

Public and Market Readiness for Nuclear-Powered Civilian Ships

by Roope Marttila at the SYP2025



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COLUMBIA UNIVERSITY
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SEATOM
ZERO EMISSION SHIPPING



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FINNISH ACADEMY OF
SCIENCE AND LETTERS



The Finnish Maritime
Foundation

FORTUM AND NESTE
FOUNDATION



The Shipowners'
Foundation in Finland



NS Savannah,
1962–1972 (US)



Otto Hahn, 1968–1979
(Germany)



Mutsu, 1970–1992
(Japan)



Sevmorput, 1988–Present (Russia)



HD Korea Shipbuilding, TBD



China State Shipbuilding Corp.

"We'll see nuclear ships on specific trade routes sooner than many people currently anticipate"

– Richard Sadler, CEO of Lloyd's Register*

Reality Check

- ❑ **Technology:** 160 naval vessels & icebreakers currently operating*
- ❑ **Economics:** ?
- ❑ **Policy:** ?
- ❑ **Social:** ?

* There exists at least 14 sunken reactors



Reality Check

- ❑ **Technology:** 160 naval vessels & icebreakers currently operating
- ❑ **Economics:** E.g. a large container ship could save €500M in fuel*
- ❑ **Policy:** ?
- ❑ **Social:** ?

* Less in the lifespan of smaller ships, a lot more with green fuels



Lifetime Fuel Economics with HFO: A Large Container Ship (10 000 TEU)

- 100–360 mt of HFO per day
- 250–330 operational days
- 450–550 USD per mt of HFO
- Avg. 25-year lifespan

~~= \$280M–\$1630M~~

= \$500M–\$900M



Lifetime Unit Economics with SMR: **A Large Container Ship (10 000 TEU)**

- SMR Unit Cost \$50M–\$150M
- Ship Building Extra \$100M–\$300M
- Fuel Cost \$100M–\$250M
- Operations & Maintenance \$150–\$250M
- Insurance \$50M–\$200M

= \$450M–\$1150M

vs. \$500M–\$900M with HFO



Lifetime Unit Economics with SMR: A Large Container Ship (10 000 TEU)

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vs. \$1500M–\$3000M with low-carbon fuels



STICKS & CARROTS

2024: Carbon Credits (ETS/EU)

2028: Carbon Fee (IMO)

2030: -20% emission reduction (IMO)

2040: -70% emission reduction (IMO)

