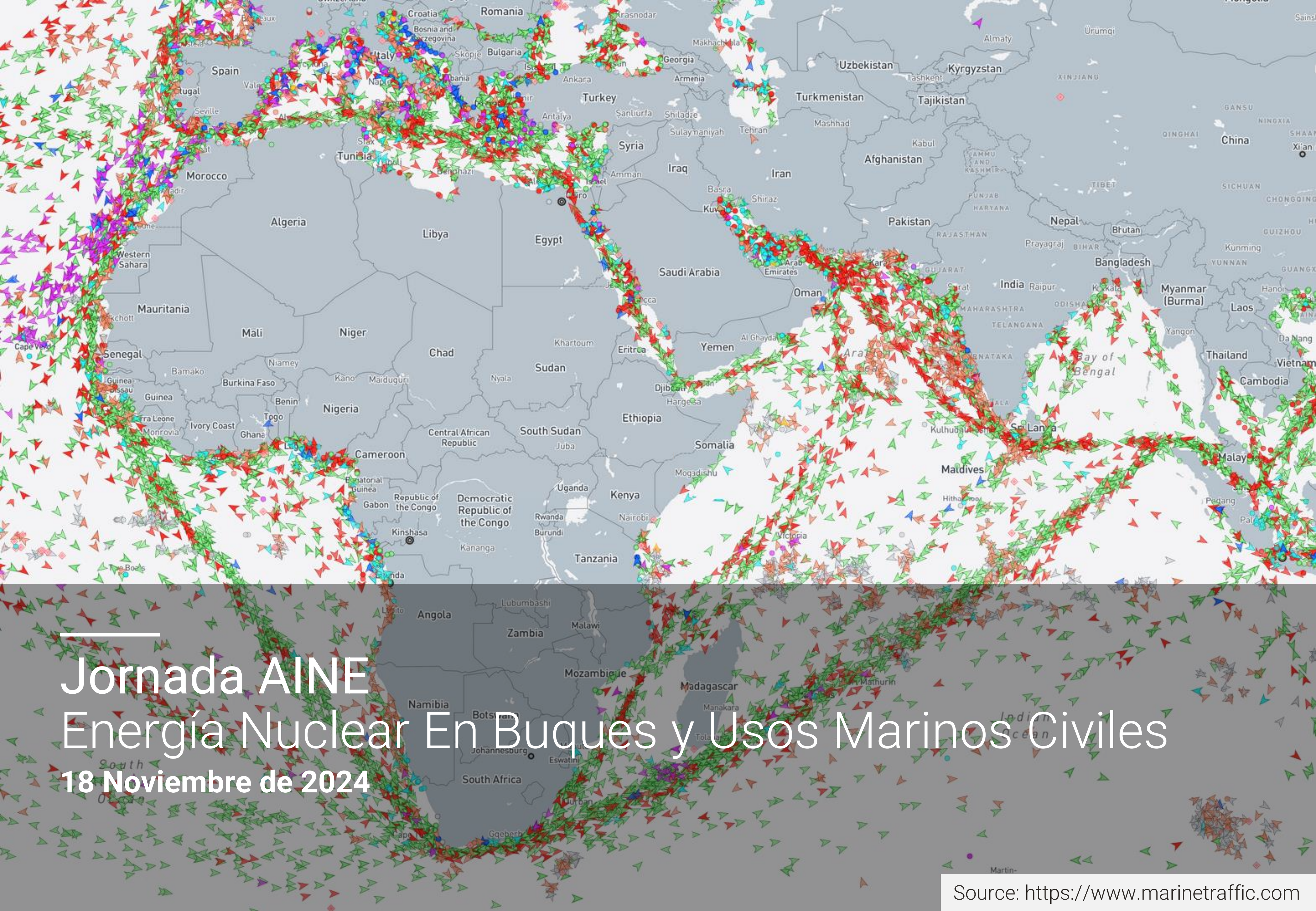

Jornada AINE

Energía Nuclear En Buques y Usos Marinos Civiles

18 Noviembre de 2024

Source: https://www.marinetraffic.com

BIOGRAPHY

Miguel Calvo

Miguel is the head of Rubicon Infrastructure Advisors' Madrid Office, an Irish based Infrastructure Investment Bank. He has 15 years of experience in the financial services industry, in financing and selling long-dated financial assets.

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Miguel has 15 years of experience across a broad spectrum of sectors, including transportation, energy, and social infrastructure in Spain, Latin America, and North America.

During his time at Rubicon Capital Advisors, Miguel has led all aspects of the deal process, from investor development, initial origination, deal preparation, due diligence, transaction execution, and document negotiation.

Throughout his time at Rubicon, he has made significant contributions to the success of some of Rubicon's largest M&A and refinancing deals.

