

Allseas – SMR impact study

Final document

Delft, October 2025



Roland
Berger

Roland Berger conducted a study on the potential impact of SMRs across maritime and onshore applications

Project background and conducted interviewed

Allseas has commissioned Roland Berger to conduct an independent impact study on the potential application of Small Modular Reactors ("SMRs") across maritime and onshore applications

The scope of this project has been to address the following topics:

- External validation of the SMR proposition, including detailed calculation of the LCOE of Allseas' SMRs in comparison to other energy sources
- External analysis of the potential of SMRs in the global maritime sector, including potential reductions in CO₂ emissions and costs
- External analysis of the potential of SMRs in key industrial sectors in the Netherlands, including potential reductions in CO₂ emissions and costs
- High-level assessment of additional use cases for SMRs, such as datacenters, defense and hydrogen and SAF production
- Economic impact analysis of SMR deployment in the Netherlands, focusing on added value, job creation, and investment opportunities
- Assessment of the impact of SMRs on the strategic autonomy of the Netherlands, including geopolitical and societal implications, energy security, grid congestion, and associated risks
- Assessment of the impact of SMRs on grid congestion in the Netherlands

This report has been developed over a period of 7 weeks from September 1st, 2025, to October 17th, 2025

1) Excluding any anonymous interviews



External interviews ¹⁾			
	(Former) position	Company	Date
Value chain	CFO - <i>Bram-Paul Jobse</i>	EPZ 	Sept 26, 2025
	CEO - <i>Ad Louter</i>	Urenco NL 	Oct 1, 2025
	Deputy Director - <i>Ewoud Verhoef</i>	COVRA 	Oct 10, 2025
Research/Other	Prof. Science, Technology & Society - <i>Wim Turkenburg</i>	Utrecht University 	Sept 17, 2025
	Prof. Nuclear Reactor Physics - <i>Jan Leen Kloosterman</i>	TU Delft 	Sept 25, 2025
	Director Consultancy & Services - <i>Joost van den Broek</i>	NRG PALLAS 	Oct 3, 2025
	COO - <i>Maarten Tossings</i>	TNO 	Oct 3, 2025
	<i>Frederik Reitsma</i>	In a personal capacity	Oct 6, 2025
	Professor - <i>Jan Emblemsvåg</i>	NTNU 	Oct 20, 2025
Market	CEO - <i>Boudewijn Siemons</i>	Port of Rotterdam 	Oct 1, 2025
	Dir. R&D and Innovation - <i>Peter van Terwisga</i>	Damen Naval 	Oct 15, 2025
	Head Construction and Conversion - <i>Jan Gabriel</i>	Deme Group 	Oct 21, 2025

Contents

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SMRs provide a scalable, CO₂-free, inherently safe, and cost-effective solution for diverse applications, strengthening the Netherlands' competitive position

Application areas of SMRs with key drivers

Maritime incl. deepsea- mining



- **Emission-free** propulsion
- **Cheaper and scalable compared** to other green alternatives
- **Multi-year operation** without refueling

Process industry



- **CO₂-free heat** for high-temperature processes
- **Decentralized electricity generation** (reducing grid dependance)
- Reliable **cost-competitive baseload supply**

Datacenters



- **Decentralized electricity generation** (reducing grid dependance)
- Reliable **cost-competitive baseload supply**

Defense



- **Decentralized, cost-competitive secure energy supply** for naval propulsion and energy supply, military bases and infrastructure backups
- **Multi-year operation** without refueling for submarines and vessels

Hydrogen and SAF production



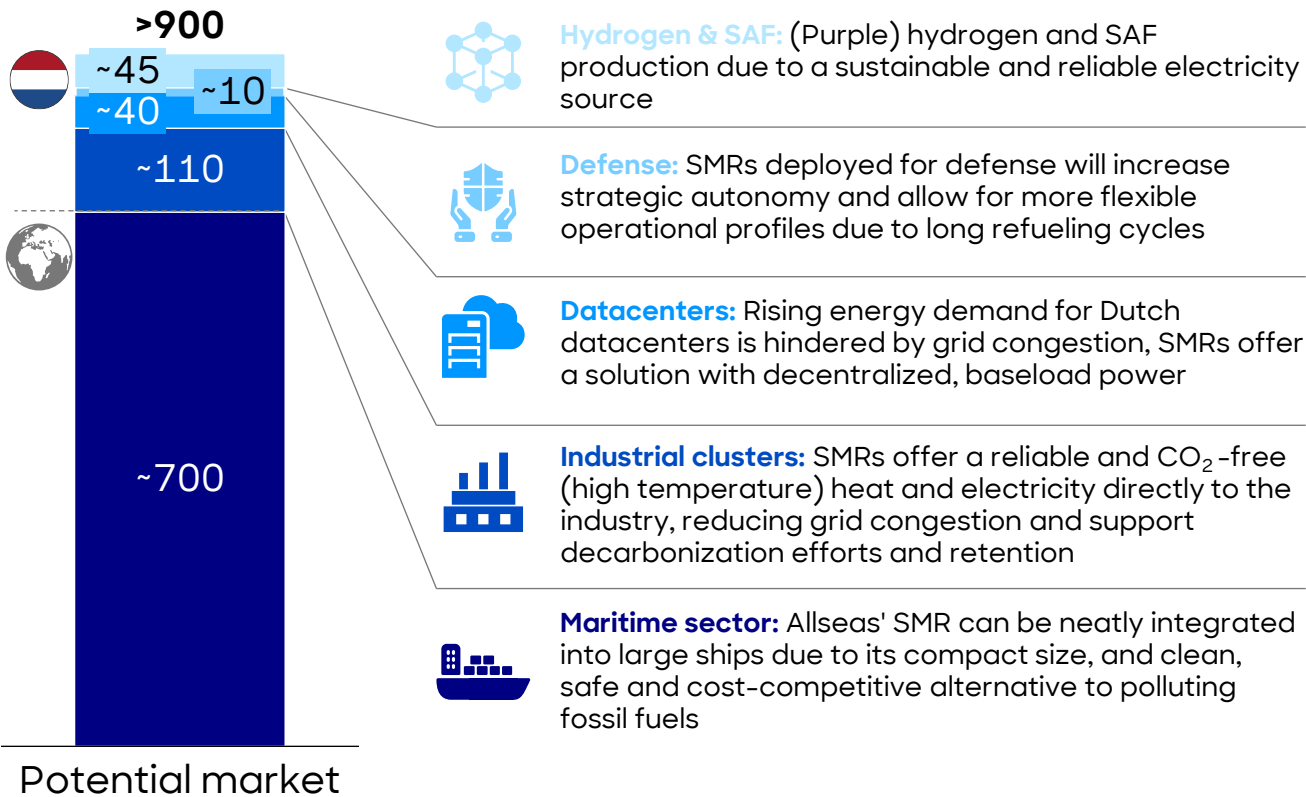
- **CO₂-free heat** for high-temperature processes
- **Decentralized electricity generation** (reducing grid dependance)
- Reliable **cost-competitive baseload supply**

Compact SMRs strengthen the competitiveness and energy security of the Netherlands with a scalable, inherently safe, and cost-effective solution

The potential addressable market exceeds over 900 Allseas' SMRs, resulting into significant economic value and CO₂ reductions

Economic potential driven by deployment of SMRs

Addressable market potential for Allseas' SMR deployment, 2050 [#]



Economic potential

Impact of addressable market

Cost savings¹⁾ [%]



Annual CO₂ reduction, 2050 [Mt]



Reduction of onshore HV grid investments, 2025-2050 [%]



~65 Mt CO₂ is equivalent to the CO₂ emissions of ~3,500,000 households

Impact of Allseas' deployment in the Netherlands

Cumulative added value, 2025-2050 [EUR bn]



Employment opportunities, 2050 [#]



Total cumulative investments, 2025-2050 [EUR bn]



1) TCO reduction of up to ~50% compared to current fossil fuels, for onshore use energy cost reduction of ~23% across the main industrial clusters in the Netherlands compared to gas boiler/turbine

The development of SMRs is important for the Netherlands, and Allseas offers an opportunity to capitalize on this momentum

The momentum of SMRs and its urgency



Globally, there is significant momentum in nuclear energy, with processes being accelerated

Small modular reactors: The next chapter of the energy revolution

British Chamber of Commerce - Sept 19, 2025

The growing global momentum behind small modular reactors

Innovation News Network - Sept 22, 2025

Trump seeks to fast-track new nuclear licenses, overhaul regulatory agency

Reuters - May 23, 2025

Britain and US to sign nuclear power pact during Trump's visit

Reuters - Sept 15, 2025



Industry is leaving the Netherlands: It is losing its competitive edge in the EU investment climate and climate targets will not be met

The Netherlands is at risk of losing its chemical industry: This is what's at stake

EW Magazine - July 29, 2025

High electricity costs, grid congestion, and complex regulations are making it increasingly difficult for companies to invest here profitably and sustainable

EW Magazine - July 29, 2025

After Shell, BP also stops with the biofuel plant in the port of Rotterdam

FD - Sept 22, 2025

Industry cancels greening plans and will not meet the 2030 climate target

NU.nl - Dec 24, 2025



The development of Allseas' SMR offers an opportunity to capitalize on this momentum

Allseas aims for rapid SMR deployment

World Nuclear News - June 5, 2025

Allseas wants to deploy SMRs on ships

Allseas is a pioneer in the next generation of clean energy: Developing an advanced nuclear power system tailored to energy-intensive offshore vessels and industrial clusters on land. *"This is more than innovation, it's a strategic shift toward long-term energy security and operational independence for both offshore and onshore industries,"* says Allseas

Nucleair Nederland - June 5, 2025

Allseas chooses nuclear option for big vessels in offshore fleet

Pioneering Dutch contractor lays out five-year plan to integrate small modular reactors into offshore vessels

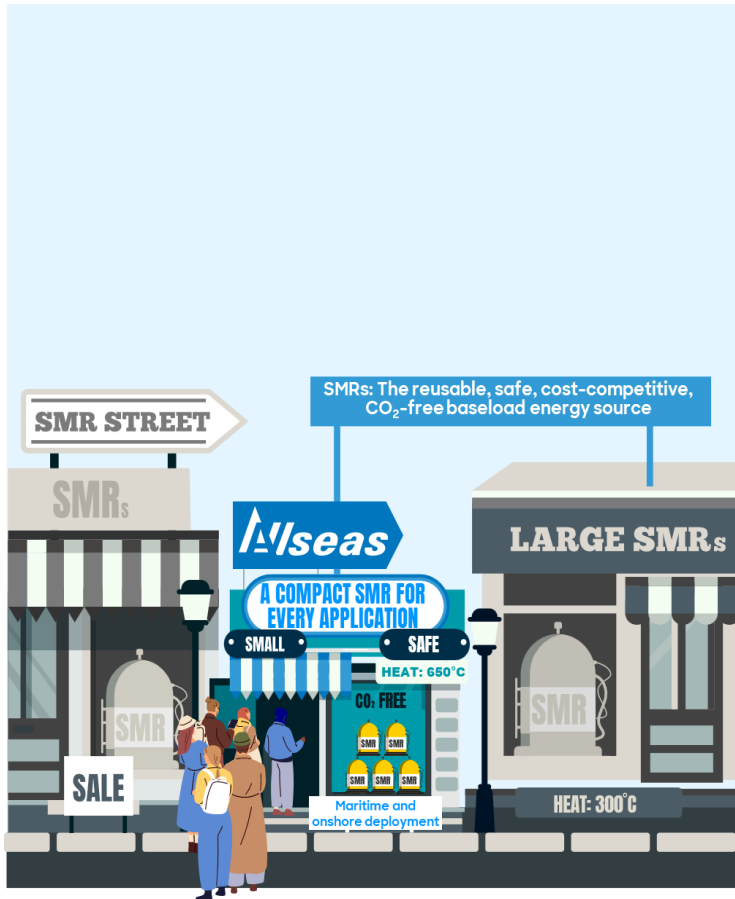
Upstream Online - June 5, 2025



1. SMR proposition

SMRs lay the foundation for a sustainable future and deliver the ideal solution for clean shipping & industrial competitiveness

SMR proposition and Allseas' USP



SMRs are the CO₂-free energy source for the future



Reliable baseload energy supply



Dual output: electricity and heat



CO₂-free power generation



Cost-competitive deployment



Scalable and flexible through modular design

Allseas' SMR stands as a unique pioneer in its field



Ultra-compact design



High-temperature heat output (~650°C)



Scalable for every energy need



Intrinsic safe design and small emergency planning zone (4th gen)



Proven HTGR technology (TRL 7/9)



No (water) cooling towers required

Furthermore...



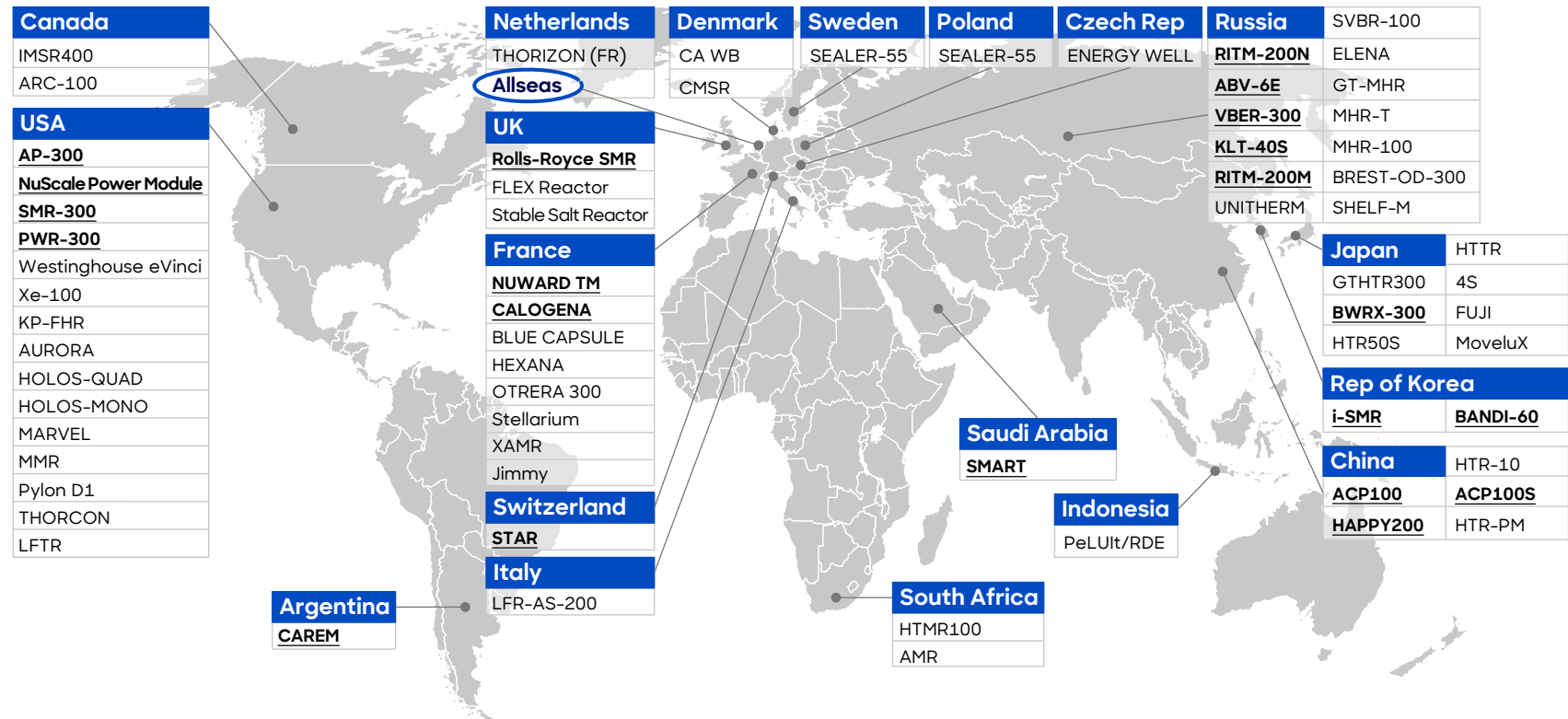
Allseas is capable to seize this opportunity as it has a strong financial base with global operations, engineering and manufacturing capabilities

Global interest in SMRs is rising, with major investments worldwide but the Netherlands remains behind – Notably, Allseas is developing its own unique SMR

SMR designs under development globally¹⁾

Characteristics of a SMR

- **Reliable baseload energy supply**
- **CO₂-free power generation**
- **Dual output:** Electricity and high-temperature heat (300–900°C)
- **Cost-competitive deployment**
- **Scalable and flexible through modular design**



xxx Light Water Reactors (3rd gen) xxx Advanced reactor types (4th gen)

1) As of October 2024; Excluding Energy Multiplier Module, Fast Modular Reactor and The Natrium Project

Allseas is developing a unique SMR that, due to its compact size, high-temperature heat output, is ideally suited for both maritime and onshore use

Allseas unique proposition



Ultra-compact design

Perfectly sized for integration into ships and space-constrained industrial sites, bringing nuclear energy where it was never possible before



High-temperature heat output (~650°C)

Ideal for energy-intensive industrial processes such as chemical production, steel, and hydrogen generation



Scalable for every energy need

Modular design producing 25 MWe/70 MWt allows for tailored energy solutions, from single units for ships to multi-unit configurations for industrial clusters



Intrinsic safe design

Passive safety systems require no human intervention, ensuring high reliability and minimal risk, which limits the emergency planning zone to the reactor surface, enabling use on vessels



Proven HTGR technology (operational in China and demonstrated in the US)

Built on High-Temperature Gas Reactor (HTGR) principles with a high technology readiness level¹⁾, making it the most mature reactor technology after the Pressurized Water Reactor



No (water) cooling towers required

HTGR designs avoid significant water use, simplifying siting and reducing environmental impact

+ Deep-dive on next slides



1) TRL 7/9, described as "System prototype demonstration in an operational environment"

With its compact size and modular design, Allseas' SMR enables a wider variety of applications than typical SMRs

Modular and ultra-compact design

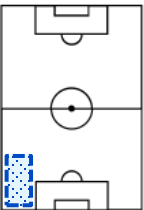
 "A SMR with a capacity of 25 MWe could be well-suited for integration at most industrial companies"
Ad Louter, Ureco

Allseas' SMR

The Allseas' SMR features a relatively **compact design** and produces 25 MWe/70 MWt, making it **ideally suited** for a **wide range of applications**



Dimensions:
25x10x15 m



- ✓ Suitable for **large maritime applications** due to **compact and scalable design**
- ✓ Suitable for deployment in spatially constrained **industrial clusters** due to its compact size
- ✓ Suitable for deployment for companies with **various** energy consumption profiles due to its **modular design**
- ✓ Suitable as a **redundancy unit or backup** during maintenance, thanks to its compact size and **lower electrical output**

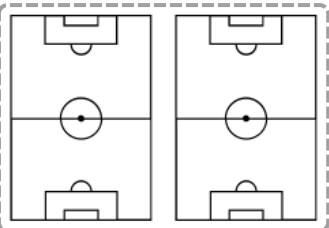
 Dimensions of SMR

Typical SMR

A typical SMR has an electrical output of around **300–350 MWe**, which corresponds to **larger reactor dimensions** compared to Allseas



Dimensions:
~2 soccer fields



- ✗ Not suitable for **maritime applications** due to **larger fixed capacities and design**
- ✗ Not suitable for deployment in spatially constrained **industrial clusters** due to its large size
- ✗ Not suitable for current industrial clusters due to **excessive electrical output**, and excess capacity **drives up costs**
- ✗ Not suitable as a redundancy unit due to **its large size and high electrical output**

The Allseas SMR is designed with intrinsic safety features that prevent overheating or instabilities during an accident

Intrinsic safety aspects of Allseas' SMR

Safety considerations resulting in small emergency planning zone

Negative temperature coefficient

- Rising reactor temperature automatically reduces power, preventing overheating or instability

TRISO¹⁾ fuel

- Billions of coated particles ensure fuel integrity, even if a small fraction fails
- Coatings and outer layer withstand high temperatures and retain fission products

Helium coolant

- Helium is chemically inert and non-radioactive, providing a stable coolant

Passive heat removal

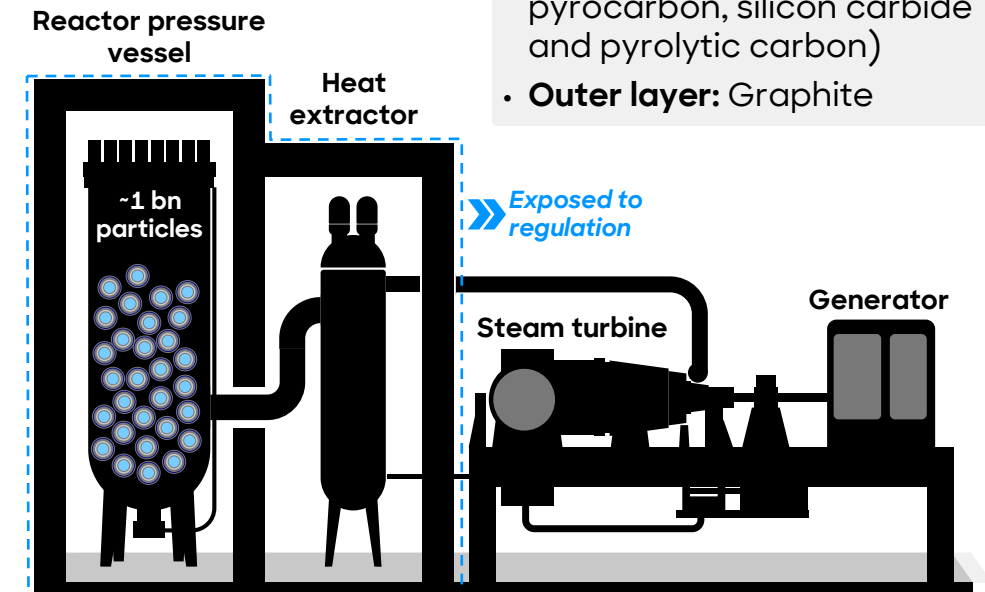
- Heat is removed through natural processes, reducing reliance on pumps or external systems

Low power density

- Low power density in HTGRs limits temperature rise and increases safety margins

TRISO fuel technology

- **Fuel:** Uranium dioxide
- **Coatings:** Several layers (buffer layer, inner pyrocarbon, silicon carbide and pyrolytic carbon)
- **Outer layer:** Graphite



+ Deep-dive on next slide

1) TRi-structural ISOtropic

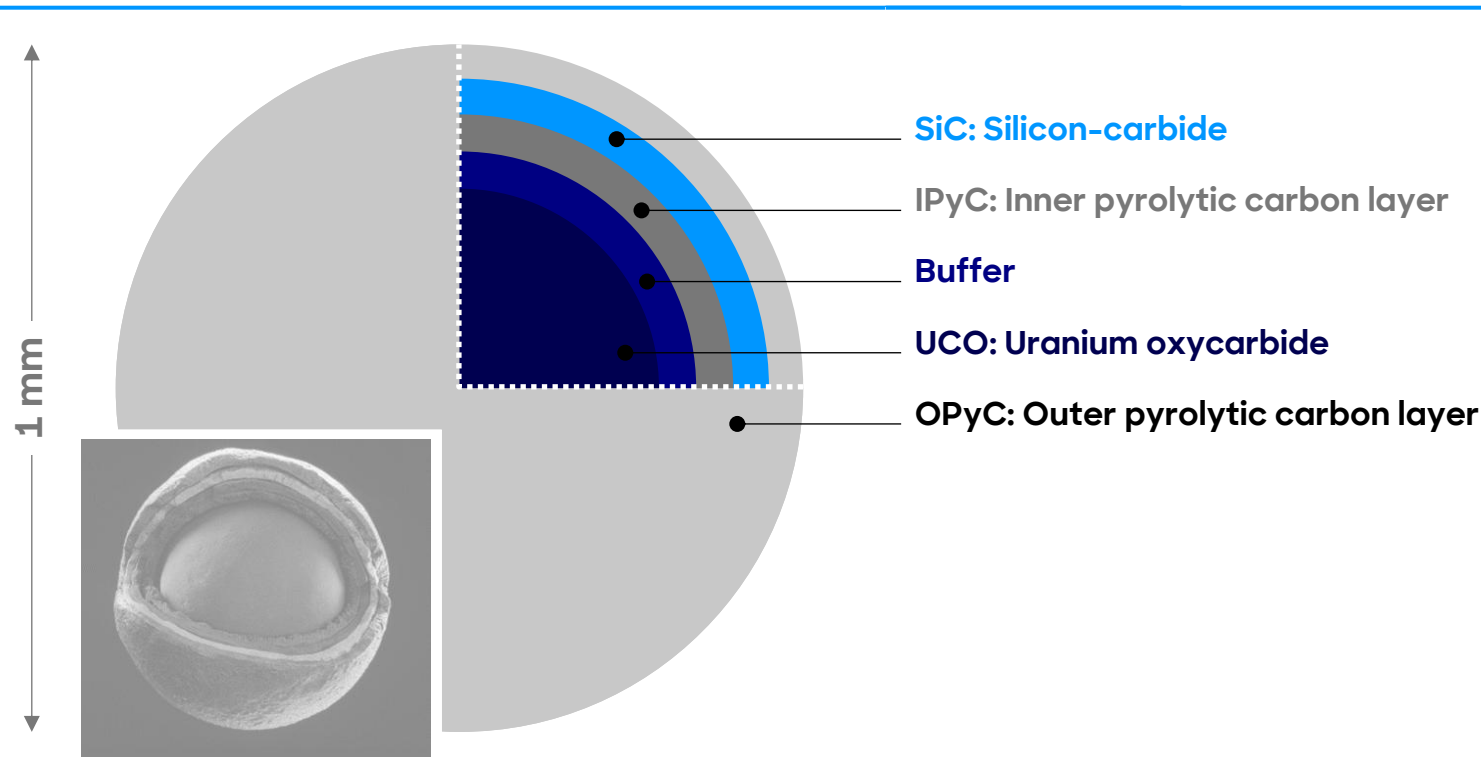
The TRISO fuel used by Allseas is inherently safe, as the fissile kernel is surrounded by three layers of ceramic coatings

TRISO fuel details

“The main advantages of using TRISO fuel are its proven safety and its ability to provide high-temperature heat through the reactor, ideal for industrial processes”

Ad Louter, Urenco

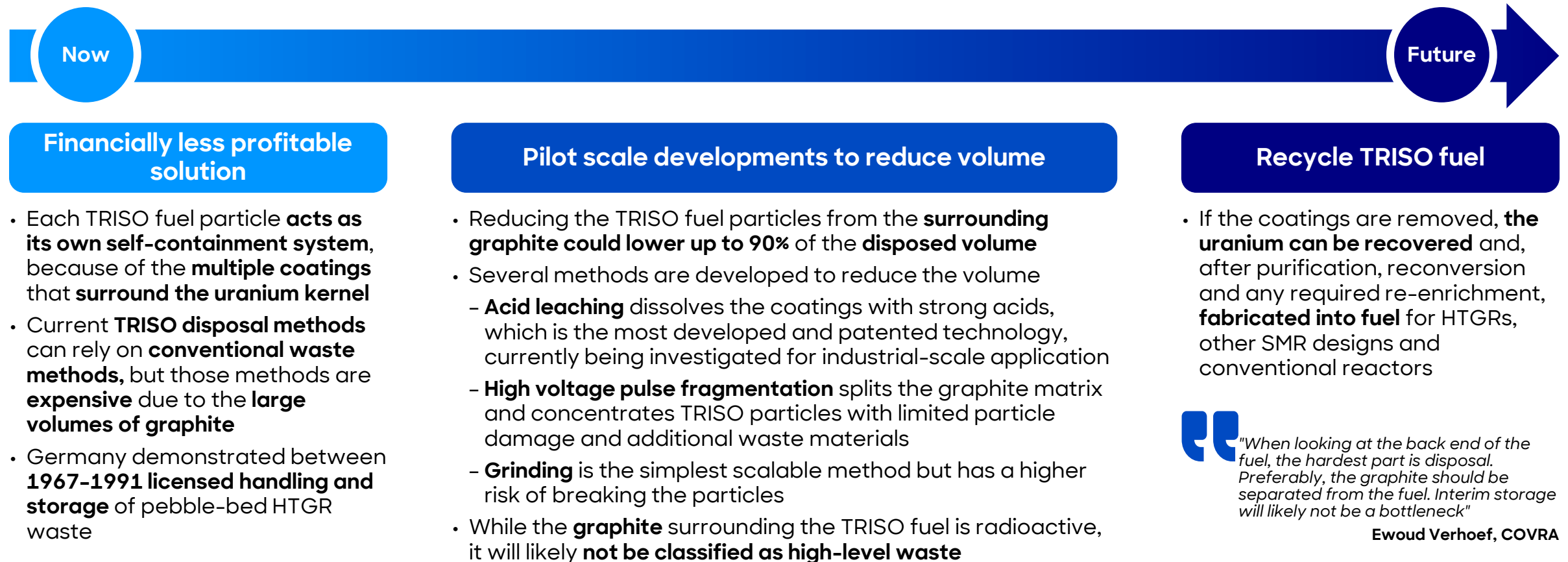
Schematic of a typical TRISO particle



- TRISO particles cannot melt in the reactor:
 - Capable of withstanding extreme temperatures well beyond heat generated within the reactor
- Particles are their own containment vessels
- There is more resistant to neutron irradiation, corrosion, oxidation, and high temperatures than traditional fuel
- Silicon-carbide layer is the primary barrier responsible for retaining fission products in the particle
- Allseas is following the same design specification as the Advanced Gas Reactor fuel, thereby relying on precedent and significantly reducing the risk and burden of a full fuel qualification program

