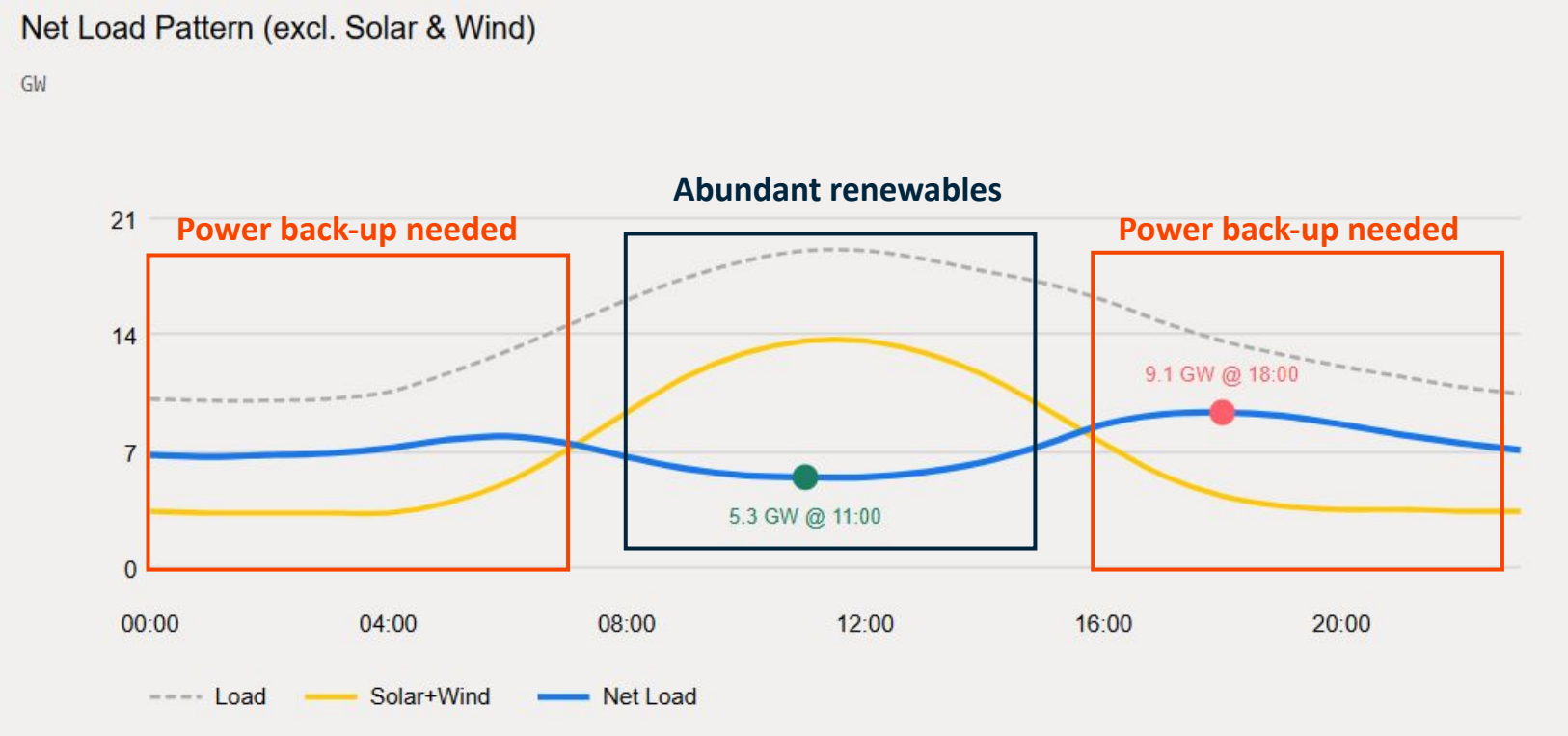
Negative prices:
- Mismatch supply / demand
- Electricity need to be balanced

Consequences:
- Can distort investment signals
- Overall costs (grid) increase

Negative prices signal insufficient flexibility

A growing duck curve driving the need for flexible back-up power

The Netherlands' growing solar capacity creates a strong midday-to-evening **imbalance** in the power system



- Midday → High solar generation → Enough / Too much electricity midday (Negative prices)
- Evening → Solar drops while demand increases

→ **Ramp of ~3.8 GW within a few hours (up to 6 GW during summer)**

Results:

- Price volatility
- Increasing reliance on flexible gas plants, storage, and imports as nuclear is declining