Prior to joining Rubicon in 2013, Miguel worked as a consultant with PwC's Public Finance Team in Spain, providing modeling and financial advisory services on infrastructure projects.

Miguel started his professional career as a banker with BBVA's Project Finance team in New York.

Miguel holds an MSc in Computer Science from Universidad Pontificia de Comillas and a Master's in Quantitative Finance, Banking, and Corporate Finance from Universidad de Alcalá.

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Net Carbon Zero by 2050 – IMO's Target

DECARBONIZATION IN THE MARINE INDUSTRY

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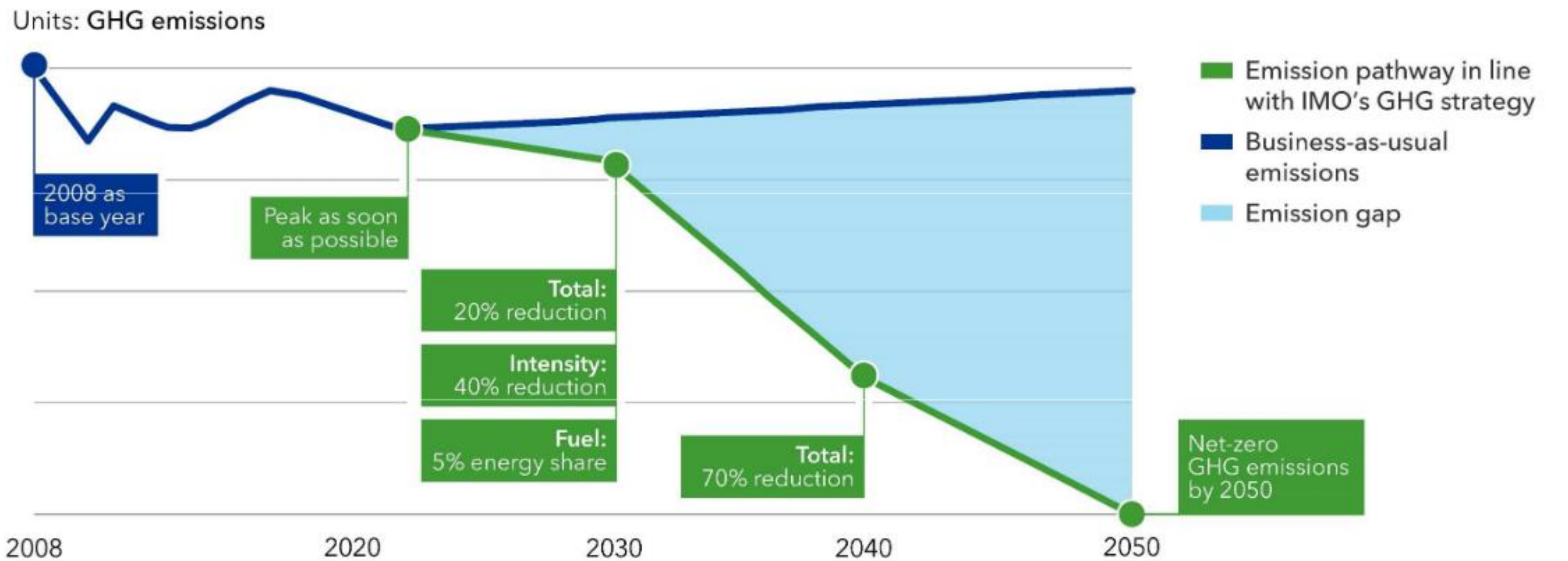
IMO´s Roadmap to Net-Zero GHG Emissions

2023 IMO STRATEGY ON REDUCTION OF GHG EMISSIONS FROM SHIPS

Strengthened IMO strategy on GHG reductions



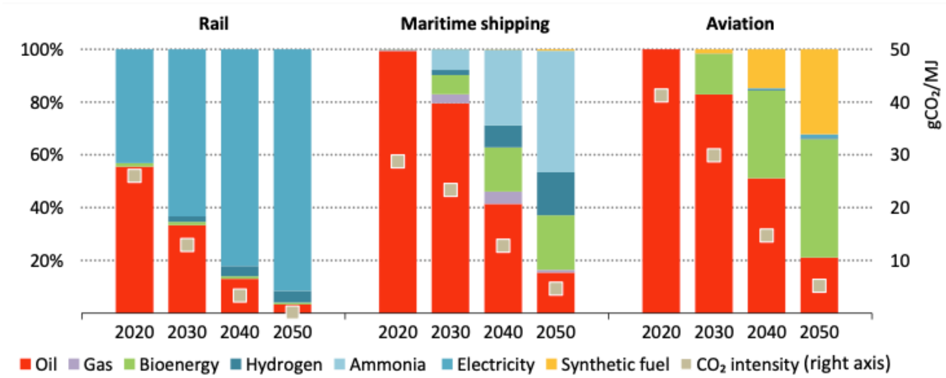
Total: Well-to-wake GHG emissions; **Intensity:** CO_2 emitted per transport work; **Fuel:** Uptake of zero or near-zero GHG technologies, fuels and/or energy sources

