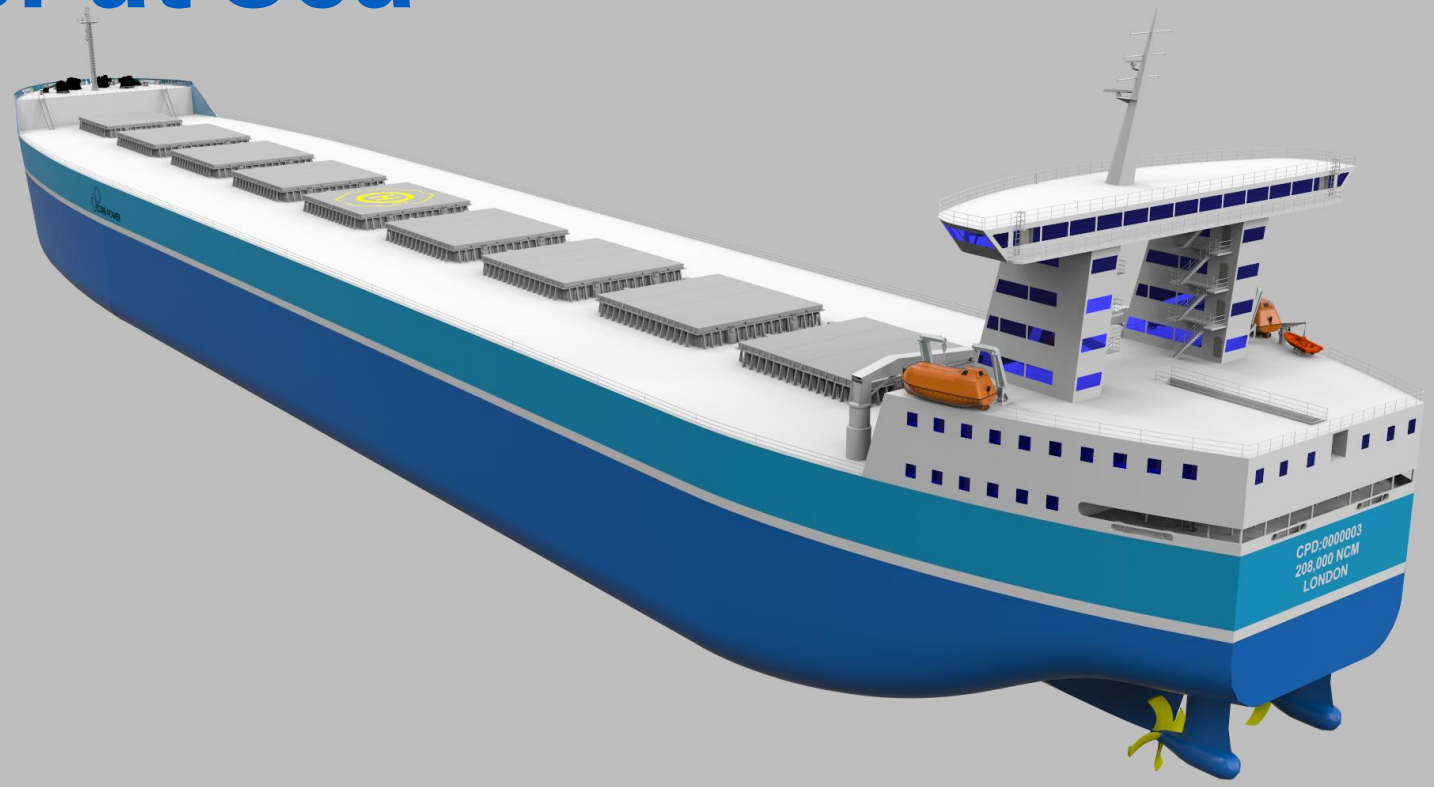
Enhanced national security • Global technology leadership • True-zero emission power

Advanced Nuclear for Sustainable Power at Sea



Giulio Gennaro
Chief Technical Officer
CORE POWER
giulio.gennaro@corepower.energy

Glasgow, 20th October 2022

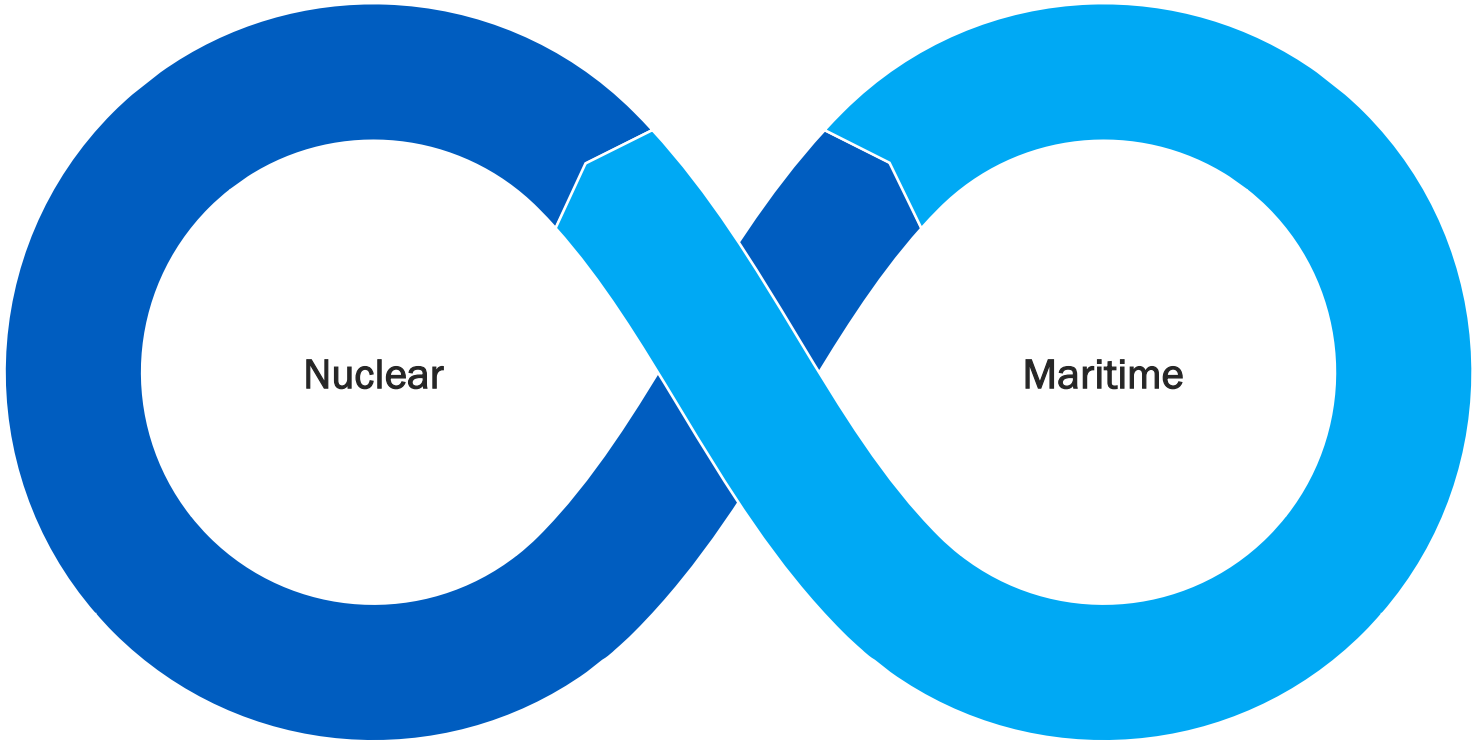
Shipping Emissions

Largest 20% ships 80% emissions

Largest 10% ships 50% emissions

The biggest ships matter most!

Making an inevitable connection



Nuclear is a true-zero emission technology in search of a mass market

Nuclear industry must move from ‘Project’ to ‘Product’

Maritime is a mass market in search of a true-zero emission technology

Maritime industry has capacity to build nuclear ‘Products’

CORE POWER Mission

Co-develop and finance advanced reactors and related marine industrial innovation

Create new markets for competitive & sustainable ‘true-zero emission’ power

Engineer the nuclear electric “power package”

Lead modernization of marine and nuclear regulations

Build quality training and management systems

CORE POWER today

14 team members ● 4 board members ● 10 advisory board members ● 21 expert consultants ● 42 shareholders

Mikal Bøe

CEO – With three decades in shipping, technology and finance, Mikal combines understanding of both atomic energy and ocean transportation with a strong ability to engage industry leaders, investors and regulators.

Nicholas Briggs

CFO - An experienced and successful Chief Financial Officer and Board Director who specializes in the management of companies within the oil & gas, power generation, manufacturing and engineering industries.

Giulio Gennaro

CTO - Chartered Mechanical Engineer with more than 20 years' experience in maritime, energy and onshore industries is uniquely skilled in advanced nuclear applications for maritime.

Tobi Menzies

Business Development Director - Senior commercial project specialist from shipping and offshore markets, with 22 years experience in compiling, managing and deploying complex maritime projects.

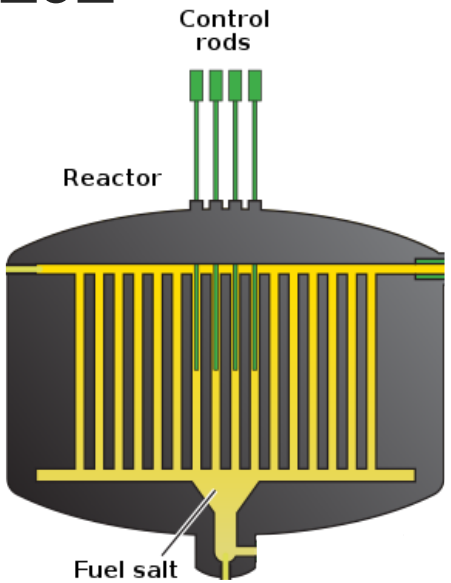
Tony Huston

Managing Director and US Country Head with over 25 years of broad international investment and corporate management experience. Responsible for US nuclear regulatory interface, industry partnership engagement and to help shape capital formation opportunities.