TRISO fuel can currently be disposed with conventional methods, while innovative methods like acid leaching are being developed to reduce the volume

TRISO waste roadmap





2. Allseas' SMR for maritime deployment

Allseas' SMR is a cost-competitive, safe and CO₂-neutral alternative for the maritime sector offering GHG emission reductions & requiring minimal refueling

Allseas' SMR for maritime deployment

 "In my view, SMRs will play a crucial role in the ship of the future. For naval vessels due to increasing power requirements and their long refueling cycle, and for commercial fleets in support of decarbonization targets"
Peter van Terwisga, Damen Naval



Maritime industry needs to significantly reduce its GHG emissions towards 2050, but there are no suitable and cost-competitive alternatives available for widely used and polluting fossil fuels

- **Over 99% of maritime fuels used are fossil-based**, with the maritime industry contributing to ~3% of global GHG emissions
- **Green alternatives are 3-5 times more expensive**, require more fuel volume and have limited availability, making them unsuitable to meet emissions targets

Allseas' SMR offers a safe, zero-emission and cost-competitive source of power for large vessels, enabling minimal refueling requirements and supporting maritime's long-term decarbonization efforts

- Provides a cost-competitive power source, with **significantly reduced fuel costs** and a **lower TCO**
- Contributes to **substantial GHG emission reductions** for maritime operations
- Designed with **compact space** and power envelope ideal for maritime use
- Enables **minimal refueling requirements** due to long fuel cycles, ideal for deep-sea mining operations
- Suitable for maritime deployment due to **inherently safe design** (no human intervention in safety systems)
- **Scalable** due to modular design and construction

Maritime industry will need to significantly reduce GHG emissions but alternatives to fossil-based fuels are expensive and insufficient to meet targets

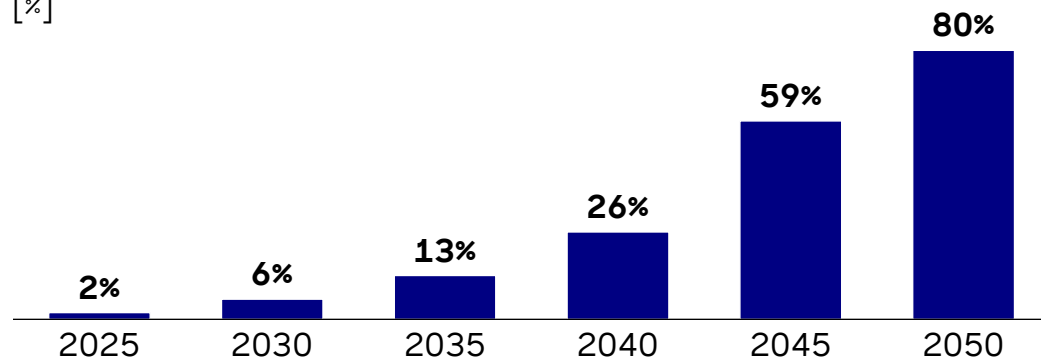
Current challenges maritime sector

Maritime industry will need to significantly reduce GHG emissions...

- Maritime industry is under pressure to significantly reduce its GHG emissions in line with Paris agreement targets
- FuelEU is targeting 80% emissions reduction by 2050, covering all EU port journeys
- IMO is targeting a 70% reduction of CO₂ emissions and 50% GHG emissions by 2050

~3%
of global GHG emissions

Annual average life cycle emissions¹⁾ reduction target FuelEU [%]

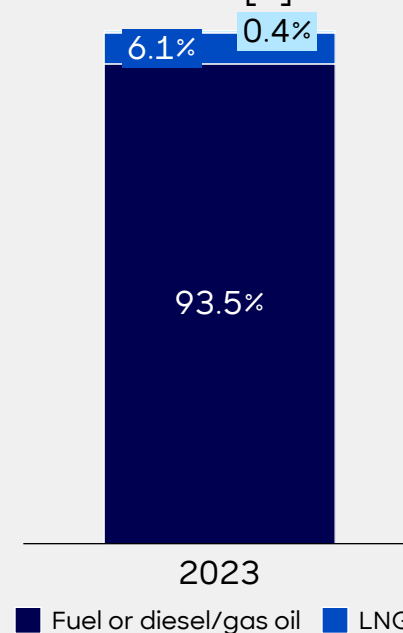


"Especially for large energy-intensive vessels, SMRs can be an attractive solution because alternative fuels weigh much more, which combined with the necessity for frequent bunker stops reduce the overall efficiency of the vessel"

Jan Gabriel, Deme Group

...but >99% of fuel used is still fossil-based and green alternatives are expensive

Maritime fuel mix, 2023 [%]



- **Fuel or diesel/gas oil:** Cheapest and most widely-used maritime fuel, but contributing to significant GHG emissions
- **LNG:** More expensive (20-40%) compared to fuel oils and limited GHG reduction of up to 45%
- **Green alternatives:**
 - **Methanol:** Limited availability, requires more volume and very expensive (4-5 times compared to fuel oils), but GHG emission reduction up to 95%
 - **Ammonia:** Limited availability, toxic and also very expensive (3-4 times compared to fuel oils), but GHG emission reduction up to 100%

1) Emissions include CO₂, methane and nitrous oxide

SMRs are the clean, safe and cost-competitive solution for large ships to meet maritime sustainability targets, while enabling long fuel cycles

SMRs as cost-competitive energy source for maritime sector

SMRs are well-positioned for maritime deployment

- ✓ **Competitive total cost of ownership**
- ✓ **Sustainable** power source able to meet future CO₂ emission reduction targets
- ✓ **Compact space and power envelope** suitable for maritime use
- ✓ **Very long fuel cycles** (> 5 years) limiting need for bunkering
- ✓ **High safety** due to unique, inherently safe design features
- ✓ **Scalable and sizeable** due to modular design

At a cost competitive costs

- **NOAK Allseas' SMR is cost-competitive with HFO** (even excl. CO₂ costs), however FOAK SMR is only competitive with 2040 CO₂ costs – This indicates that Allseas' **SMR will become cost-competitive between 2030 and 2040** as SMR costs will go down and CO₂ costs will increase
- Compared to **renewable alternatives**, **SMRs have a significantly lower TCO**, primarily driven by much lower fuel costs – Alternative fuels will be more suitable for smaller vessels, a segment of the market unserved by SMRs



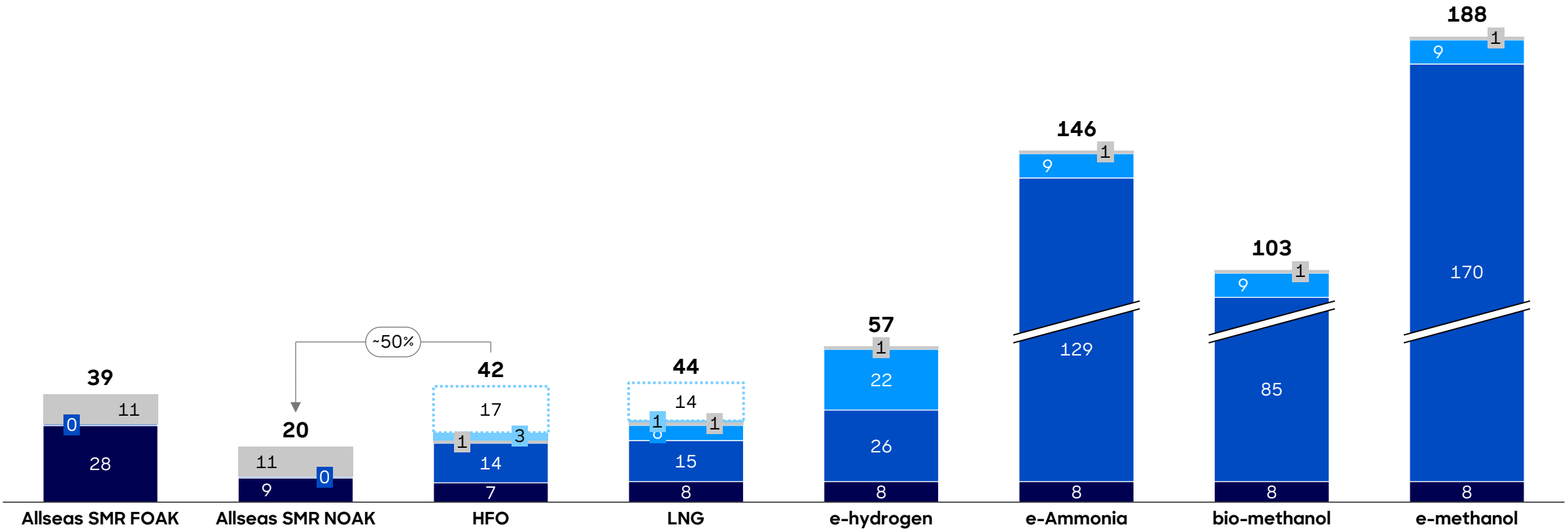
Case
example
25 MWe ship

~**50%** cost reduction resulting
in **EUR ~22 m** annual savings

NOAK Allseas' SMR is cost-competitive with HFO even excluding CO₂ costs, while the FOAK is already competitive with alternative fuels for large vessels

Total cost of ownership¹⁾, 2030E [EUR m/annum]

“Cost economics are positive for SMRs on vessels, even for the first-of-a-kind for large ships. Furthermore, the additional revenue from higher sailing speeds and reduced refueling downtime represents a significant upside.”
Jan Emblemstvang, NTNU



■ Annualized CAPEX ■ Fuel costs ■ Fuel storage costs²⁾ ■ Other operating costs ■ CO₂ costs, 2030³⁾ ■ Additional CO₂ costs, 2030-2040⁴⁾

1) For 25 MWe powered ship, travelling 156 k nautical miles per year; 2) Including economic cost of lost cargo capacity due to larger fuel storage volume - Assuming there are no space gains when using SMR compared to HFO; 3) Based on IMO net-zero regulations as presented in April 2025; 4) Conservative assumption that the Direct compliance GFIT is the same as base GFIT as no direct compliance target has been set yet for 2040

SMRs can effectively be deployed in container ships and offshore vessels due to high fuel cost reduction potential and remote operating profile respectively

Global SMR deployment by vessel type, 2025

Total addressable fleet size: $\Sigma \sim 12,000$

Criteria for SMR maritime deployment...

» Ship size

» Vessel type

» Focus on decarbonization

» Operating profile

... to cost-competitively meet CO₂ emission reduction targets



Bulk carrier

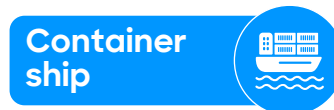
- Ship designed to transport unpackaged bulk cargo

Fleet size (>60,000 GT) 2,071

Average fuel usage [t/day] 40-70

SMR adoption likelihood

- Relatively low fuel consumption due to lower speed, making fuel cost savings less significant compared to other vessel types



Container ship

- High speed, long-range vessel built to carry standardized shipping containers

1,923

100-400

- High speed combined with fixed, long-distance routes leads to high fuel cost savings potential using SMRs



Offshore vessel

- Ship used to support activities such as drilling, construction, maintenance and deep-sea mining

319

50-150

- Can benefit from long fuel cycles with SMRs, due to its remote operating locations (e.g. oil and wind fields)



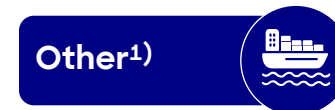
Oil tanker

- Ship designed to transport liquid cargo, including crude oil, chemicals and LNG

1,981

80-120

- Lower focus on decarbonization leading to lower SMR adoption likelihood, although fuel cost savings could potentially be significant



Other¹⁾

- Includes vessel types such as ro-ro cargo ships, gas tankers and service ships

928

50-80

- Relatively low fuel consumption due to lower speeds, making fuel cost savings less significant compared to other vessel types

High adoption likelihood Low adoption likelihood

1) Excluding passenger ships

SMRs are **critical for deep-sea mining** operations by providing a long-duration power source for remote offshore facilities, **eliminating the need for frequent refueling**

Maritime deployment could enable ~700 SMRs by 2050, reducing CO₂ emissions by ~55 Mt and leading to a TCO reduction of up to ~50%

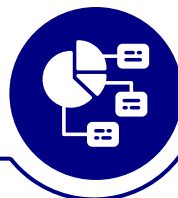
Potential impact of maritime SMR deployment



"If, in a few years, SMRs are deployed on ships, the Port of Rotterdam must be prepared to maintain its leading position"

Boudewijn Siemons, Port of Rotterdam

Global SMR deployment volume, 2050

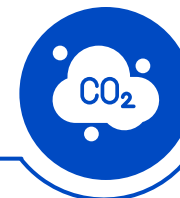


[#]

~700

Global fleet could already accommodate **deployment of ~700 Allseas' 25 MWe SMRs by 2050**, across both retrofit and newbuilt vessels

Global annual CO₂ reduction, 2050



[Mt CO₂]

~55 Mt

As **zero-emission alternative** to current polluting fossil fuels, one SMR can save ~80,000 tonnes of annual CO₂ emissions, resulting in **~55 Mt annual CO₂ emission reductions by 2050** (-5% of annual maritime emissions)

Total cost of ownership reduction per SMR



[%]

~50%

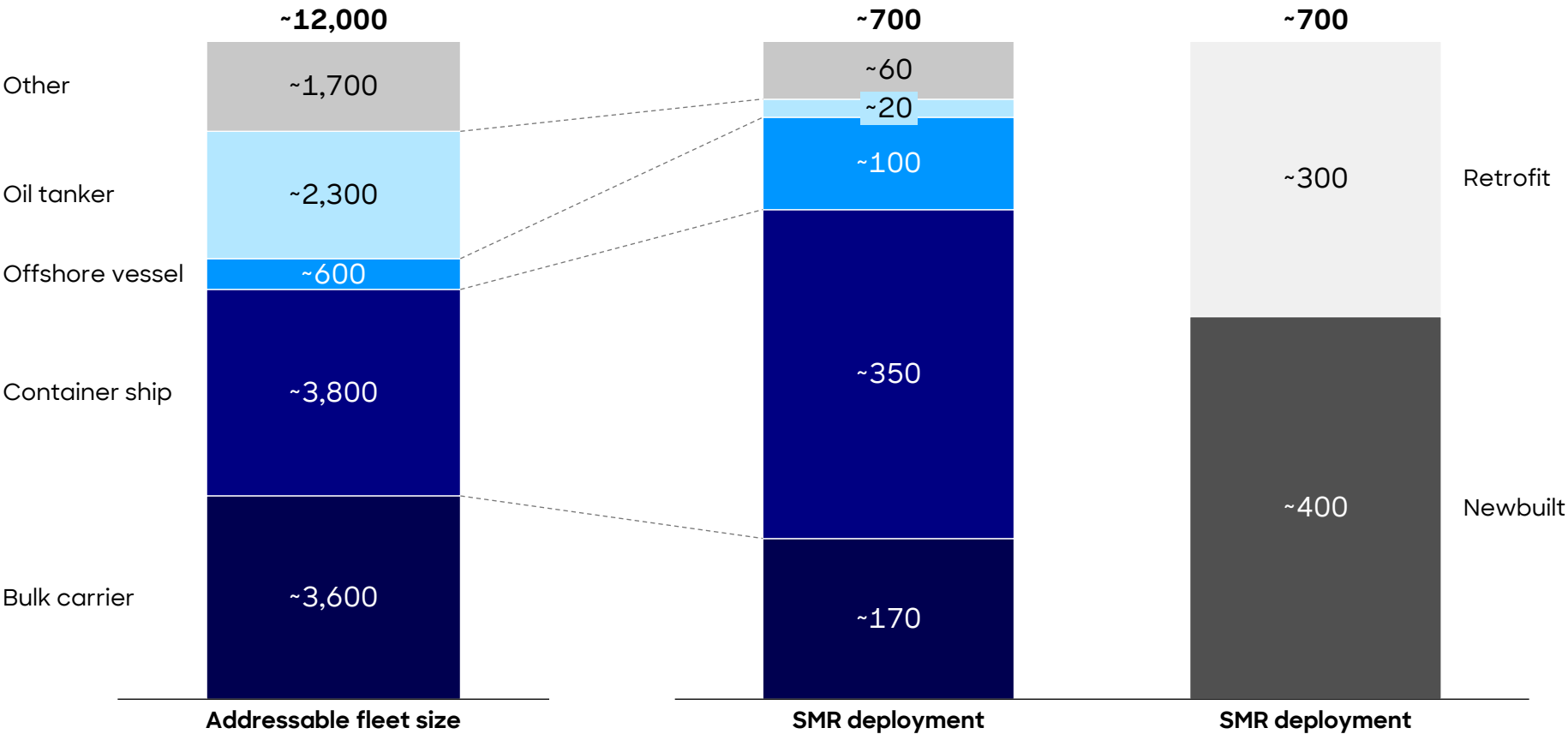
Deploying Allseas' SMR can lead to a **TCO reduction of ~50%** compared to current fossil fuels, taking into account future CO₂ costs¹⁾

~55 Mt CO₂ is equivalent to the CO₂ emissions of ~3,000,000 households

1) 2040 scenario for future CO₂ costs

There is potential for deployment of ~700 SMRs across the global fleet by 2050, primarily on large container ships, bulk carriers and offshore vessels

Global maritime SMR¹⁾ deployment potential, 2050 [#]



“In the maritime sector, using SMRs on large vessels is probably the most realistic way to decarbonize”
Maarten Tossings, TNO

New EU rules aiming to decarbonise the maritime sector take effect
 European Commission – Jan 10, 2025

Shipping faces major obstacles in achieving decarbonisation
 Sustainability Magazine – Oct 23, 2024

1) Allseas' 25 MWe SMR



3. Allseas' SMR for industrial clusters

Allseas' SMR offers a reliable, zero-emission, and cost-competitive source of heat and electricity directly to the industry, supporting industrial retention

Allseas' SMR for industrial clusters



Industrial clusters are struggling to decarbonize while remaining competitive, driven by sustainability demands and grid constraints that limit the expansion of existing industries and hinder the development of new ones

- **Elevated energy prices** have created a significant competitive gap between European industry and global counterparts
- The **electricity grid is saturated**, leading to high network costs and waiting lists
- **Strict decarbonization targets** are difficult to meet, as many industrial processes depend on fossil fuels for high-temperature heat, making electrification technically and economically challenging
- Reduced competitiveness is **threatening industrial retention**, putting long-established sectors at risk

Allseas' SMR offers a reliable, zero-emission, and cost-competitive source of heat and electricity directly to the industry, supporting both decarbonization efforts and long-term industrial retention in the Netherlands

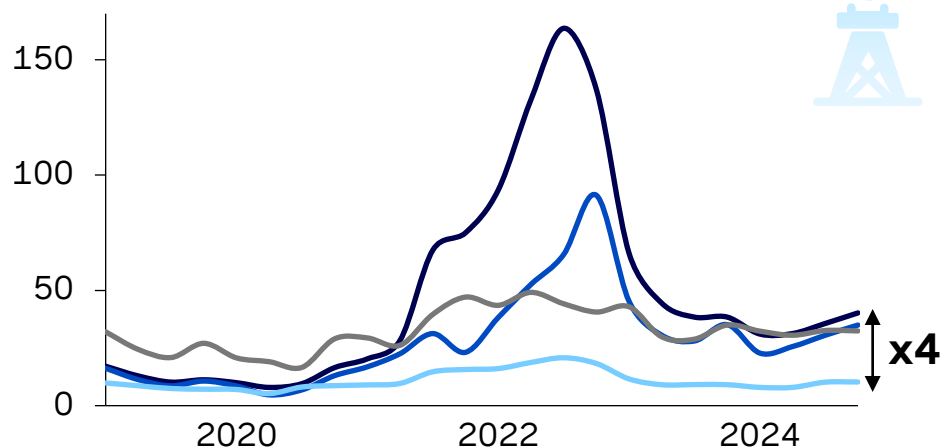
- Delivers **scalable heat** and **electricity** at **competitive costs**
- Provides **high-temperature heat output of ~650°C** ideal for industrial processes
- Helps **alleviate grid congestion** and **reduces network costs** due to localized generation
- **Contributes** significantly to meeting **CO₂ reduction** and sustainability targets
- Suitable for onshore deployment due to **compact and safe design** (no human intervention in safety systems)
- **Enhances competitiveness** and **energy security**, helping retain existing industries and foster new growth

High energy and carbon emission prices have caused a large competitive gap between Dutch industry and US and Chinese players

Challenge of high industrial energy prices

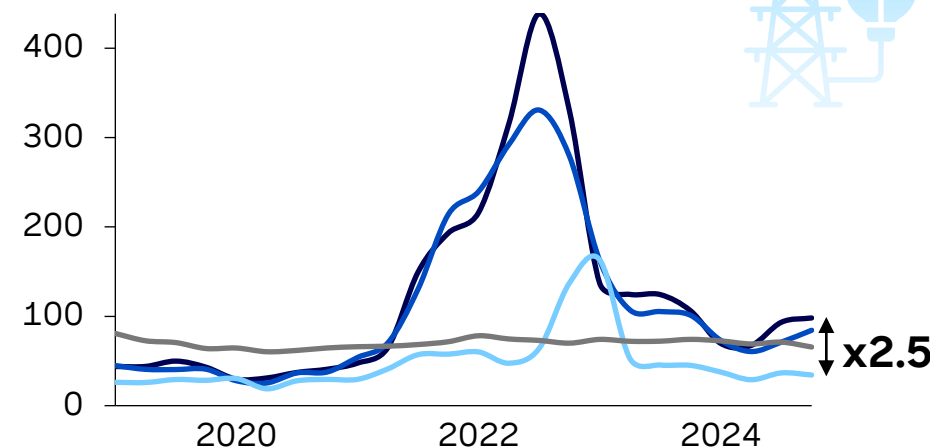
— Netherlands — Europe¹⁾ — United States — China

Natural gas prices for industrial consumption, 2019-2024 [USD/MWh]



- Gas prices were **increasing since 2021** and peaked in 2022 due to the **war in Ukraine**
- Since then, prices have decreased but are **not expected to return to pre-2022** values; **~20-30 EUR/MWh price gap between Europe and the US** is expected to remain

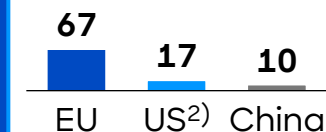
Electricity prices for industrial consumption, 2019-2024 [USD/MWh]



- **Electricity prices** are up strongly, decreasing competitiveness of European producers
- **Electricity price gap of 30~40 EUR/MWh** of European to US prices expected to remain beyond 2030

- Dutch energy intensive industries are struggling due to rising energy costs
- This is further driven by increasing CO₂ emission prices

CO₂ prices, 2024 [EUR/t]



1) German gas price taken as proxy for Europe; 2) Regional Greenhouse Gas Initiative (RGGI) values

The steel and chemical industries are under most pressure from rising energy costs, competition and climate targets and are highly suited for SMRs

Pressure on Dutch industry

Criteria for SMR onshore deployment...

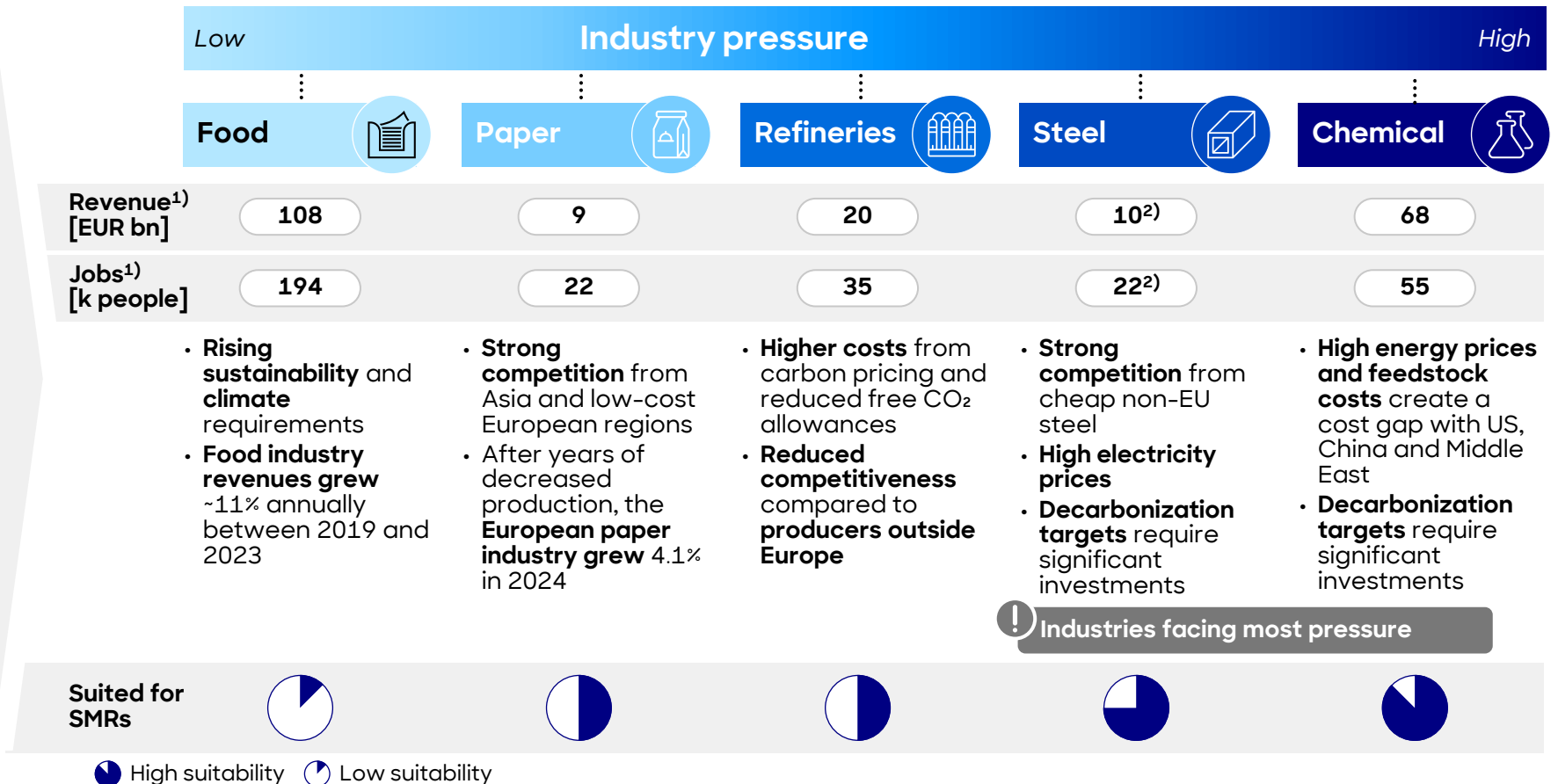
- **Baseload electricity**
- **Heat demand for industrial processes**
- **Focus on decarbonization**
- **Energy price dependency**

... to relief industry pressure



"The rising demand for high-temperature heat, combined with grid congestion and increasing grid costs, makes SMRs an attractive solution for industries under pressure"

Boudewijn Siemons, Port of Rotterdam



1) Netherlands, 2023 values; 2) Including other basis metals

Industrial companies are stopping production and relocating abroad, while SMRs offer a way to strengthen the Netherlands' industrial competitiveness

Allseas' SMR as cost-competitive energy source

The Netherlands is at risk of losing its chemical industry: This is what's at stake

EW Magazine - July 29, 2025

NXP factory leaves Nijmegen: "Germany was more active and faster"

BNR - May 23, 2025

Is the Netherlands losing its manufacturing industry? Time to wake up!

