Allseas nuclear developments

March 2025

The best investment in reliable and scalable carbon-free energy is nuclear


Ulseas
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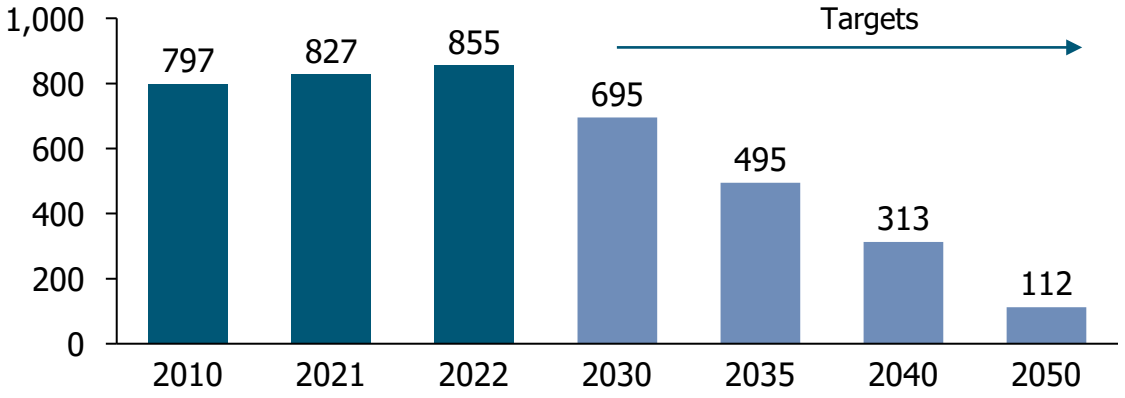
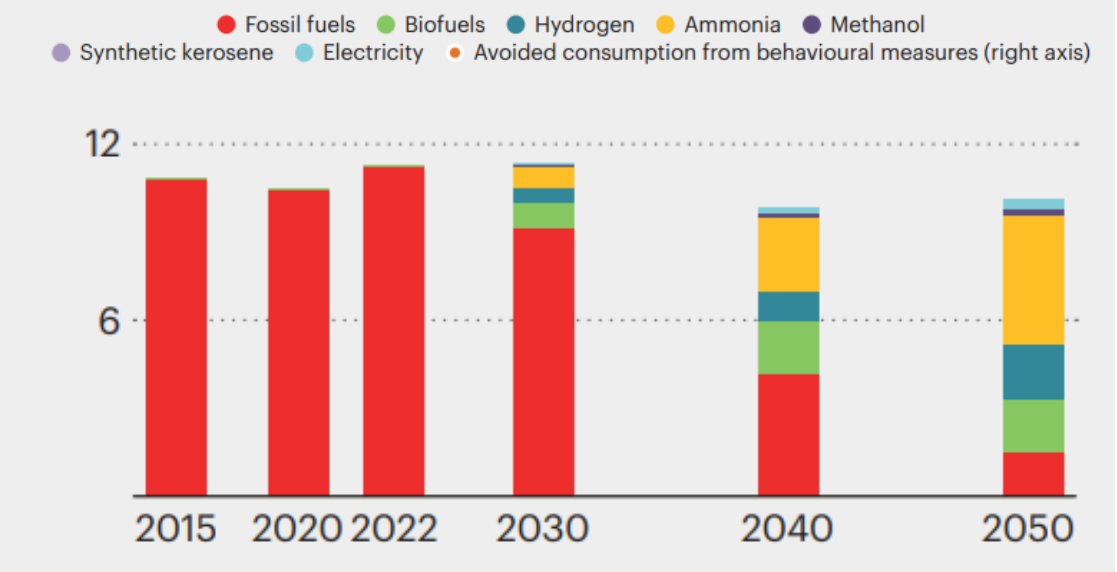
Maritime industry faces major challenges to align with targets

Emissions from international shipping (Mt CO_2)



Shipping energy consumption (EJ)