©DNV 2023

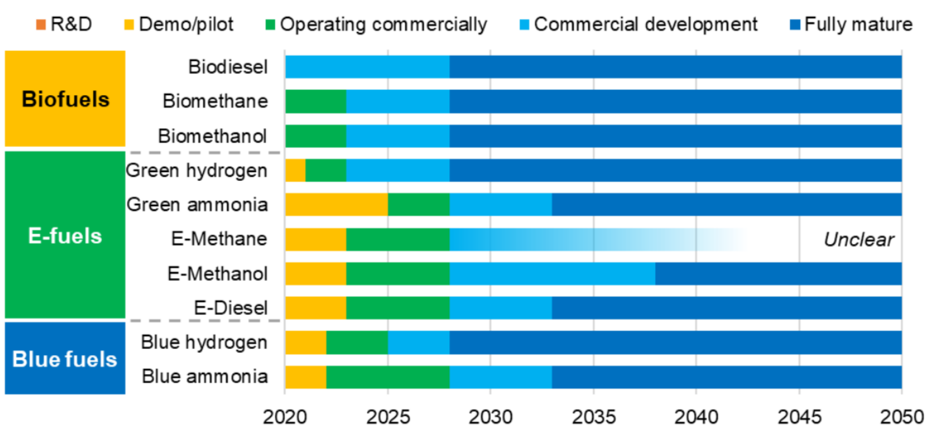
Transitioning Into Alternative Fuels

- Alternative fuels are energy sources that can be used to power vehicles and equipment instead of traditional petroleum-based fuels like gasoline or diesel.
- New fuels will be crucial for decarbonizing the shipping sector. The IMO has published a list of fuels which they consider as viable alternatives.
- As of today, the IMO does not consider nuclear power as part of their energy mix.
- Complementary studies by other organizations, such as the International Renewable Energy Agency ("IRENA"), or the International Energy Agency ("IEA") also do not consider nuclear power as an integral part for the decarbonization of the shipping industry.