Source: *Electricity map, Electricity grid review 2025: Netherlands*

HEXANA's value proposition: Bridging the gap to market

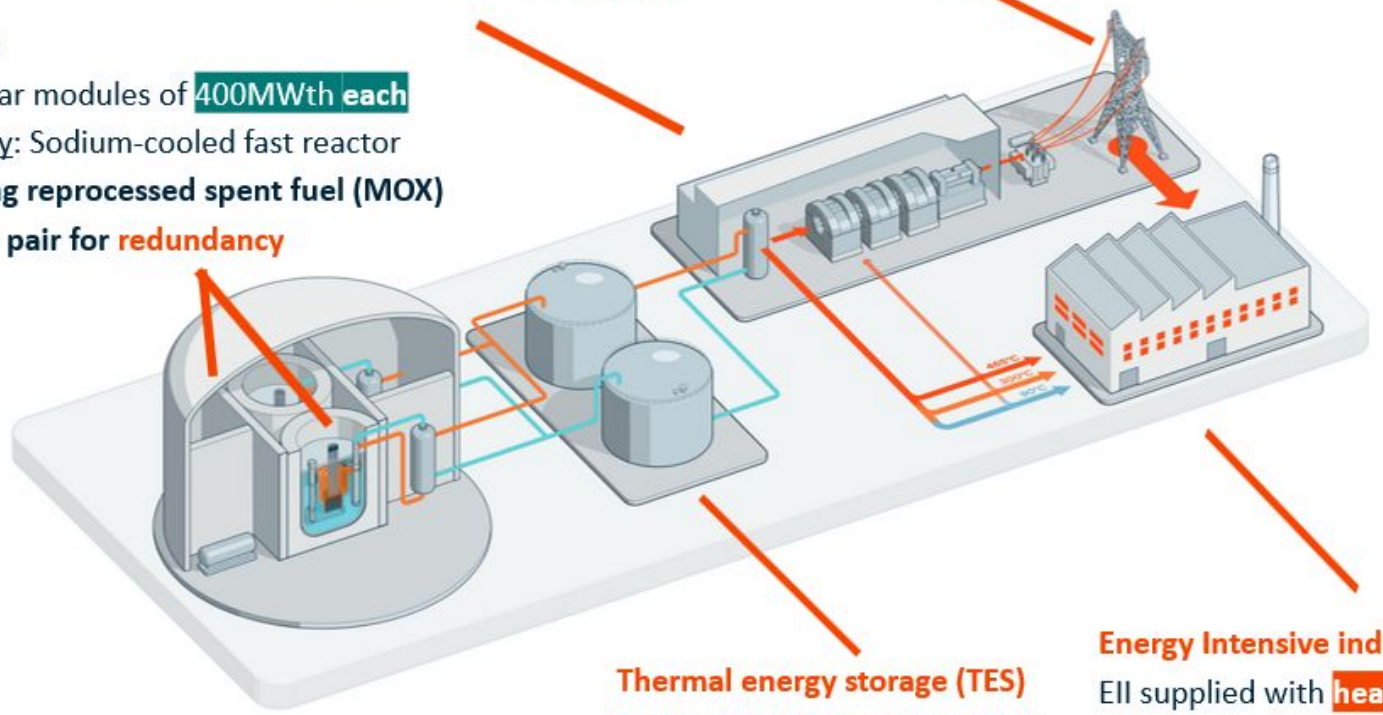
How HEXANA aims to deliver on industrial decarbonisation and grid flexibility through next-generation nuclear

An energy platform to support industrial decarbonisation & flexibility

Grid
Supplied with **flexible** & ultra-low carbon power (2 gCO_2eq/kWh)

Conventional island
Output capacity: 335MWe*

Nuclear Island
Two nuclear modules of 400MWth each
- Technology: Sodium-cooled fast reactor
- Fuel : **Using reprocessed spent fuel (MOX)**
- **Always by pair for redundancy**



Thermal energy storage (TES)
Technology: Molten salt storage
Safety by design

Energy Intensive industries (EII)
EII supplied with heat (up to 465°C) and/or ultra-low carbon power

Product & services

- High-temperature heat (465°C)
- Ultra-low-carbon power generation (2g CO_2eq/kWh)
- Reliable, dispatchable and economically competitive flexible energy system

** Output capacity of 2 reactors only (excluding the additional capacity provided by thermal storage)*

Sodium-cooled fast reactors (SFR): a proven technology

SFR : 440+ years of exploitation worldwide of **which 80 years in the EU and 40 years in the UK**
 HEXANA inherits directly of **70 years** of experience from construction to dismantling

1966
MASURCA
Critical model
~100 kWth

Fast neutron physics

1967-1983
RAPSODIE
Proof of Concept
40 MWth

Feasibility SFR

1973-2010
PHENIX
Demonstrator
250 MWe

Qualification of materials, MOX fuel, components, operation, maintenance, power generation

1986-1997
SUPERPHENIX
Industrial FOAK
1200 MWe

Industrial feasibility of high-power SFR (construction, operation, dismantling)

Beyond Superphénix: The European know-how, experience & potential

Superphénix :

- Joint project **led by France, Italy and Germany**
- **World largest SFR** ever operated (1200 MWe)
- Industrial feasibility of high-power SFR : **construction, operation, dismantling**

Beyond Superphénix :

- **7 reactors built** in Europe of which 6 operated
- **120 years** of cumulative operating experience (France, Germany, UK)
- **Extensive European cooperation :**
  - SNR 300 (Germany): + +