Dr. Rory Megginson

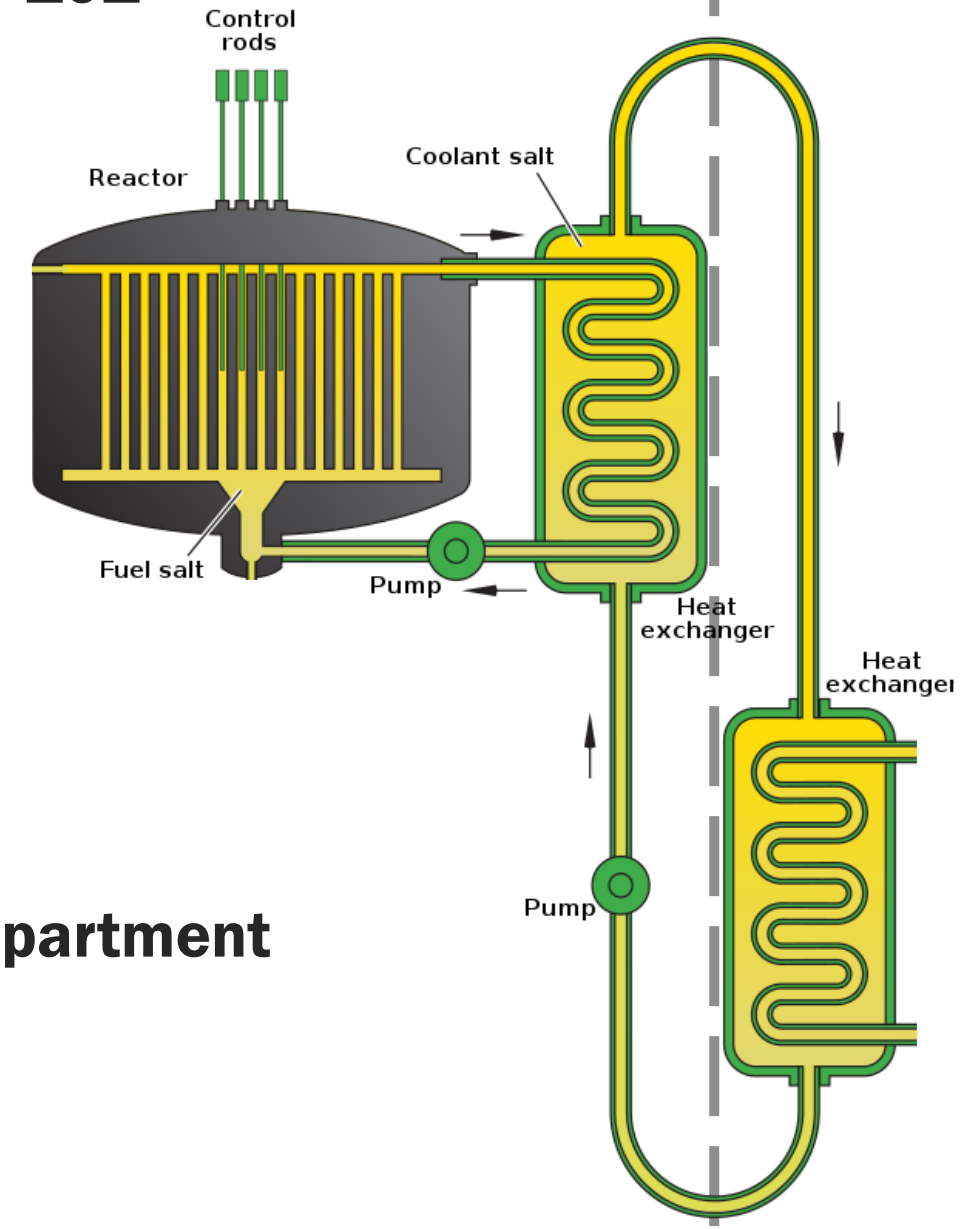
Director of Analytics - Joined CORE POWER after completing a PhD in Chemistry at the University of St Andrews. Rory heads up the Analyst team at CORE POWER and main area of focus is the creation of green fuels using marinized nuclear power.