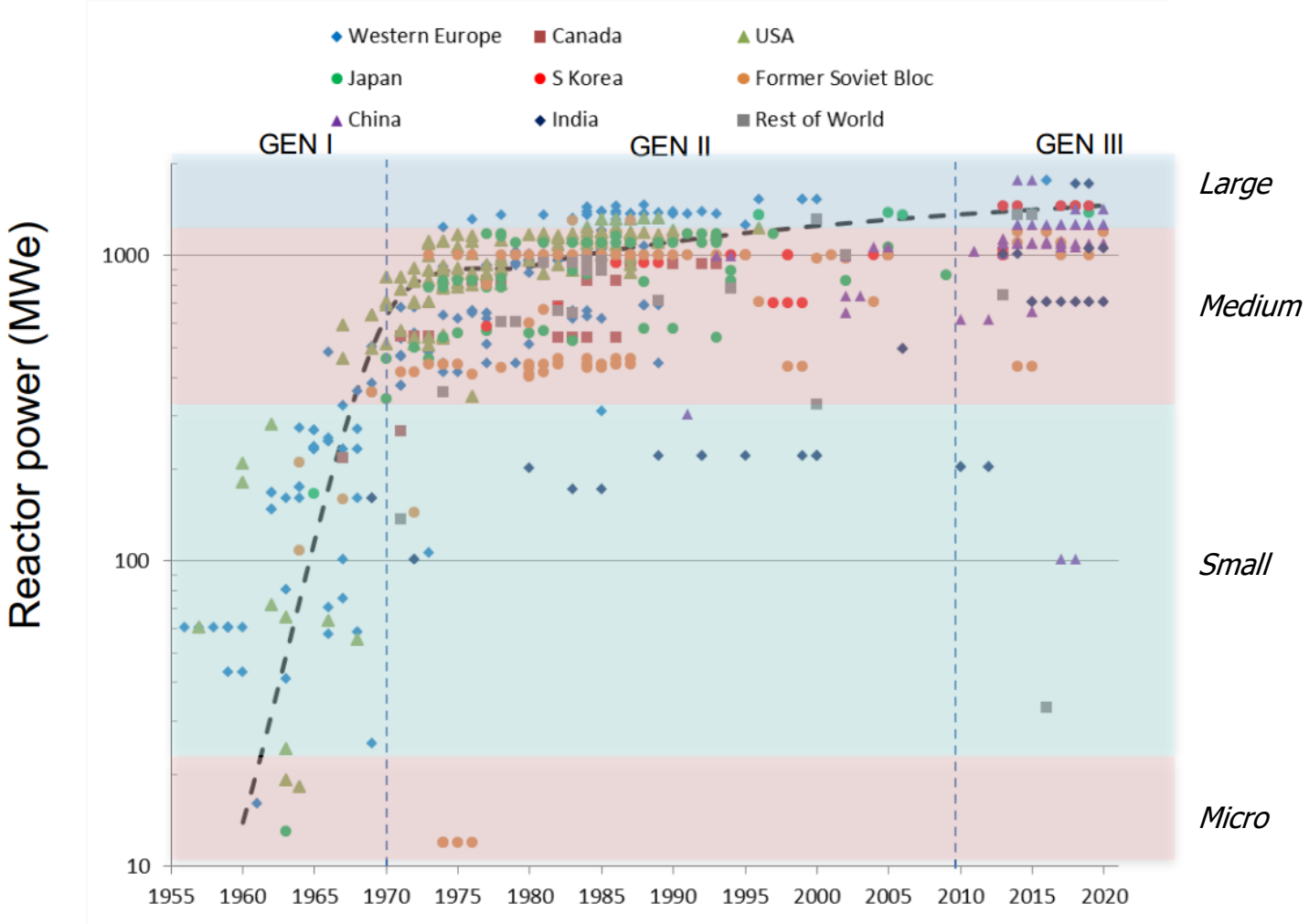


- International shipping uses ~300 million tonnes of fossil fuels yearly corresponding to ~3% of global ghg emissions
- 80% of emissions by 13% of global fleet
- IMO target to reduce CO_2 emissions by at least 20% by 2030 and 70% by 2040, compared to 2008
- Strategy based on energy efficiency and increased uptake of zero or near zero emission fuels
- Producing green fuel for shipping will require 2.7 times the total EU electricity demand in 2022
- **Alternative fuels are not a solution for large vessels that stay offshore for long durations**

2023 IMO STRATEGY ON REDUCTION OF GHG EMISSIONS FROM SHIPS

IAE | Net zero roadmap |Table A.4: World CO2 emissions

In the beginning there were only small reactors..