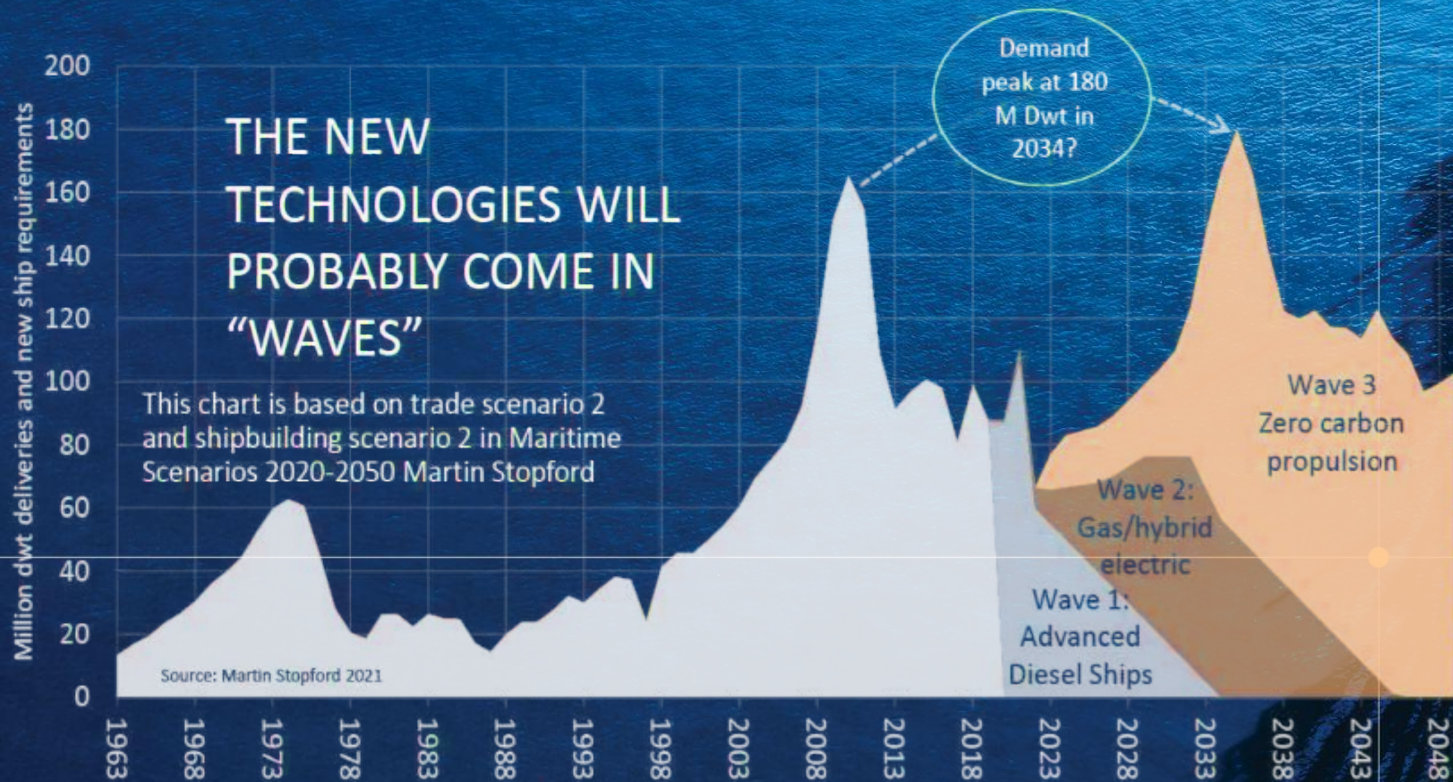
2050: Net Zero (IMO & EU)



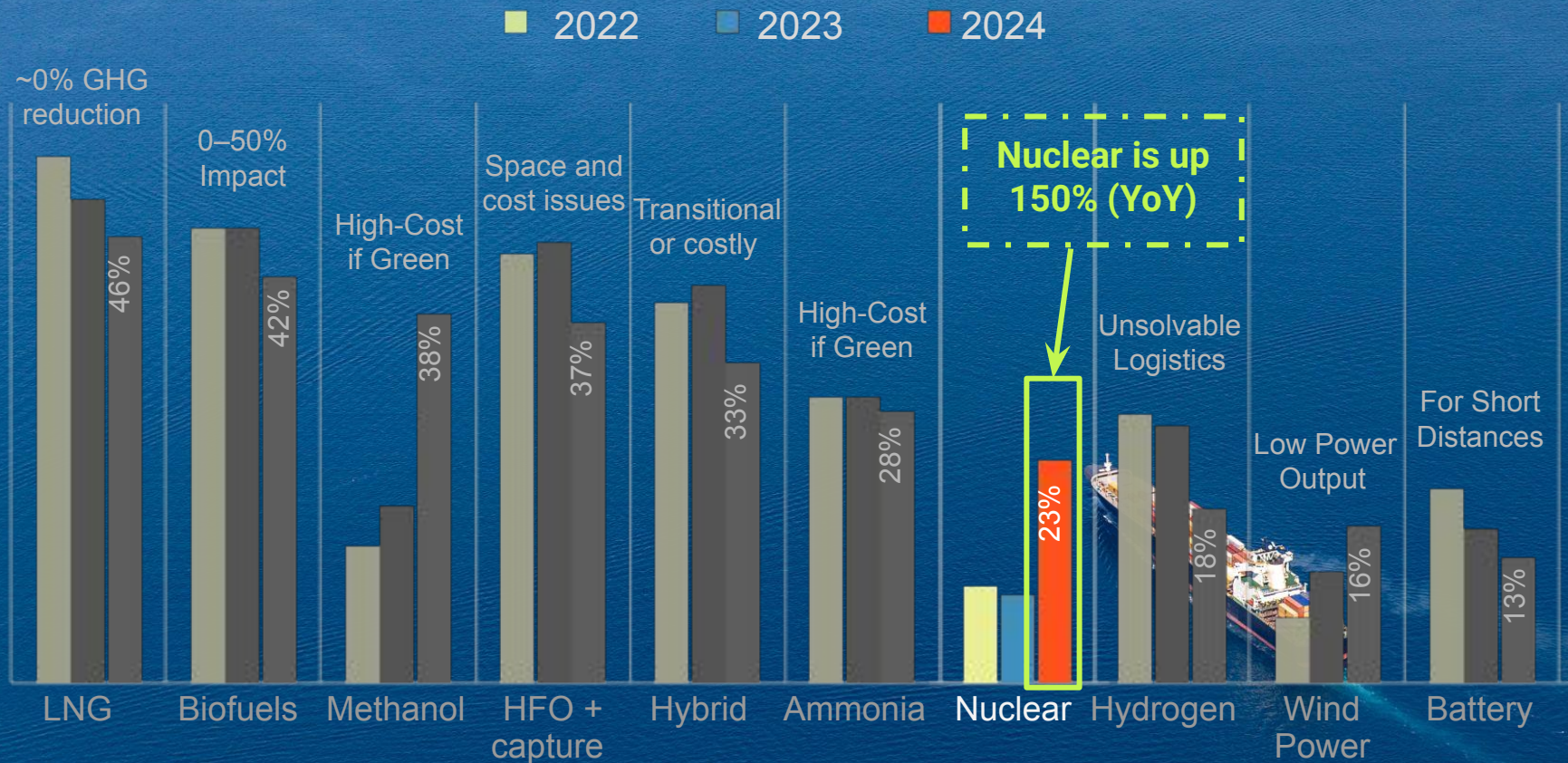
Source 1: https://climate.ec.europa.eu/eu-action/transport/reducing-emissions-shipping-sector_en