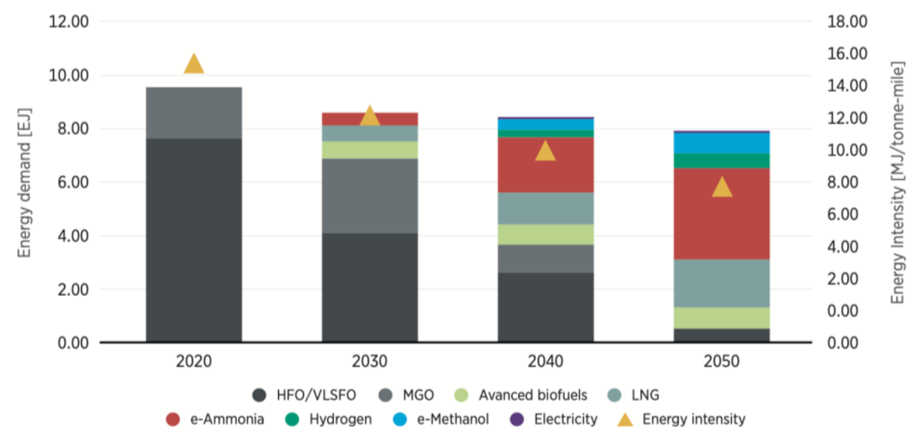
IEA 2023: NET ZERO ROADMAP



IMO'S FORECAST OF READINESS AND AVAILABILITY OF FUEL PRODUCTION PATHWAYS



IRENA'S 2023 MARITIME DECARBONIZATION ROADMAP, 2018-2050



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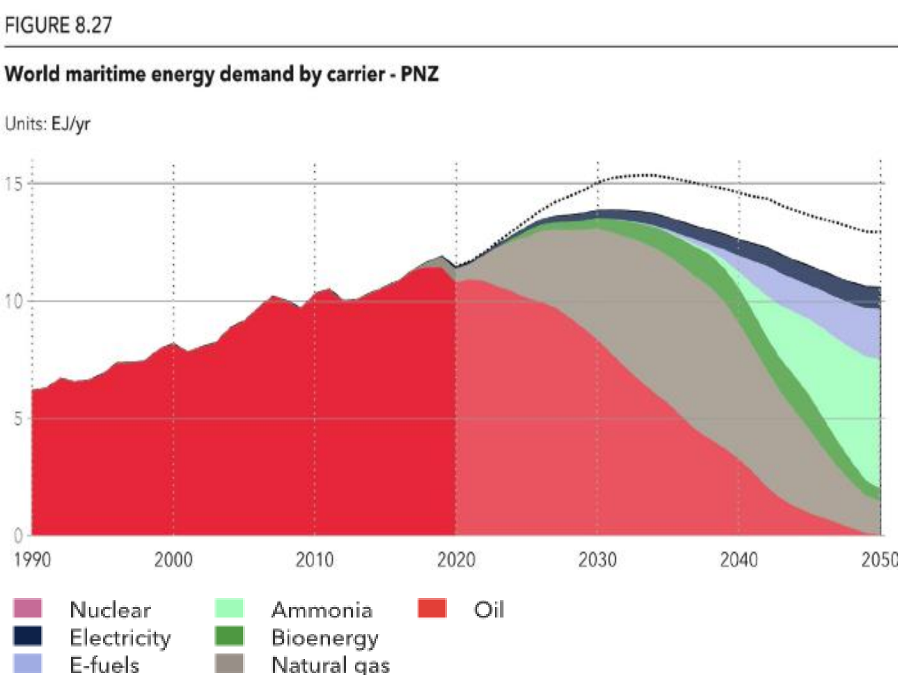
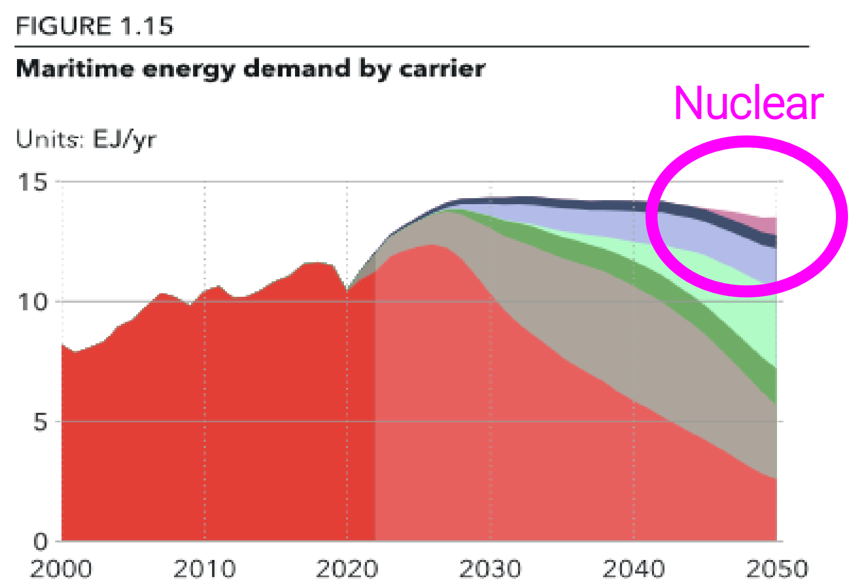
But, What About Nuclear?

- Some independent third-party studies are beginning to consider the idea of incorporating nuclear power into the mix. Although it currently lags behind alternative fuels, there are clear scenarios where the technology could surpass its competitors in terms of cost and environmental advantages.
- DNV, one of the world's leading certification, assurance, and risk management providers, regularly publishes a maritime forecast. Every year it publishes its Energy Transition Outlook ("ETO"), presenting its own independent global energy system forecast until 2050, as well as Pathways to Net Zero ("PNZ"), which is DNV's proposal accelerate the transition into Net-Zero.
- In its latest Energy Transition Outlook, nuclear energy is, for the first time, included as part of the energy mix.