Today we are looking at SMRs (<300MWe) and GenIV technologies:

- **Safety**: improved & passive safety systems, accident tolerant fuels, less radioactive material, smaller incident consequences
- **Economics**: lower capex, scalability, standardization, lower operating cost
- **Versatility**: modularity, wider range of applications, transportation

SMR presentation at IOP 2016

For large consumers spending a lot of time offshore – nuclear is the only way

- Carbon-free
- Reliable
- Refuelling cycle of years
- Cost effective??

PATHWAYS TO A LOW CARBON FUTURE LNG CARRIER NUCLEAR SHIP CONCEPT DESIGN | ABS / HEC 2024

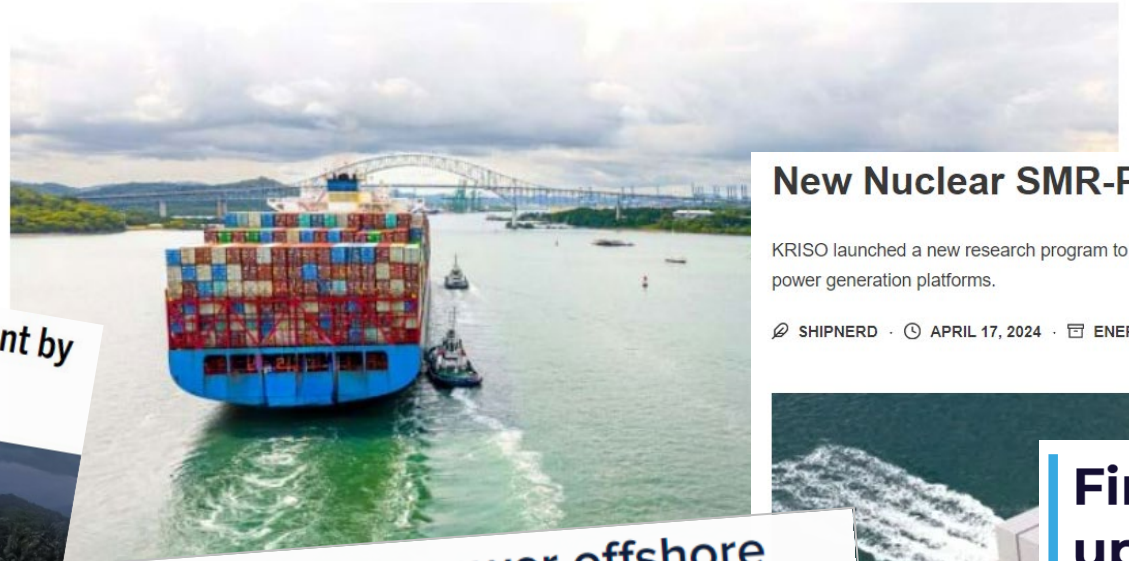
Many initiatives worldwide exploring nuclear power for maritime industry

LR, Core Power and Maersk look into nuclear container ship propulsion

by Mariska Buitendijk | Aug 16, 2024 | Emissions, Energy transition, Marine fuels, Maritime research, News, Nuclear, Ship propulsion