Superphenix - Operation 1986-1997

RWE

EDF

ENEL

Sodium-cooled fast reactors (SFR): a proven technology

GEN III/III+ SMRs and GEN IV AMRs offer promising technological advancements

	Reactor Technology	Experience with technologies at EU level[1]
GEN III/III+ SMR	**PWR (Pressurised Water Reactor)** The most widely used reactor technology globally, representing nearly 75% of all reactors. It is employed for both electricity generation and marine propulsion. More than 300 units operate worldwide, including over 80 within the EU.	Very Good
	BWR (Boiling Water Reactor) This is the second most widely used technology for power reactors. Over 40 operate worldwide, with 7 in the EU (27 units operated previously). This deployment has led to less BWR technology expertise among European industries than PWR technology.	Very Good
	iPWR (Integrated Pressurised Water Reactor) This nuclear reactor integrates primary circuit components like the reactor vessel, steam generators, and pressuriser into a single unit. Compared to traditional PWRS, the design aims to improve safety, reduce costs, and increase efficiency.	Good
	Heat-dedicated LWRs This type of LWR produces only heat, not electricity, and operates at low temperatures and pressures.	Good
GEN IV – Advanced Reactors AMR	**HTR (High Temperature Reactor)** High-temperature gas-cooled reactors (HTR or HTGR) are helium-cooled graphite-moderated nuclear fission	Moderate
	SFR (Sodium Fast Reactor) Sodium Fast Reactors (SFRs) are advanced nuclear reactors that use liquid sodium as a coolant and operate with fast neutrons instead of slowing them down with a moderator. This allows for efficient fuel	Good
	LFR (Lead Fast Reactor) Lead-cooled Fast Reactors (LFRs) are fast neutron reactors using lead or lead-bismuth alloy coolant. One advantage over sodium is the elimination of chemical reactions with water or air. It could use various fuel types, including recycled nuclear waste.	Moderate
	MSR (Molten Salt Reactor) A self-regulating critical geometry uses an enriched molten salt mixture as coolant and fuel to generate heat.	Low

1 Experience based on the number of reactors and test facilities built and operated in the EU since the 80s and the number of research
2 SMRs/AMRs projects, identified by the Alliance within the first batch, corresponding to the technologies

58

Source: European Industrial Alliance on SMRs, Strategic Action Plan 2025-2029,

SFR (Sodium Fast Reactor)	Good
Sodium Fast Reactors (SFRs) are advanced nuclear reactors that use liquid sodium as a coolant and operate with fast neutrons instead of slowing them down with a moderator. This allows for efficient fuel use and the potential to recycle nuclear waste.	

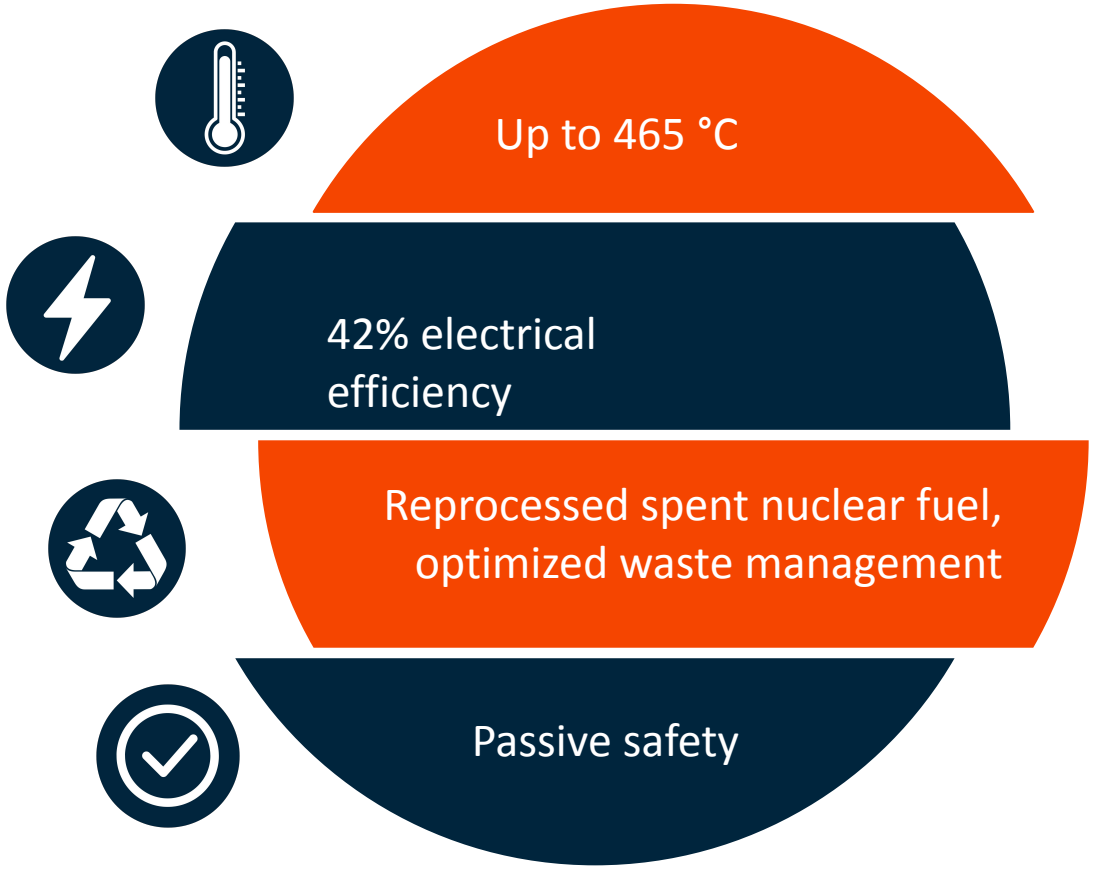
Experience qualified as '**good**':

- **Highest-ranked** GEN IV technology
- a level **comparable to certain GEN III**