Techniek - June 4, 2025

Canceling Shell's biofuel plant is a new blow to the Dutch sustainable economy

FD - Sept 3, 2025

In short:

- Shell previously called biofuel essential for reducing CO₂ emissions in the aviation sector
- Other industrial companies are also putting their biofuel projects on hold
- Airlines must start blending this year

After Shell, BP also stops with the biofuel plant in the port of Rotterdam

FD - Sept 22, 2025

In short:

- It is the umpteenth setback for the port, where companies stop activities or do not invest more. Previously also Gunvor, Tronox, LyondellBasell, Westlake and Indorama stopped their production
- The municipality of Rotterdam and the province of South Holland want the cabinet to intervene
- High electricity costs, grid congestion and complex regulations make it increasingly difficult for companies to invest profitably and sustainably here

SMRs are well-positioned for onshore deployment



Cost-competitive energy source



Sustainable electricity and heat supply



Reliable and consistent baseload



Reduced grid congestion due to localized generation



Local heat generation



Ability to meet future growing energy demand

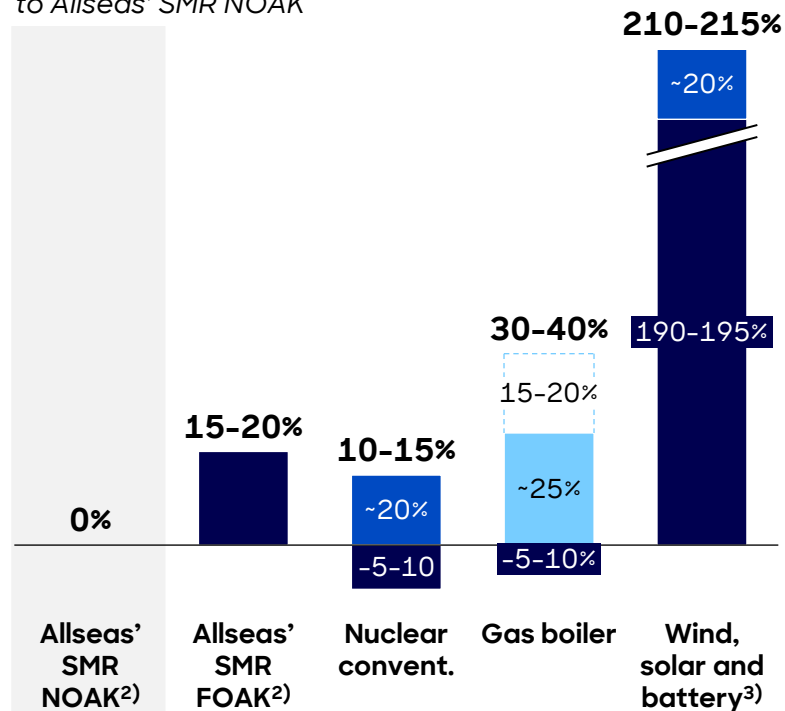
Allseas' SMR has the potential to offer industrial heat at the right temperature at a lower cost than renewables – CO₂-free electricity is also cost-competitive

Levelized cost of energy¹⁾ (LCOE) incl. grid & CO₂ costs in the Netherlands vs. Allseas' SMR NOAK, 2030E [%]

Heat between 350 and 650 °C



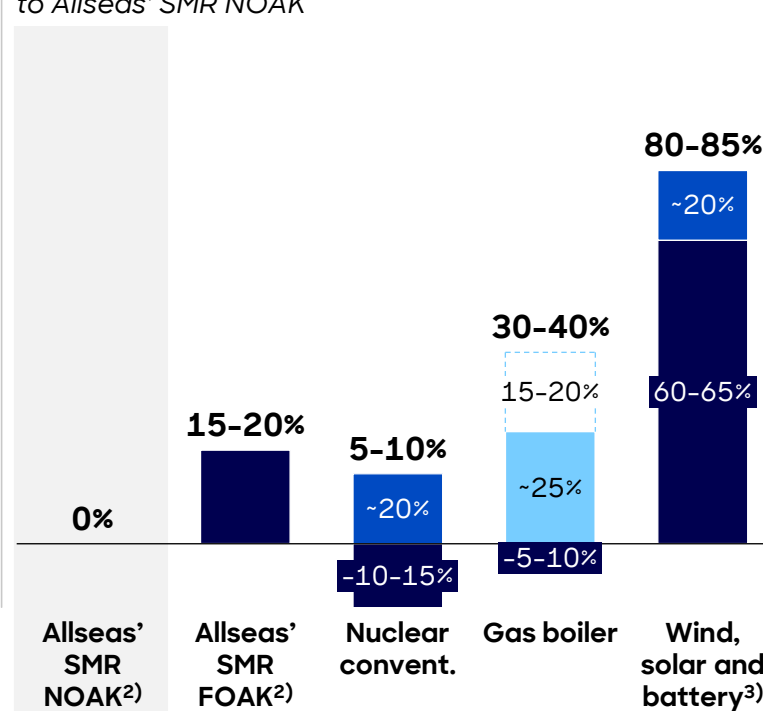
Price difference (%) compared to Allseas' SMR NOAK



Heat between 50 and 350 °C



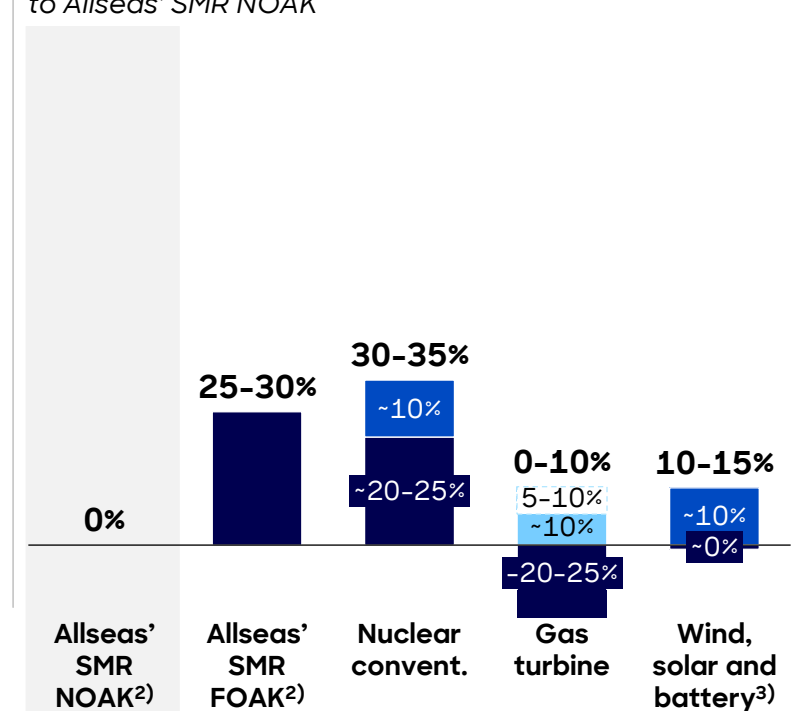
Price difference (%) compared to Allseas' SMR NOAK



Electricity



Price difference (%) compared to Allseas' SMR NOAK



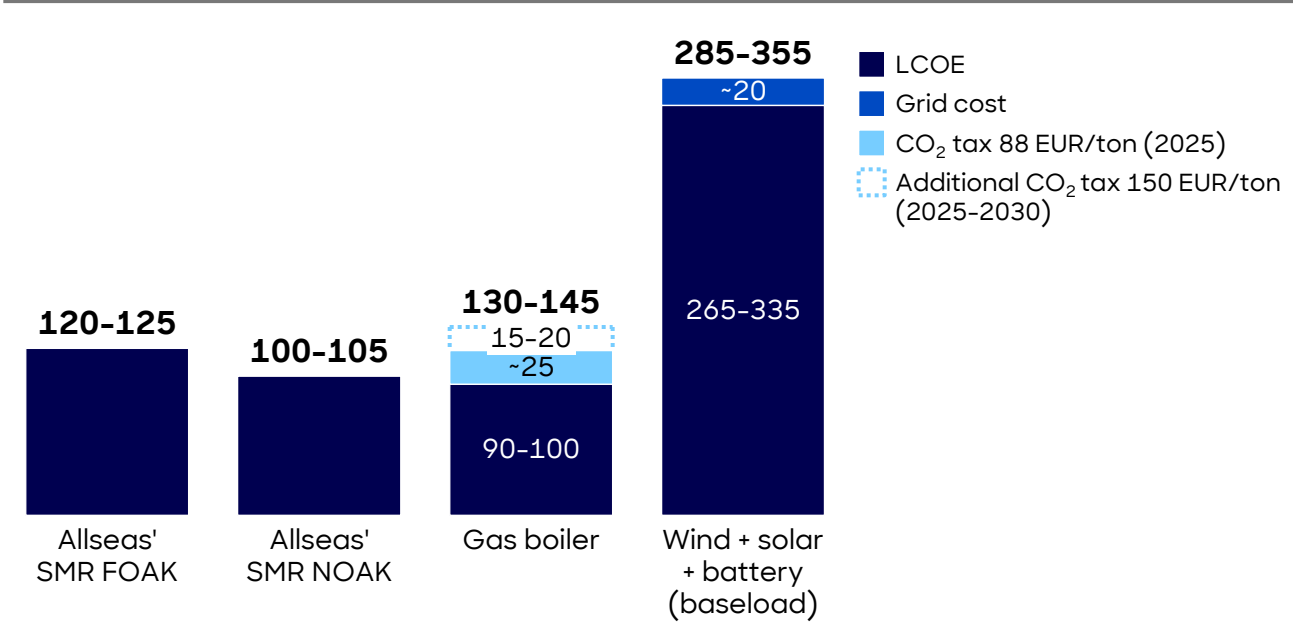
■ LCOE ■ Netwerkkosten ■ CO₂-belasting 88 EUR/ton (2025) ■ Extra CO₂-belasting 150 EUR/ton (2025-2030)

1) Discounted over 20 years, assuming 60% debt (8% cost of debt), 40% equity (12% cost of equity), and 2.25% inflation; 2) Eliminated CAPEX costs of electricity generation, corrected for auxiliary costs; 3) Including CAPEX of electric furnace (between 350-650 °C) and E-boiler (between 50-350 °C)

SMRs offer a cost-competitive solution for onshore industries' energy challenges, saving the Rotterdam-Moerdijk cluster around EUR 735 m annually

Allseas' SMR as cost-competitive energy source for industrial clusters

Cost comparison high temperature¹⁾ heat NL, 2030E [EUR/MWh]



- HTGR SMRs are cost-competitive compared to renewable energy sources and have the advantage of reliability and consistency in electricity supply
- SMRs are much more cost-competitive compared to gas boilers, which would be the benchmark for consistent electricity supply

Case example Rotterdam - Moerdijk, 2050



~**24%** cost reduction resulting in **EUR 735 m** annual savings

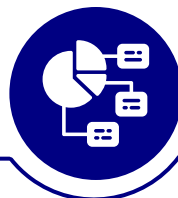
	Total demand [TWh]	Supplied by SMR ²⁾ [TWh]	Cost difference ³⁾ [EUR/MWh]	Cost savings [EUR m]
Electricity	31	2	2.5	~5
Heat ⁴⁾	41	20	36	~730

1) Heat between 350 and 650 °C; 2) Considering Allseas' SMR, based on a 5% adoption for electricity and 50% for heat demand; 3) Compared to gas boiler; 4) 2030 figures

Deployment across the main industrial clusters could enable ~110 SMRs, with reducing the energy costs of the clusters by ~23%

Potential impact of deploying Allseas' SMR across key industrial clusters in the Netherlands¹⁾

Dutch SMR deployment volume, 2050³⁾



[#]

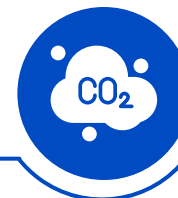


Excl.
Global
potential

~110

Deployment across the **main industrial clusters in the Netherlands** could potentially accommodate **~110 SMRs**, based on an output of 25 MW_e/70 MW_t per SMR

Dutch annual CO₂ reduction, 2050³⁾



[Mt CO₂]

~10 Mt

Providing **clean electricity** to the main industrial clusters in the Netherlands could potentially **cut their CO₂ emissions by ~25%**, equivalent to roughly **10 Mt CO₂**

Equivalent to the CO₂ emissions of ~500,000 households

Energy cost²⁾ savings per cluster, 2050³⁾



[%]

~23%

Deploying Allseas' SMRs across the Dutch industrial clusters could **reduce energy costs by EUR 1.5 bn**, representing a **~23 % decrease**

1) Excluding datacenters, hydrogen electrolysis and SAF production, covering Noord Nederland, Noordzeekanaalgebied, Rotterdam-Moerdijk, Cluster 6, Zeeland/West-Brabant, Chemelot; 2) Compared to gas boiler/turbine; 3) SMRs deployed for heat applications are based on 2030 figures



4. Potential other use cases for Allseas' SMR

Thanks to its unique characteristics, Allseas' SMR is also well-suited for other applications, including datacenters, defense, and hydrogen & SAF production

Potential other use cases for Allseas' SMR in the Netherlands¹⁾



Datacenters

Σ ~40

- **Decentralized electricity:** SMRs generate electricity locally, reducing reliance on the grid
- **Reliable baseload supply:** SMRs deliver stable, continuous power, meeting datacenters' uninterrupted electricity needs



Defense

Σ ~10

- **Energy security:** SMRs provide reliable power for naval propulsion and energy supply, military bases, and critical infrastructure, independent of vulnerable fuel supply chains and secures multi-year energy supply amid growing demand
- **Resilience:** SMRs can strengthen national security infrastructure against grid outages or attacks



Hydrogen and SAF production

Σ ~45

- **High-temperature heat:** Allseas' SMRs deliver process heat, ideal for hydrogen electrolysis, direct air capture (DAC) and SAF production
- **Decentralized electricity:** SMRs provide reliable local baseload power, reducing dependence on the grid, thereby supporting emerging applications of hydrogen and SAF production

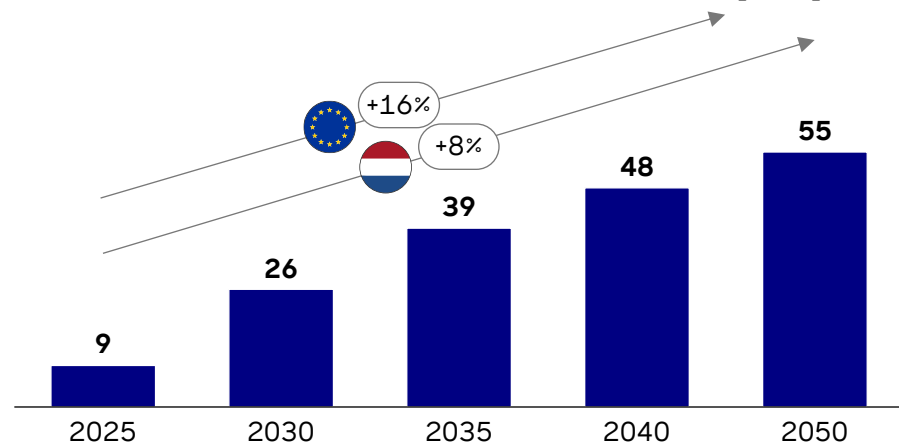
1) Excluding other application areas such as municipalities

Rising demand for Dutch datacenters is hindered significantly by grid congestion, SMRs offer a viable solution with decentralized, baseload power

Allseas' SMR for datacenters in the Netherlands

Without grid constraints, electricity demand from Dutch datacenters is expected to rise sharply

Electricity demand of Dutch datacenters, 2025-2050 [TWh]¹⁾



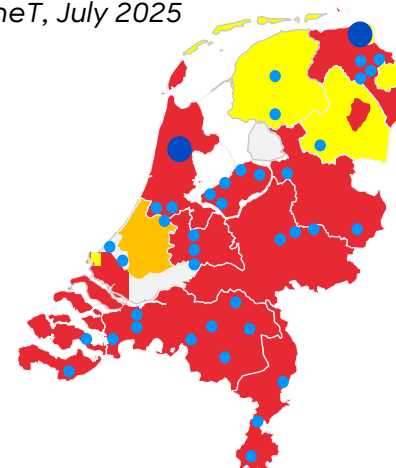
- IEA projects global datacenter power demand to double by 2030, driven largely by AI growth
- In the Netherlands, datacenter electricity demand could reach 40-70% of current national consumption
- The Dutch regulator (ACM) does not prioritize grid access for datacenters or telecom providers

However, growth is limited by grid congestion – SMRs offer a solution through local, reliable power

Demand congestion map of TenneT, July 2025

- Datacenter
- Datacenter campus

Selection of datacenters:



- Grid connection wait times currently average around 10 years
- Limited grid capacity slows Dutch datacenter expansion compared to leading European markets
- SMRs provide reliable baseload power and reduce grid dependence due to decentralized generation

Potential of Allseas' SMR deployment, 2050 [#]²⁾



“Allseas SMRs are well-suited for datacenters. Thanks to their compact size, they can operate as flexible units, allowing multiple reactors to maintain stable power generation even during maintenance, eliminating the need for a grid connection”

Ad Louter, Urenco

Electricity consumption by datacenters is set to explode in the coming decades, the grid cannot handle this

De Volkskrant – May 13, 2025

The Netherlands risks higher costs and greater dependence due to a shortage of data centers

NU.nl – Okt 9, 2025

1) Average of II3050 scenarios as provided by Netbeheer Nederland; 2) Considering an adoption rate of 15% of electricity demand in 2050 and SMR of 25 MWe

● No grid congestion ● Ongoing congestion research
● Limited transport capacity ● Congestion management area

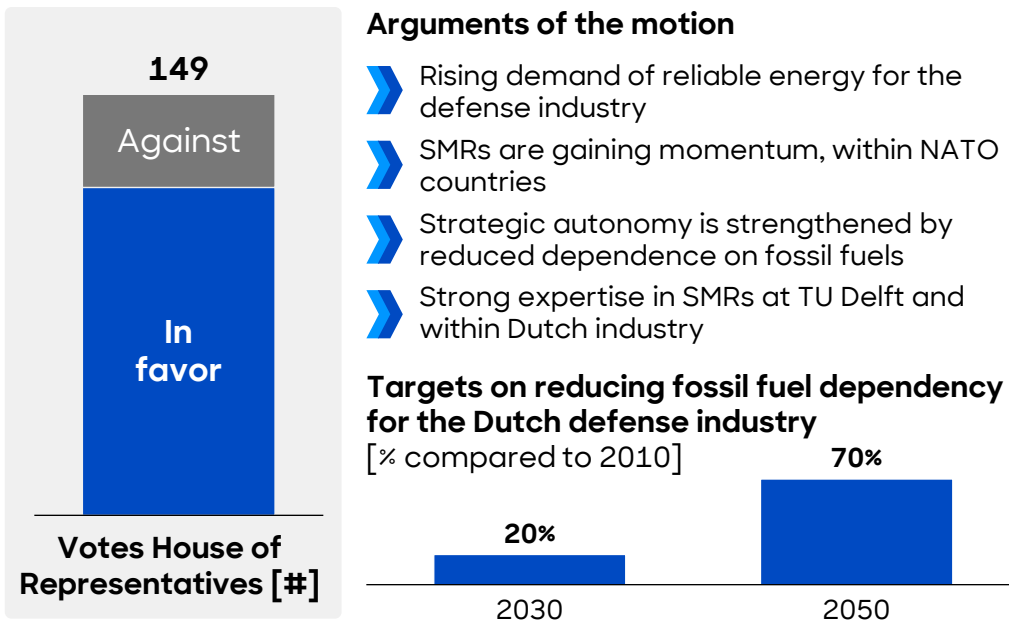
In response to rising energy demand & growing emphasis on strategic autonomy, SMRs offer a reliable energy source well-suited to diverse defense applications

Allseas' SMR for the Dutch defense sector

There is growing political support for using small-scale nuclear energy (SMRs) in the Dutch defense industry



Motion on small-scale nuclear energy in the Dutch defense industry adopted by a majority of the house of representatives, June 2025



“SMRs offer promising applications for defense, providing reliable power for naval operations, enabling sustainable energy supply at temporary military bases, supporting advanced technologies such as laser and directed-energy weapons, and meeting backup energy needs for critical infrastructure”

Maarten Tossings, TNO

Applications of SMRs in the defense industry

Naval propulsion and/or energy supply

Current fleet¹⁾:

- 13 large surface units (e.g. frigates, patrol ships)
- 14 small surface units (e.g. support vessels, mine countermeasure vessels)
- 4 Walrus-class submarines



Temporary military bases

(incl. high-power laser and radiation weapons)

- Missions²⁾:
 - NL: currently 10-15 (large and smaller ones)
 - UN: 35 missions between 2010-2024³⁾



Critical infrastructure backup

- Examples: Energy, telecommunications, transport, drinking water, water, chemicals, nuclear, finance, government, public order and safety, defense



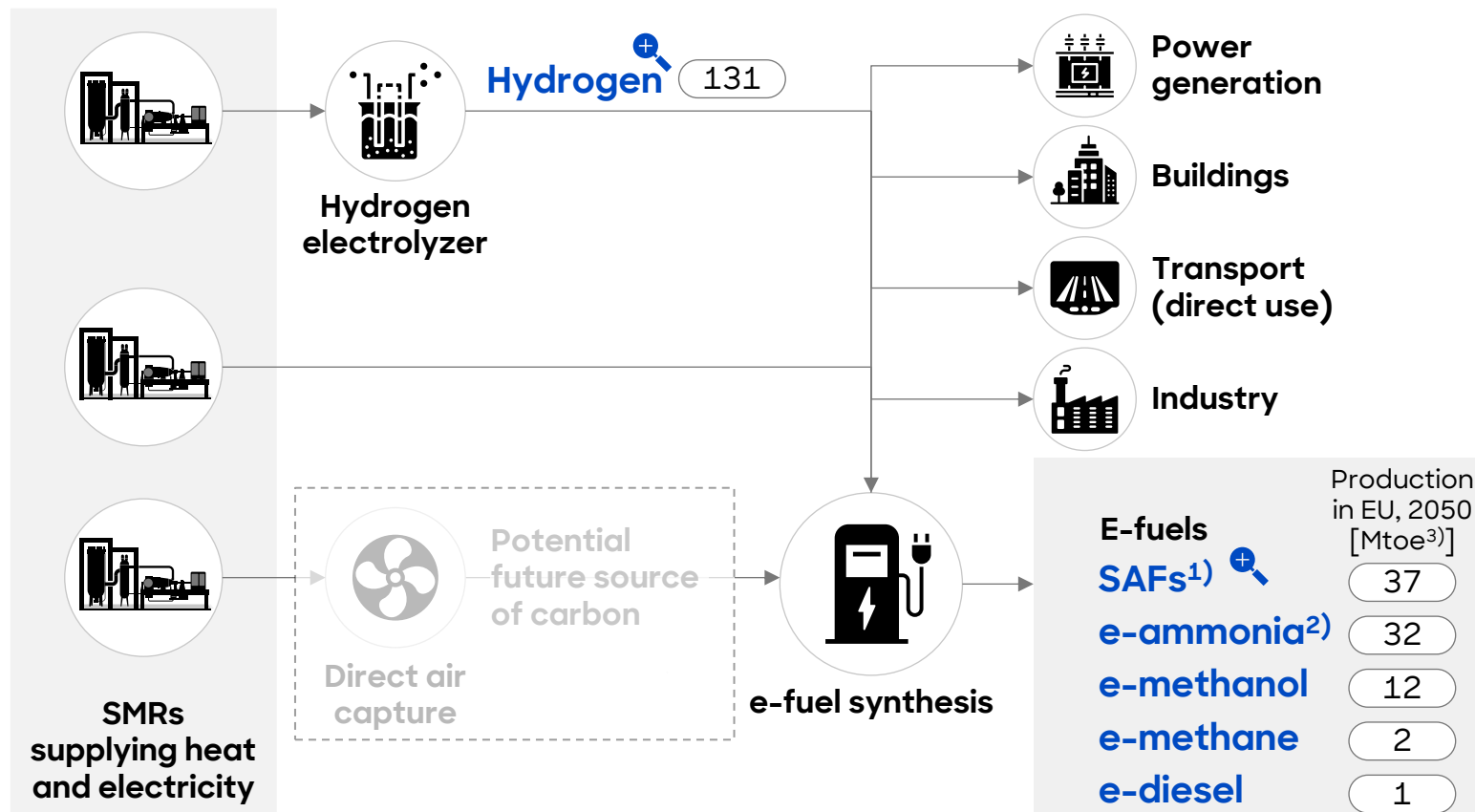
~10

Potential of Allseas' SMR deployment, 2050 [#]⁴⁾

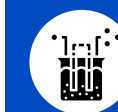
1) Large surface units: 6 frigates, 2 amphibious transport ships, 1 supply ship, 4 patrol ships. Small surface units: 5 mine countermeasure vessels, 2 hydrographic survey vessels, 1 torpedo work ship, 1 support vessel in the Caribbean, 1 sailing training ship, 1 Navy training ship, 3 diving vessels. Subsurface units: 4 Walrus-class submarines; 2) Including missions in collaboration with other countries and alliances; 3) Includes peacekeeping operations, special political missions and good offices engagements; 4) High-level analysis, based on planned replacement of naval propulsion (Defensie Projectenoverzicht, 2025-2030) incl. typical installed power per ship, numbers of missions, etc.