Source 2: <https://www.imo.org/en/OurWork/Environment/Pages/IMO-Strategy-on-reduction-of-GHG-emissions-from-ships.aspx>

A ROUGH DECARBONIZATION TIMELINE



International Chamber of Shipping (ICS): The Most 'Viable' Tech for the 2030s



Waters

Land

High Seas

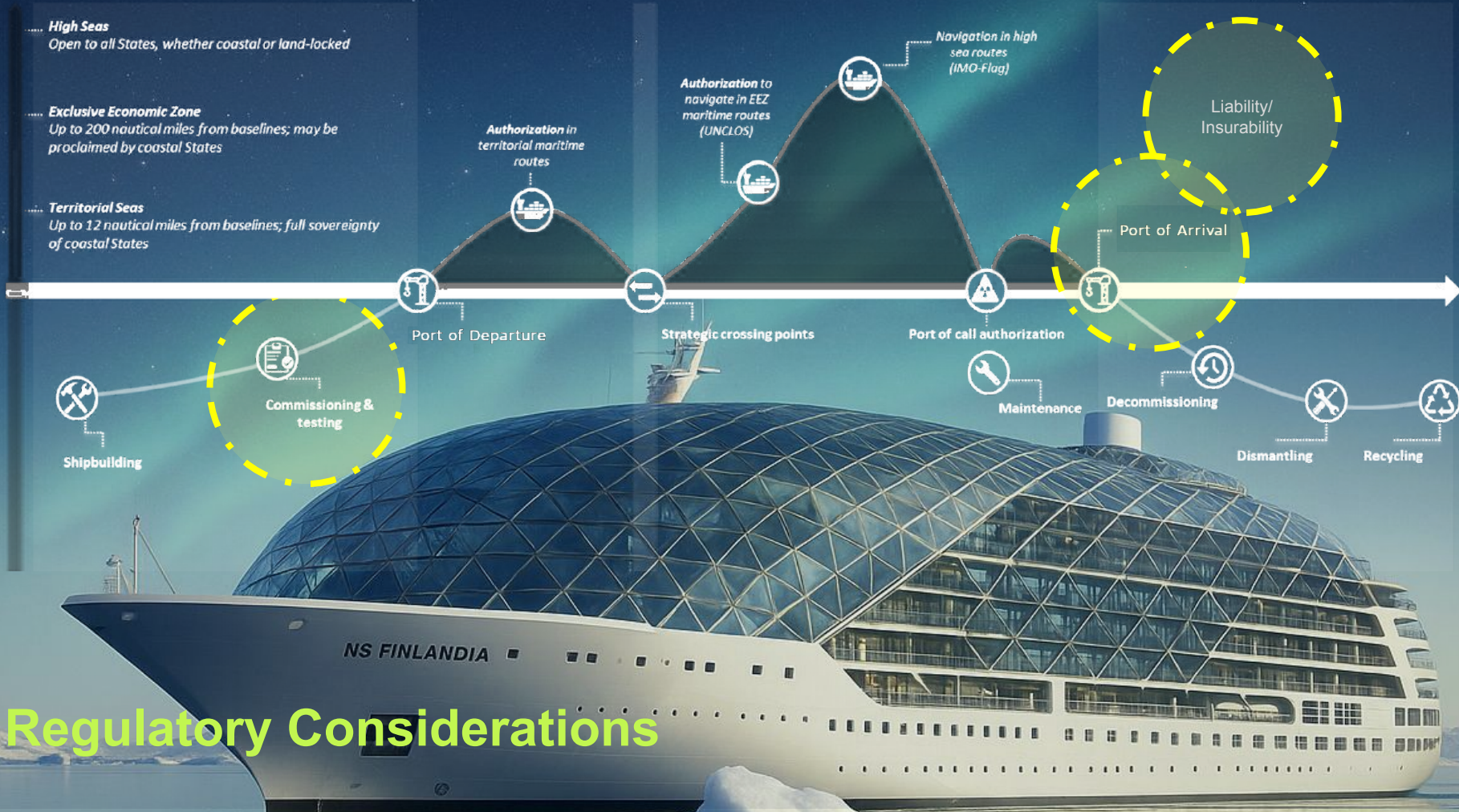
Open to all States, whether coastal or land-locked