HEXANA - First of A Kind expected in 2035 - No demonstrator or prototype

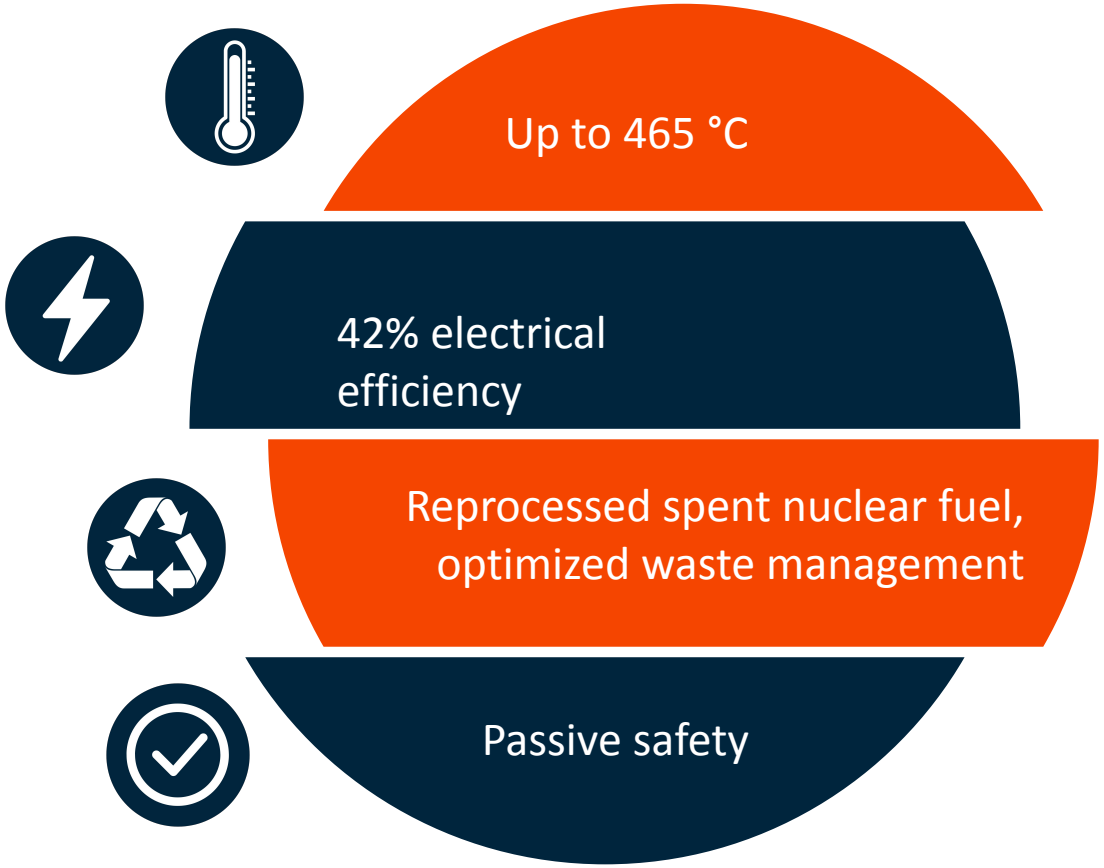
Strategic benefits of HEXANA's gen IV platform versus existing gen III reactors

Favorable technical specifications...

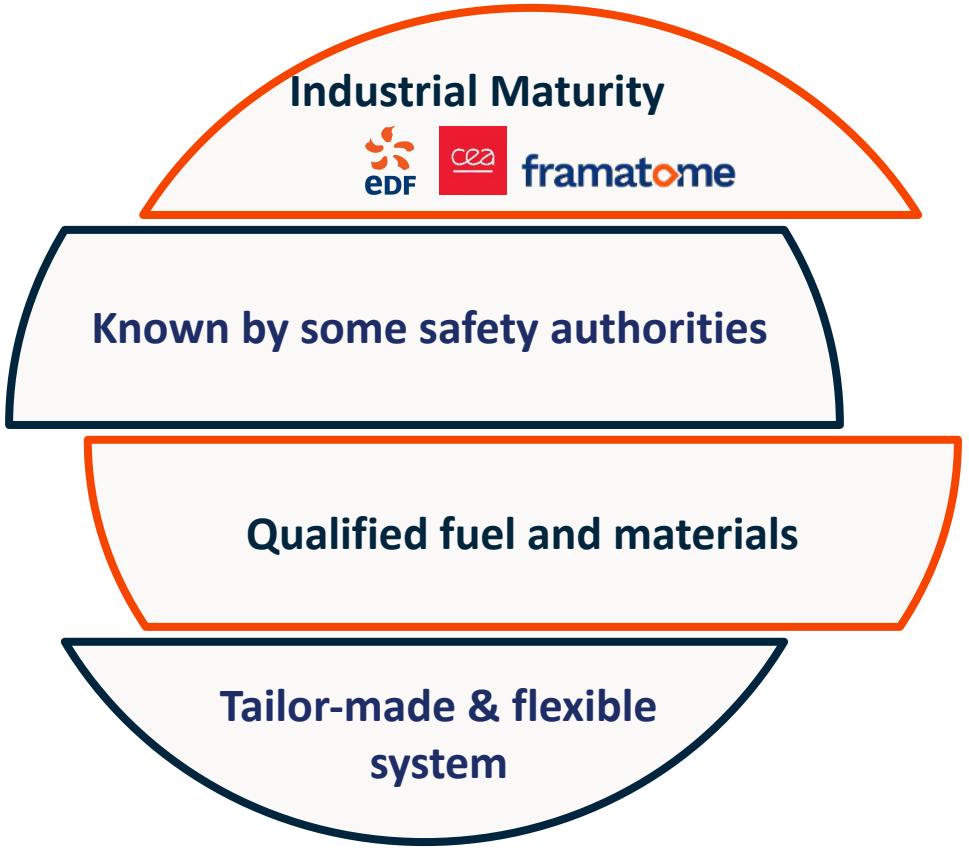


Backed by a pragmatic approach that minimizes complexity to shorten time-to-market

Favorable technical specifications...