Nuclear-power container shipping could be possible within the decade

Article by Aniqah Majid



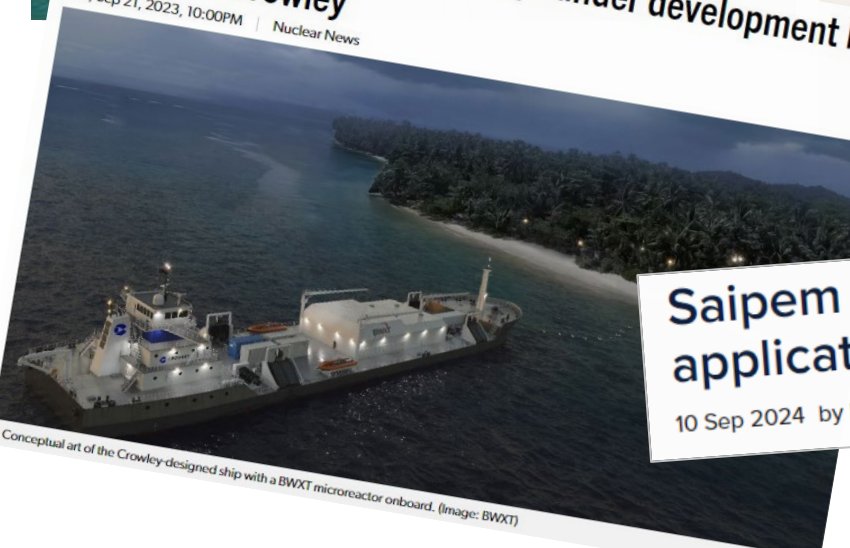
Kepco E&C teams up with shipbuilder for floating reactors

Tuesday, 6 October 2020

South Korea's Kepco Engineering & Construction Company and Daewoo Shipbuilding & Marine Engineering recently signed a Memorandum of Understanding to cooperate on the development of floating nuclear power plants.

Offshore nuclear power concept under development by BWXT and Crowley

Thu, Sep 21, 2023, 10:00PM | Nuclear News



Conceptual art of the Crowley-designed ship with a BWXT microreactor onboard. (Image: BWXT)

Saipem studies nuclear power offshore applications

10 Sep 2024 by Martyn Wingrove

New Nuclear SMR-Powered Ships Project from 2024

KRISO launched a new research program to develop small modular reactors, SMR-powered ships and floating SMR power generation platforms.

SHIPNERD · APRIL 17, 2024 · ENERGY & COMPLIANCE, NAVAL & ENGINEERING

Fincantieri, RINA team up with newcleo to test feasibility of nuclear naval propulsion

BUSINESS DEVELOPMENTS & PROJECTS

July 25, 2023, by Jasmina Ovcina Mandra

Nuclear powered vessels are not new..

1962 – 1972	NS Savannah – demonstrator general cargo ship
1968 – 1975	USS Sturgis – Panama canal power barge 10MW
1968 – 1979	Otto Hahn – demonstrator bulk cargo ship
1969	Mutsu – demonstrator
Current	Russian icebreakers & power barge(s)
Current	100's of naval vessels

All based on PWR technology

wikipedia

Opportunities for The Netherlands

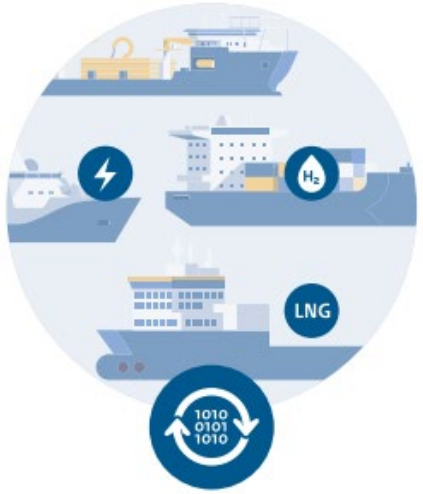
- Clean and reliable energy for maritime sector and industrial clusters, e.g. ports
- Economic development
- Strategic autonomy
- Defence

chatgpt

Dutch sector agenda Maritieme Maakindustrie - koploperprojecten

Nuclear propulsion on ships is one of the 5 key projects

1 Het Maritiem Masterplan



Doel is om ca. 40 klimaatneutrale demonstratieschepen te ontwikkelen. Met nieuwe werkwijzen: cyclisch, modulair en digitaal.