Exclusive Economic Zone

Up to 200 nautical miles from baselines; may be proclaimed by coastal States

Territorial Seas

Up to 12 nautical miles from baselines; full sovereignty of coastal States



Regulatory Considerations

Ongoing Research at the University of Helsinki

North Atlantic Port Access Study

- Authors: Roope Marttila, **Bálint Téglásy** (NTNU), **Prof. Henrik Ringbom** (Åbo Akademi), **Prof. Juhani Hyvärinen** (LUT)

Article on the Finnish Nuclear Energy Law Reform

- At this drafting stage, the new law aims to further differentiate the regulatory framework for nuclear-powered ships vs. F/NPPs
- Also potentially informs regulatory reforms elsewhere in Europe

Cross-National Public Opinion Survey

- Data from Finland, Germany, and the Netherlands
- Authors: **Roope Marttila** (University of Helsinki), **Dr. Markku Lehtonen** (the Universitat Pompeu Fabra), **Prof. David Reiner** (University of Cambridge, EPRG)

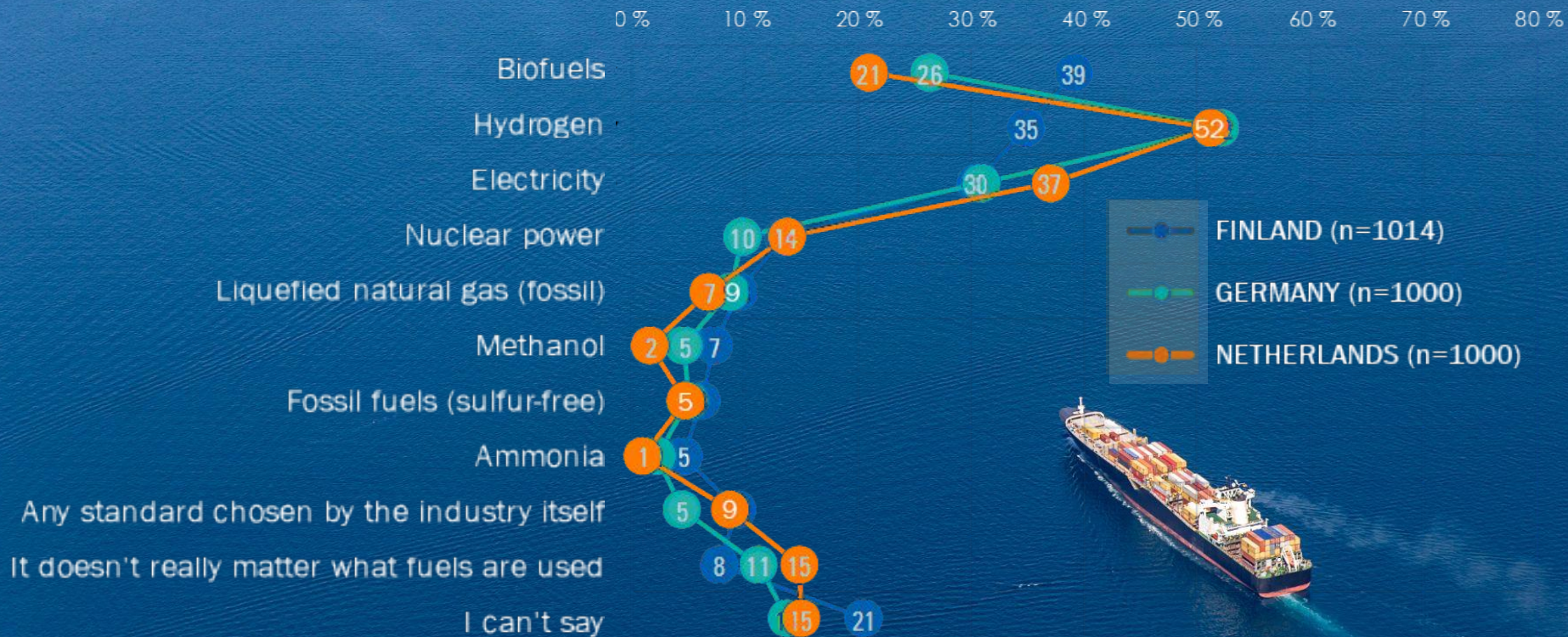


Cross-National Public Opinion Survey on Nuclear-Powered Ships & Marine Fuels

- To be published in Fall 2025
- Might be expanded to the US (a '23 UK Study Exists)
- A sneak peek on some preliminary data

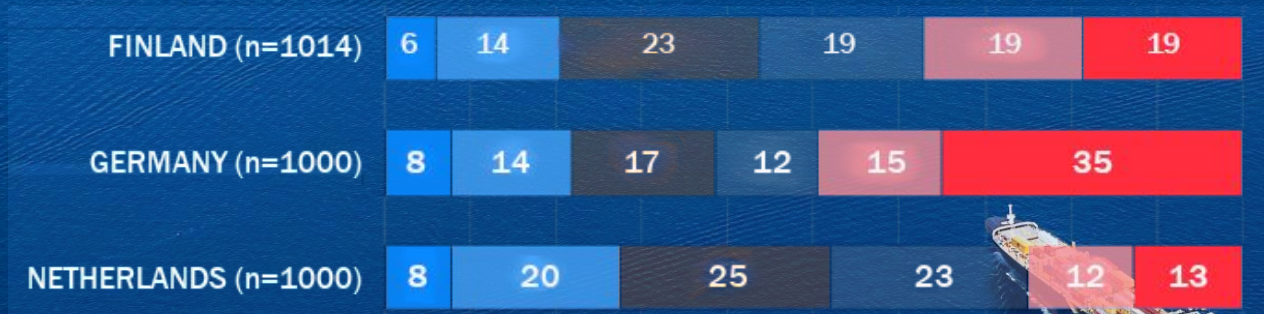


Which fuel would you prefer to be used in marine freight transport?