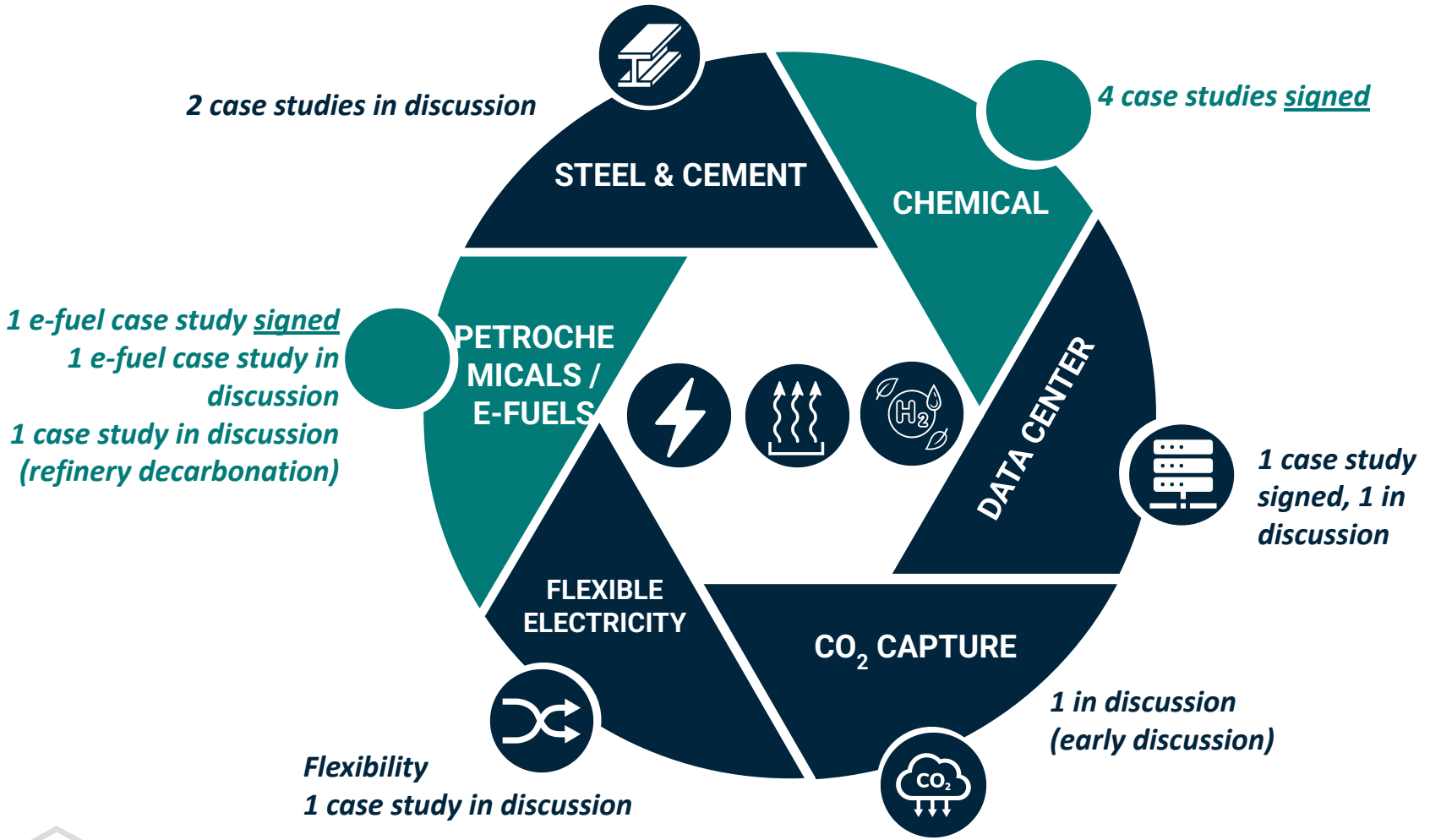


.. and above all a mature, credible industry!