2 De werf van de toekomst

Doel is om hier de modernste schepen te bouwen (circulair & schaalbaar) met 10-15% kostenreductie via o.m. digitalisering & robotisering. Tevens helpt dit het personeelstekort op te lossen.

3 Smart Maritime

Doel is om effectief samenwerkende (onbemande) schepen te ontwikkelen met systemen voor maritieme veiligheid (safety) en beveiliging (security).

4 Robotisering wind op zee

Doel is om sneller en veiliger windparken op zee aan te leggen via digitalisering en robotisering.

5 Nucleaire voortstuwing van schepen

Met dit project wordt verkend hoe de voordelen van kernenergie benut kunnen worden voor duurzaam varende schepen met permanente energievoorziening.

“Fasttrack” design and development of offshore nuclear reactor

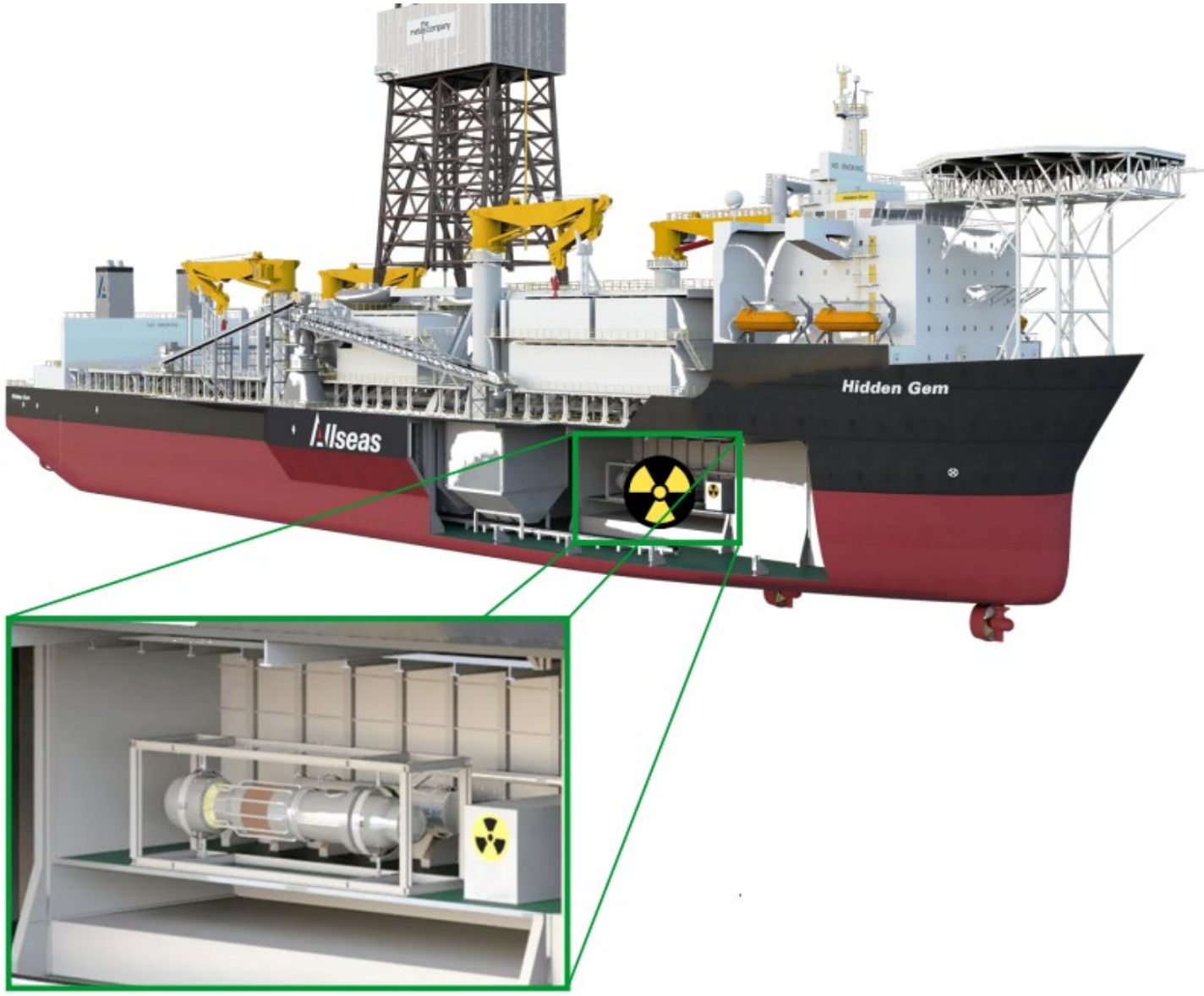
- 40 years of maritime experience
- Unique innovative and complex project management capabilities
- Committed to sustainability and the economic strengthening of the maritime sector and industrial clusters/ports