Nuclear Power 101



Reactor Compartment

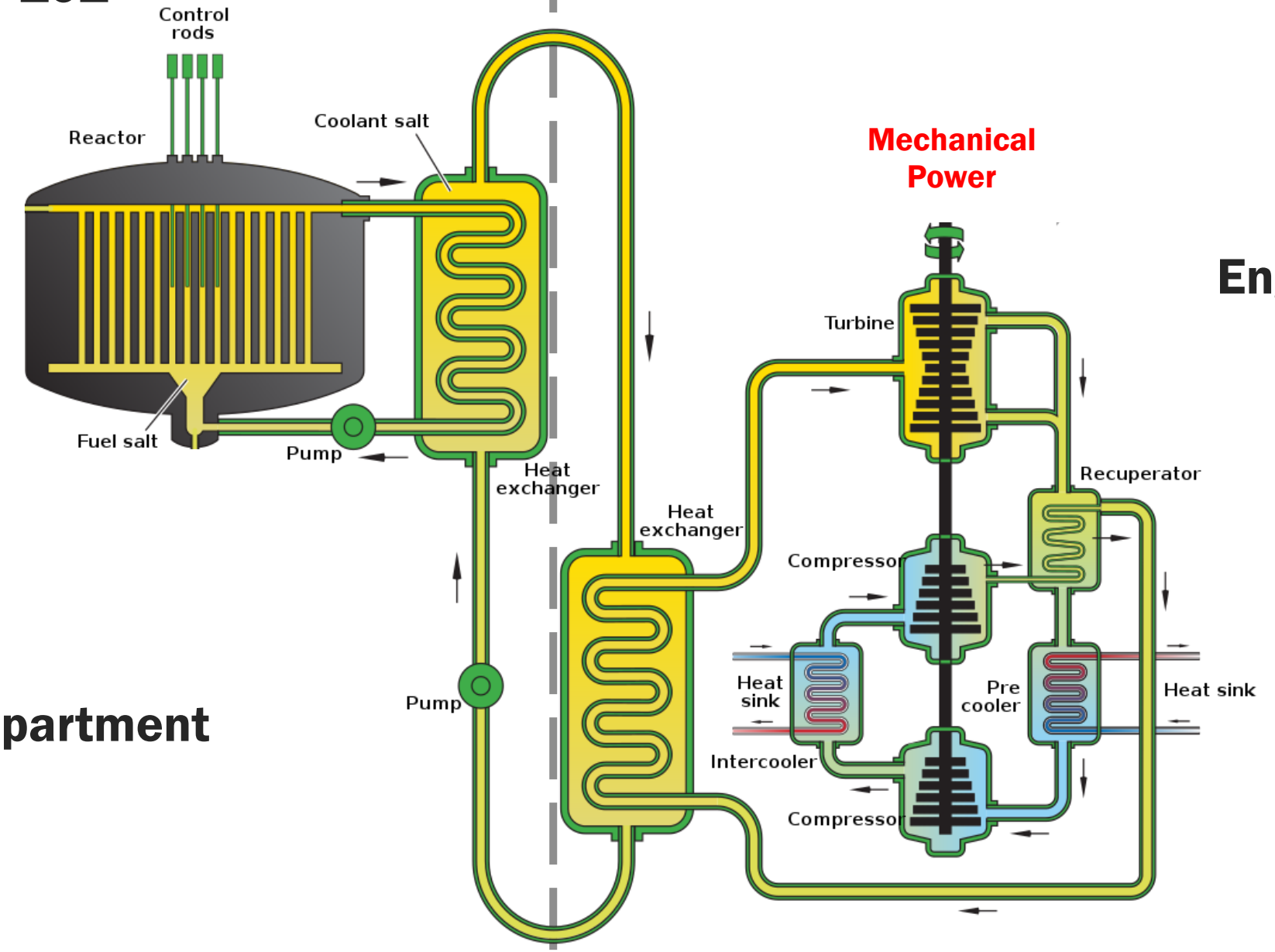
Nuclear Power 101



Reactor Compartment

Engine Room

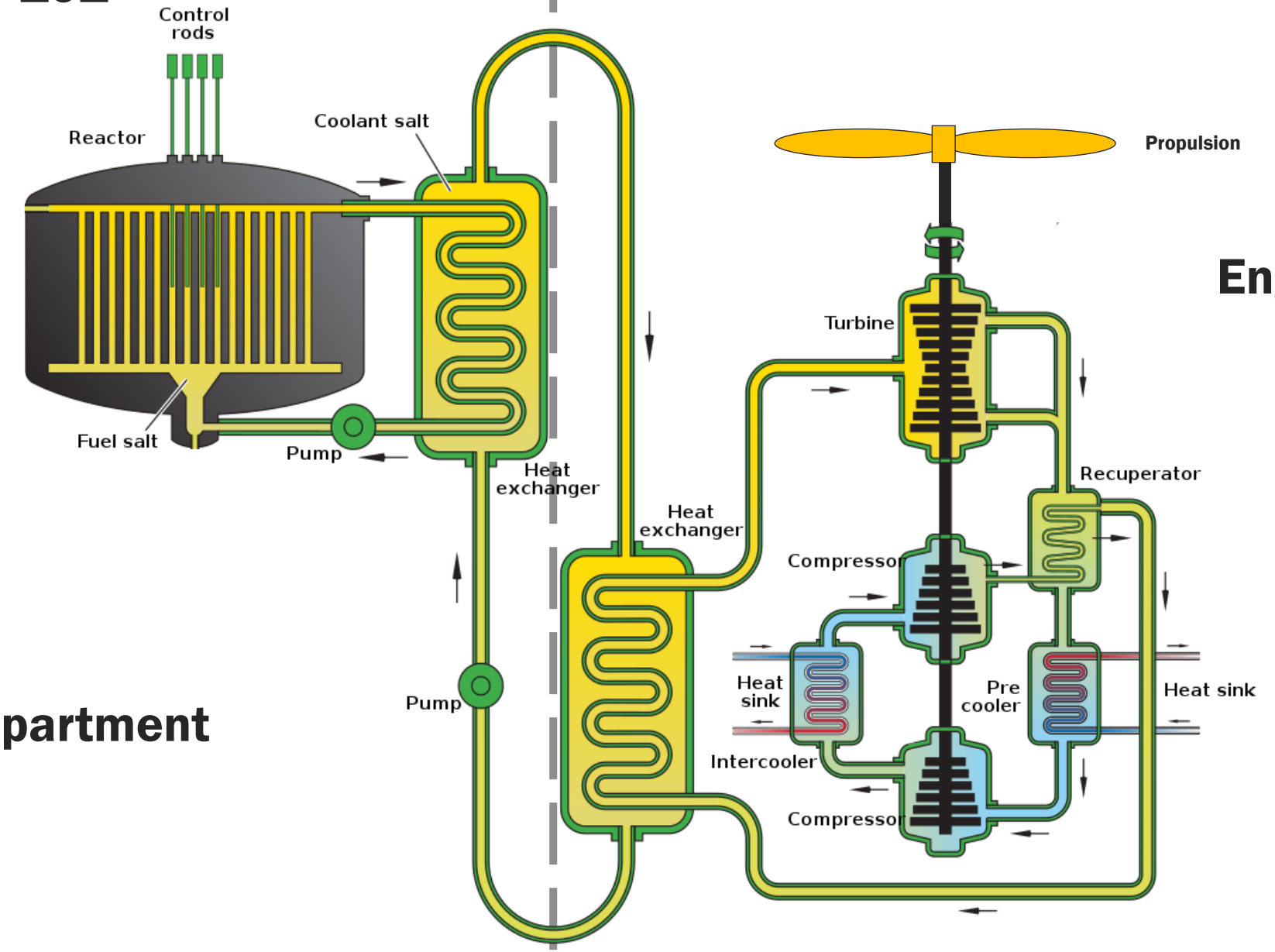
Nuclear Power 101



Reactor Compartment

Engine Room

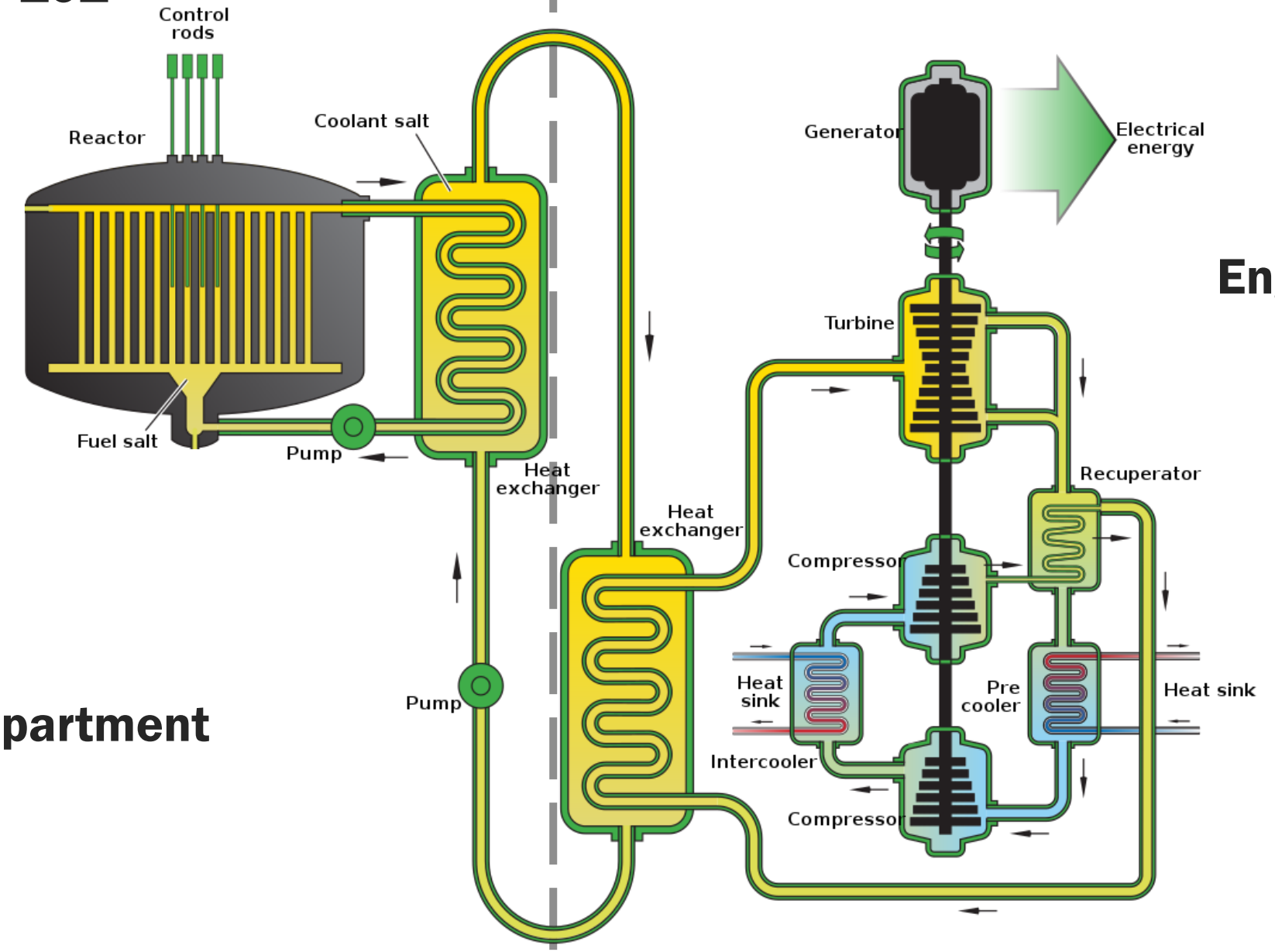
Nuclear Power 101



Engine Room

Reactor Compartment

Nuclear Power 101



Engine Room

Reactor Compartment

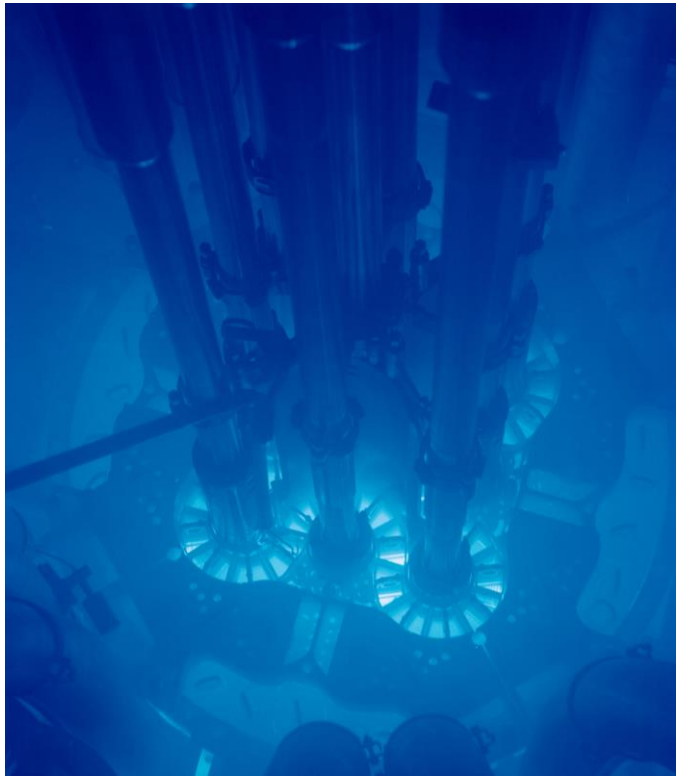
3 Key criteria for marine applications

Exceptional fuel efficiency

Long fuel cycle

Modular construction

Affordable



Unpressurized core

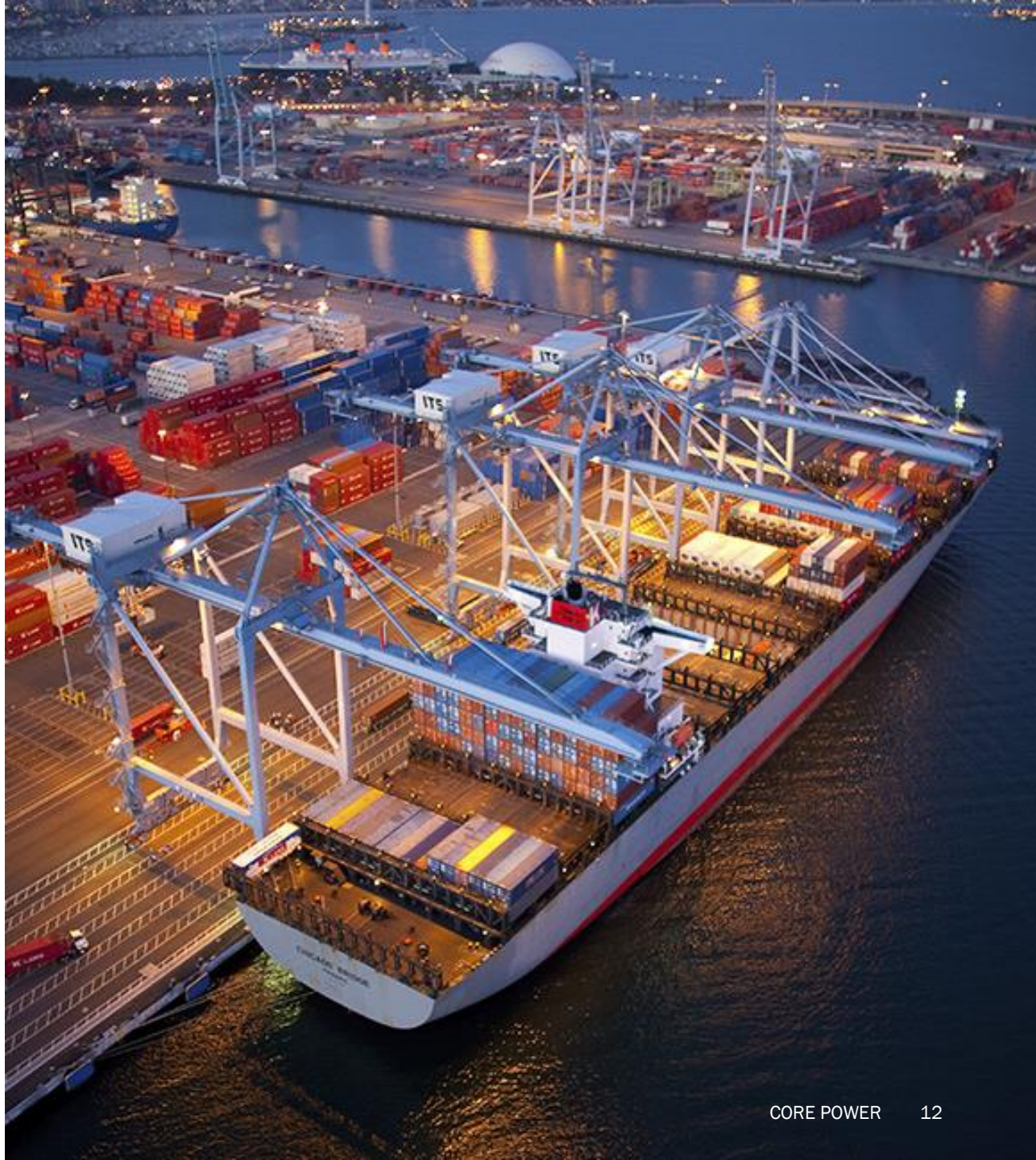
Minimal Emergency Zone

Emergency Planning Zone EPZ

Large Pressurized Reactors > 80 km

Small Pressurized Reactors > 10 km

Small Unpressurized Reactors - meters



‘Award winning’ team

CORE POWER

TerraPower

orano

Southern Company

U.S. DoE ARDP award
80/20 cost share

Substantial private
sector investments

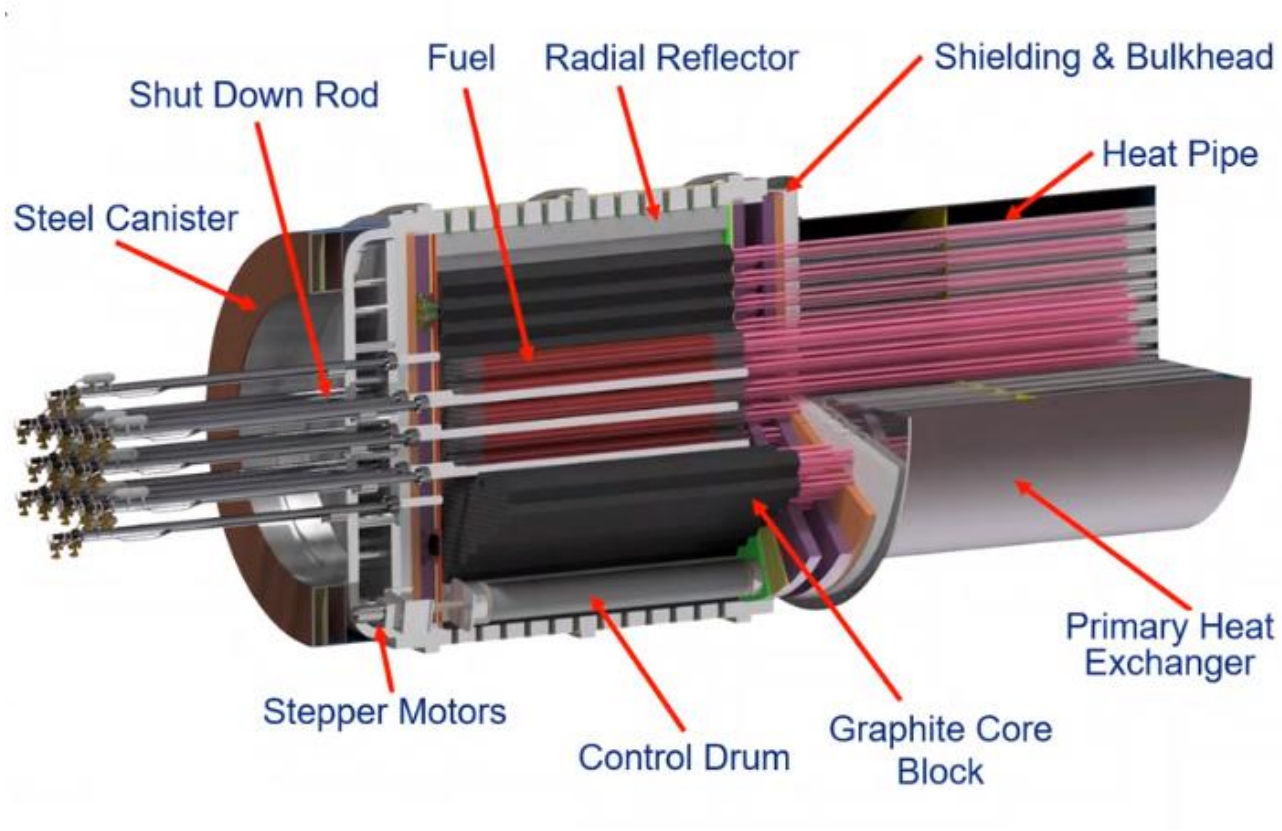