A Customer-Driven Approach: Working With and For Industrials

EIIs, data-centers, hydrogen/e-fuels industries form a high-value market with strong growth potential



Optimal for :

- Energy consumers with **energy demand** > 300 MW with **CHP / high temperature heat demand**
- **Hydrogen and e-fuel production**
- **Grids** or customers requiring operational **flexibility**
- **Data-centers**
- **Industrial clusters**

6 Industrial case-study signed, 7 in discussion and 2 MoUs signed

Accelerating time-to-market through strategic focus

Limiting technological innovation & uncertainties

⟶ leapfrogging certain steps ⟶ **Faster & realistic time-to-market (FOAK 2035 in France)**

- Fuel already qualified (MOX) ⟶ EU resources ⟶ reducing geopolitical uncertainties
- Innovation to meet new applications ⟶ **Customer driven**

A clear and well-defined role in the supply chain

- **HEXANA - Techno-provider & Business Developer & Turnkey solution provider**
  - Lead architect, reactor system
  - Focusing on customer needs ⟶ **6 industrial contracts signed, 2 MoUs with offtakers**

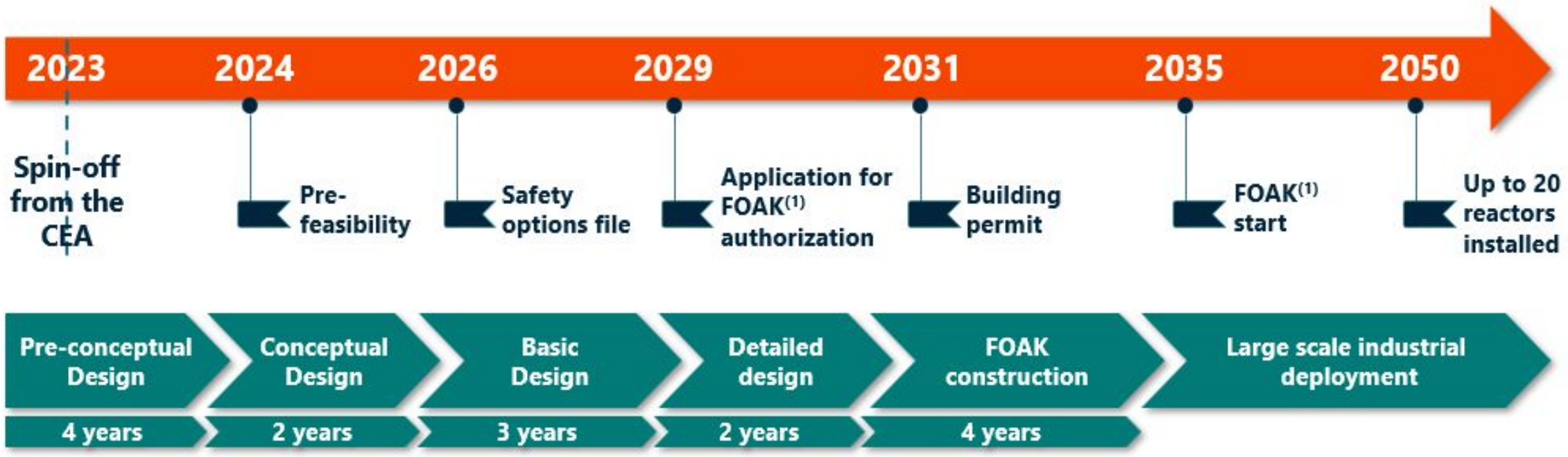
Partnering with proven industry leaders

- **SFR Industrial leader**
- **Operators**: Ensuring operational expertise and best practices
- **Fuel suppliers**: Use of reprocessed spent fuel ⟶ MOX
- **Engineering partners**

And already working with the supply chain for critical components: e.g tanks/piping

Deployment perspectives in the Netherlands

Fast-track project to deploy a first nuclear unit by 2035 in France



A first NOAK deployed in the Netherlands could start operations by 2039

Key challenges to be addressed for successful SMR deployment

Supporting and de-risking projects

- High CAPEX → ***Deployment of de-risking instruments (CfDs, RAB, state guarantees) to improve financing conditions and support competitiveness***
- *Long-term strategy on nuclear*

Identifying concrete industrial demand

- Confirm market demand through early engagement with industrial & secure long-term energy offtake agreements ***Create incentives for industrials to engage with SMR developers and confirm the potential applications***

Fuel availability

- Secure the long-term availability of fuel and MOX ***Continue the reprocessing of spent nuclear fuel***
- Explore the potential contribution of Fast Neutron reactors to the Dutch long-term energy strategy, to enhance energy security and resilience

Licensing and regulatory readiness

- Regulatory harmonisation at the European level to avoid country-specific designs
- Enhance dialogue between regulators (e.g ANVS / ASNR)

Social acceptability

- Key enabler for project deployment, especially in densely populated regions.
- Acceptance is generally higher in communities familiar with nuclear activities, while additional engagement efforts may be required in regions without a nuclear legacy

Supply chain readiness

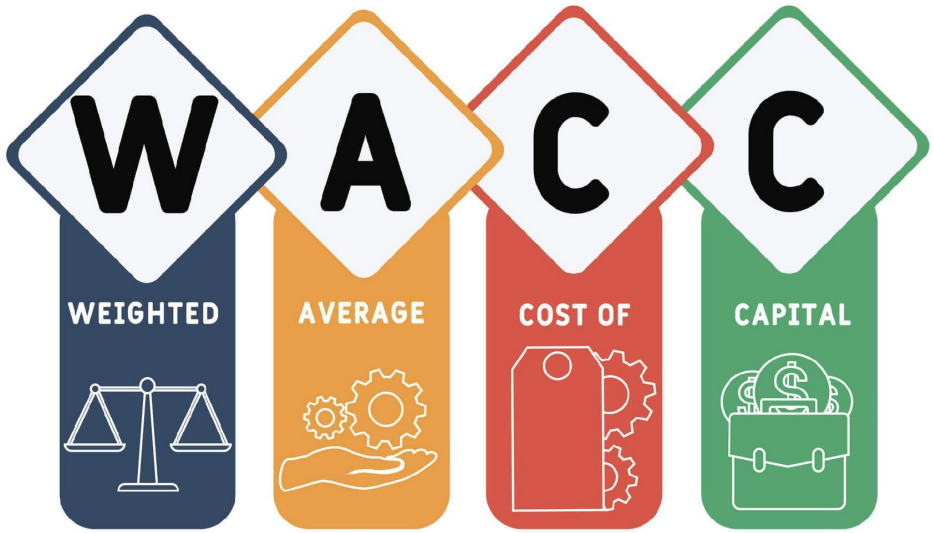
- Strong & redundant EU supply chain to drive down costs and ensure Europe's energy security