SMRs can support in producing hydrogen and SAF by providing heat and electricity for electrolysis, direct air capture and e-fuels synthesis

Allseas' SMR for Hydrogen and SAF¹⁾ production



Application of SMR



Hydrogen electrolysis

Heat lowers the bond energy of water, reducing the electricity required for electrolysis and thereby improving overall efficiency



E-fuel synthesis

In the industrial production of e-fuels, hydrogen is combined with carbon or nitrogen which requires (high-temperature) heat and reliable electricity



Direct air capture (DAC)

DAC requires both electricity and heat to capture CO₂ from ambient air and release it from the capture medium

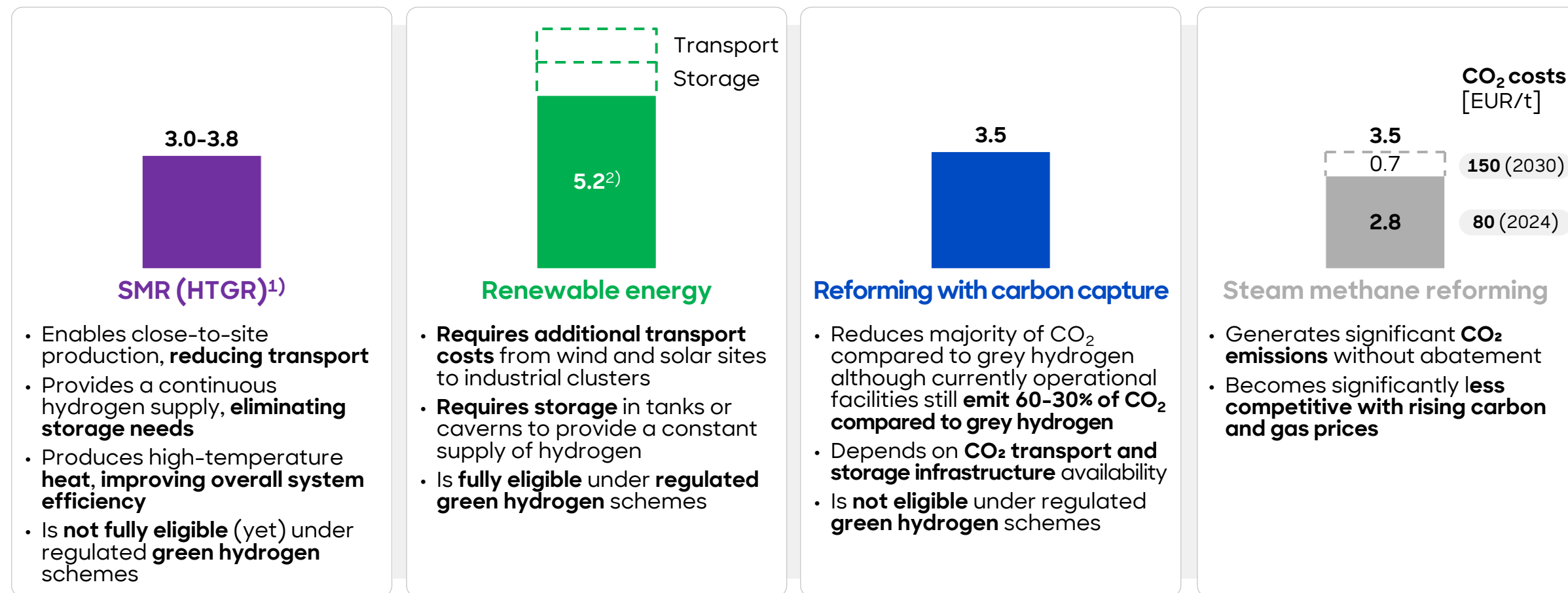
xx Production in EU, 2050 [Mtoe³⁾] + Deep-dive on next slides

1) Synthetic aviation fuel; 2) Requires nitrogen instead of carbon; 3) Million ton of oil equivalent

Source: European Commission, European Hydrogen Observatory

Hydrogen produced with SMRs has a lower LCOE than renewables and is close to grey hydrogen in 2024, which will become more expensive as CO₂ costs rise

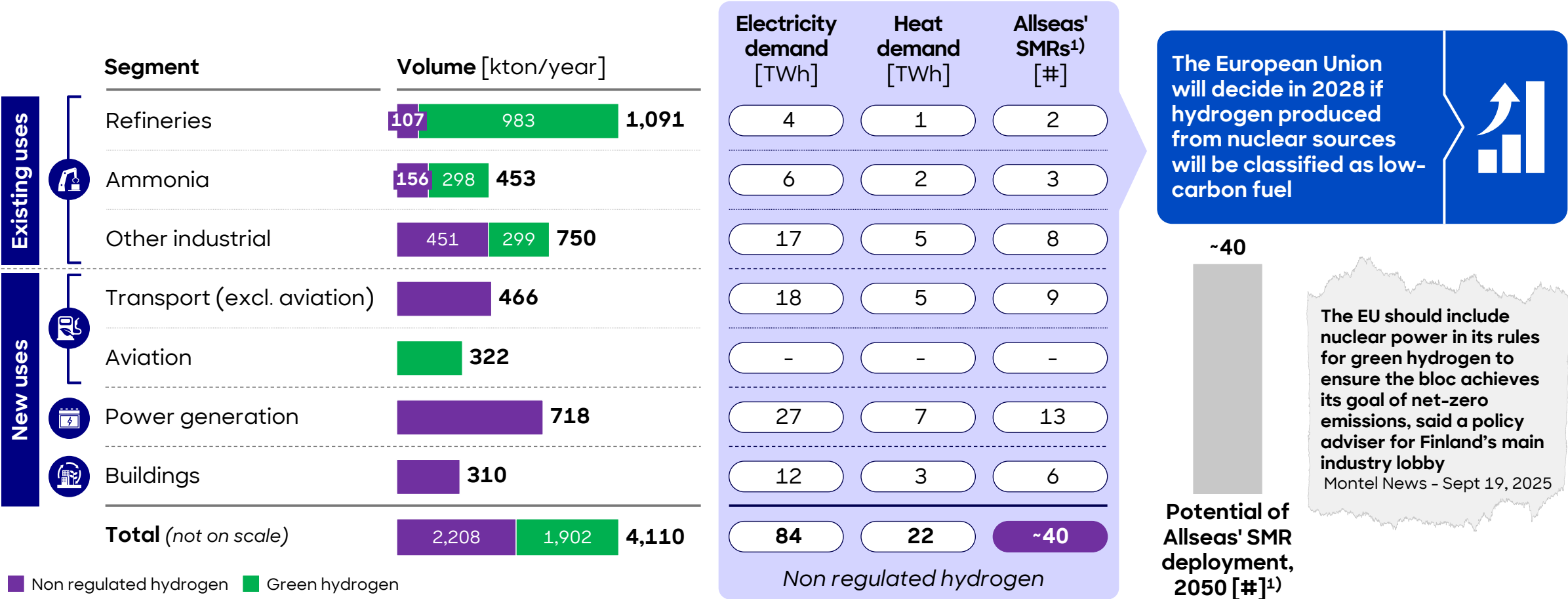
Levelized cost of hydrogen (LCOH) in the Netherlands, 2024 [EUR/kg]



1) Based on a SMR with 800 MW thermal capacity in France; 2) Considering capacity factors for PV, onshore and offshore wind of 18%, 56% and 45% respectively

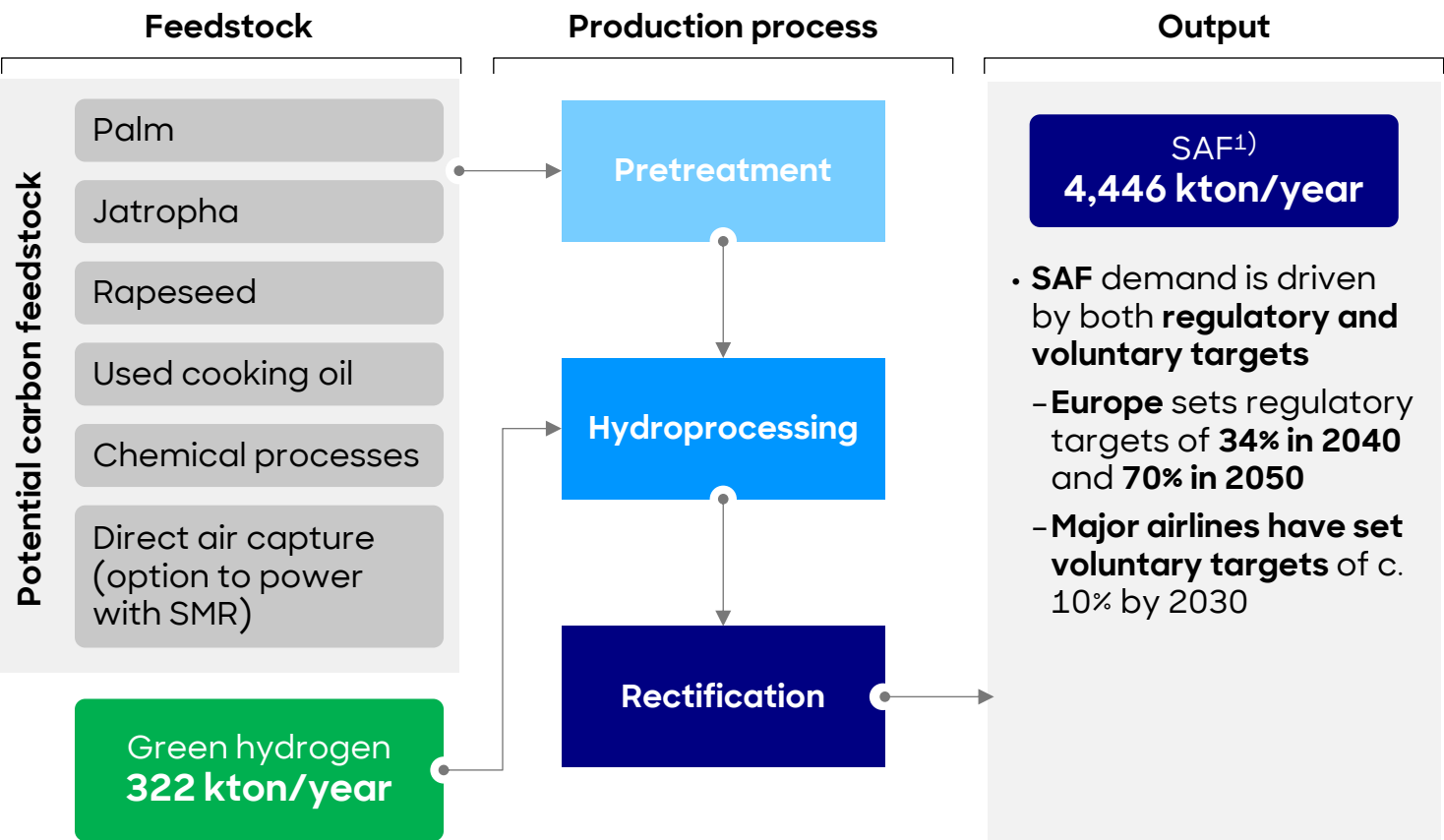
For non-regulated electrolysis ~40 SMRS could be deployed by 2050 – If nuclear is included in green hydrogen targets, SMR demand could significantly increase

Potential addressable market of Allseas' SMRs for hydrogen electrolysis in the Netherlands, 2050

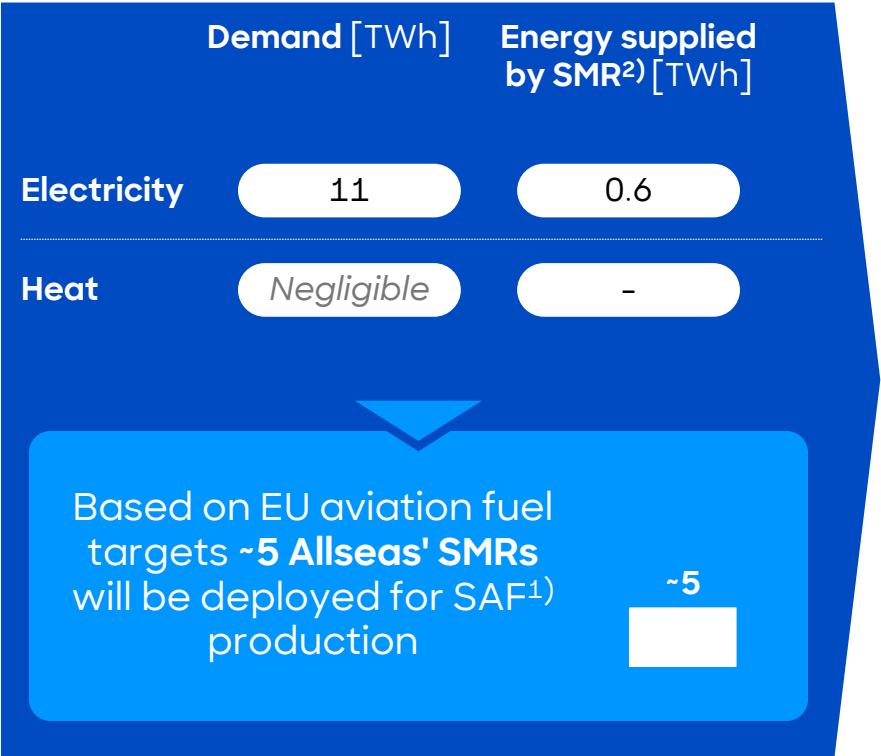


Based on EU aviation fuel targets, around five SMRs would be required to supply the electricity for SAF production in 2050

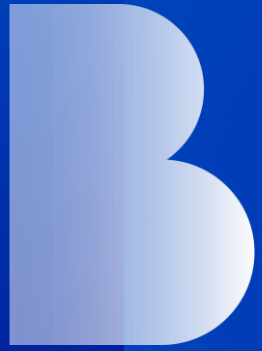
Allseas' SMR for SAF¹⁾ production in the Netherlands, 2050



Allseas' SMR deployment potential (excluding green hydrogen electrolysis)



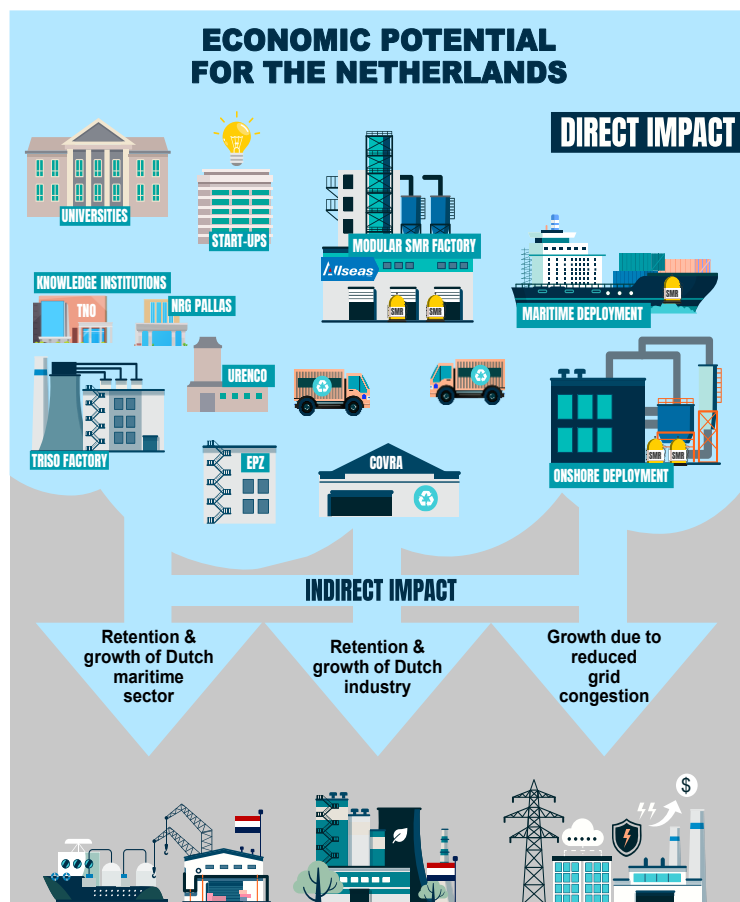
1) HEFA-SPK, the most mature SAF technology; 2) Considering 5% adoption for electricity, in line with the assumptions for industrial clusters



5. Economic potential

Deployment of SMRs in NL could generate cumulative added value of EUR 120-140 bn, 45-55 k employment opportunities & EUR 18-22 bn investments in 2050

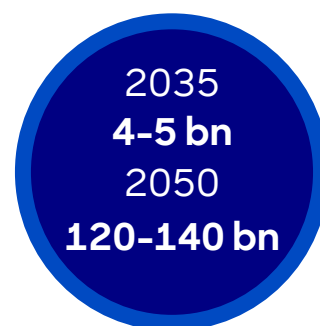
Economic potential of Allseas' SMR



Allseas' initiative to develop, construct and deploy SMRs for both maritime and onshore use is able to generate significant added value, employment opportunities and additional investments - With support from the government, regulators and value chain stakeholders, this impact will be predominantly captured within the Netherlands

- **Growth of suppliers and companies across the entire value chain:** Economic impact will trickle down through entire value chain, allowing the Netherlands to further develop its already strong nuclear knowledge and ecosystem
- **International commercialization of SMRs:** SMRs can be exported shown by strong international interest, extending their impact beyond domestic use
- **Emerging start-ups and spin-offs through further development of SMR-related technologies:** SMR development is expected to act as a catalyst for start-ups and spin-offs, which in turn will generate economic value
- **Accelerated access and deployment of SMRs in the Netherlands:** Deployment of SMRs will contribute to the growth and retention of industrial clusters and the Dutch maritime sector, and reduce grid congestion

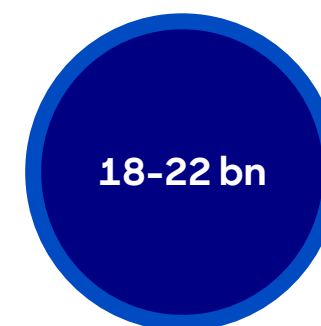
Cumulative added value,
'25-'50 [EUR bn]



Employment opportunities,
2050 [#]



Total cumulative investments,
'25-'50 [EUR bn]



The Netherlands already has proven nuclear players across the value chain – This presents a unique opportunity to build on existing capabilities and invest locally

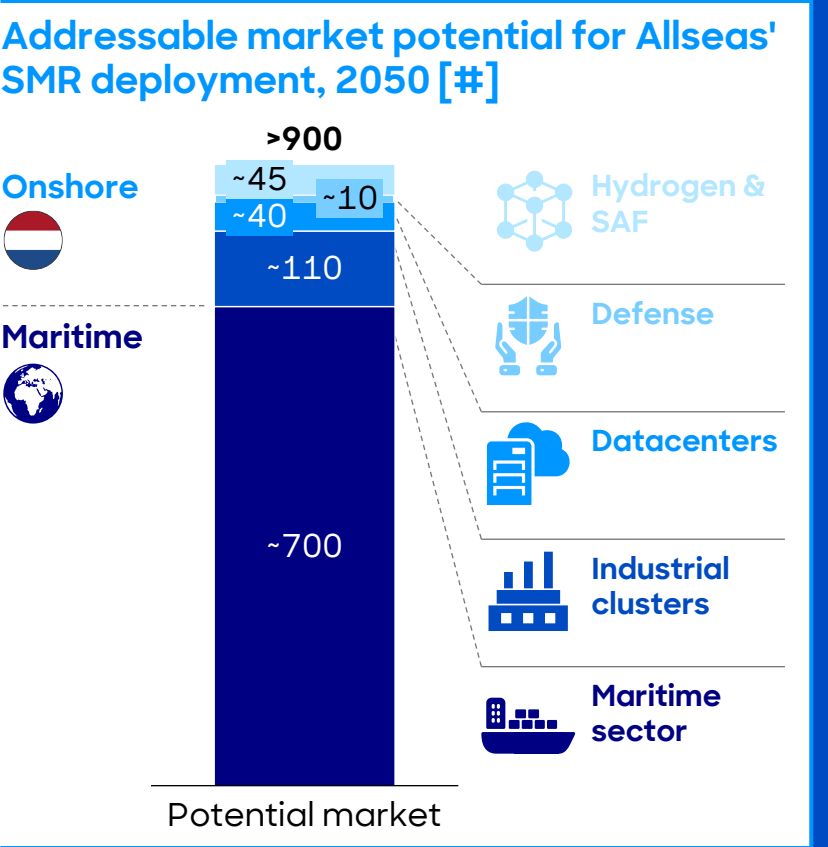
Role of SMRs in nuclear value chain in the Netherlands



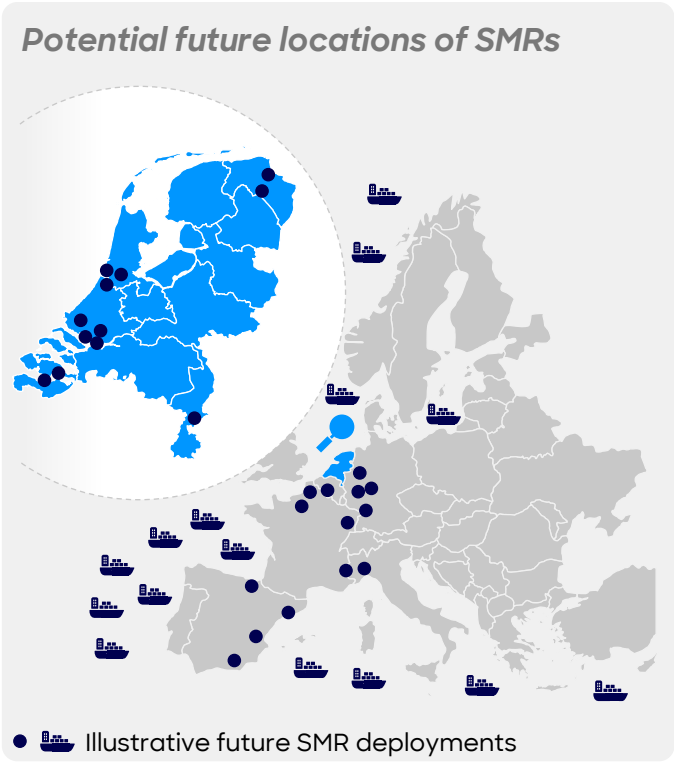
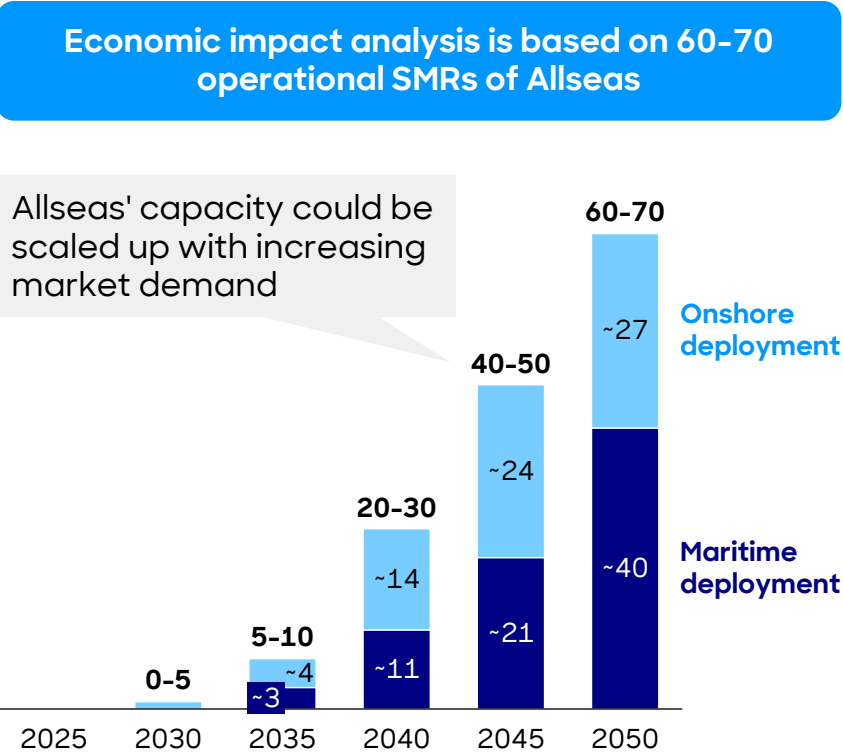
1) Excluding mining and conversion; 2) Urenco's Dutch facility enriches uranium up to around 10% U-235, while TRISO fuel typically requires enrichment levels of 15–20% U-235

Economic impact is based on 60-70 operational SMRs by 2050, which can be scaled up given the potential addressable market of over 900 SMRs

Deployment of Allseas' SMRs

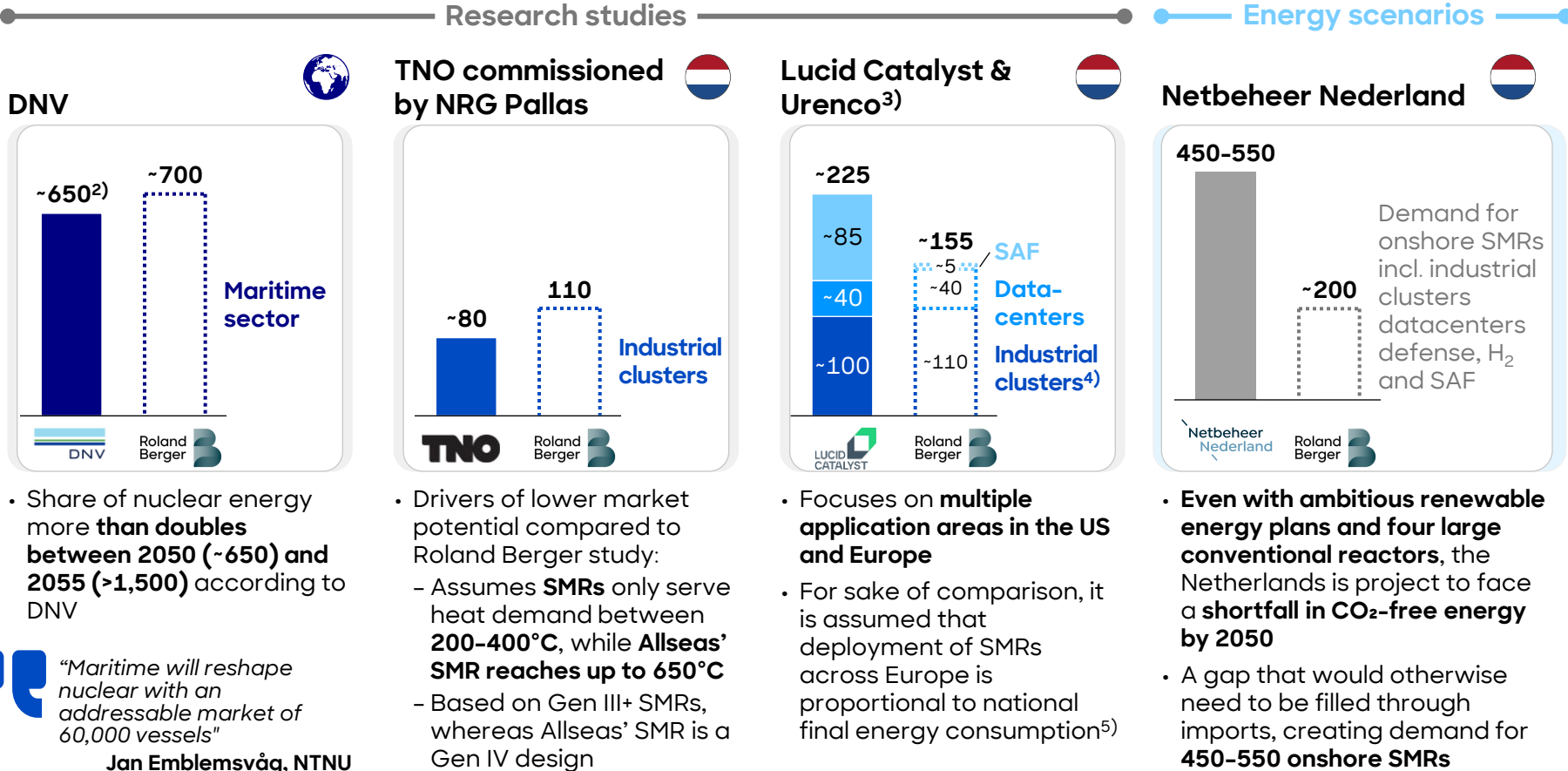
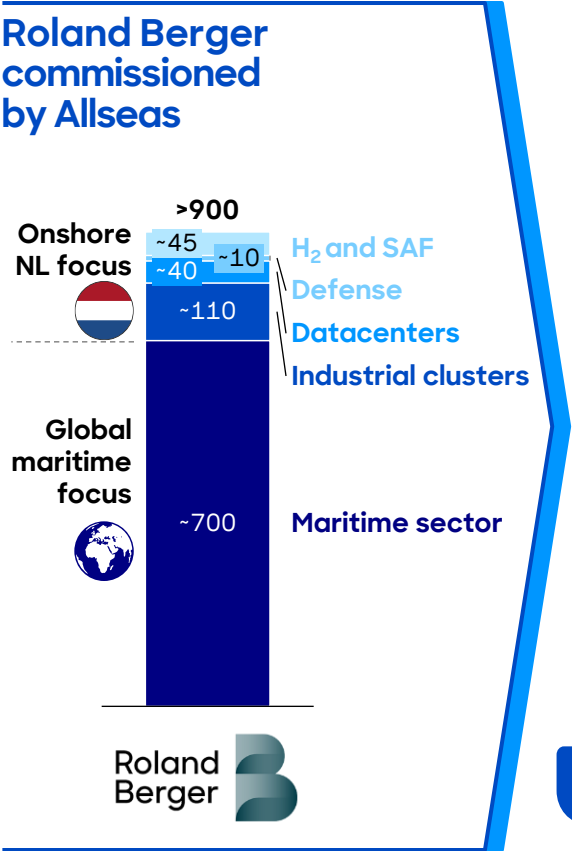


Expected number of Allseas' SMR operational, 2025-2050 [#]



Published studies indicate demand for around 200 SMRs for Dutch onshore use and about 700 for the global maritime sector, aligned with this report

Comparison of market potential in the Netherlands for deployment of Allseas' SMR, 2050 [#]¹⁾