DNV'S PATHWAYS TO NET ZERO – PNZ 2024



DNV'S ENERGY TRANSITION OUTLOOK - ETO 2023



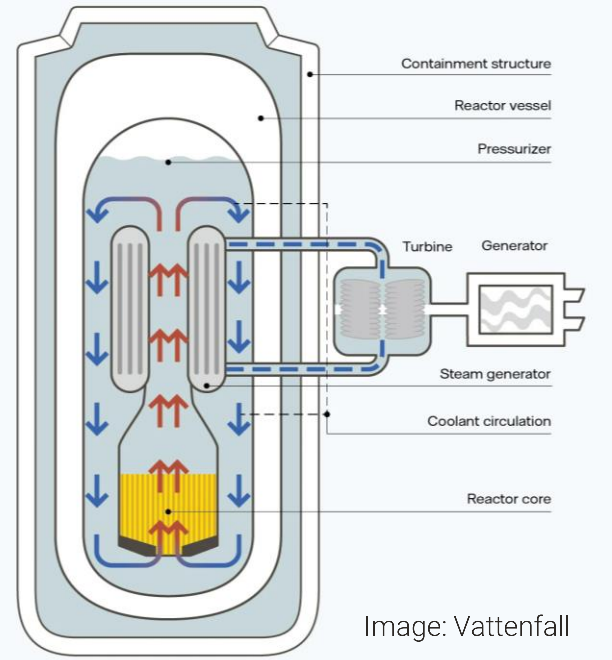
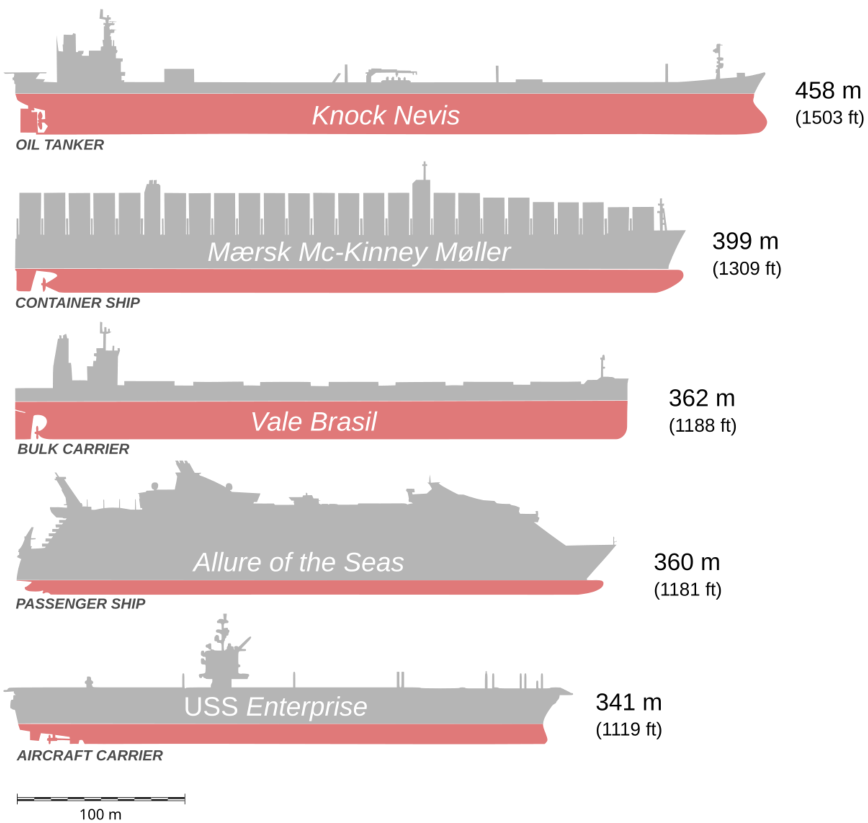


Image: Vattenfall

How Financially Feasible are Nuclear Powered Vessels?

How Much Do New Vessels Cost?

- Today, there are over 100.000 vessels in the world.
- 93% of global shipbuilding by gross tons occurred in China, Korea and Japan.
- Over half of the world's fleet by tonnage in dwt is owned by Asian Companies.
- Accurate estimates for new different vessels are difficult to source, as these ships are typically tailor-made. The estimates below are based on publicly available information which, although it might not be fully accurate, it serves as a proxy for this discussion.



OIL TANKER:

- Very Large Crude Carrier / Ultra Large Crude Carrier: Up to $125m.

CONTAINER SHIP:

- $200m for Maersk Triple-E.

BULK CARRIER:

- $100m for a Very Large Ore Carrier (VLOC).

PASSENGER SHIP:

- Up to $2Bn for the Icon of the Seas.

MILITARY AIRCRAFT CARRIER:

- $13Bn for the Gerald R. Ford

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How Much Would Nuclear Power Propulsion Cost?

- There is not much information available regarding the direct and indirect costs of building, operating, maintaining, and decommissioning an SMR (Small Modular Reactor) for naval applications.
- Current estimates for land-based SMRs generally range from $4,000 to $10,000 per kilowatt (kW) of installed capacity. This means that for a **50 MW SMR, the cost would range from $200 million to $500 million**. It is unclear, however, how much it would cost to operate and maintain an SMR in a naval setting.
- In addition to the direct costs associated with the construction and operation of an SMR, there will be additional indirect costs linked to this technology. These could include financial expenses (such as additional insurance, reserve requirements for maintenance and decommissioning), increased fees imposed by ports to offset their infrastructure costs, and others.
- Other hidden or unknown expenses may arise throughout the vessel's lifespan, such as health and safety-related costs due to changes in regulations, environmental impact and sustainability expenses, changes in or removal of subsidies, and the introduction of new taxes that might specifically affect this technology.
- Decommissioning costs are also a significant unknown and represent a shift for the industry. Currently, vessels typically have a positive scrap value at the end of their life, whereas with an SMR-equipped vessel, there could be substantial costs beyond the vessel's operational life.