Molten Chloride Reactor
Experiment by 2025

The Molten Chloride Fast Reactor

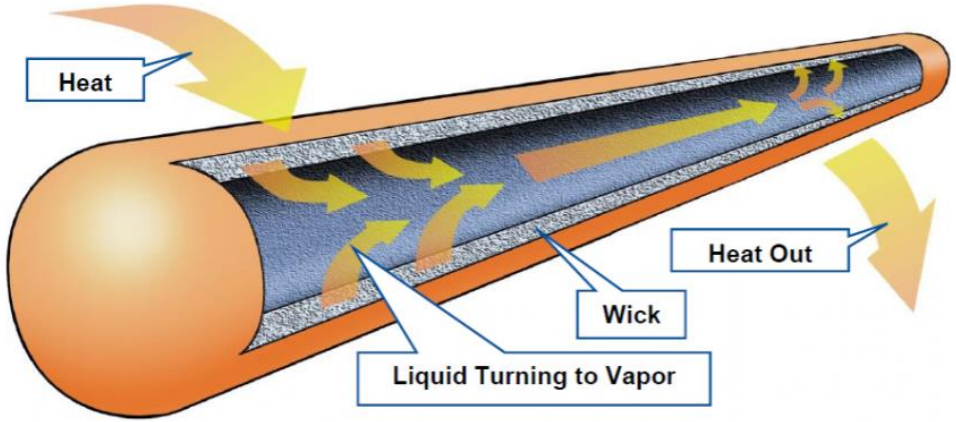
- Demonstration post-2026
- Exceptional fuel-efficiency
- Compact, modular, up to 720 MW thermal
- Ambient pressure only = Minimal EPZ

eVinci micro heat pipe reactor, 5 MWe

eVinci Reactor



Heat Pipes

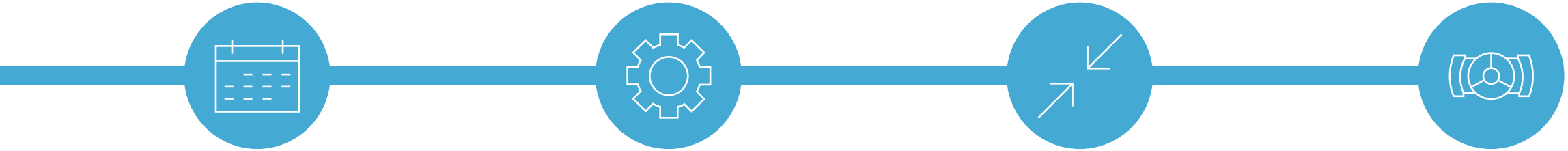


Joint Development Agreement

5 year development program

Pre-licensing lodged w NRC

$50 mill in US and CAN govt grants



Demonstration 2026

Solid state reactor, no moving parts

Very compact, modular, 15MWth

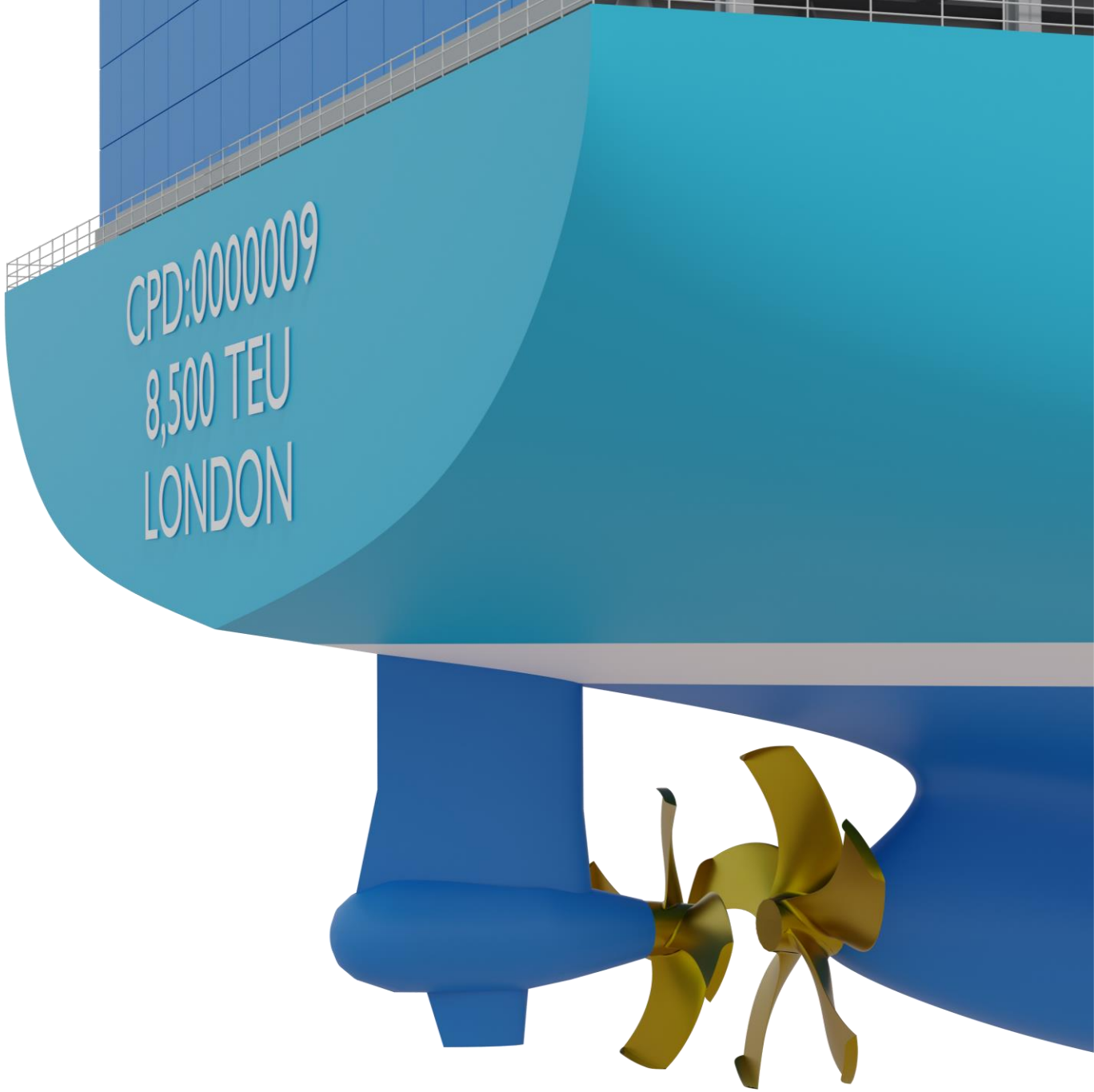
Unpressurised minimal EPZ

Nuclear Electric Propulsion

Type Approved & Licensed Nuclear Power Pack

Nuclear – Electric Propulsion

Advanced Propulsion Arrangements



Container Ships

Conventional / LSHFO

21 Knots design, 15 – 18 knots Operation
Large FOC, large emissions
Large ships: profitable but not flexible
Small ships: flexible but unprofitable