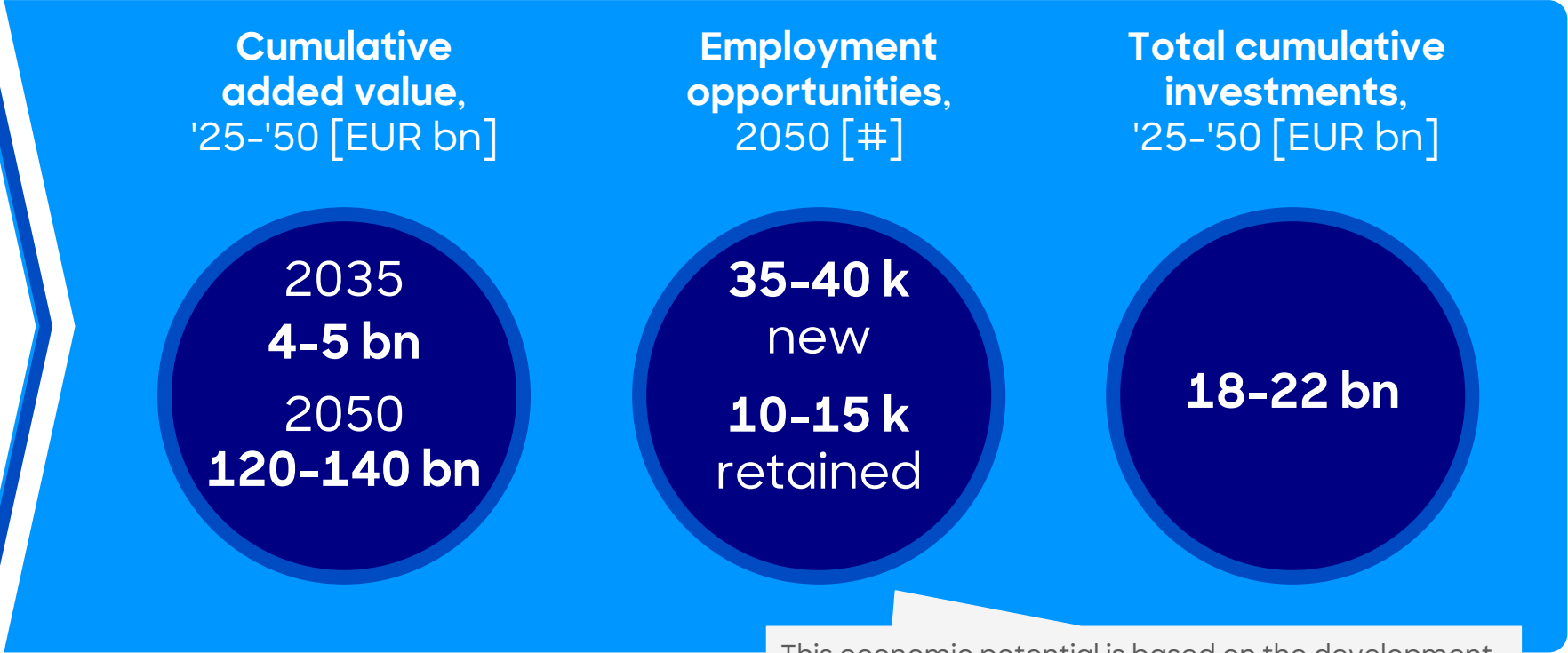
1) Data normalized to the Allseas' SMR of 25 MWe; 2) Capacity factor of 90% applied; 3) Considering the second-most ambitious scenario, “shipyard manufacturing”; 4) Chemicals and coal repowering; 5) Netherlands is representing ~4% of the European total

The introduction of SMRs could potentially lead to the emergence of a new energy ecosystem in the Netherlands and drive economic growth

Economic potential of deploying Allseas' SMR

Economic potential

- Boosts the Dutch economy
- Generates significant employment
- Ensures domestic returns on (domestic) nuclear investments
- Contributes to the knowledge economy



This economic potential is based on the development and construction of 60-70 SMRs by Allseas, the overall market potential for SMRs is significantly larger

The economic potential of Allseas' SMR is based on a conservative estimate of 5-10% of the total market - Capacity can be scaled up to rising demand

Rationale economic potential of Allseas' SMR

Rationale

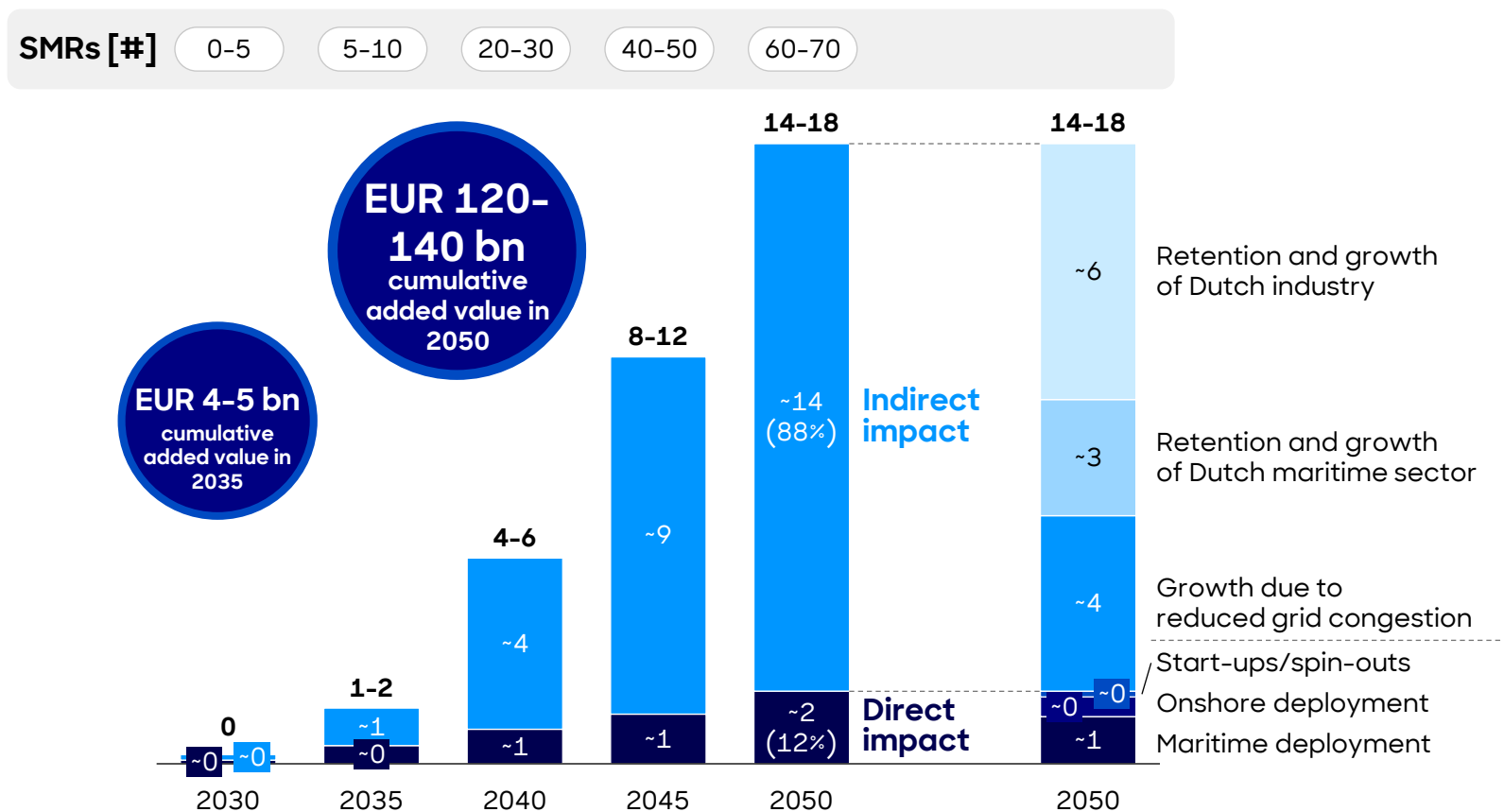
- **Allseas** will build **SMRs** for both **maritime** and **onshore** deployment
- A **dedicated factory** is being constructed, with a capacity to produce ~4 SMRs per year
- By 2050, 60-70 SMRs can be built, representing a **5-10% share of a total market potential** of over 900 units
- This estimate is **conservative** and **production** can be **scaled up** if demand increases
- Economic potential **includes** establishing a **TRISO fuel facility** in the Netherlands

Direct and indirect potential

Direct potential	Maritime/onshore deployment		• Added value directly within Allseas and across the entire value chain, from the development to the construction of SMRs
	Start-ups and spin-outs		• Development and deployment of SMRs triggers the emergence of start-ups and spin-outs across the value chain that in turn will start generating revenue over time as well
Indirect potential	Retention and growth of Dutch industry		• As industrial clusters face increasing pressure to meet decarbonization targets and secure reliable and affordable energy supply, SMRs offer cost-effective and sustainable solution to retain these clusters in the Netherlands • SMRs are expected to drive corporate investments in emerging technologies, including biofuel and hydrogen plants
	Retention and growth of Dutch maritime sector		• SMRs will help retain the maritime sector by positioning the Netherlands as a leader in maritime decarbonization • Allseas' SMR will also drive growth, generating added value through multiple pathways: increased ship traffic via the Port of Rotterdam, expanded shipbuilding (led by Damen, Feadship, and Oceanco), enhanced offshore operations enabled by longer fuel cycles, and a rise in repair and maintenance activities
	Growth due to reduced grid congestion		• Expanding of current business and growth of new businesses are significantly constrained by grid congestion. SMRs can help alleviate this bottleneck, unlocking economic potential

Allseas' SMR will bring EUR 120-140 bn cumulative added value to the Dutch economy in 2050, with ~90% through indirect impact

Annual & cumulative added value due to deployment of Allseas' SMRs, 2030-2050 [EUR bn]



Direct impact

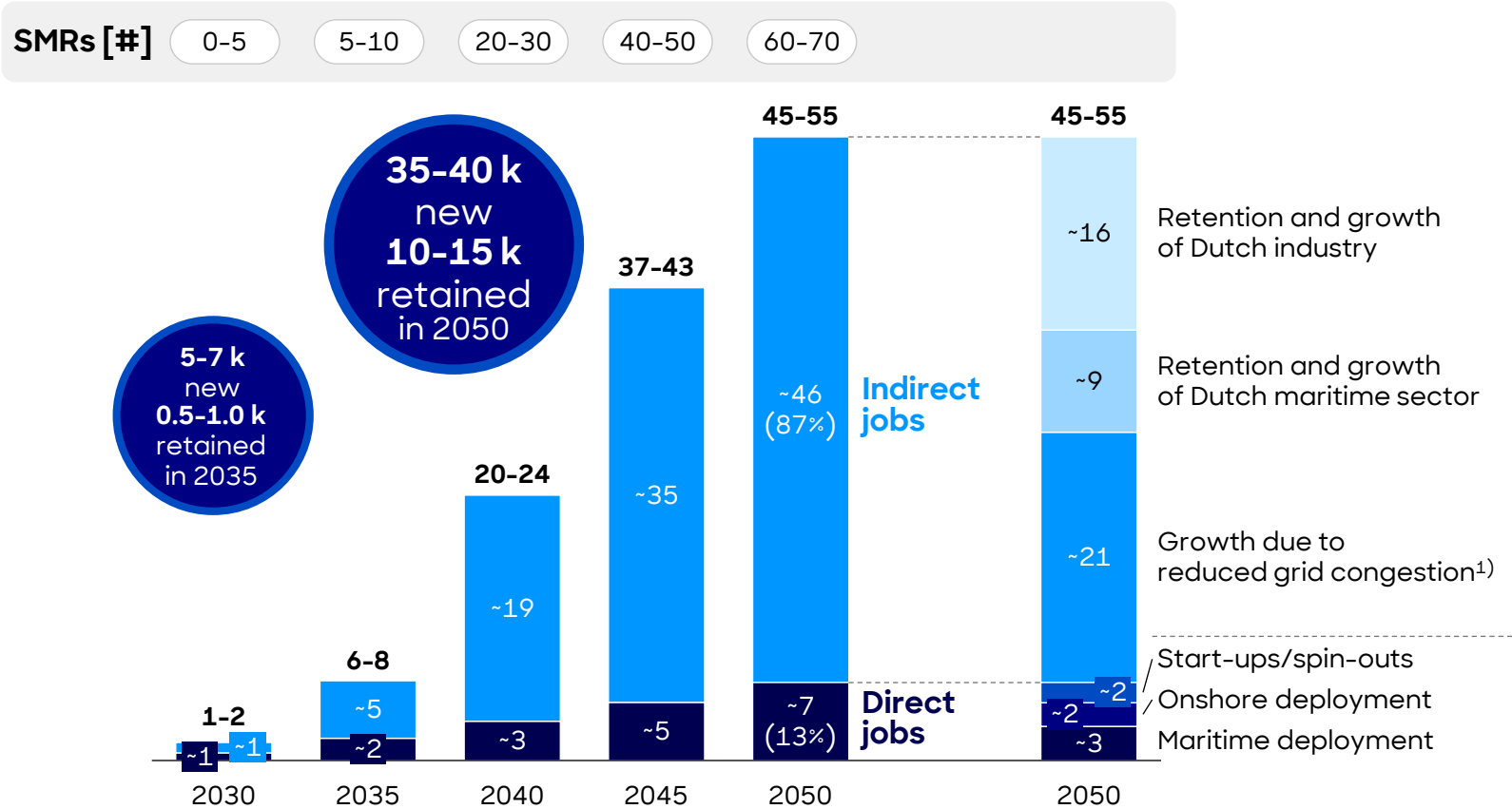
- **Maritime/onshore deployment:** EUR 7-10 bn cumulative added value for maritime and EUR 7-8 bn for onshore until 2050 directly within Allseas and across the entire value chain
- **Start-ups and spin-outs:** EUR 2-3 bn cumulative added value until 2050 through start-ups and spin-outs across the value chain

Indirect impact

- **Retention and growth of Dutch industry:** EUR 45-55 bn cumulative added value until 2050 by both retention (EUR 35-40 bn) and growth (EUR 10-14 bn) of Dutch industry
- **Retention and growth of Dutch maritime sector:** EUR 17-22 bn cumulative added value until 2050 by both retention (EUR 3-5 bn) and growth (EUR 14-17 bn) of Dutch maritime sector
- **Growth due to reduced grid congestion:** EUR 40-45 bn cumulative added value until 2050 due to expansion and emergence of new businesses

In addition, it will generate 45-55 k annual employment opportunities in 2050, with a large portion of these consisting of highly educated professionals

Employment opportunities due to deployment of Allseas' SMRs, 2030-2050 [# '000]



Direct jobs

- Includes jobs created throughout development, construction and operations of SMRs **directly at Allseas** as well as jobs at companies **across the entire the value chain**
- Significant portion of the direct jobs created consists of **highly educated professionals**, as >50% of people currently employed in the broader nuclear sector are higher educated
- Share of start-ups/spin-outs in job creation is higher compared to added value**, as start-ups typically have a lower added value per FTE compared to larger companies

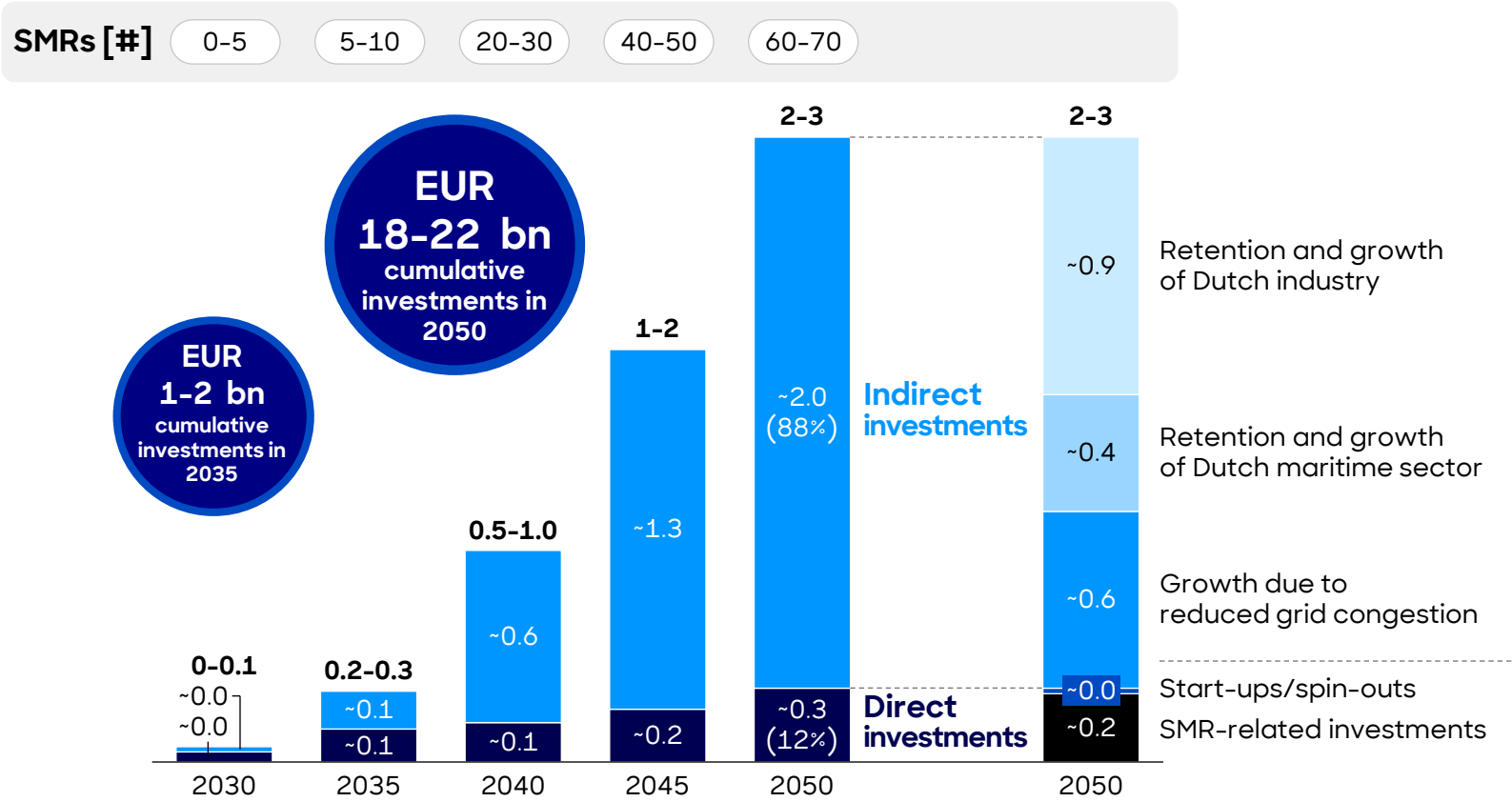
Indirect jobs

- Similarly, added value per FTE is higher for **industrial clusters**, meaning the share of **total job creation is lower compared to share of total added value**

1) Based on EUR 3 k/MWh lost added value from grid congestion and the average added value per FTE

An additional cumulative investment of EUR 18-22 bn will be directed primarily in R&D and innovation, reinforcing global leadership of NL in strategic technologies

Annual & cumulative investments due to deployment of Allseas' SMRs, 2030-2050 [EUR bn]



Direct investments

- EUR 3-4 bn cumulative investments between 2025-2050, including **development cost, investments in SMR and TRISO fuel factories and other additional investments** throughout the value chain

Indirect investment

- EUR 15-18 bn cumulative investments between 2025-2050, through increased **retention of industrial clusters** leading to **more investments, stronger maritime sector and less grid congestion constraints**

Investments in **conventional nuclear energy will come on top of these investments**, and can **complement** one another due to **strengthened knowledge ecosystem** and the **growing energy demand**

This economic potential can only be realized in the Netherlands with government support - Accelerated regulation would help to retain the value domestically

Importance of accelerated regulatory process

Globally, there is significant momentum in nuclear energy, with processes being accelerated

- The United States and the United Kingdom have signed a MoU to **accelerate** the **development** of maritime nuclear energy
- Both countries aim to jointly develop breakthrough technologies, **accelerate licensing**, **remove market barriers**, and secure the supply chain

Trump seeks to fast-track new nuclear licenses, overhaul regulatory agency

Reuters - May 23, 2025

Britain and US to sign nuclear power pact during Trump's visit

Reuters - Sept 15, 2025

With government support, Allseas can deploy its first SMR by 2030, ensuring that the economic potential is captured and retained within the Netherlands

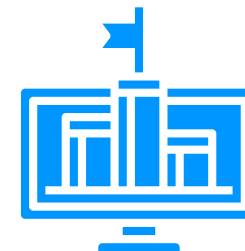
- Technically and in terms of capacity, **Allseas is capable** of having its first SMR ready **for industrial deployment by 2030**
- Meeting this timeline depends, among other factors, on **government support**
- Allseas invites the government to **collaborate** and proactively enable an **accelerated permitting process**

- ✗ No significant financial support
- ✗ No compromise on quality standards
- ✓ **Only a fast-track regulatory process**

Accelerated regulation would help Allseas **stay ahead of international competition** and ensure most of the economic value remains in the Netherlands

Without fast-tracking, there is a significant chance that the economic potential will be seized by foreign competitors

- Without fast-tracking, Allseas' SMR may be **delayed** or **deployed abroad**, increasing the risk of foreign companies capturing the opportunity
- A **Dutch player** seizing the SMR opportunity helps to keep the **economic value local**
- Once Allseas **falls** behind international competitors, **catching up** becomes **extremely difficult**
- Industrial and maritime players will then opt for **established foreign names** with experience and **economies of scale**

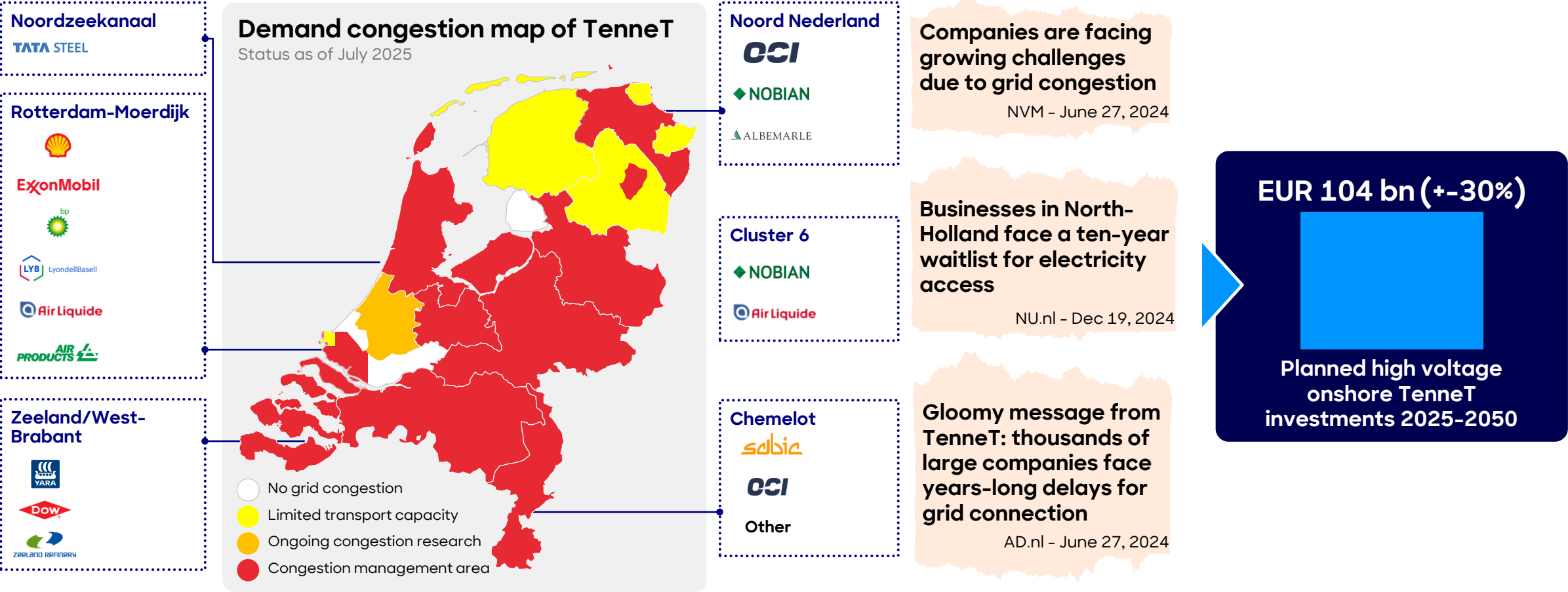




6. Grid congestion

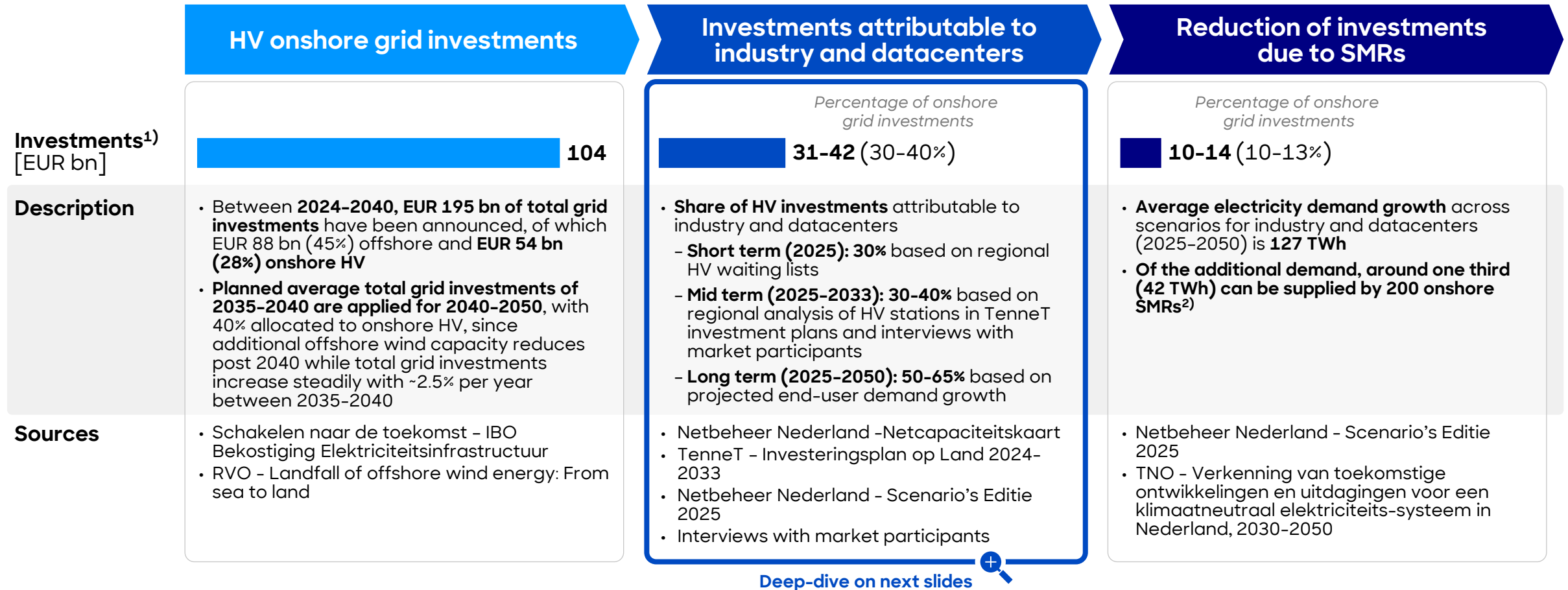
Significant investments are required to reduce grid congestion and thereby enable industries and datacenters to develop

Demand congestion constraints in the Netherlands



A regional analysis of HV waiting list connections, TenneT plans, and energy scenarios was conducted to evaluate the impact of SMRs on grid investments

Methodology to assess the impact of SMRs on grid investments, 2025-2050



1) Excluding bandwidth of +30% stated in the investment plans of TenneT; 2) Based on electricity demand supplied by Allseas' SMR design (25 MWe)

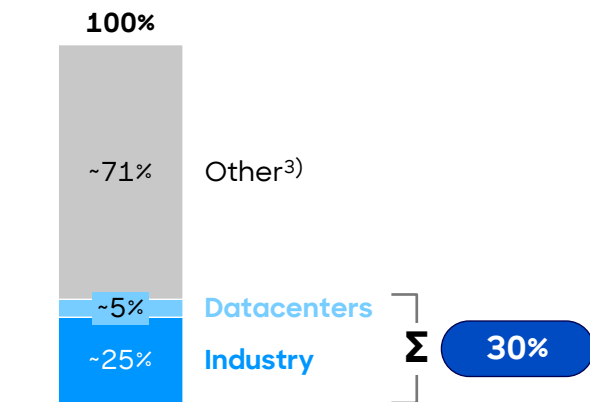
Public data and market participants indicate that, industry and datacenters account for 30% of HV onshore investments in the short term, rising to 40%