NUCLEAR 21®
PERSPECTIVE FOR YOUR DECISIONS

Technology

Target system design requirements

- Small Modular Reactor – 25MW electric
- Inherently safe – reactor should cool down itself in case of malfunction
- High technology readiness level – no scientific challenges, only engineering
- Size of reactor should be workable on vessel
- "Plug & Play" - Connection to existing infrastructure of the engine rooms and the power distribution systems/switch boards



Safety is the key driver for our chosen technology: HTGR

- **Inherent safety and security features**
  - TRISO fuel to contain fissile material
  - Negative temperature coefficient
  - Passive cooling
  - Coolant decoupled from neutronics

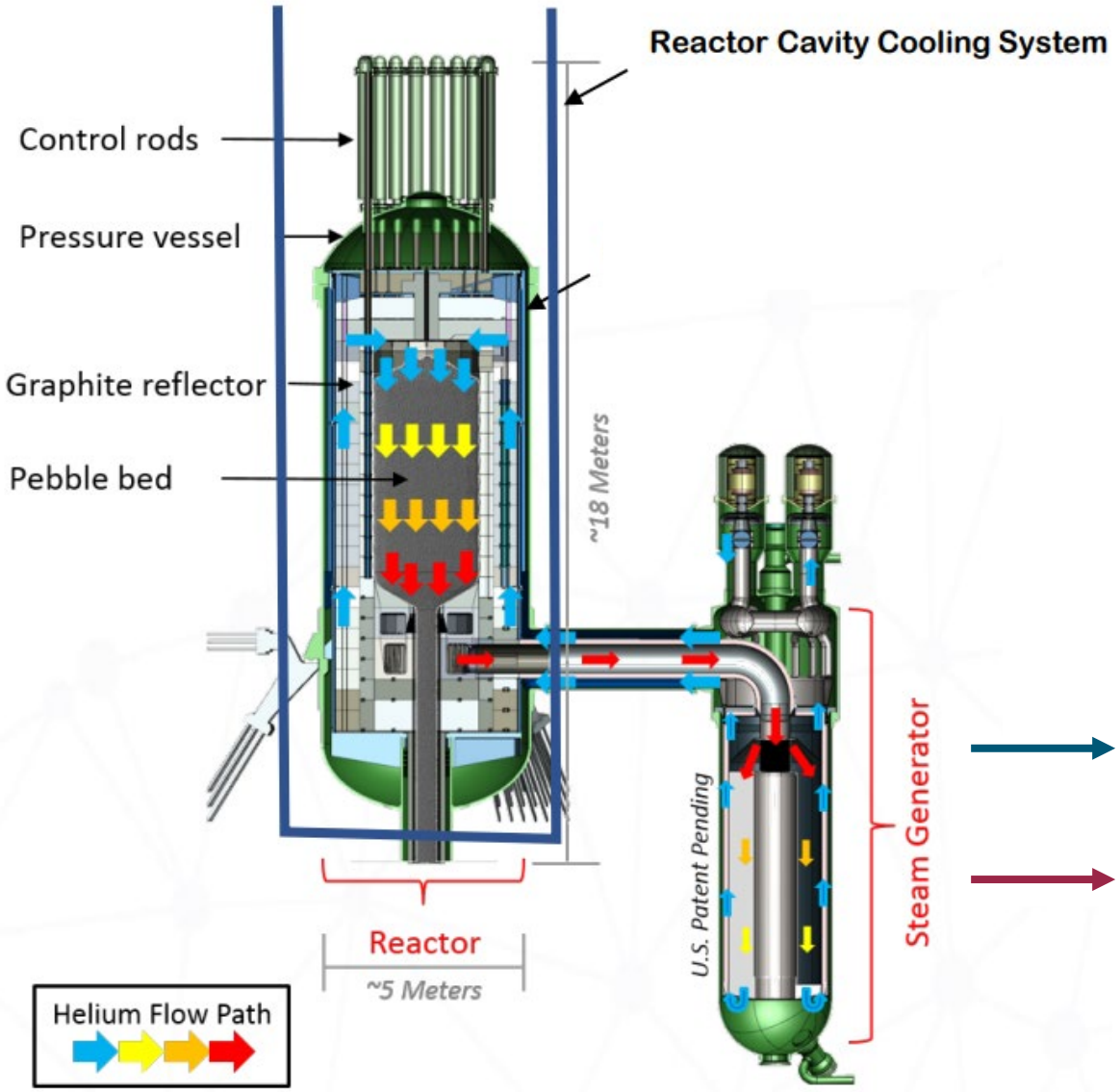
And other benefits that make it the better choice