Atomic / mMSR

Faster: 25 – 30 knots,
No slow steaming: design = operation
True zero emissions
Large ships: much more profitable
Small ships: flexible and profitable

Ore Carriers

Iron Ore, Brazil - South Asia, 60 days round trip

LSHFO	Gr. NH3	mMSR
3,700 t LSHFO	8,800 t NH3	1.1 kg HALEU
11,200 t CO2	Low TLC emissions	Lowest TLC emissions
700 $/t + carbon tax	3 - 6 x LSHFO price	450M USD TLC savings

LNG Tankers

vs 20 Knots conventional

1.5 B USD savings

- 4.3 M tons CO_2eq

+ 6.5% capacity

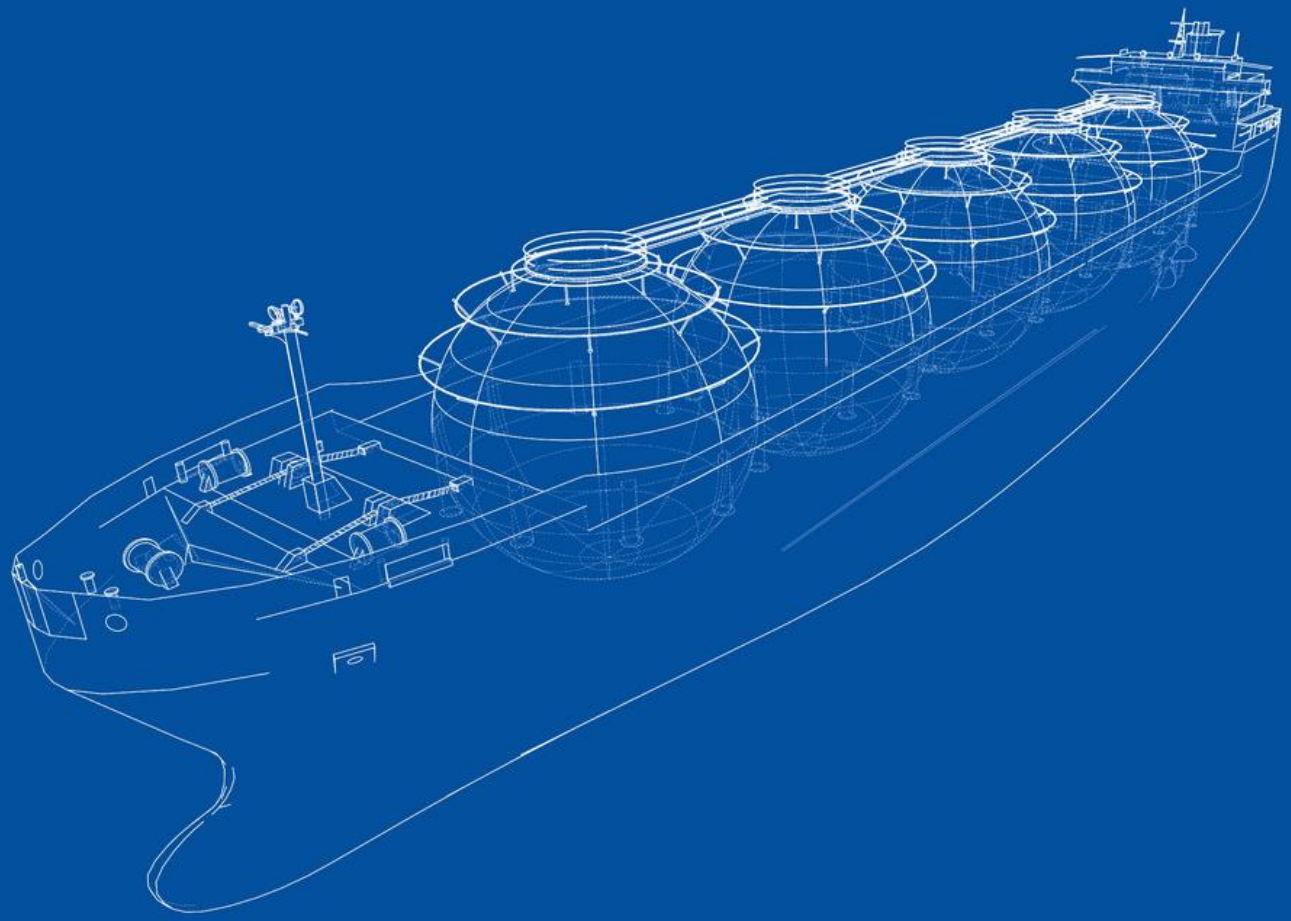
vs 16 Knots conventional

1.3 B USD savings

- 3.2 M tons CO_2eq

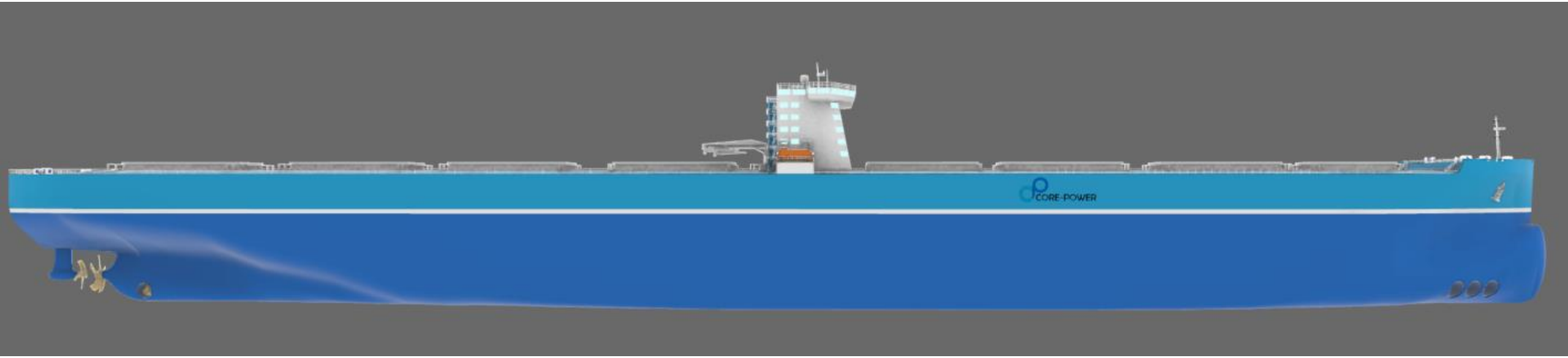
+ 27% capacity

Full Re-liquefaction



Ultra-competitive ocean transportation

Zero Emissions | Higher Profits | No Slow Steaming | No fuel volatility



High CAPEX / Very Low OPEX => New Business Model: long term PPA / lease

Safety by Design + Defense in Depth

Redundant safety

Sealed, shielded, inaccessible

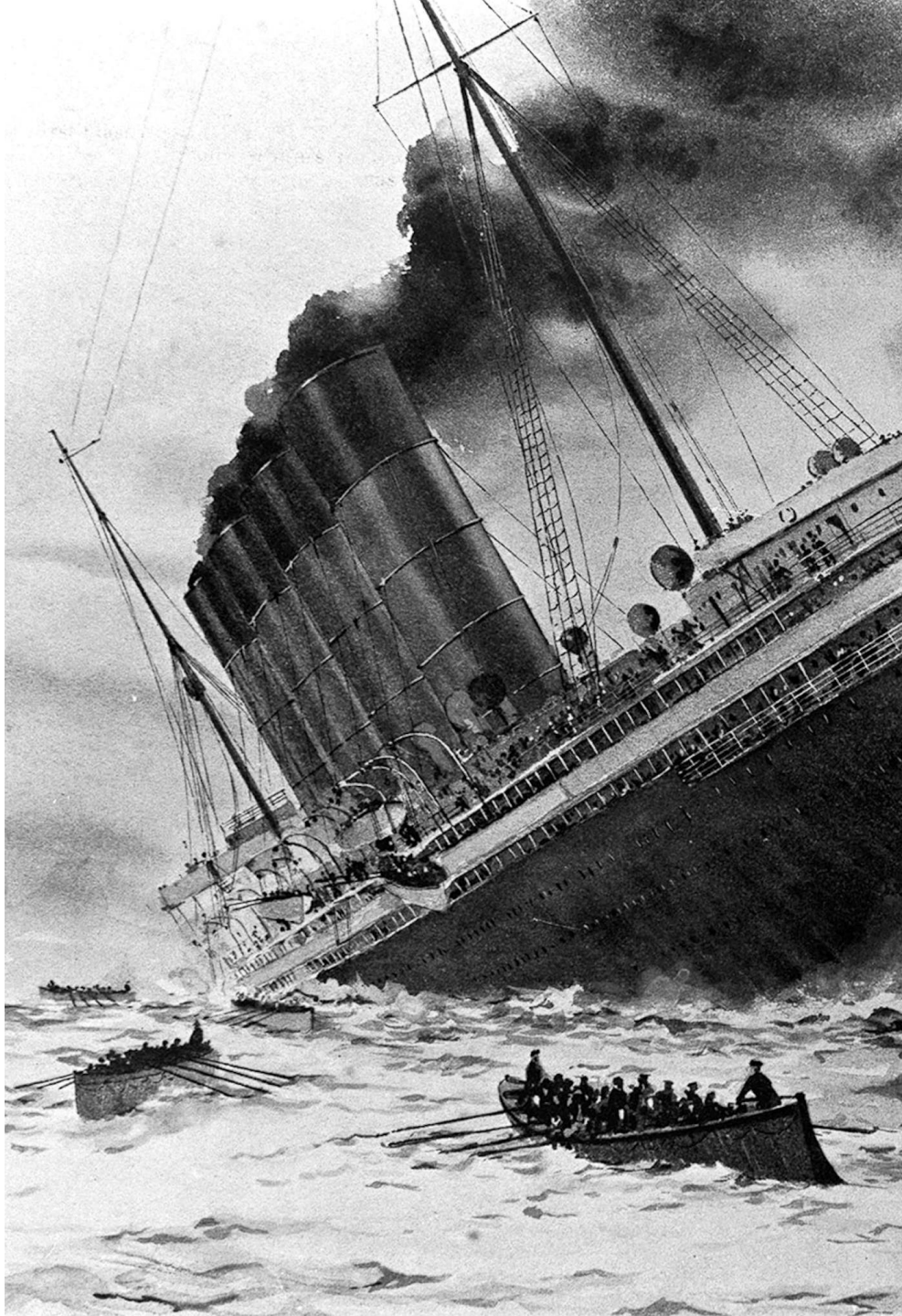
Containment vessel, shielding, bulkheads, (B/5)