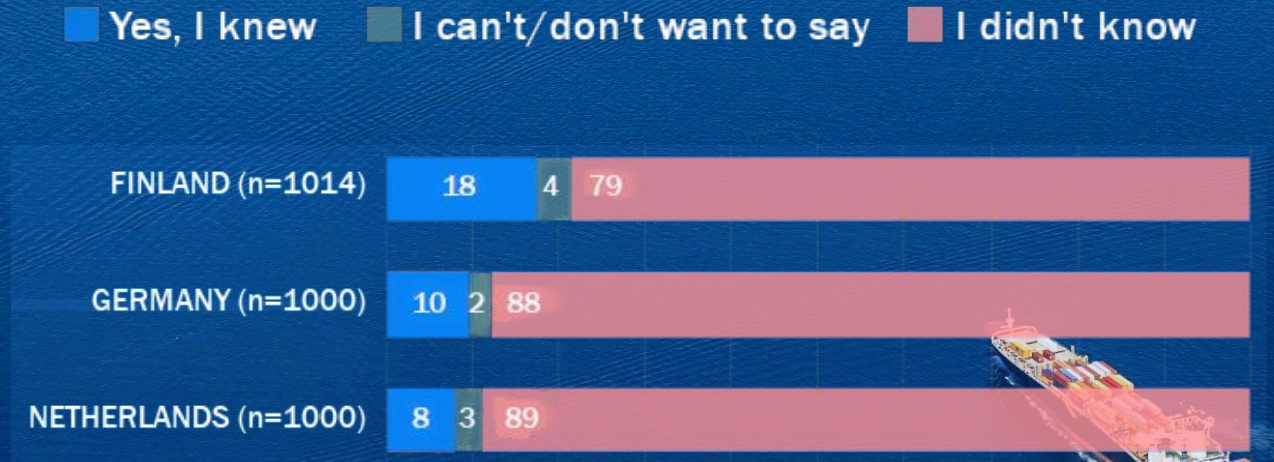


How do you feel about the use of nuclear-powered cargo ships in the Baltic Sea? (Netherlands: ...in the North Sea?)

■ I support a lot ■ I support somewhat ■ I neither support or oppose ■ I can't say ■ I oppose somewhat ■ I oppose a lot

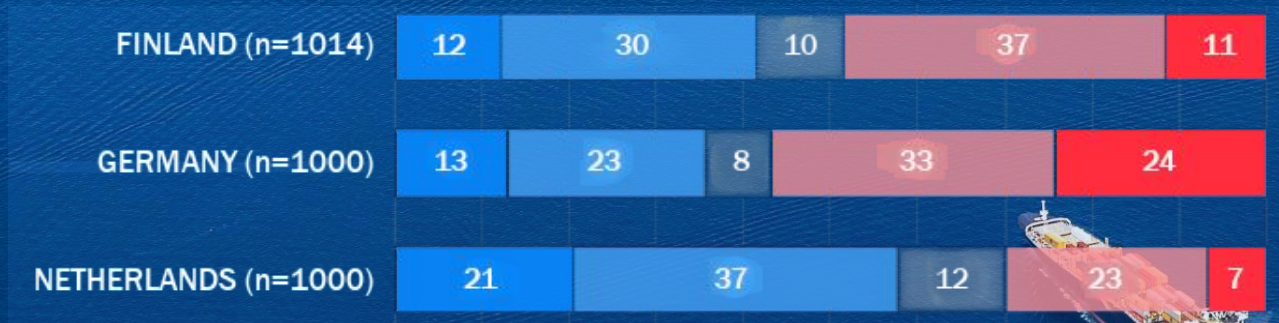


Did you know that a nuclear-powered cargo ship is already operating in the Baltic Sea? (Netherlands: ...in the North Sea?)



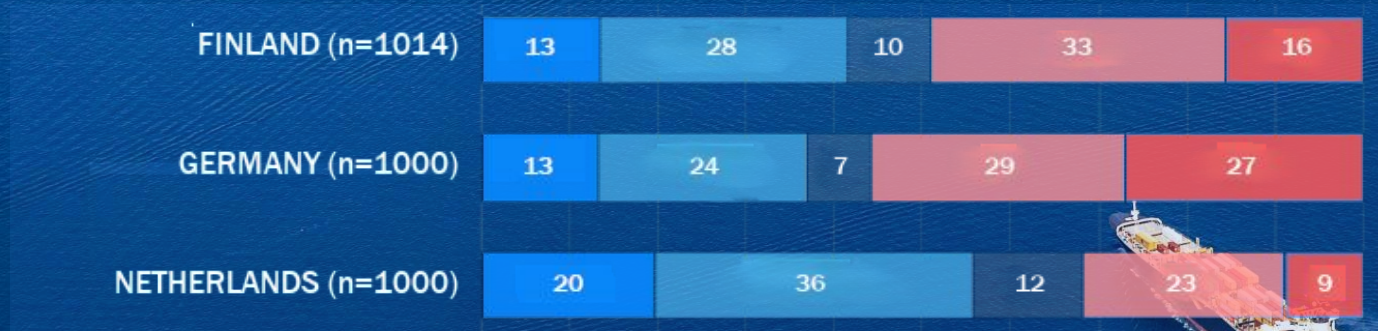
Does the thought of nuclear-powered ships in the ocean-going traffic worry you?