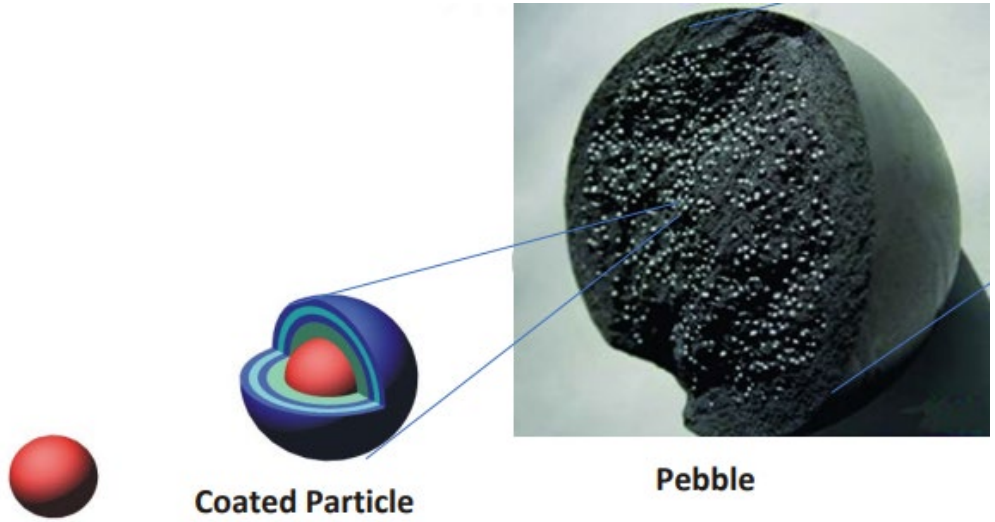
- The **Emergency Planning Zone** can be limited to the vessel size enabling harbour access due to its safety features

- **High technology readiness level** benefit regulatory process as well as time to completion. The technology is developed since the 1960's.

- High operating temperatures facilitate use of **heat** (up to 950C) **for industry** or hydrogen generation on-land as alternative market

High temperature gas cooled reactor explained





Turbine & generator → Electricity

Heat

Scenario's that we review

Vessels

- Large vessels with high power demand
- Long duration at sea
- Operating mainly in international waters, no inland waterways

International regulatory landscape poses risk for timeline

Power barges

- Power barges providing power to regions with temporal power requirement
- In port, decentral supply for incoming transport or intra harbour transport