Share of HV onshore grid investment [%]

Short term

Based on current net congestion (waiting list) on the HV grid, 2025¹⁾

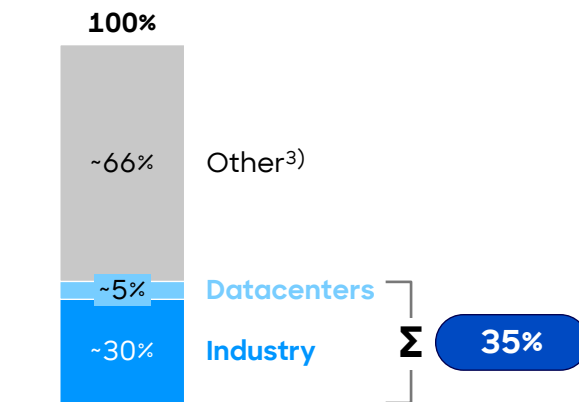
- **Locations of constrained HV stations**
 - **Datacenters** concentrated in North Holland and Groningen
 - **Industrial** congestion highest around Rotterdam, Zeeland, Brainport area, and Chemelot



Mid term

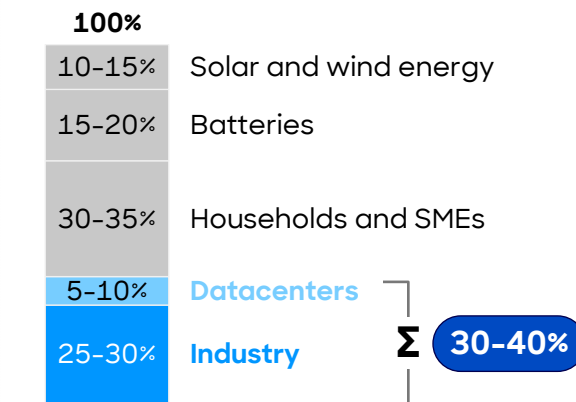
Based on announced investments²⁾ in HV stations, 2024-2033

- **Investments by HV station location:**
 - **Datacenter** investments are concentrated around North Holland
 - **Industry** investments are highest in South Holland and Zeeland
- Investments are estimated **by voltage and type of project** (new build, expansion, renovation)



Market participant interviews, 2024-2033

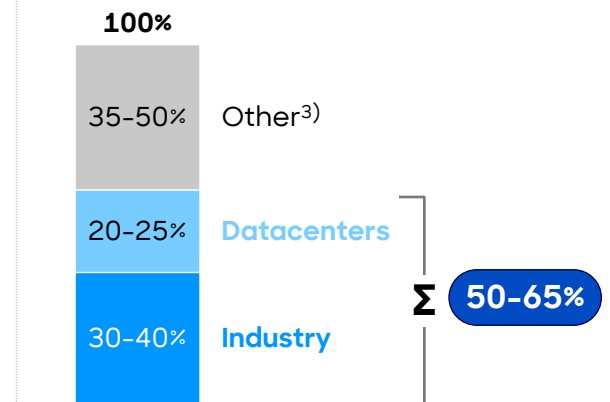
- Based on **electricity demand forecasts** and **expected congestion in HV infrastructure**, indicating where **investments in new builds, expansions, and renovations** are required



Long term

Based on energy demand scenarios, 2025-2050

- Derived **end-market shares** from Netbeheer Nederland (edition 2025) energy-demand scenarios



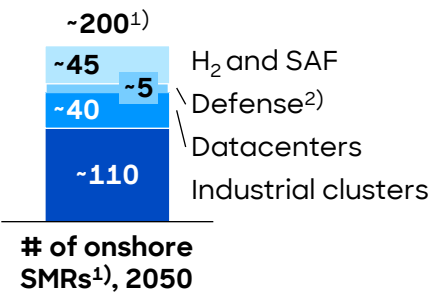
1) Capaciteitskaart April 2025; 2) TenneT investment plan Net op Land 2024-2033; 3) Including solar and wind energy, batteries and households and SMEs (including EVs)

The deployment of the full potential of 200 SMRs can help reduce HV onshore grid investments with EUR 10-14 bn (10-13%) by 2050

Effect of SMR deployment on grid congestion, 2025-2050

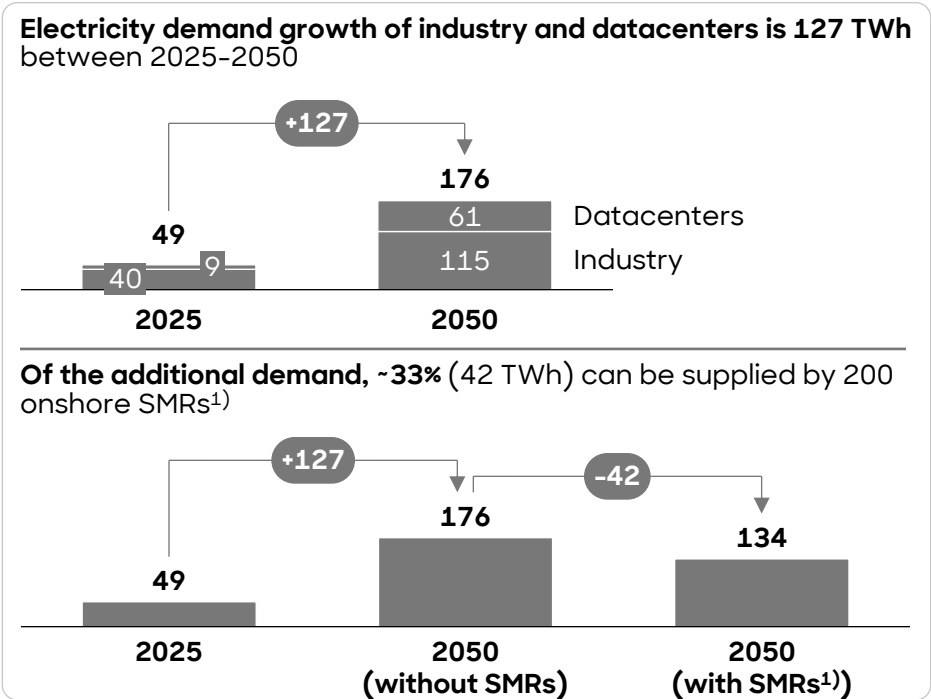
Without SMR

Effect of onshore SMRs



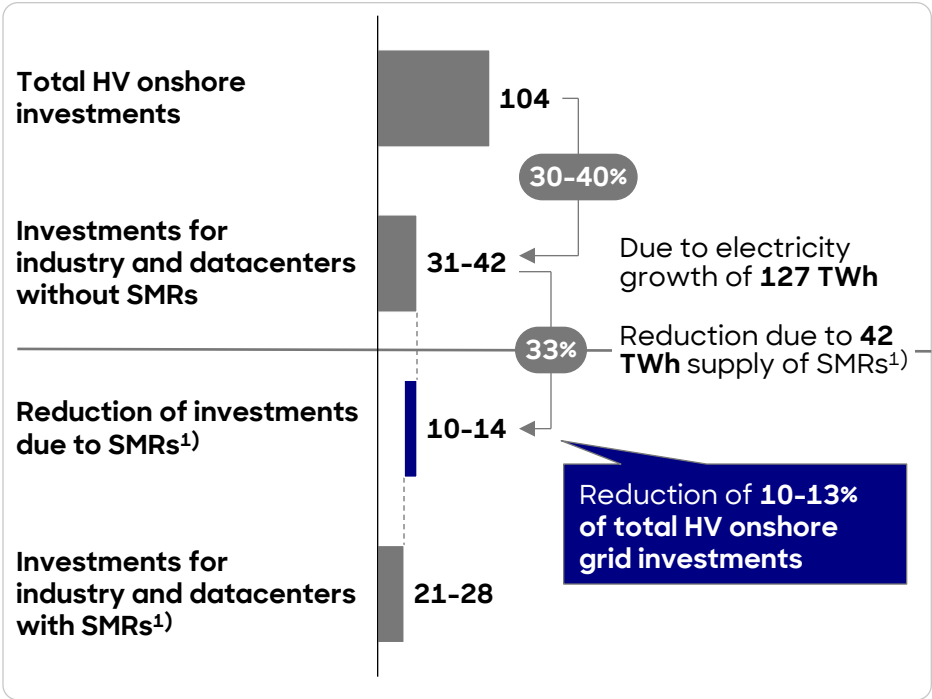
Effect on electricity demand

Average of electricity demand scenarios Netbeheer Nederland, 2025-2050 [TWh]



Effect on grid investments

HV onshore investments, 2025-2050 [EUR bn]



1) Based on electricity demand supplied by Allseas' SMR design (25 MWe); 2) Excluding 5 SMRs which are not deployed onshore in the Netherlands



7. Strategic autonomy

SMRs enhance strategic autonomy for the Netherlands by strengthening energy security and reducing reliance on non-EU countries for critical materials

Strategic autonomy

SMRs strengthen strategic autonomy by providing stable, geopolitically resilient energy and reducing reliance on non-European countries



Secure energy supply

- SMRs enhance energy security by enabling **local energy production**, which is particularly important for the Netherlands, a major energy importer that demonstrated vulnerability during recent energy crisis



Secure critical materials

- SMRs provide reliable, long-duration power for operations such as **deep-sea mining**, helping to **reduce import dependence** of critical materials and decrease reliance on non-EU countries



Prerequisite: Secure value chain capabilities

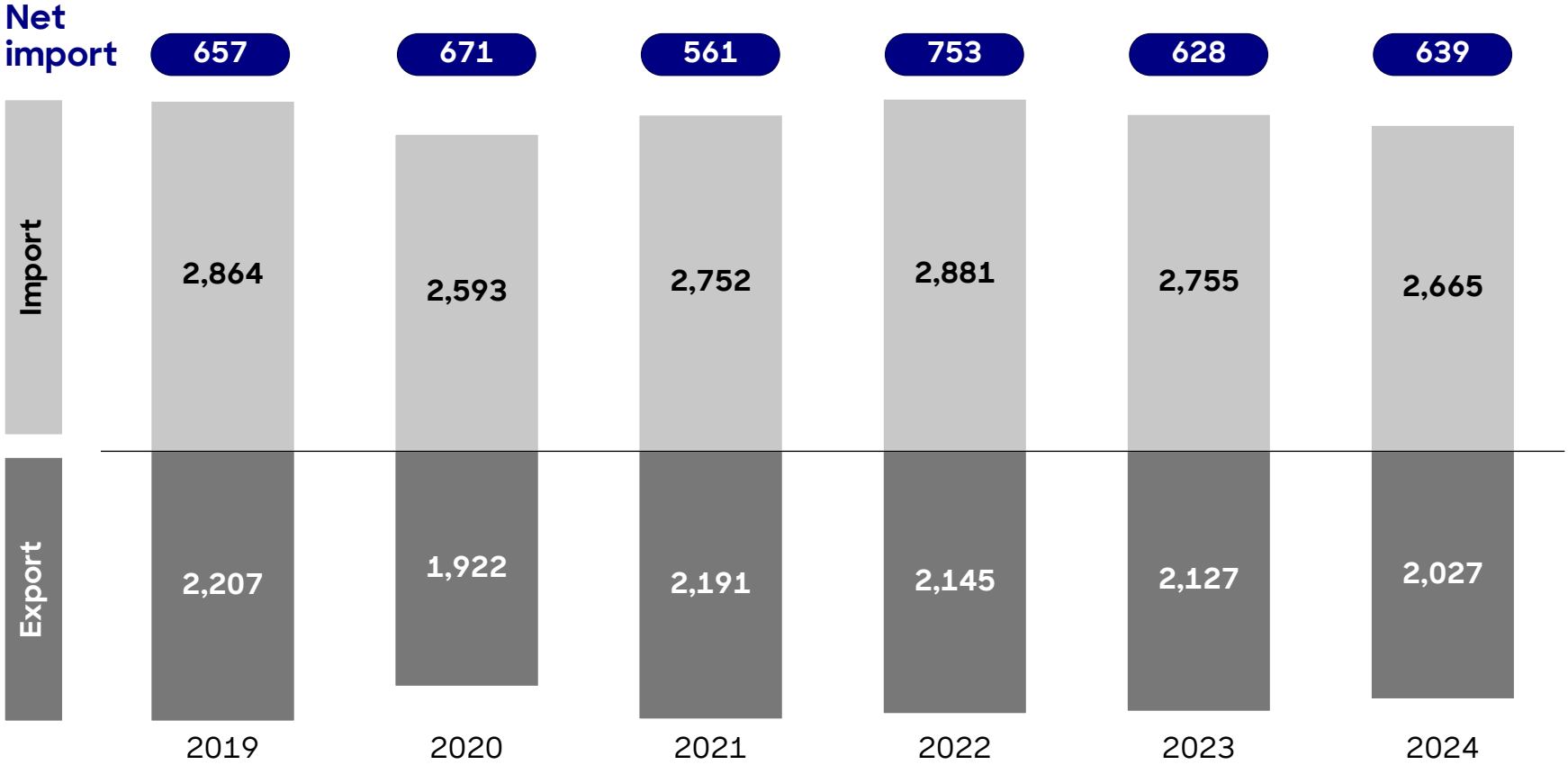
- Achieving strategic autonomy requires **control** over all **key stages of the nuclear value chain**. The Netherlands and Europe possess most of these capabilities, except for **enrichment and TRISO fuel fabrication**. **Developing** these activities is **essential** to attain full autonomy

The Netherlands is a major energy importer – Securing domestic energy supply is vital to strengthen strategic autonomy and reduce reliance on foreign sources

Dutch energy import-export balance, 2019-2024 [TWh]

SMRs strengthen strategic autonomy

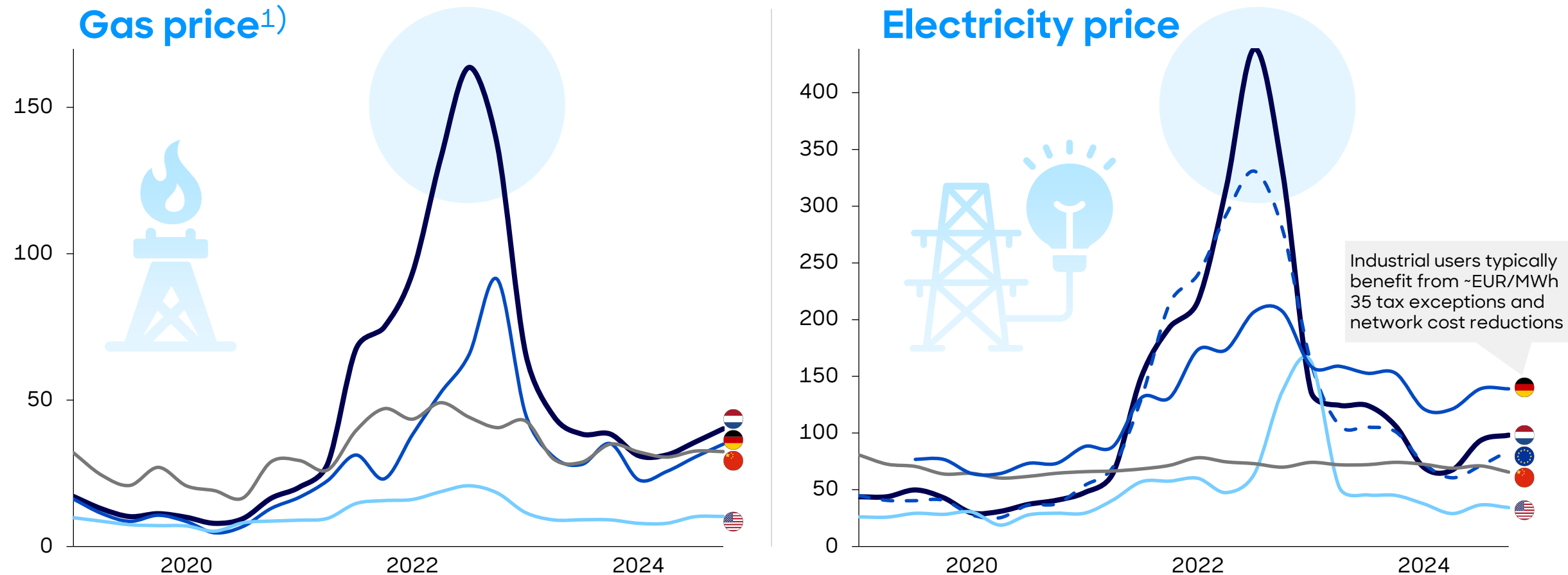
- As a **major energy importer**, the country remains vulnerable, especially in light of geopolitical tensions
- **SMRs can strengthen energy independence** by supplying reliable domestic electricity and heat, thereby reducing dependence on countries outside Europe¹⁾



1) Provided that a European TRISO fuel value chain is established

As a result, The Netherlands was among the hardest-hit by energy prices, exposing vulnerability – SMRs can play a key role in enhancing national resilience

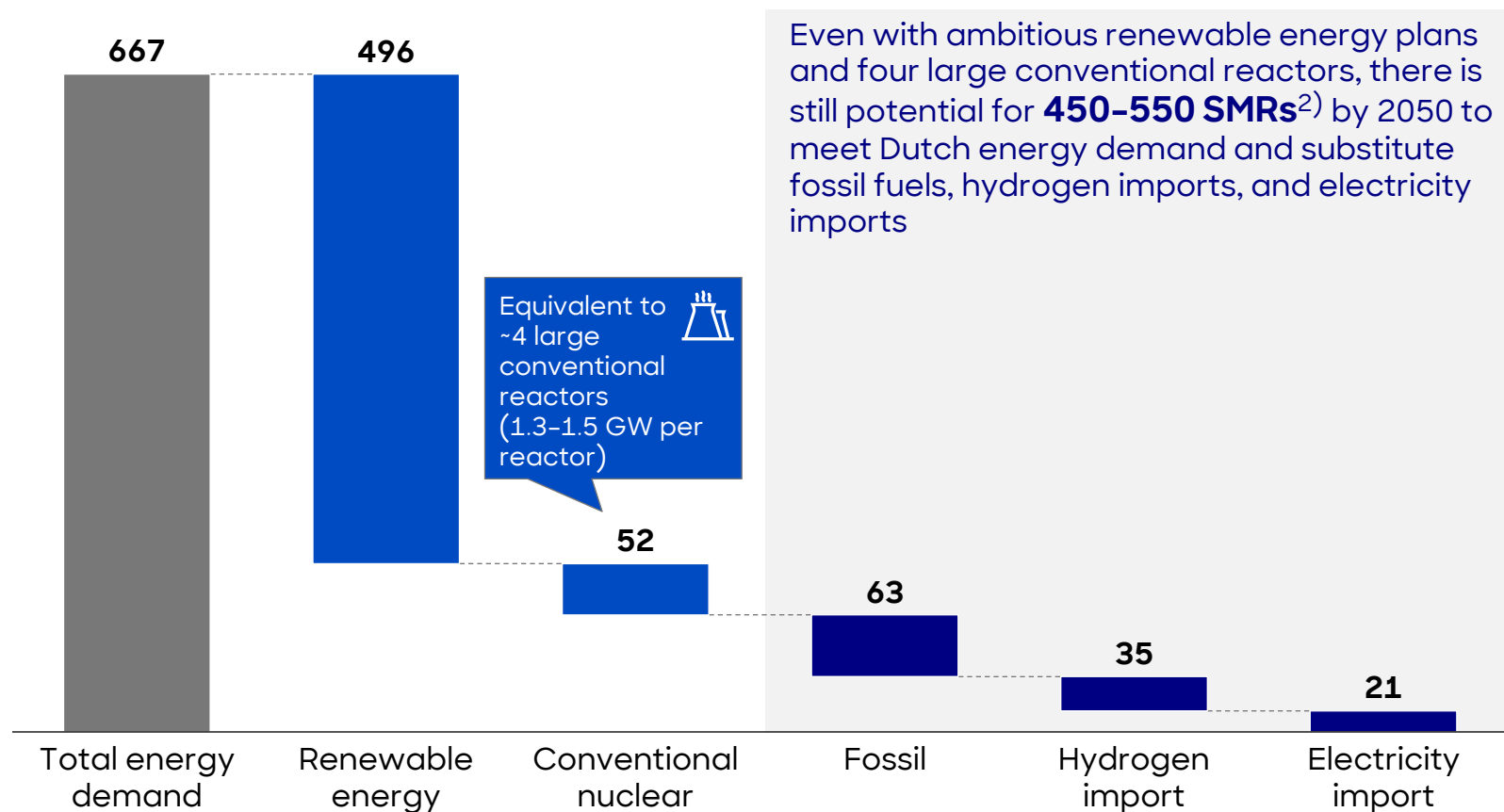
Industrial energy prices, 2019-2024 [EUR/MWh]



1) Average of Europa not available

Even with the plans on wind, solar, & conventional nuclear, NL still faces a gap of low-carbon energy by 2050, creating demand for 450–550 Allseas' SMRs

Dutch energy supply average of II3050 scenarios¹⁾, 2050 [TWh]

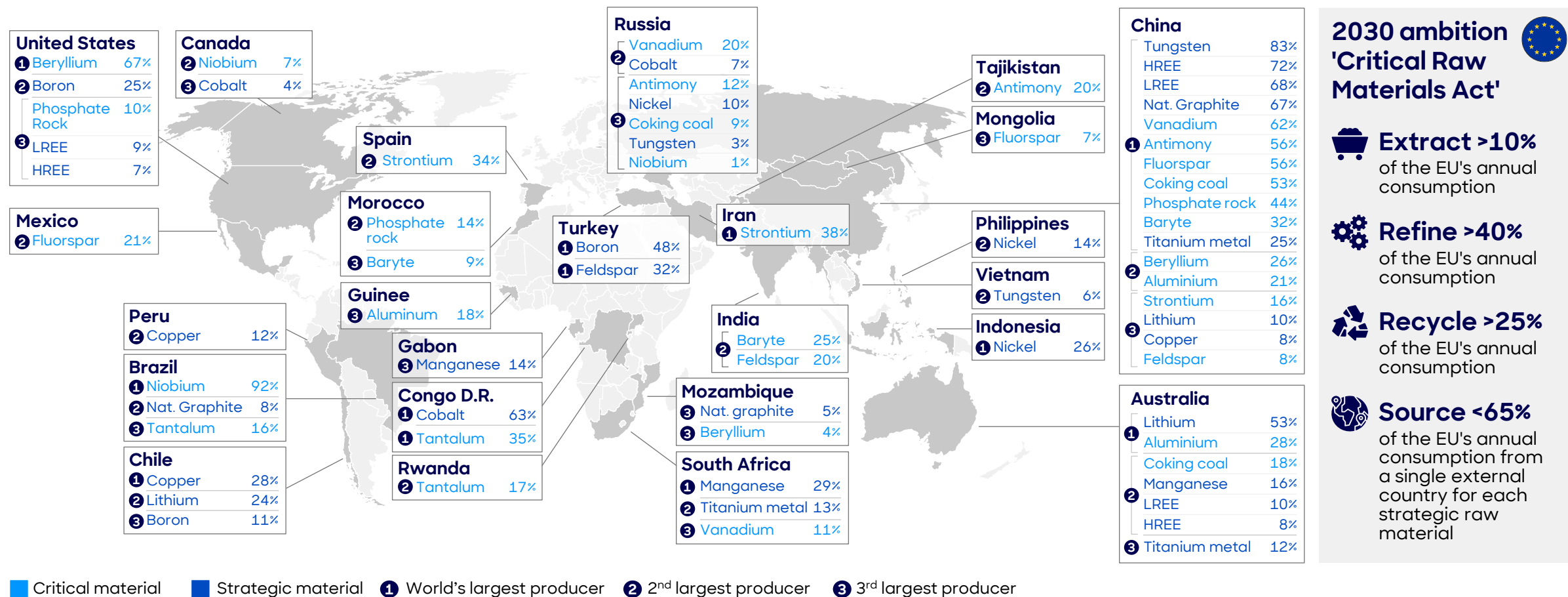


- Future energy demand in the Netherlands continues to provide significant scope for the **deployment of SMRs, alongside the planned construction of large conventional nuclear reactors**
- Even with **strong growth of renewables, adjustable baseload capacity from hydrogen and conventional nuclear, SMRs are needed** to ensure security of supply during periods of low wind and solar production

1) Considering 4 large nuclear reactors instead of 2, additional capacity is subtracted proportionally from fossil, hydrogen import and electricity import; 2) Based on electricity and heat demand supplied by Allseas' SMR design (25 MWe/70 MWt)

Critical material extraction is dominated by China, Australia & Russia – Enhancing EU strategic autonomy requires developing these capabilities domestically

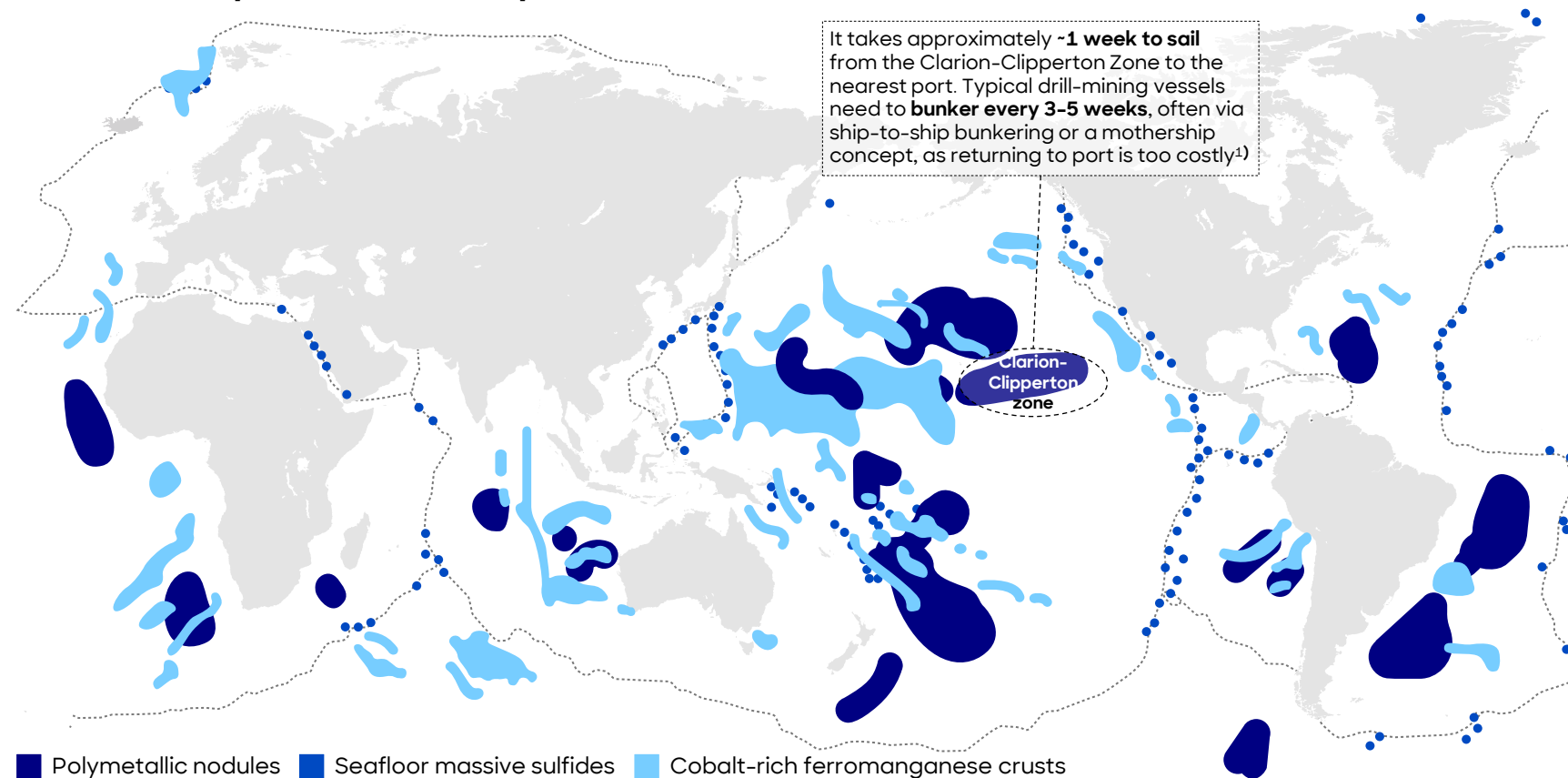
Raw extraction of critical materials: World's top 3 producers, 2024 [% of total world extraction]



SMRs are critical for deep-sea mining, providing long-duration power for remote offshore facilities, thereby reducing reliance on minerals from outside the EU

SMRs for deep-sea mining

Areas of deep-sea mineral exploration in international waters



- SMRs are well-suited for deep-sea mining, delivering **multi-year power without refueling**, significantly **reducing costs** compared to current methods
- This **reduces reliance on critical** minerals like nickel, cobalt, copper, and manganese from countries such as China, **strengthening Europe's control over strategic value chains**
- By localizing these activities, the Netherlands and Europe could **lower their vulnerability to geopolitical tensions** and **global supply disruptions**

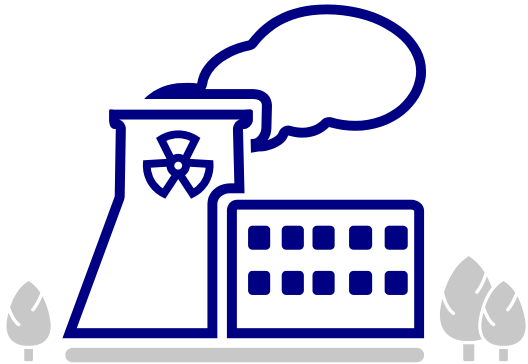
1) High-level analysis, depending on the size of the vessel, engine power, consumption (DP mode/station keeping), fuel capacity, etc.