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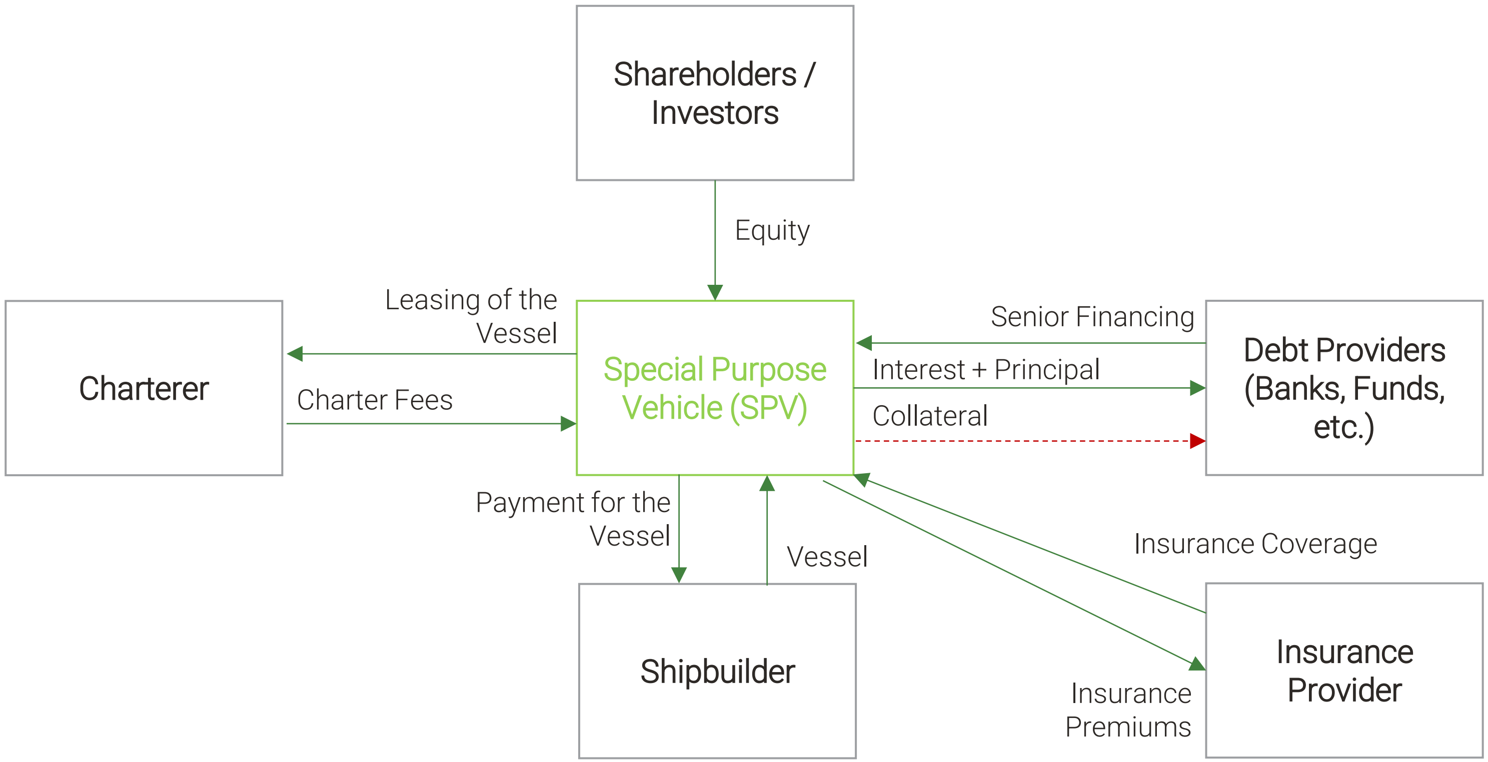
Shipping Financing Alternatives

There are various financing options of private finance available for purchasing a vessel:

- Traditional Bank Financing / Corporate Finance:
  - Use of traditional equity instruments and loans.
  - Capital/Debt is raised at a corporate level. The entirety of the borrowing company is responsible for said capital.
- Asset Financing / Off-Balance Sheet Financing:
  - A newly created company is created for the purpose of owning the vessel, which is the collateral of the investment / loan.
  - Investors / Lenders do not have any recourse to the parent Company, hence "off-balance sheet".
- Sale and Lease-back:
  - The Vessel is owned by a lessor (leasing company).
  - The operator leases the vessel in exchange for a regular lease/hire payments.
  - During the lease, the operator is typically responsible for the operation and upkeep of the vessel.
  - Benefits include access to ships without long-term commitment and ownership responsibilities.
- Public Financing / Government Grants and Subsidies:
  - Governments might strategically provide direct support to the shipping industry via loans or grants.