Infinite cooling capacity

In case of accident:

Fuel entombed in the reactor

No radiation is released to the environment



And what about the waste?

ULCS 30 years at 30 knots
1.8 tons / 0.6 m^3 waste fuel

Reduce / Reuse / Recycle:
MRI supply chain, waste burner

Nuclear waste is not delivered to humans or environment

The Sea is the Limit

Offshore Nuclear = Faster, Safer, Cheaper

Fast and cheap shipyard construction

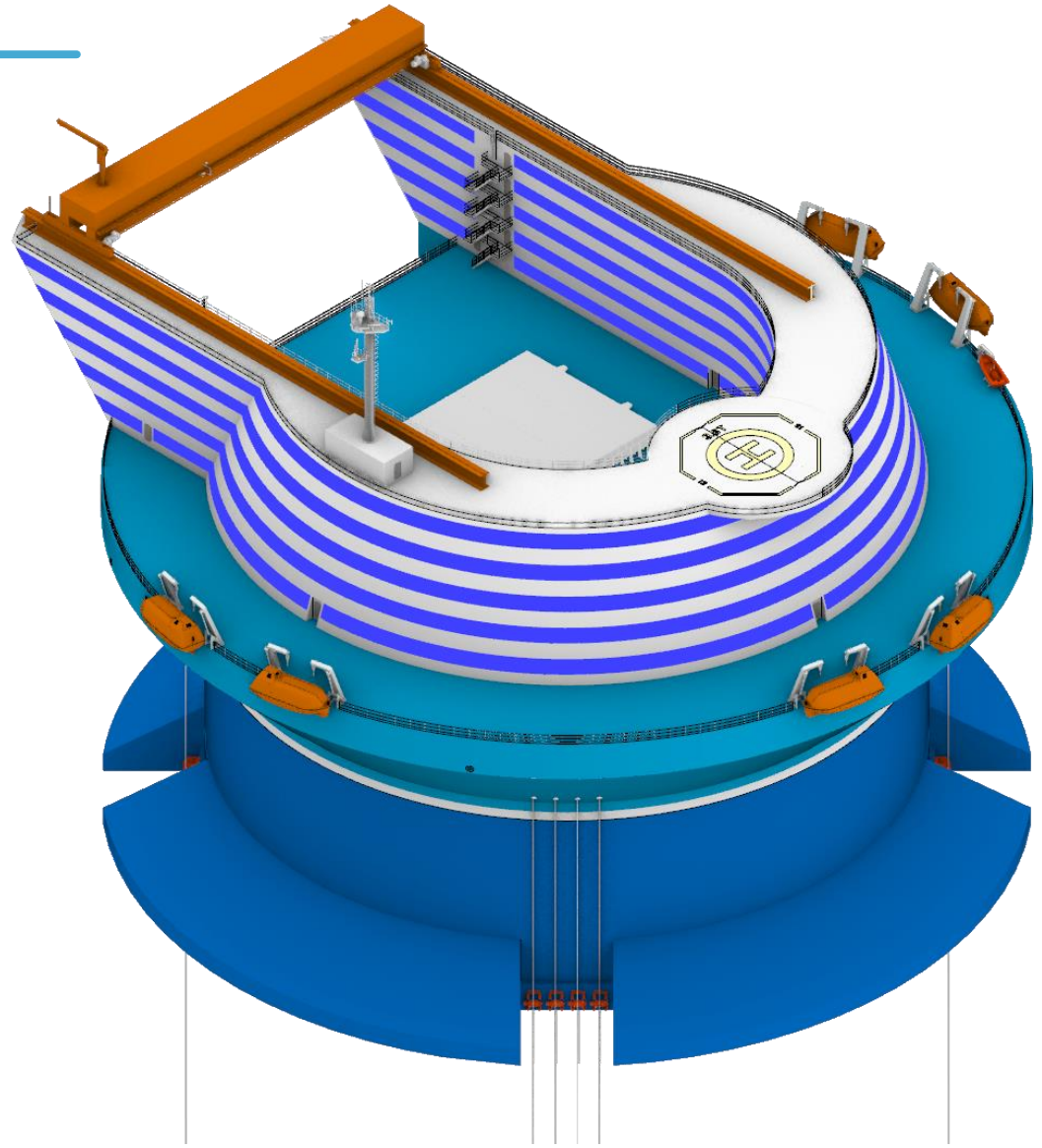
Far from human settlements

Sea provides infinite cooling

Immune to earthquakes and tsunamis

Decouples licensing and construction

No on-site decommissioning



Floating vs Land Based

> 50% building cost reduction