As with solar & wind, the Netherlands missed the chance to lead in conventional nuclear and medium- to large-scale SMRs, but can still excel in small-scale SMRs

Opportunity to lead in development of small-scale SMRs

"If the Netherlands aims to have a role in the construction of nuclear reactors, it should focus on medium or small-scale SMRs. The country is too small for an industry based on large scale conventional reactors, and mid- to large-scale SMRs are already well advanced in other countries"
Bram-Paul Jobse, EPZ

Conventional nuclear reactors



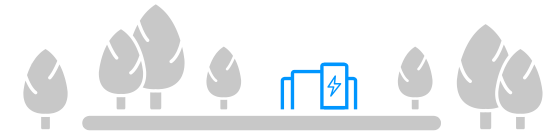
- **Large-scale power plant** that generates electricity by using nuclear fission to produce heat, which drives steam turbines
- Typically connected to the **grid** and designed for centralized, **high-capacity power** generation with a typical power output of **more than 350 MWe**

Medium- to large-scale SMRs



- Typically **smaller in size and output than conventional** reactors, serving **applications beyond grid electricity**
 - Power output: 300-350 MWe
 - High-temperature heat output: ~300°C
 - Dimensions: ~2 soccer fields

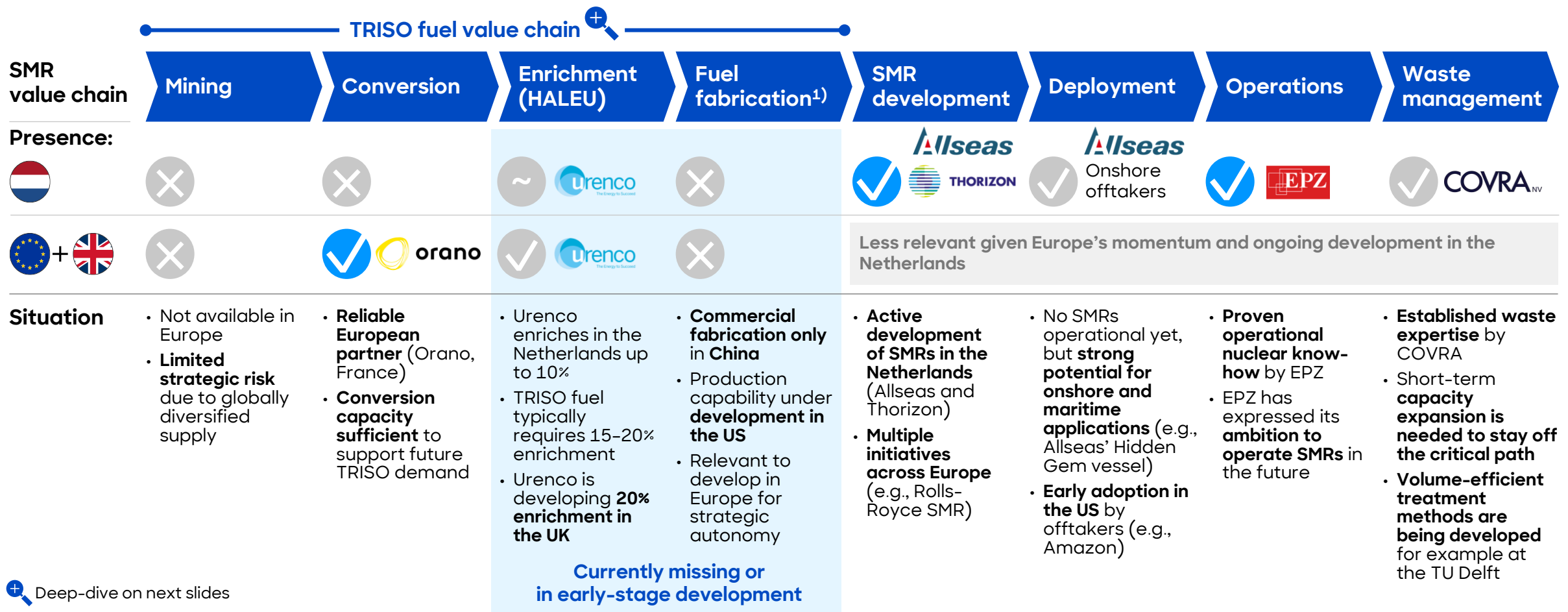
Small-scale SMRs



- The Allseas SMR features a relatively **compact design, ideally suited for a wide range of applications**:
 - Power output: 25 MWe/70 MWt
 - High-temperature heat output: ~650°C
 - Dimensions: 25x10x15 m

Strategic autonomy requires control of all key steps in the value chain – Adding enrichment & TRISO fuel fabrication in the EU or NL will achieve full autonomy

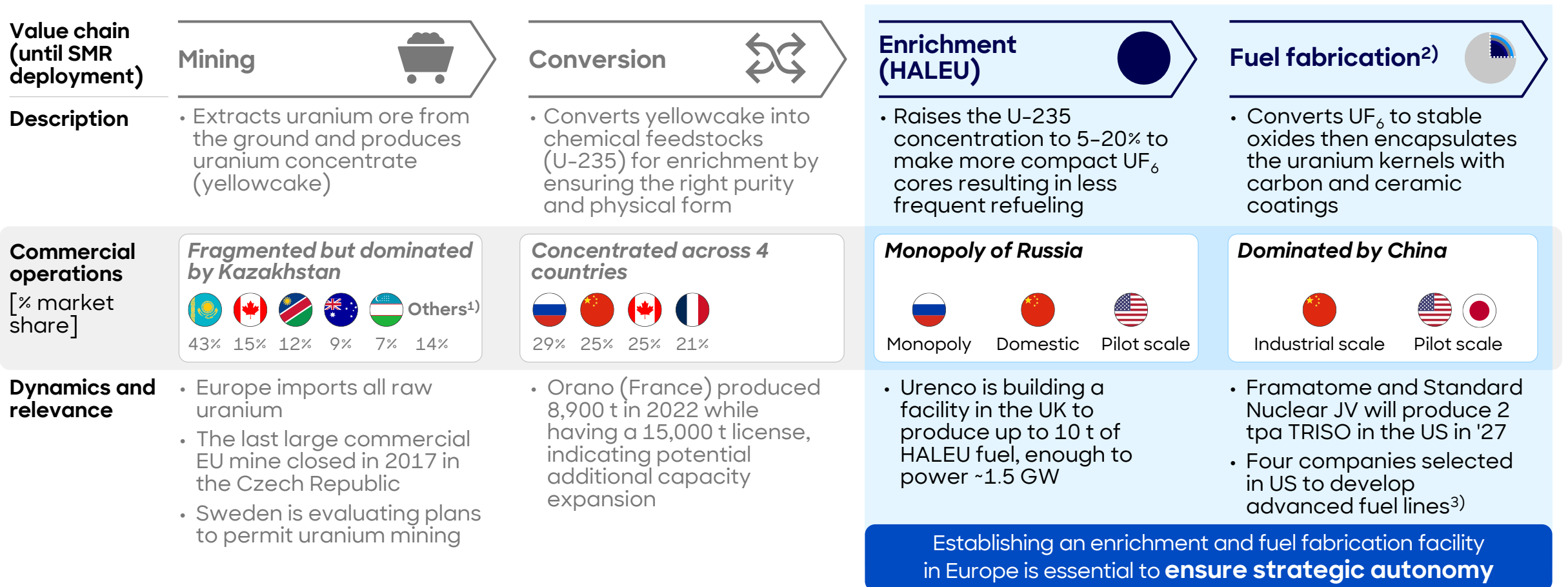
Dutch and European presence in the SMR fuel value chain



1) Including deconversion

Russia and China have a monopoly in respectively enrichment and TRISO fuel fabrication, developing those capabilities is essential to ensure strategic autonomy

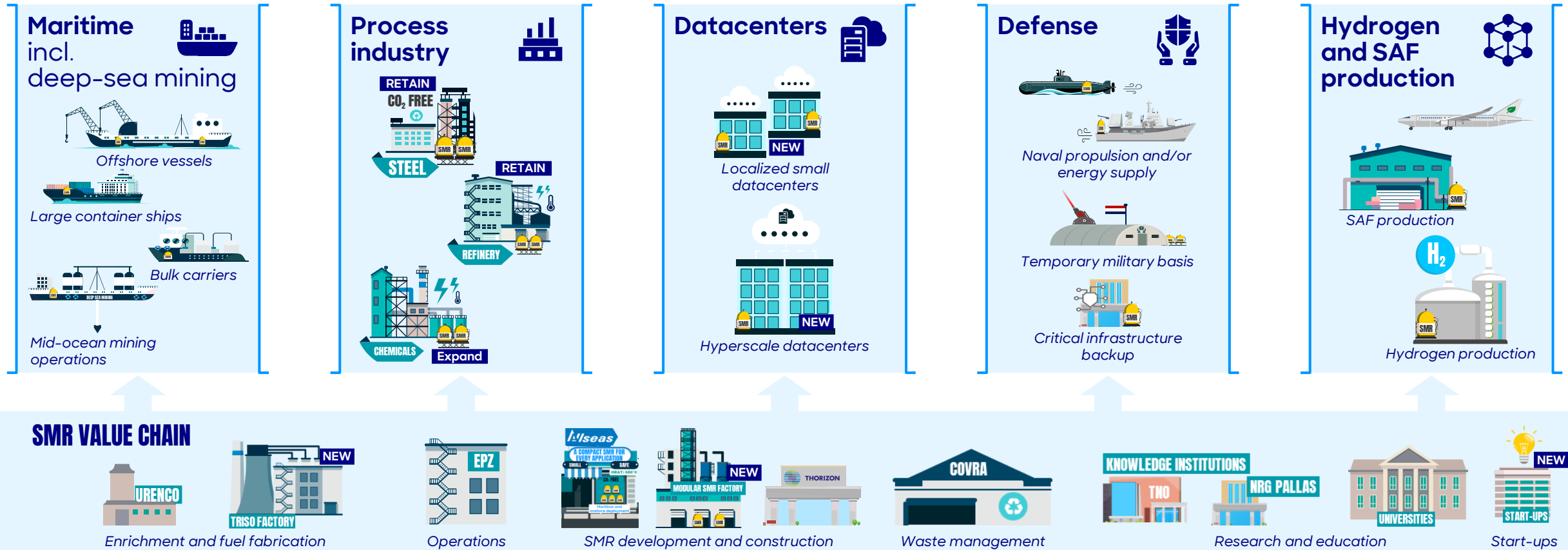
TRISO fuel value chain



1) Russia, China, Niger, India, South Africa, Ukraine, US; 2) Including deconversion; 3) Of which Tennessee-based TRISO-X will build an additional laboratory facility to provide pilot-scale integration, training and validation to support a forthcoming commercial TRISO fuel fabrication plant

SMRs are suitable for a wide range of applications – Developing SMRs in the NL strengthens strategic autonomy and engages all players across the value chain

Future SMR value chain and its application areas

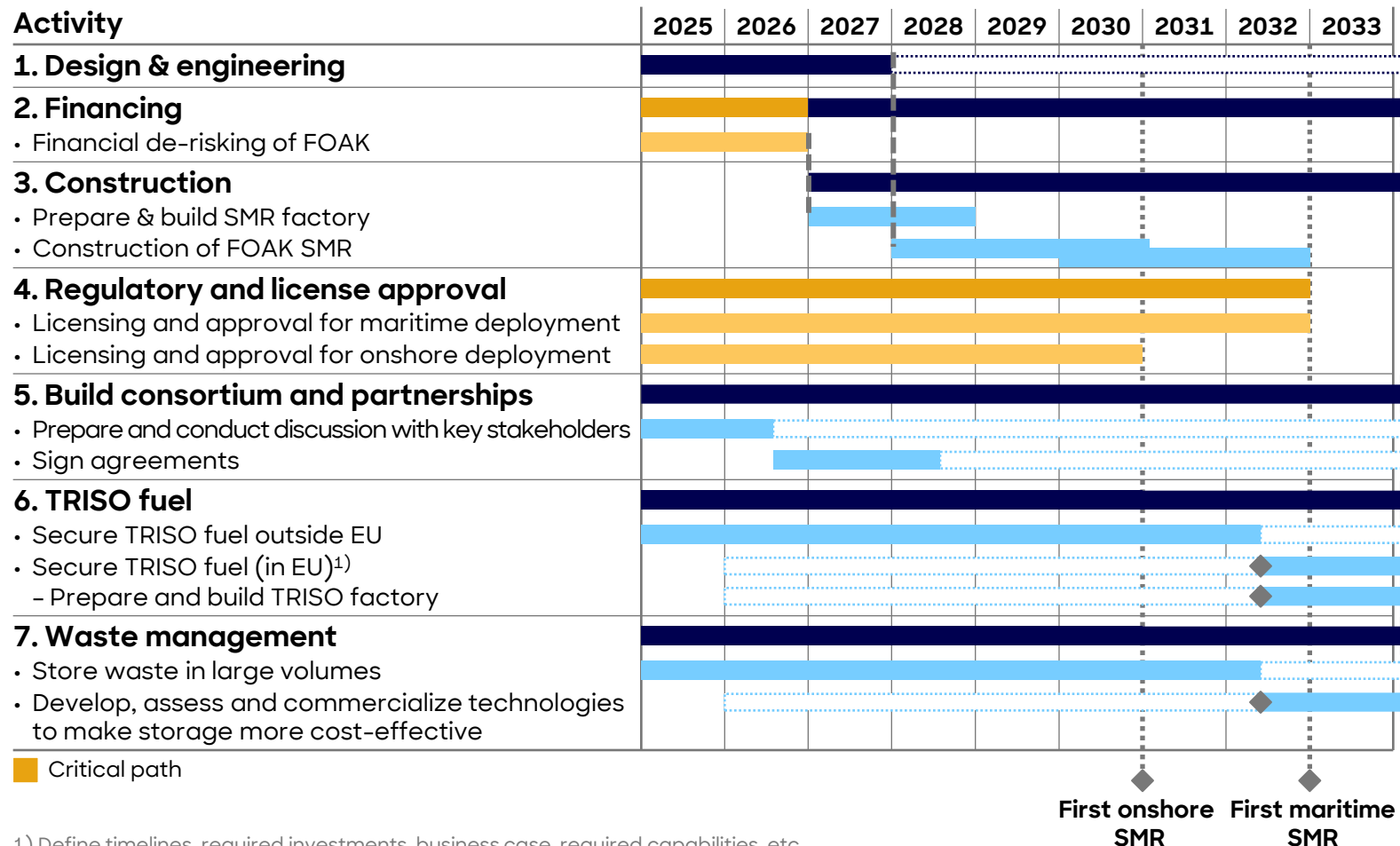




8. Next steps

Given the technological readiness, Allseas could deploy the first onshore SMR by 2030, if there is government support for an accelerated regulatory process

Expected timeline of Allseas' SMR



- Allseas' choice of a **proven HTGR reactor** makes deploying the first SMR by **2030 technically feasible**
- Unlike traditional nuclear plants, **SMRs are smaller**, and **faster** to build, and therefore past timelines are not a reliable benchmark
 - After the FOAK unit, construction times should decrease further
- **Regulatory licensing** remains **critical**, requiring proactive government support to accelerate approvals
- The **TRISO fuel factory** can be removed from the critical path by **initially sourcing fuel internationally** (e.g., from the US) **while building a TRISO facility** in the EU/UK for long-term supply
- The same approach applies to **waste**: Start with **safe interim storage** while **developing cost-effective long-term solutions**



"I believe in the potential of SMRs. Within the next 6 years, before I retire, I'm confident the first SMR of Allseas will be operational"

Jan Leen Kloosterman, TU Delft

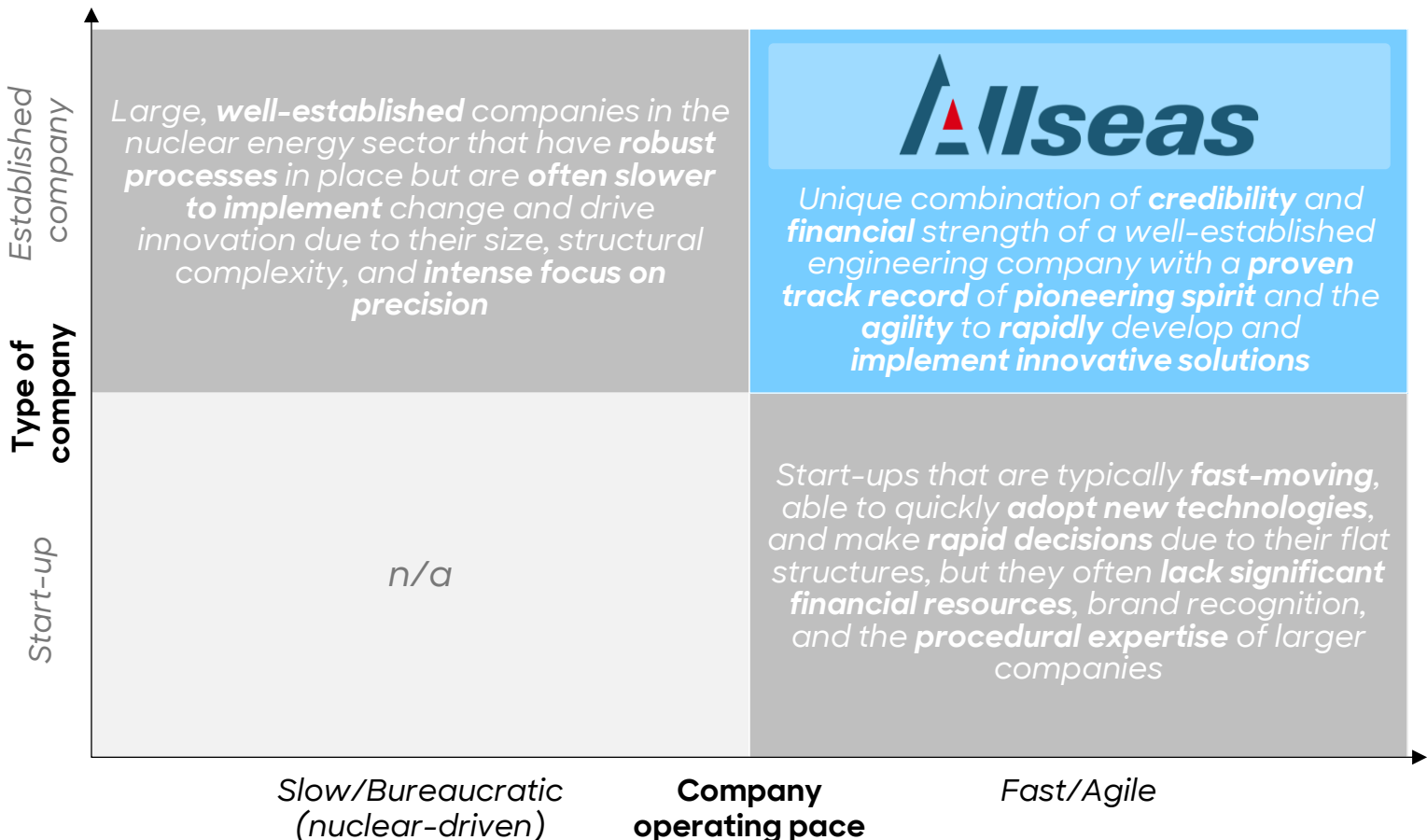
"If we were to develop the Pallas reactor program again, the timelines would be significantly shorter. The schedules of earlier projects, especially those of conventional nuclear reactors, are not a reliable benchmark for SMRs. Besides, you learn a lot from building the first one and after that it goes a lot faster"

Joost van den Broek, NRG Pallas

1) Define timelines, required investments, business case, required capabilities, etc.

Allseas combines the stability and resources of an established company with the speed and innovation of a start-up, resulting in a high chance of success

Allseas' unique position



• While **achieving operational readiness** for Allseas's first SMR by 2030 is widely seen as **ambitious**, **several factors** strongly support its **feasibility** (assuming government cooperation is secured)

- **Allseas:**
 - **Strategic positioning:** Compared to other companies developing SMRs, Allseas holds a **unique position**, combining the **credibility and financial strength** of a well-established company with the fast-moving decision-making and **innovative drive** of a start-up, giving Allseas's SMR development a **strong likelihood of success**
 - **Proven engineering capability:** With a solid track record in constructing large-scale, technically advanced infrastructure, and in-house construction resources, Allseas is well-equipped to deliver
 - **TRISO fuel:** TRISO fuel is gaining global momentum. Beyond China, the United States is now investing in production facilities, underscoring its international viability and long-term potential
 - **HTGR reactor:** The HTGR selected by Allseas is based on a mature and proven technology significantly reducing technical risk

 "Allseas occupies a unique sweet spot in the industry. They are neither a large nuclear organization often hindered by slow decision making processes, nor a start-up lacking financial resources and robust systems. If any company is equipped to succeed, it's Allseas"

Frederik Reitsma

Countries worldwide are actively supporting SMRs – Many governments provide support through subsidies, fast-track regulation and being a launching customer

Examples of support from foreign governments for SMR projects



“The US and UK are already discussing bilateral corridors for nuclear-powered vessels, while the EU risks falling behind”

Jan Emblemstvang, NTNU

Country	Financial support	Regulatory license & approval	Bilateral shipping corridors	Launching customer	Export support/ partner-ships with other countries
United States 	• EUR 900 m funding to de-risk the deployment of Gen III+ SMR • EUR 575 m for the design and licensing of NuScale's SMR plant • DOE is running projects to build domestic TRISO fuel lines	• 7 reactor designs cleared for use in the US by the NRC • NRC is required to license micro/modular reactors within 18 months, significantly reducing approval timelines	• The US and UK signed a MoU on the Technology Prosperity Deal, committing to explore civil maritime nuclear applications, develop international standards, and assess a potential nuclear maritime shipping corridor between both nations	• DOE is directed to launch three SMR pilot projects by July, 2026 • The Department of Defense must commission its own reactor within three years	• The US and the UK have signed a MoU to accelerate the development of maritime nuclear energy
United Kingdom 	• EUR 2.5 m to support development of SMRs • Rolls-Royce has received government backing to build three SMRs • US financial firms can co-invest in UK SMR projects	• Policy changes to free up additional sites for SMRs • The ONR¹⁾ is processing three design assessments • Established a framework for streamlined regulation together with US and Canada		• GBE-N³⁾ bought two Hitachi sites for nuclear development • GBE-N will likely be the customer for Rolls-Royce SMRs, with site selection planned for later this year and grid connection targeted for the mid-2030s	• The UK and Czechia signed an agreement to cooperate on SMRs and seize export opportunities • The US and the UK have signed a MoU to accelerate the development of maritime nuclear energy
France 	• EUR 1.0 bn to support development of SMRs • EUR 300 m for Nuward • EUR 500 m for start-ups involved in innovative SMR projects	• Nuward submitted its safety options file to the ASN in July 2023, beginning the pre-licensing process • Newcleo has completed the preparatory phase		• No formal customer yet, EDF (state-owned) is currently negotiating with several parties	• India and France sign SMR and AMR partnership letters of intent • EDF has signed agreements with Fortum to develop SMRs in Finland and Sweden
China 	• Strong financial support (via state-owned company CNNC²⁾)	• The first commercial SMR, Linglong One, has received IAEA approval and is now in the final installation phase		• Via its state-owned company CNNC • In 2023, China brought the world's first HTR-PM SMR into operation	• CNNC has stated that they see significant export potential for the Linglong One, given its subsidized price of EUR 0.6 m
Russia 	• Strong financial support (via state-owned company Rosatom)	• Regulatory approval facilitated through active political support		• Via its state-owned company Rosatom	• Russia uses intergovernmental agreements and export deals to expand (agreements with Myanmar, Kyrgyzstan, and Iran)

1) Office for Nuclear Regulation; 2) China National Nuclear Corporation; 3) Great British Energy-Nuclear



Appendix

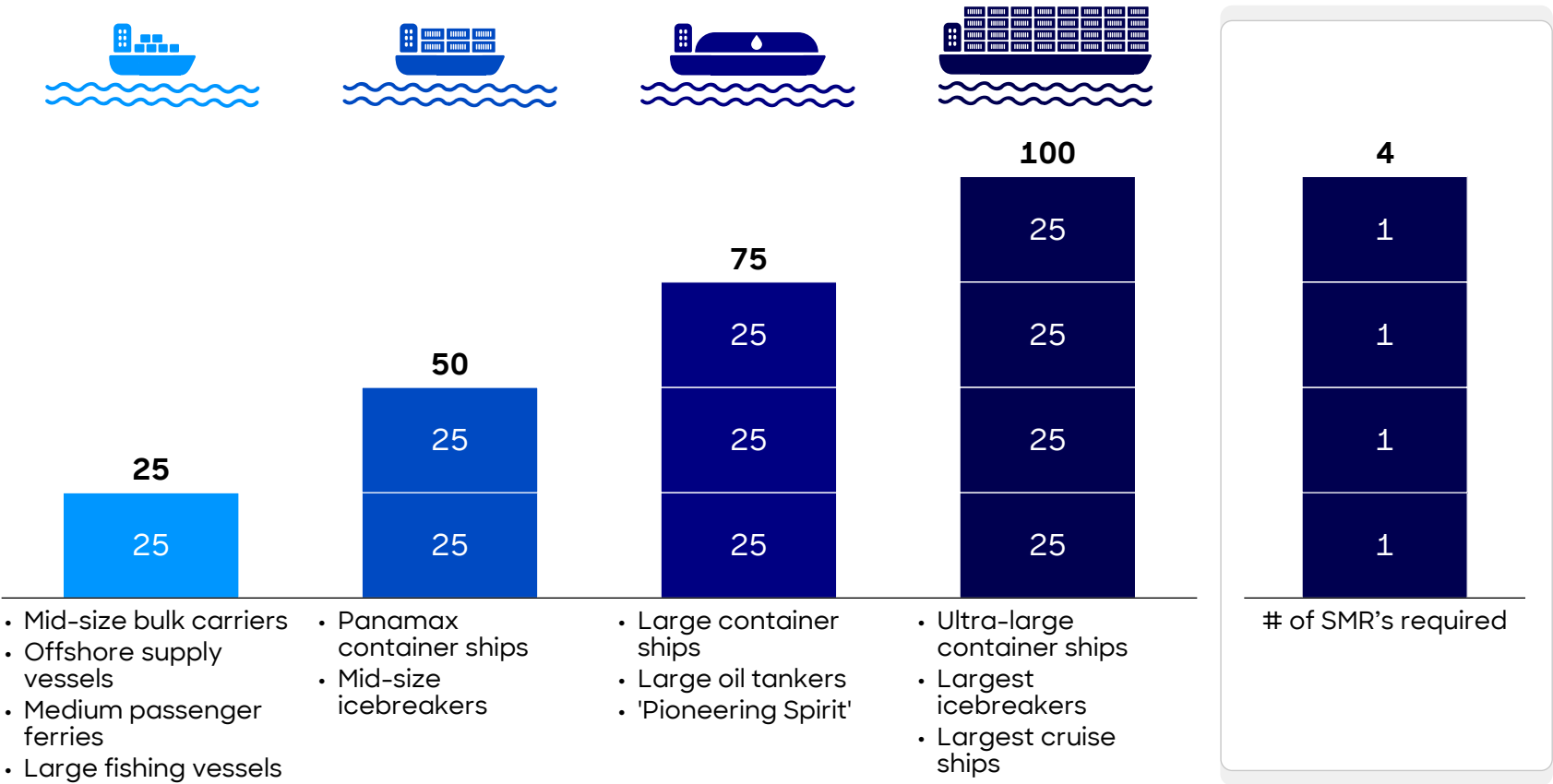


Appendix

2. Allseas' SMR for maritime deployment

Allseas' 25 MWe SMR is able to address a significant portion of the maritime market (focused on large ships), due to its compact and modular design