 Introduction with Dutch supply chain (e.g workshop based on SMR future needs)

Public support will be key in driving down LCOE

WACC (the cost to finance the capital) is :

- **the primary cost driver of LCOH/LCOE**
- **Largely shaped by risk perception**
- **Can be decreased by public de-risking tools (CfDs, RaB, guarantees, state-backed financing, etc).**



Example: Reducing the rate from 7% to 5% leads to a ~25% decrease in LCOE

WACC *is the rate of return a company must pay to finance its assets, weighted between debt and equity sources*

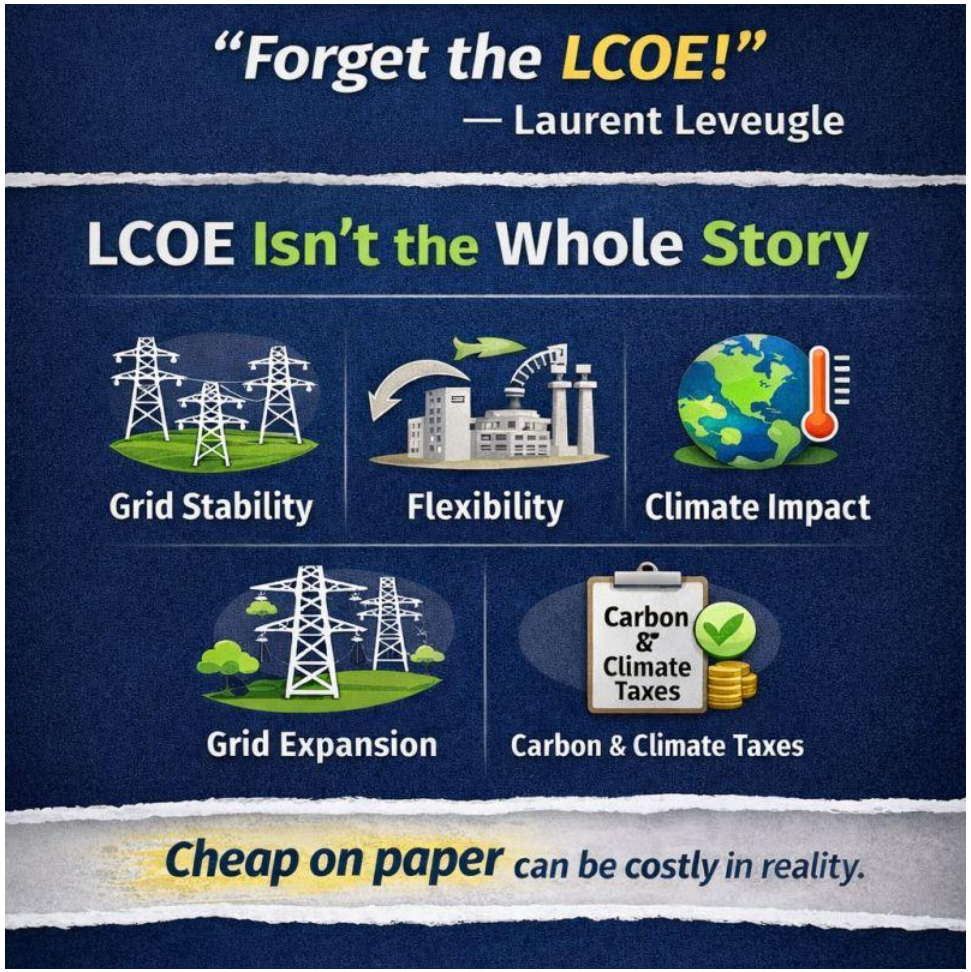
But LCOE is not the whole story!

(Key) services / cost components not taken into account in the LCOE:

- **Energy security & price stability** → long-term stable marginal cost, low fuel exposure VS Gas *(highly volatile market)*
- **Dispatchable and reliable generation** : Firm & Fully dispatchable source VS Renewables *(weather-dependent)*
- **Ultra-low carbon energy: ~2 gCO_2e/kWh**
  - vs ~400 gCO_2e/kWh for NG or ~800 gCO_2e/kWh for coal

  → ***LCOE do not take into account financial cost of CO2 emissions (ETS)***
- **Storage & value optimisation:** Energy can be stored and released when market/grid prices are most favorable

→ Supports arbitrage opportunities and improves overall system economics



LCOE captures cost of energy, but not the system value of reliability, flexibility, and decarbonisation

Partnering with citizens: HEXANA's MoU with De Atoomcoöperatie

DE ATOOMCOÖPERATIE

- **MoU signed in November 2025**

Atoomcoöperatie aims to enable socially supported, cooperative nuclear projects in the Netherlands by bringing together **citizens, industries and nuclear technology providers** and plans to **use cooperative ownership models** to enable **shared participation in nuclear projects**.