Licensing likely a lot easier

On-land

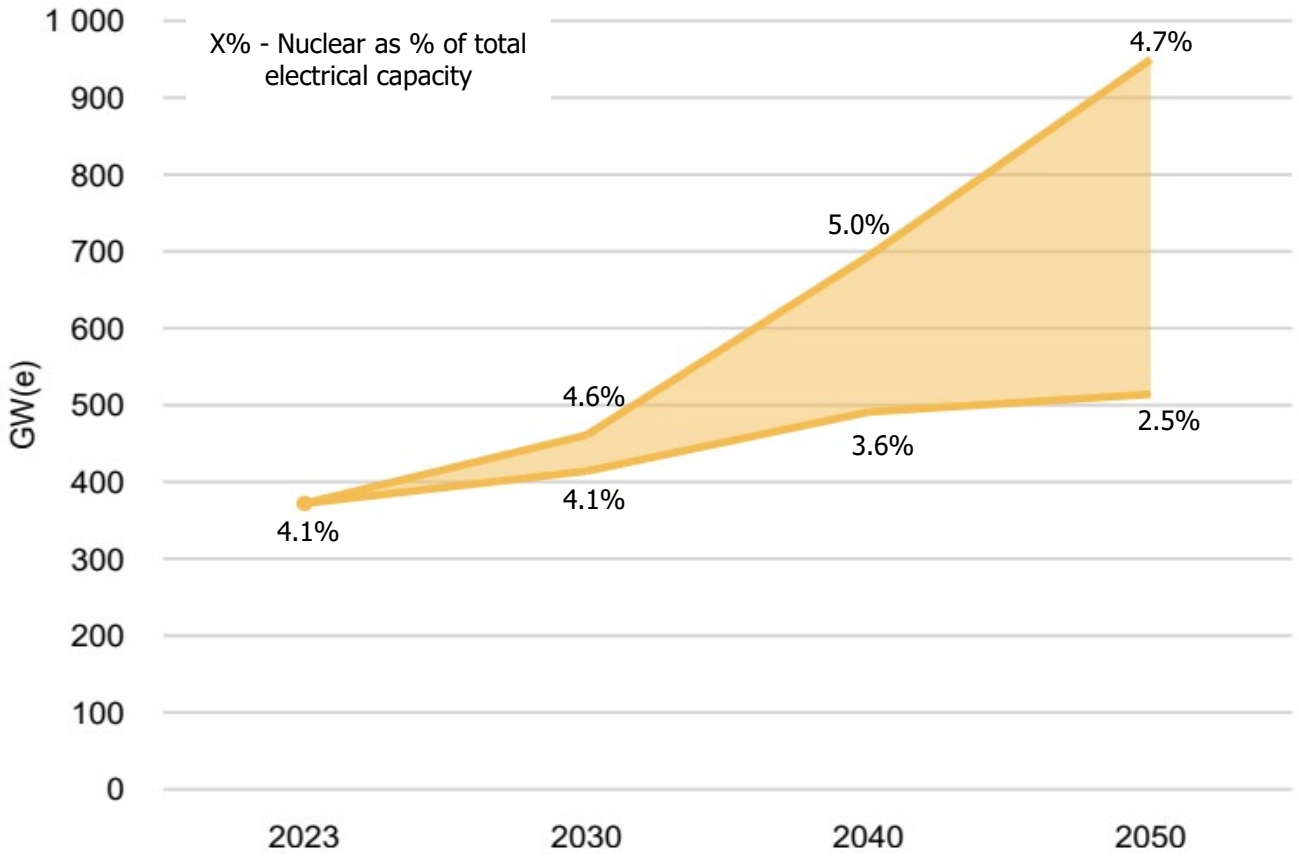
- Heat and/or electricity supply for industry-intensive zones (like PoR)

Licensing not an issue

Vessel type	Installed power
FPSO's	25 – 150 MWe
Container vessels	25 – 80 MWe
Drill ships	40 – 50 MWe
Offshore construction vessels	20 – 100 MWe
Dredgers and pipelay vessels	5 – 50 MWe

Nuclear growth may be significant; if SMRs are successfully deployed

IAEA projection for global nuclear electrical generating capacity



- Nuclear electrical generating capacity is projected to increase between 25% and 2.5 times by 2050 compared to 2023
- **Regulation and cost will be key drivers**