Installed propulsion power for different vessel types [MWe]



- Due to its compact design, Allseas' SMR can be neatly integrated into both large existing and newbuilt ships
- Through the relatively lower 25 MWe power compared to competitors combined with its modular design approach, the SMR is able to address a large portion of the maritime market (with focused on large ships), able to be deployed in ships with a required propulsion power of 25-100+ MWe
- For large vessels, SMRs will offer an affordable and sustainable solution. For smaller-scale shipping, there is a strong likelihood that alternative fuels will be considered



Appendix

3. Allseas' SMR for industrial clusters

Chemicals and steel are industries that are well-suited for SMRs while facing significant industry pressure

Assessment of SMR suitability for onshore deployment and industry pressure

Energy demand, 2030 [TWh]¹⁾

Excluding energy produced from internal processes

Suited for SMRs

Pressure on industry

Local baseload electricity

CO_{2eq} emission

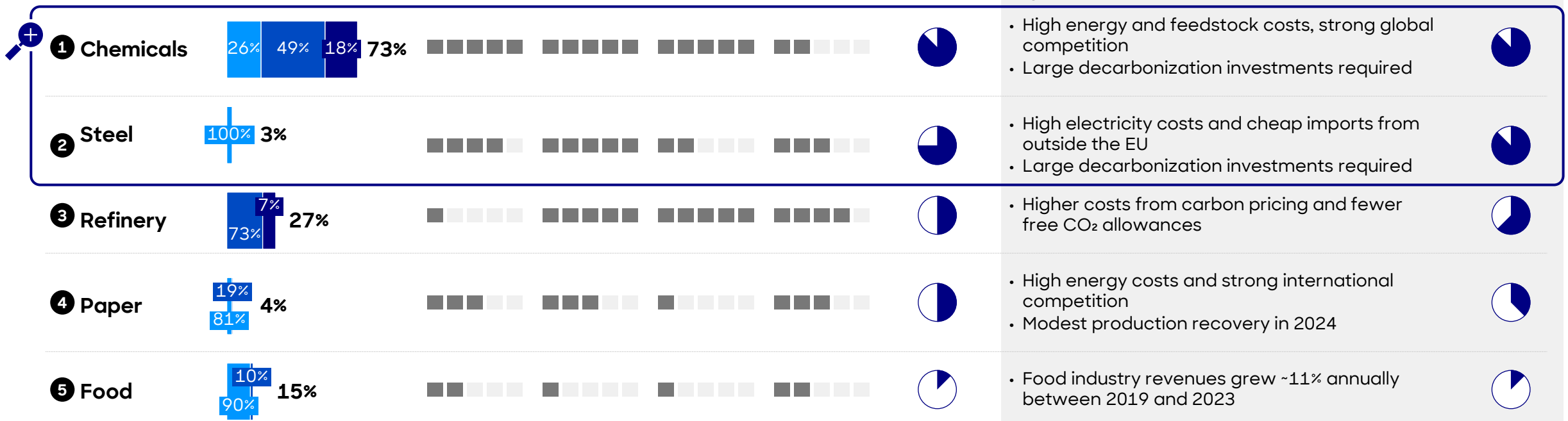
Heat demand

Energy price dependency

Total score

Argumentation

Total score



■ Electricity
 ■ Low temp heat (<500 °C)
 ■ High temp heat (>500 °C) |
 ■ ■ ■ ■ ■ ● Low score
 ■ ■ ■ ■ ■ ● High score

[Deep-dive in next slides](#)

1) Primary electricity demand average of scenarios

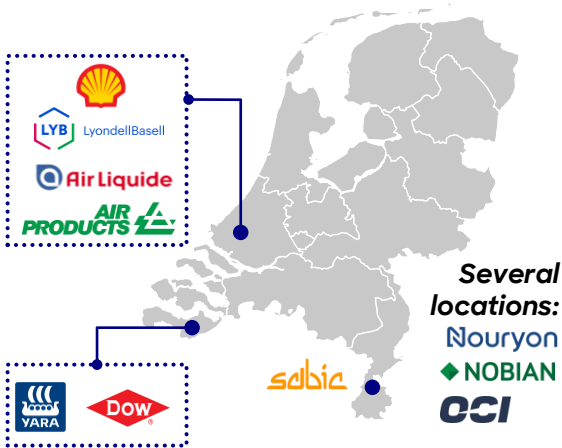
Source: Energy Transition Model, Netbeheer Nederland

The chemical sector is a promising SMR offtaker with high baseload demand, heat needs and CO₂ reduction potential, while under strong industry pressure

Industry deep-dive: Chemical sector

Industry profile

Key facts of sector NL	
Main activities:	Olefins, base chemicals and industrial gasses
Electricity demand, 2030:	19 TWh
Heat demand ¹⁾ , 2030:	52 TWh
Revenue, 2023:	EUR 68 bn
Jobs, 2023:	55,000



SMR suitability

Overall score:

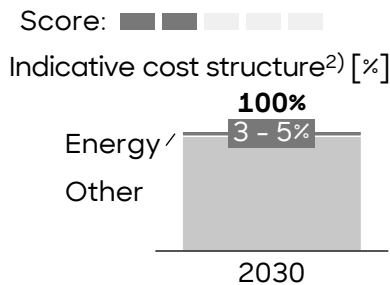
Local baseload electricity

- Score:
- Chemicals rely largely on continuous electro-chemical processes
 - Emerging electrification of cracking will add to electricity demand, driving high and stable baseload consumption

Heat demand

- Score:
- Steam cracking, reforming and distillation require high-temperature heat
 - Separation and compression require large steam volumes

Energy price dependency



CO₂ reduction potential

- Score:
- Most of the largest companies in the sector participate in the 'maatwerkafspraken' to significantly reduce CO₂ emissions

Industry pressure

Overall score:

- High energy and feedstock costs create a structural disadvantage versus US, China and Middle East
- EU climate and sustainability targets require large-scale decarbonization investments to cut CO₂ by 55% by 2030 compared to 1990 levels
- Heavy and complex regulation (REACH, PFAS ban, Green Deal) increases compliance costs and investment uncertainty

Low score Medium score High score

1) Heat above between 50 and 650 degrees °C; 2) Variations are possible for certain chemicals, 2030 based on electricity energy share and price projections, assuming other costs constant

Industry deep-dive: Steel sector

Key facts of sector NL



A map of the Netherlands showing its provinces. A blue dot is placed on the western coast, near Amsterdam, indicating the location of Tata Steel. The text 'TATA STEEL' is written in blue capital letters to the left of the dot.

Overall score:

Local baseload electricity

Heat demand

Energy price dependency

Stacked bar chart for 2030. The bar is divided into two segments: 'Energy' (top, 7-9%) and 'Other' (bottom, 100%).

Category	Percentage
Energy	7 - 9%
Other	100%

CO₂ reduction potential

- Targeting a 40 % reduction in CO₂ emissions by 2030, moving toward CO₂-neutral steel by 2045
- Dutch subsidies has been requested to be able to achieve the targets

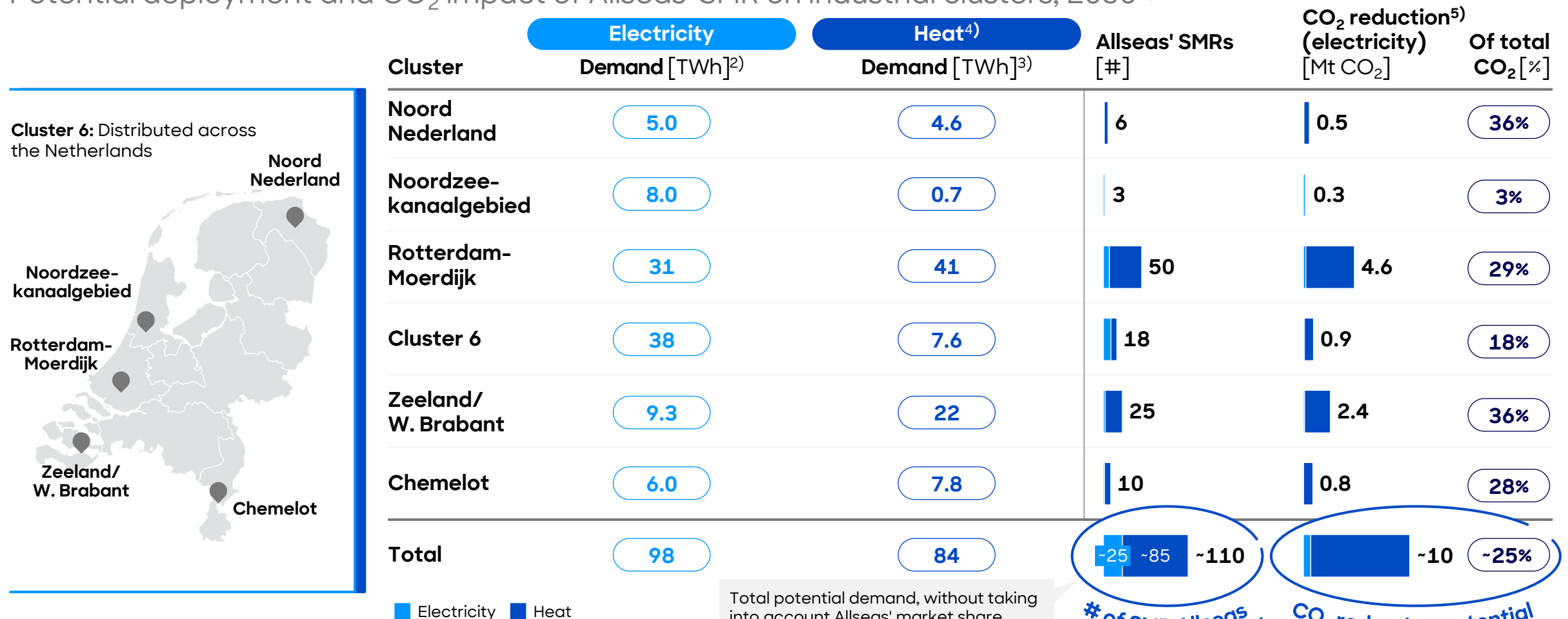
Overall score:

- Strong competition from cheap non-EU steel, with global overcapacity and low-cost imports from Asia
- High electricity prices impacting cost base, as Dutch producers face higher electricity prices than international competitors
- Decarbonization targets require significant investments, with costly shifts to hydrogen DRI and electric arc furnaces that depend on subsidies and new infrastructure



Deployment across the main industrial clusters could enable ~110 SMRs, with the resulting clean electricity reducing the CO₂ emissions of the clusters by 25%

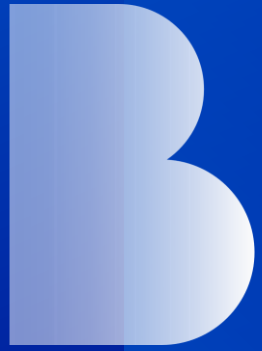
Potential deployment and CO₂ impact of Allseas' SMR on industrial clusters, 2050¹⁾



1) Excluding datacenters, hydrogen electrolysis and SAF production;

2) Adoption rate of 5% assumed; 3) Adoption rate of 50% assumed; 4) Heat demand at temperature below 650 °C and based on 2030 figures;

5) Relative CO₂ emissions from electricity generation differ by cluster, heat emissions are compared to emissions from a gas boiler

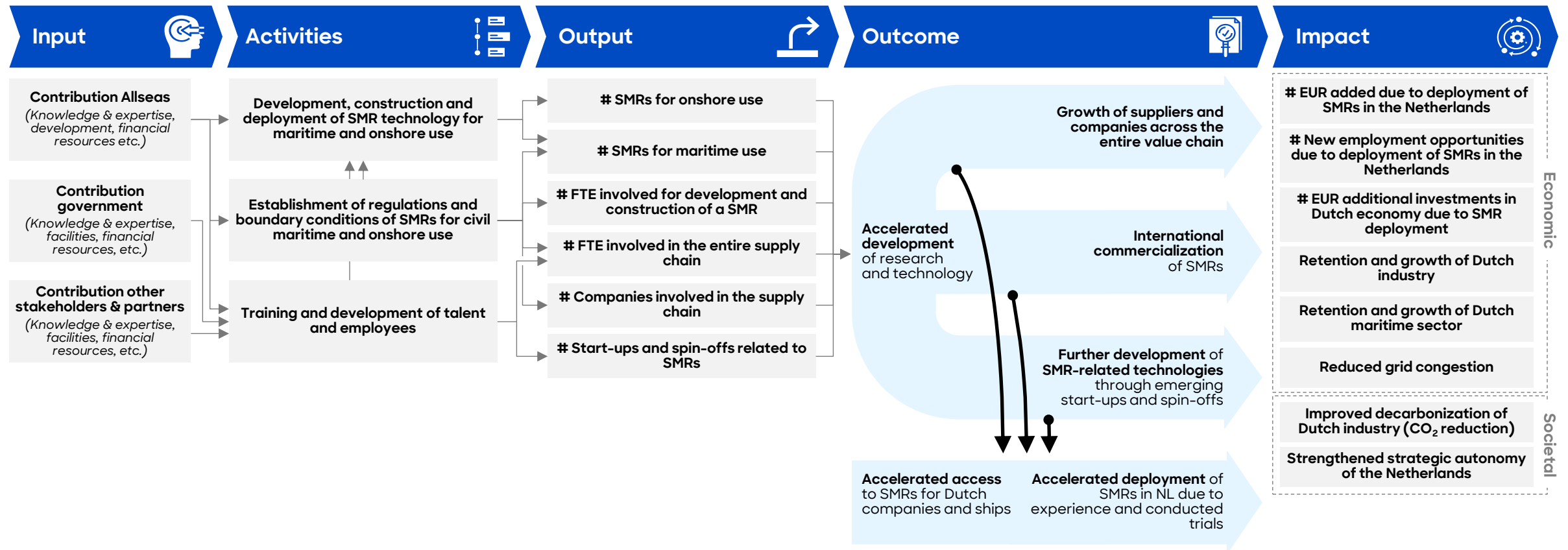


Appendix

5. Economic potential

The future economic and societal potential of Allseas' SMR has been assessed through an impact model

Overview of Allseas' SMR potential



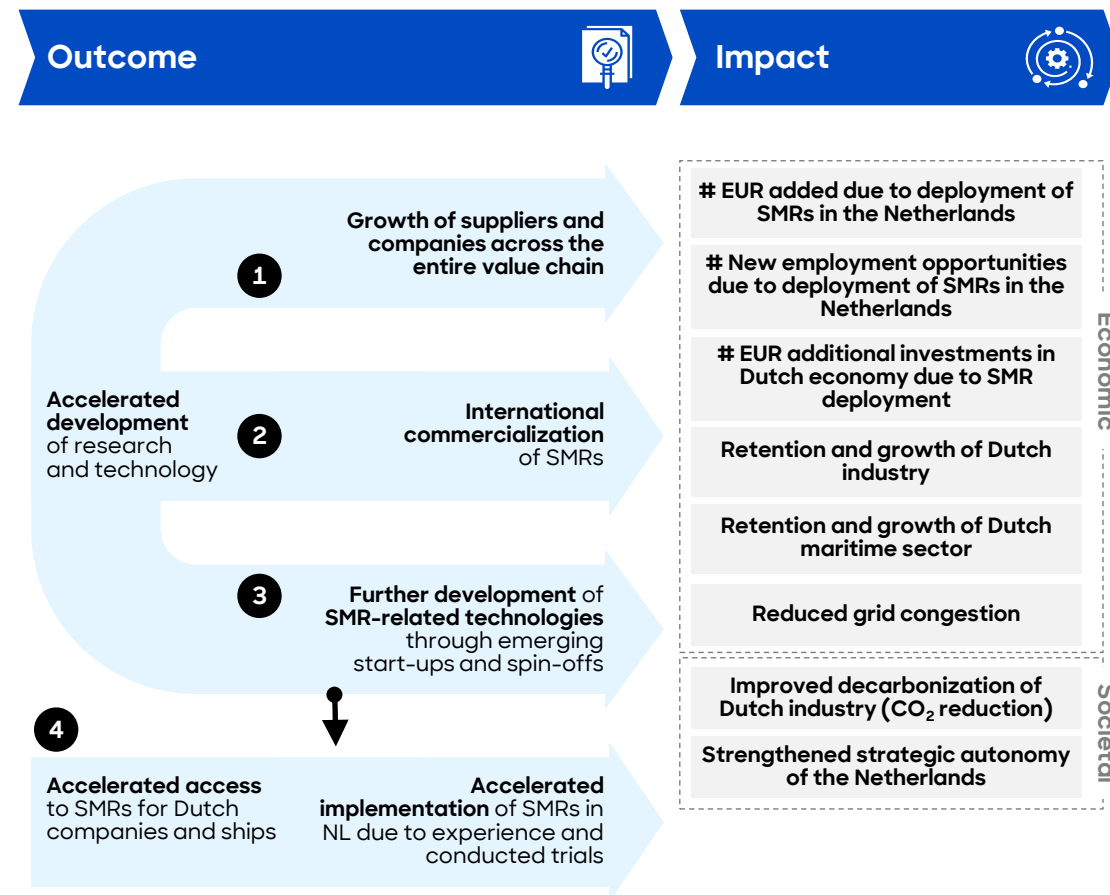
If Allseas continues to develop its SMR and the government supports within the regulatory process, the Netherlands will retain most of the economic value

Overview impact pathways

SMR deployment by Allseas creates four main impact pathways

- If Allseas is able to continue the development of its SMR technology and the government supports the acceleration of the regulatory process, the majority of the added value and economic impact will be captured within the Netherlands
- Without an accelerated trajectory, Allseas' first SMR would only become available in the Netherlands at a much later stage, increasing the likelihood that the potential will be seized by foreign companies

Direct	Impact pathway 1	• The presence of strong knowledge, talent, facilities, partners, and capital within the Dutch nuclear ecosystem, combined with government support for accelerated regulation, enables Allseas to significantly speed up the development of its SMR technology • This will further grow all involved suppliers and companies across the entire value chain
	Impact pathway 2	• The SMRs of Allseas are expected to be marketed internationally, extending their impact beyond the domestic market • This international deployment will generate revenue and added economic value for the Dutch nuclear ecosystem
	Impact pathway 3	• The accelerated development of the technology acts as a catalyst for the emergence of start-ups and spin-offs • The start-ups and spin-offs will create new technologies, which will increase the added value of the economy and strengthens the entire ecosystem
Indirect	Impact pathway 4	• Allseas will accelerate the development of its SMR technology within the Dutch innovation ecosystem • SMR technology is co-developed from an early stage with Dutch researchers, companies, and tested in Dutch industrial settings • Hence, the Netherlands gains early access to this emerging technology and, upon market launch, SMRs will be implemented more rapidly in the Netherlands





Appendix

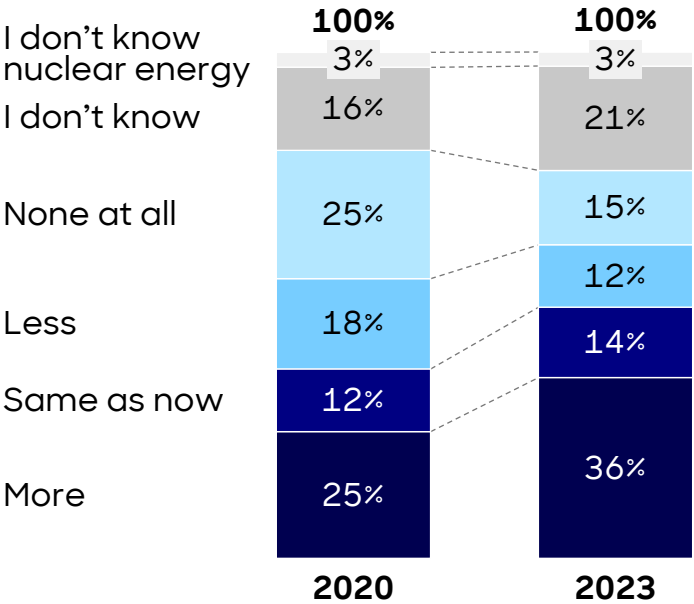
7. Strategic autonomy

Public support for nuclear energy has increased in the Netherlands, and majority of political parties now advocate for its inclusion in the national energy mix

Public and political opinion on nuclear energy in the Netherlands

Public opinion has shifted positively and is expected to continue improving

Public opinion on nuclear energy [%]



- Support for **more nuclear energy increased with ~11%** from ~25% in 2020 to 36% in 2023
- **Support for less or no nuclear energy declined with ~6%** from 33% to 27% over the same period

Most political parties support the use of nuclear energy

Political parties supporting nuclear energy



Political parties opposing nuclear energy



"Nuclear energy as the key electricity source: preserving Borssele, building new plants, fully committing to SMRs, investing in thorium research, and recycling nuclear waste"

JA21, 2025

"The CDA views nuclear energy as an important solution for sustainable energy. Initially, we envision small modular reactors in industrial areas and in regions currently facing energy scarcity"

CDA, 2025

"Inhabitants of Zeeland, which houses the only nuclear power plant in the Netherlands, are most in favor of nuclear energy compared to the other provinces"

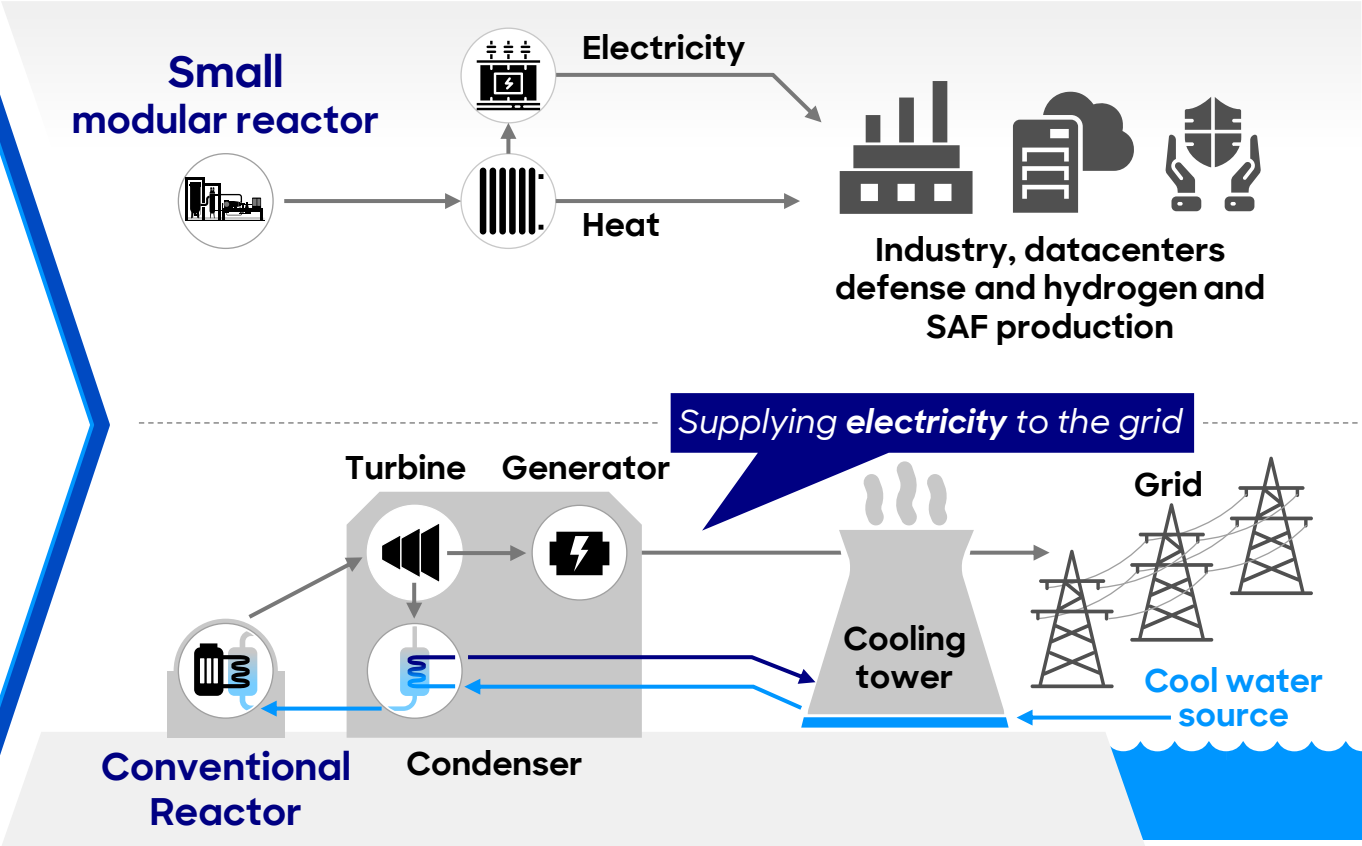
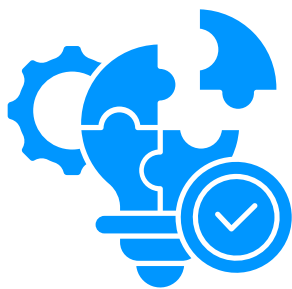
CBS, 2023

Conventional reactors and SMRs are complementary as conventional reactors supply the grid and SMRs provide local energy including high-temperature heat

Complementary roles of conventional reactors and SMRs

SMRs are complementary to conventional reactors

- **Conventional reactors** such as Borssele supply **electricity to the grid**
- **SMRs** provide decentralized electricity and high-temperature heat



The deep-sea mining market offers NL the opportunity to gain position in a USD 25 bn market, gain strategic independence & strengthen its innovation capabilities

Rationale for entering the deep-sea mining industry



Global USD 25 bn market

Global deep-sea mineral revenues are projected to reach **USD 25 bn annually already by 2035¹⁾**, offering a **significant economic opportunity** to capitalize on this emerging industry



Growing domestic demand

The **Dutch domestic market for critical minerals**, valued at **EUR 4.1 bn in 2022²⁾**, is **expected to undergo substantial growth**, which could be met through deep-sea mining



Strategic independence

Developing a domestic supply chain for critical minerals can **reduce the Netherlands' and Europe's strategic dependency on other countries³⁾**, especially in light of the concentrated global supply and rising geopolitical instability.



Strengthen innovation and high-tech industry climate

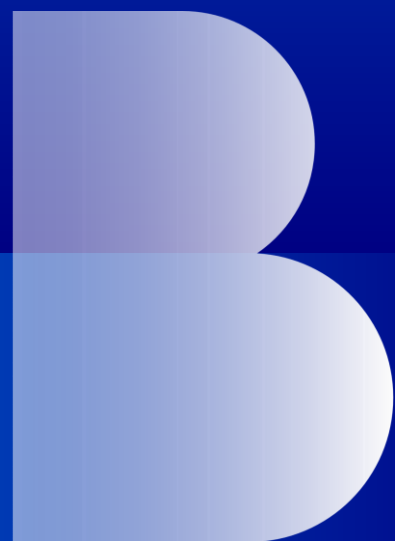
Deep-sea mining can serve as an **catalyst for innovation** across other sectors (e.g., robotics, AI, offshore engineering, marine biology), and **strengthen the Netherlands' position to attract high-tech manufacturing industries**



Environmental leadership

Deep-sea mining offers the Netherlands an opportunity to **strengthen its global environmental leadership** by ensuring **minimal ecological impact of deep-sea mining**, while **contributing to the sustainable transition** through secure access to critical minerals

1) Assuming a modest scenario of the 19 active deep-sea mining sites; 2) Excl. coking coal; 3) For its imports of critical minerals, the Netherlands depends on a relatively small group of countries, such as China (e.g., RREs, Lithium) and Russia (e.g., Nickel)



Roland
Berger