Typical Asset Financing Structure



Typically, investments in large projects / assets is done though Special Purpose Vehicles (SPV). SPV provides several benefits, especially in terms of risk management, flexibility, and efficiency.

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Evaluating Long-lived Investments

An investment opportunity is considered **investable** when it meets certain criteria that suggest it can provide a positive return for investors relative to the risk involved. While the specifics can vary based on the type of asset (stocks, real estate, startups, etc.), there are some general factors that contribute to whether something is deemed investable:

1. **Profit Potential:** There should be a reasonable expectation of future growth in value or earnings. This is often based on market trends, business models, or demand for the asset or company.

2. **Risk vs. Reward:** Investable assets have a clear understanding of their associated risks. High risks might still be investable if they come with a potentially high reward. The risk should align with the investor's risk tolerance. Higher risk/volatility could attract investors seeking short-term profits.

3. **Liquidity:** An investable asset is one that can be easily bought or sold (liquidity) without significantly affecting its price. Stocks and bonds are highly liquid, whereas real estate or private equity investments may be less so. The more accessible an investment is in terms of market participation (low barriers to entry, low transaction costs), the more investable it becomes.

4. **Regulatory Environment:** For an asset to be considered investable, there needs to be a regulatory framework that protects investors and ensuring fairness.

5. **Track Record and Historical Performance:** While past performance does not guarantee future results, a proven track record of consistent returns can make an asset more attractive to investors.

6. **Macroeconomic Conditions and Geopolitical Factors:** Economic and political stability, trade policies, international relations, and regional conflicts can create uncertainty, affecting investor confidence. For instance, international trade wars, political unrest or sanctions can disrupt markets, while stable geopolitics encourage foreign investments and trade, boosting market growth.

Something becomes investable when it offers a reasonable balance of potential returns with acceptable levels of risk, is relatively liquid, in demand, and operates within a favorable regulatory and economic environment.

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Risk and Reward Analysis of Nuclear-Powered Vessels

Nuclear Powered Vessels	Risk / Reward Analysis
Profit Potential	✓ Fuel Efficiency. Fixed fuel costs. They can operate for years without the need to refuel. ✓ Operational Range: Nuclear vessels can potentially operate at higher speeds for longer durations without refueling. ✓ Market differentiation: might be attractive to a particular target market, specially those with strong ESG values. ✓ Regulatory compliance: as new regulations are put in place to achieve decarbonization goals. ✗ Up-front Capital Expenditure: The technology, nuclear reactors, and specialized shipbuilding infrastructure are expensive. ✗ Increased Operational Expenses: Compliance with strict international and national regulations related to nuclear safety, waste disposal, and environmental impact is unclear and potentially costly. ✗ High Maintenance Requirements: Nuclear propulsion systems require meticulous and specialized maintenance to ensure safe operation. ✗ Decommissioning Costs: At the end of a nuclear-powered vessel's life, the decommissioning and disposal of the nuclear reactor add a further layer of costs, which must be factored into profitability calculations.
Liquidity:	✗ Liquid assets are those that can be quickly and easily bought and sold minimal loss of value. This could be the case for standard vessels, not for nuclear powered vessels.
Regulatory Framework:	✗ Untested Regulatory Framework: while the foundational regulatory framework exists, it is undergoing significant updates to accommodate the future of nuclear-powered shipping. ✗ Changes in Regulation: As technology evolves, so do safety and environmental regulations. A company investing in nuclear-powered vessels must ensure that their technology complies with current regulations, but future changes in safety standards could require costly retrofits or upgrades. The regulatory framework in nuclear power plants over land has a terrible track record of ever-growing requirements. This may be an additional uncertainty. ✗ Liability Limitations: Private sector companies will never be able to provide sufficient guarantees in the event of a severe spillage or accident. ✗ Lack of Insurance Products or Back-Stop Agencies: Insurance companies will need to provide coverage for this type of technology backstopped by governmental entities for any residual risk. Current Protection&Indemnity insurance policies should be modified to cover these new risks.