Solution Value Proposition

- **Creating value beyond electricity:** CHP with high temperature heat for industrial clusters, and economically efficient energy system flexibility **Core focus**

- **High-production capacity:** Thermal output: 800 MWth / Power output: 335 MWe
  Cluster configuration (up to 6 reactors : 2400 MWth / 1000 MWe)

- **An ultra-low carbon cogeneration platform:**
  - High-temperature heat or pre-heat up to 465 °C avoiding over-electrification Maximized efficiency **Hard-to-abate industries Ultra-low carbon (~2 gCO_2e/kWh)**, continuous power supply with a dual reactor strategy

- **Built-in flexibility without added cost :**
  - **Reactors operated** in baseload Flexibility from TES without impacting the BM

- **Long-term price stability: shielded from external shocks**
  - **EU-based & recyclable fuel**: **OPEX stabilized**
  - **Optimized waste management** Circularity & better acceptability

Company Value Proposition

A credibility based on :

1- Proven technology maturity & accelerated deployment

- SFR: **440 reactor-years worldwide** (120 in Europe)
- HEXANA inheriting of 70 years industrial experience (design → operation → decommissioning)
- Pre-qualified fuels and materials + Low-Risk Technological Approach

 Industrialization already began !

2- A strategic focus and well-defined role: Acting as a **turnkey techno-provider**, identifying the partners, financing schemes

3- Partnerships with established nuclear leaders

4- Customer deployment model

- **6 case studies signed and launched,** 2 completed → **2 MoUs signed**
- Requirements defined before standardization

 Deployable design in Europe (not country or sector-specific)

5- A differentiated business model focused on products and services beyond the capabilities of PWRs, helping overcome the economic challenges historically faced by SFRs

FOAK targeted 2035 (no prior demonstrator required)

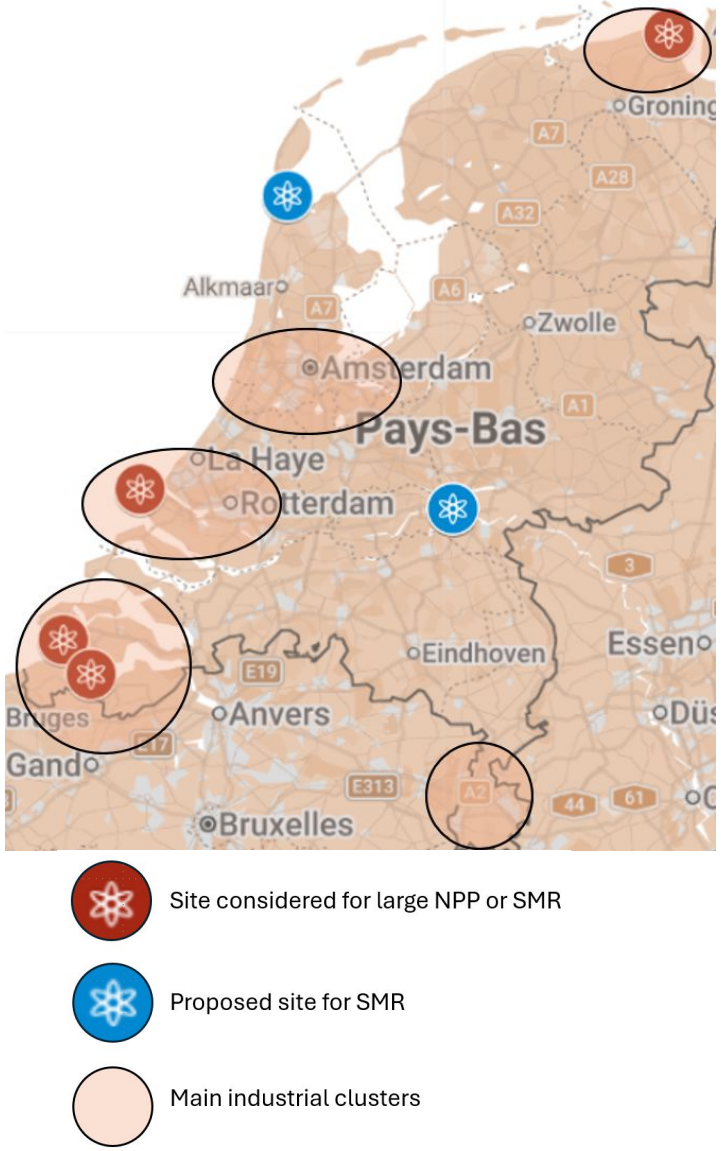
THANK YOU FOR YOUR ATTENTION

SMR siting in the Netherlands: balancing regulatory readiness, industrial needs and local acceptance

Siting constraints are a key bottlenecks for SMR deployment

- **Siting is one of the main challenge regarding SMR deployment** (limited land availability in industrial clusters, high population density security and acceptability challenge);
- **Easier to deploy on a site already licensed & in operation** only site in NL is Borssele NPP
- **Other sites considered by the Government & close to industries** might be chosen for the deployment of large NPPs instead
- **Other options:**
  - **Sites studied by municipalities** (Den Helder, Dodewaard);
  - **Whole new sites**

Public support could encompass formal identification of potential sites in industrial clusters



One system - different options to adapt to EII needs