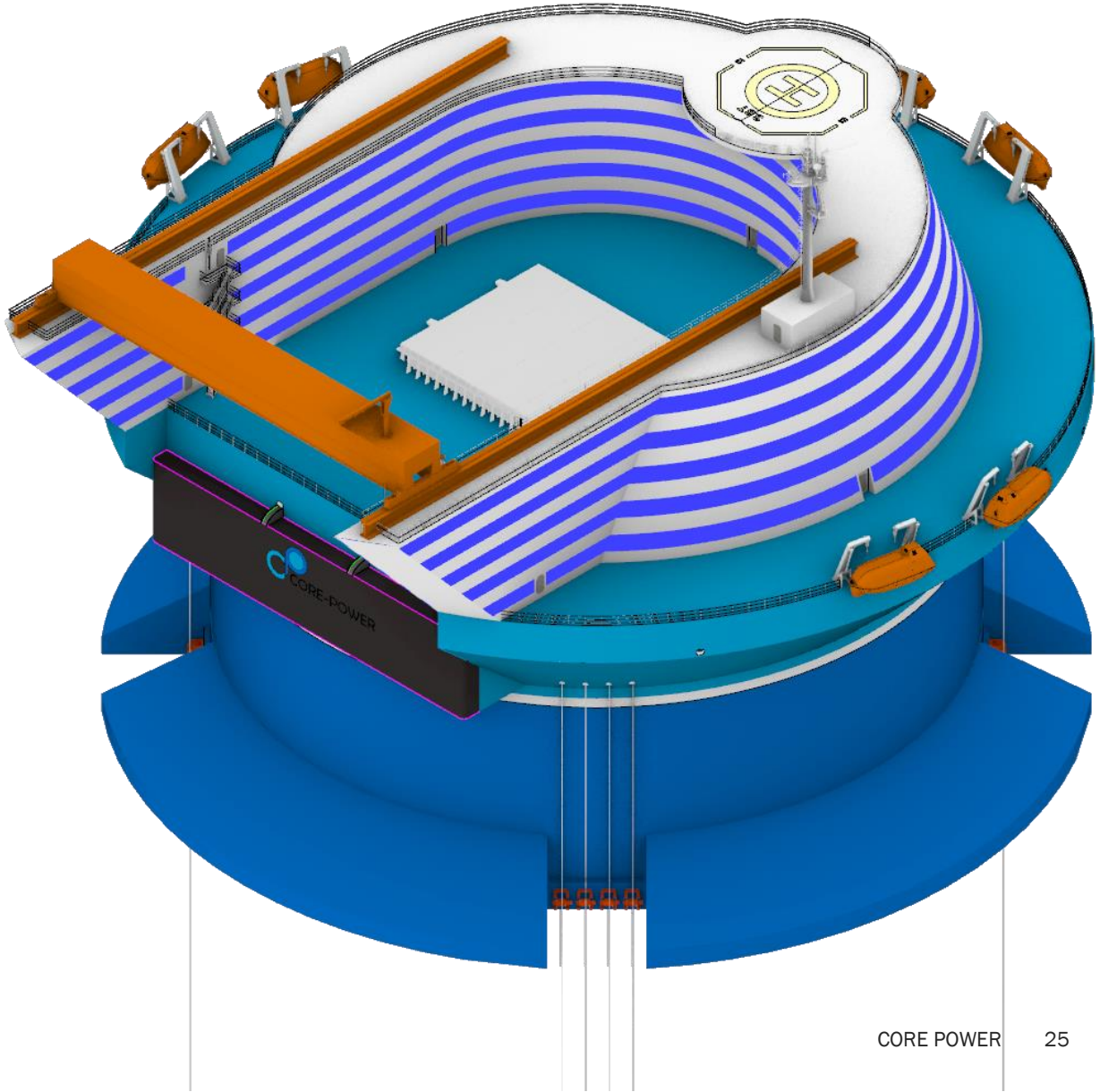
> 33% reduced build time

> 15 times less concrete

50% more steel

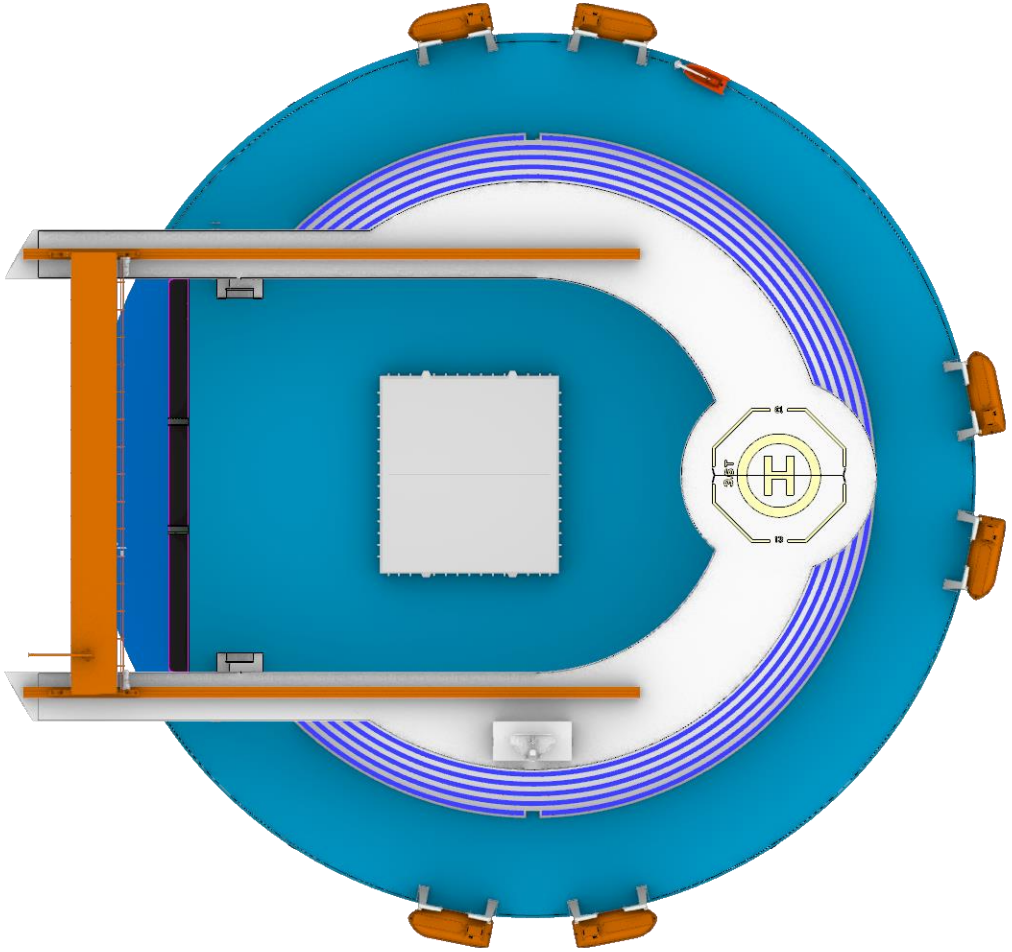
Large scale / serial manufacturing

Skilled workforce / Learning curve / Kaizen



Applocations

- Power to shore
- Water desalination
- eFuel production
- Offshore processing
- Coastal industry
- Load balancing for VRE
- Floating data centres



1200 MWe Nuclear Floating Power Plant

Main Dimensions

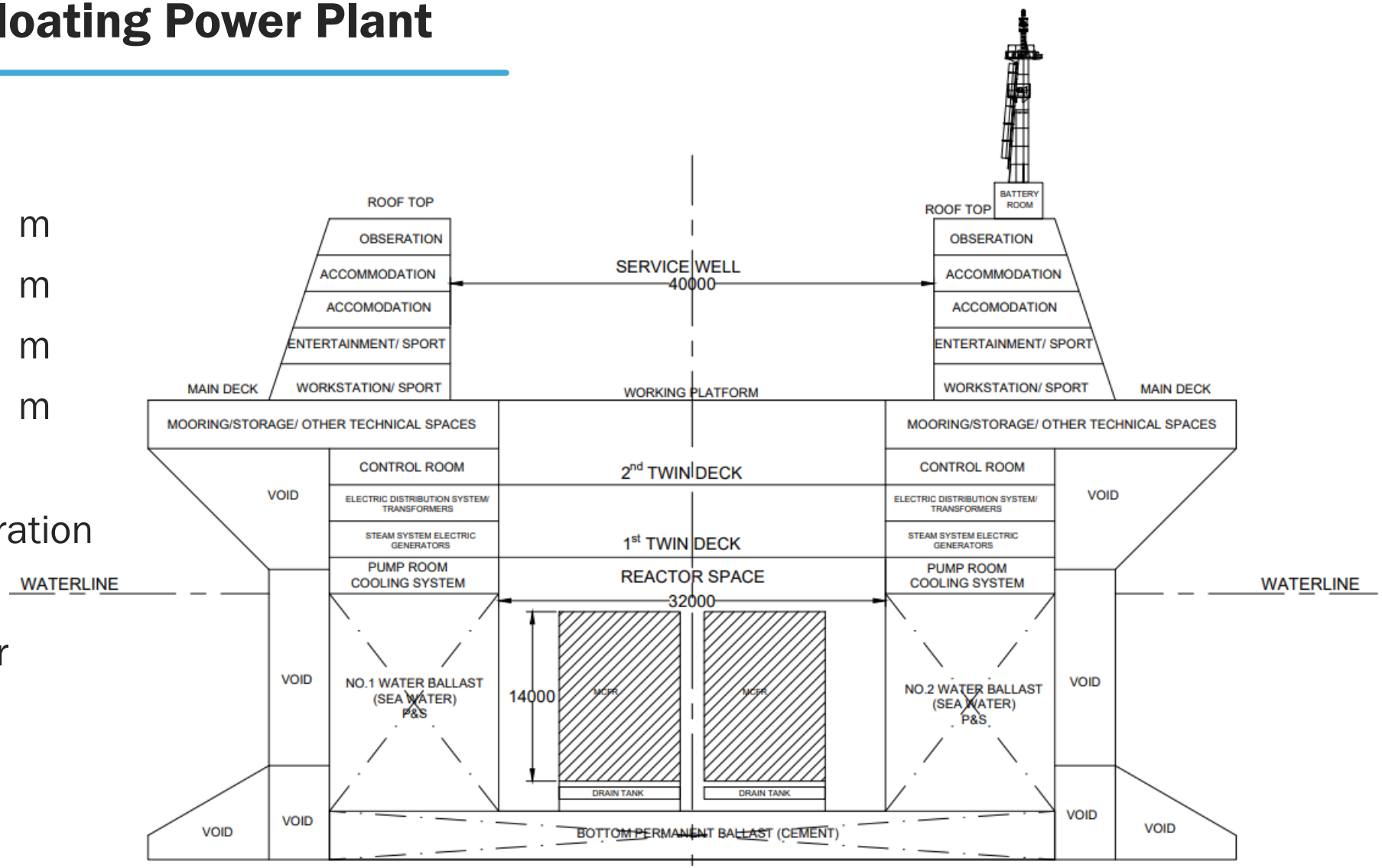
Hull diameter	70	m
Main deck diameter	90	m
Main deck height	38	m
Total height	53	m

1.2 GW electric power generation

or

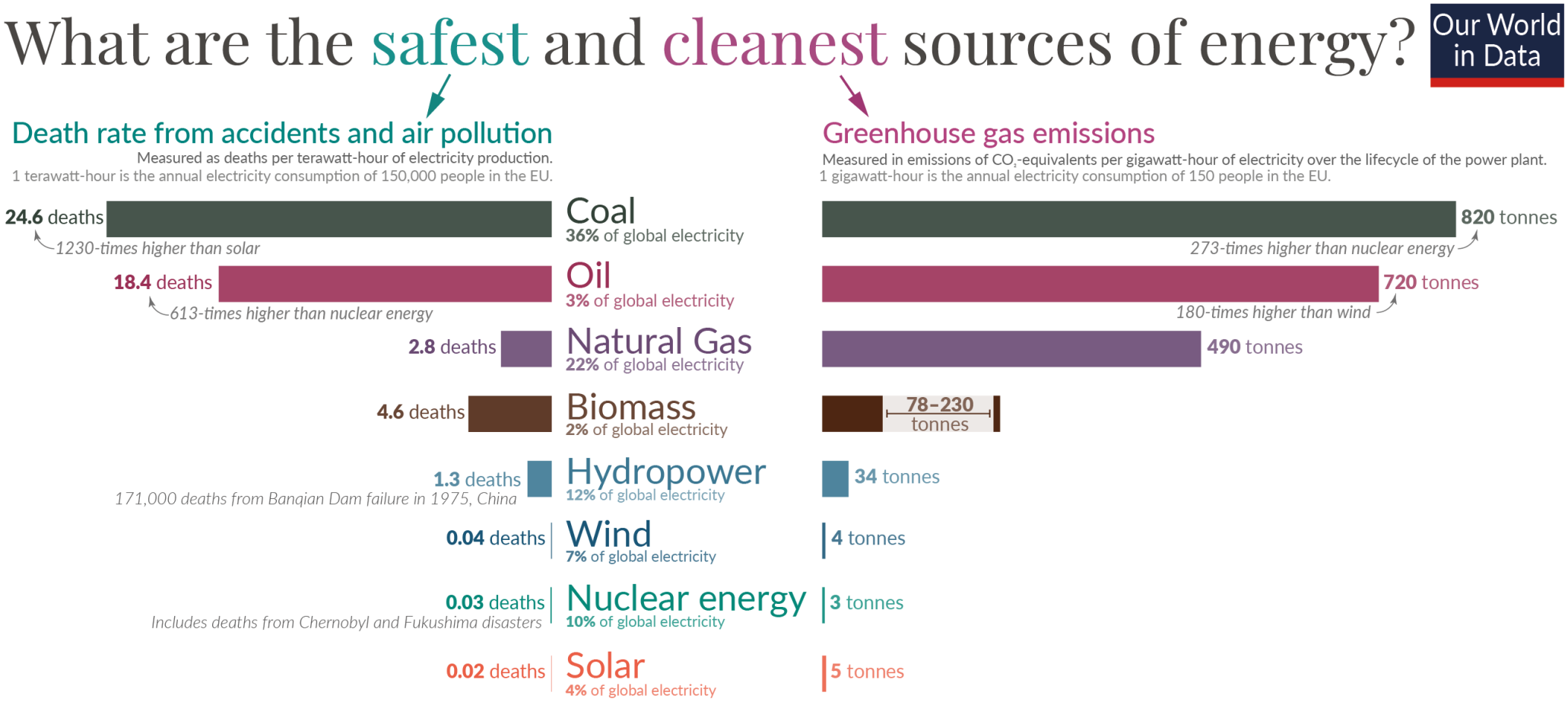
up to 200,000 tons H2/year

(at 95% capacity factor)