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Risk and Reward Analysis of Nuclear-Powered Vessels

Nuclear Powered Vessels	Risk / Reward Analysis
Macroeconomic Conditions and Geopolitical Factors	✗ Geopolitical Factors: Geopolitical tensions could heighten concerns over nuclear technology, impacting international regulatory frameworks. ✗ Political Stability and International Cooperation: The development of nuclear-powered ships relies on international cooperation for setting regulatory standards. ✗ Sanctions and Trade Restrictions: Geopolitical conflicts or sanctions on countries with nuclear technology could limit their ability to build or operate nuclear-powered vessels. ✗ Sabotage, Attacks, Boarding and Hijacking: Vessels with nuclear reactors are prime targets for ill-intended parties in conflict zones.
Other Concerns	✗ Technological Obsolescence and Technological Advancements should be serious concerns for early participants. ✗ Pressure to Innovate Zero-Risk Technologies: As environmental scrutiny increases globally; companies may be pressured to adopt technologies that minimize or eliminate the risks associated with nuclear waste and radiation exposure. Failure to keep up with environmental standards could render nuclear vessels less desirable or impose additional operational costs. ✗ Limited Expertise and Workforce Availability: The skills required to maintain nuclear propulsion systems are highly specialized, and there may be limited availability of trained personnel. Any shortage in qualified technicians or engineers could increase maintenance costs and risks of system failure. ✗ Long-Term Waste Storage: Nuclear waste from the reactor needs to be stored safely for long periods, sometimes decades or even centuries. The technology for long-term storage may change, or new regulations may arise, imposing unforeseen costs and logistical challenges on companies that own nuclear-powered vessels. ✗ Repairs: Not every repair shipyard in the world will be able to repair this vessels. For periodic repairs, they may schedule in advance. Unforeseen repairs, may be an additional problem. ✗ Supply Chain Dependency: Nuclear propulsion systems depend on highly specialized components, materials, and fuel (e.g., enriched uranium). Any disruption in the supply chain—whether due to geopolitical issues, raw material shortages, or technological restrictions—could pose a risk to maintaining and operating the nuclear vessel. If critical parts or technologies are delayed or unavailable, it could lead to extended downtimes and financial losses. ✗ Time to market: A conventional ship is contracted in year 1, construction begins in year 3, and it is delivered in year 5. The shipping company and its financiers can rely on a predictable timeline. However, the lead times for nuclear-powered vessels are uncertain, particularly due to potential regulatory requirements and delays caused by governing entities. This uncertainty could especially impact early adopters."

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What Does This Mean For The Future Of The Industry?

The development of nuclear-powered vessels is still in its early stages, and several critical challenges must be overcome to integrate this technology into efforts to decarbonize the maritime industry. Without substantial governmental support, it will be difficult for the private sector to initiate and accelerate the adoption of this promising solution.

For nuclear-powered vessels to become a viable component of the maritime sector, governments must take ambitious and decisive action. Some immediate areas of action include the following:

1. **Establish a Robust International Regulatory Framework:** Develop clear regulations that enable the safe and efficient operation of nuclear-powered vessels across global waters.

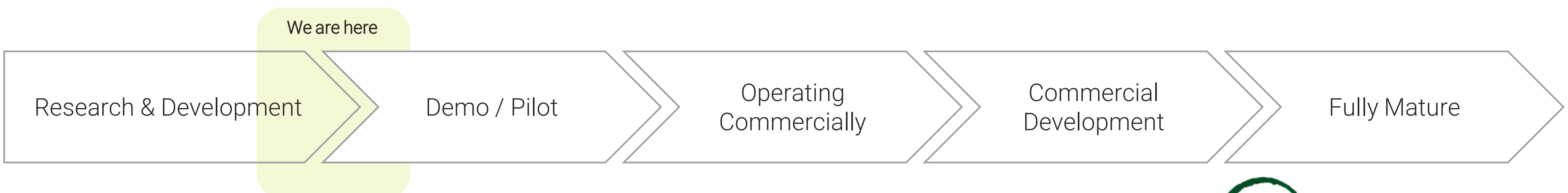
2. **Establish Rules to Limit Liability for Ship Owners and Operators:** Set liability caps and create a dedicated regulatory body. This body, in conjunction with insurance protocols, would act as a backstop to limit financial risks and address potential accidents or incidents.

3. **Increase Government Investment in Technology Development:** Provide direct financial support to advance the research and development of nuclear propulsion technologies.

4. **Fund Pilot Projects to Demonstrate Viability:** Allocate public funding for demonstration projects that validate the technical and economic feasibility of nuclear-powered vessels.

5. **Invest in Port Infrastructure and Strengthen Supply Chains:** Upgrade ports, shipyards and logistics networks to accommodate nuclear-powered vessels and their unique operational requirements.

6. **Reward Early Adopters:** Provide incentives and recognition for early adopters, encouraging innovation and paving the way for broader industry uptake.



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Thank you.

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