NOTE: H2 best produced at the point of usage to avoid costly handling and shipment

Nuclear Power = Lower Externalities



Death rates from fossil fuels and biomass are based on state-of-the art plants with pollution controls in Europe, and are based on older models of the impacts of air pollution on health.
This means these death rates are likely to be very conservative. For further discussion, see our article: OurWorldinData.org/safest-sources-of-energy. Electricity shares are given for 2021.
Data sources: Markandya & Wilkinson (2007); UNSCEAR (2008; 2018); Sovacool et al. (2016); IPCC AR5 (2014); Pehl et al. (2017); Ember Energy (2021).
OurWorldinData.org – Research and data to make progress against the world's largest problems.

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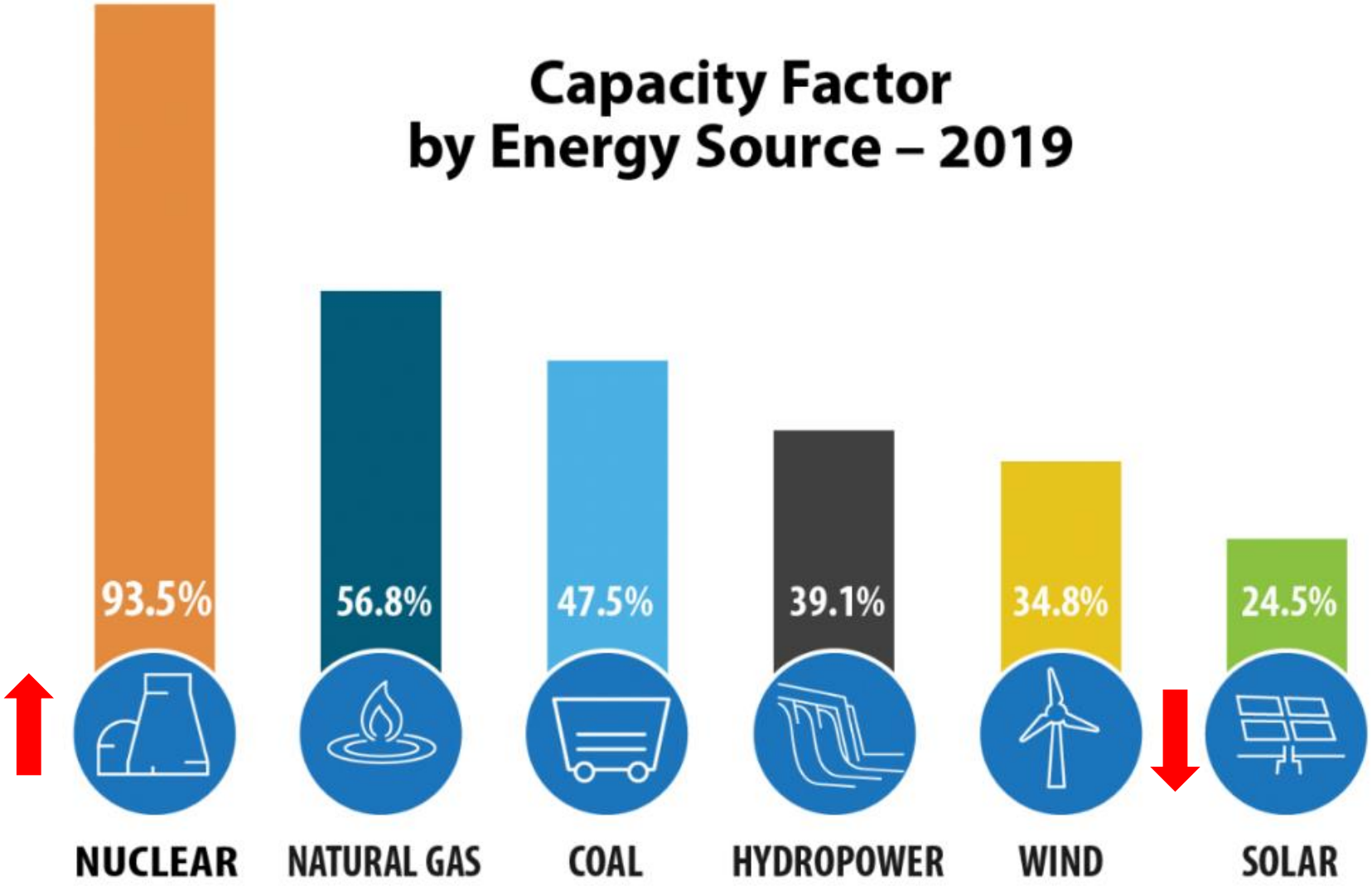
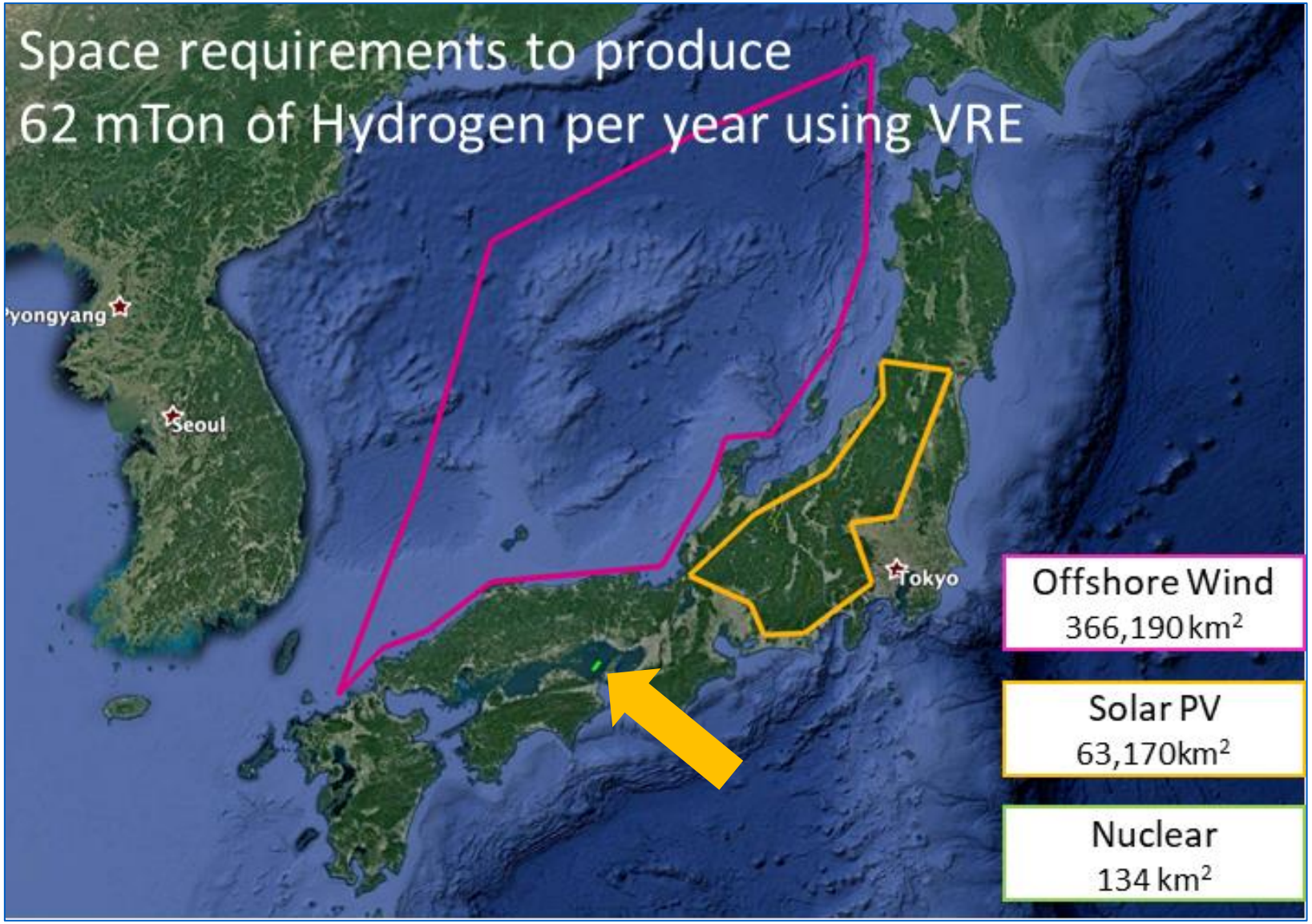
Nuclear Power = Highest Capacity Factor



Nuclear Power = Lowest Footprint



Regulatory process to 2030

IAEA

International Nuclear Safety Standards

IMO INTERNATIONAL MARITIME ORGANIZATION

International Maritime Safety Standards

Current framework proposals

ONR
UK MCA
LR Class

AUKUS

NRC
USCG
ABS Class

(NRA)
(MLIT)
(NKK Class)

Holistic QA framework for Licensing, Regulation and Classification by 2030

Current regulatory work-scope

SOLAS VIII into UK law in 2022

Working group with Regulators and Classification led by CORE POWER

US DoE ARDP

Working group with Regulators and Classification led by CORE POWER

TNPP and FNPP working groups

CORE POWER expert consultant

World Nuclear Transport Institute

Transportation of nuclear materials

CORE POWER chairs the maritime working group

Maritime Nuclear Applications Group

Idaho National Lab/NRIC (US DoE)

CORE POWER plays a major role

CORE POWER is also engaged with