■ Does not worry at all ■ Not too worried ■ I can't say ■ Worries me a bit ■ Worries me a lot



Does the thought of nuclear-powered ships arriving in your country's ports worry you?

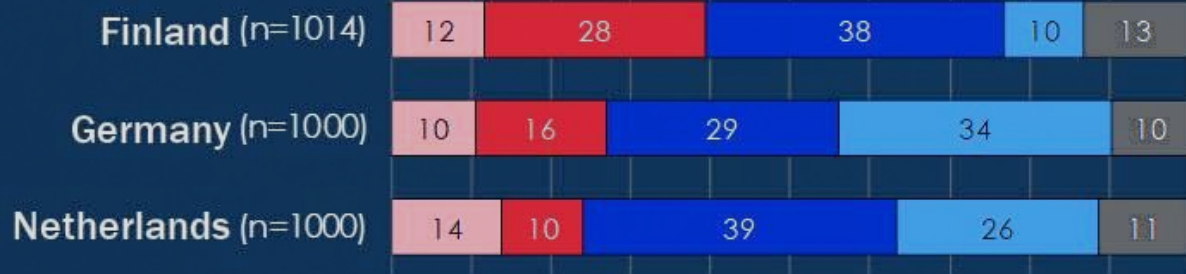
■ Does not worry at all ■ Not too worried ■ I can't say ■ Worries me a bit ■ Worries me a lot



If you would take a cruise, would you rather take a conventionally powered ship or a nuclear-powered ship?

- Nuclear-powered cruise ship
- Conventionally powered cruise ship
- Either one, depending on the ticket price and other details
- Neither
- I don't know

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

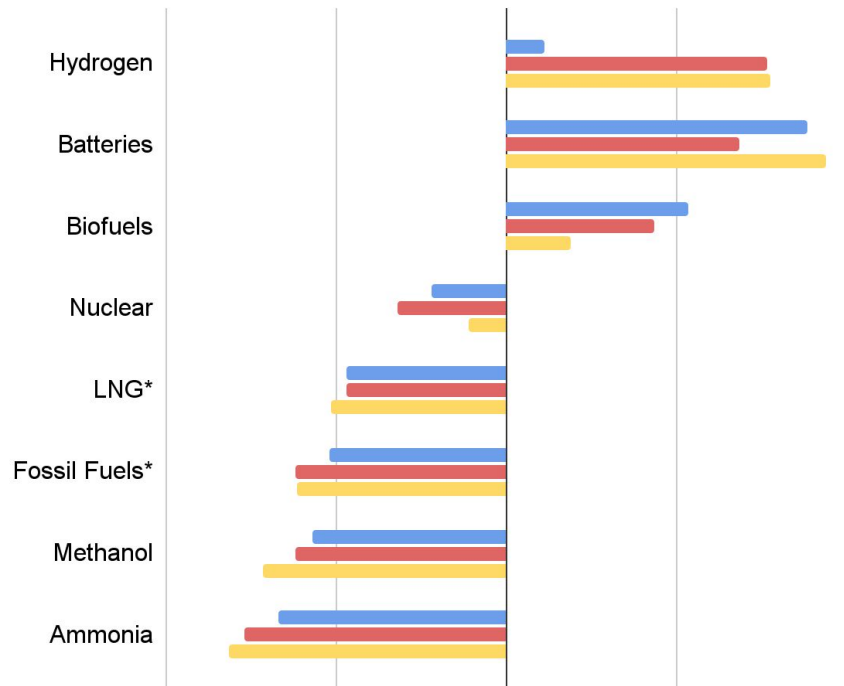


APPENDIX



Public Preference for Marine Fuels (3 countries, 10/2024)

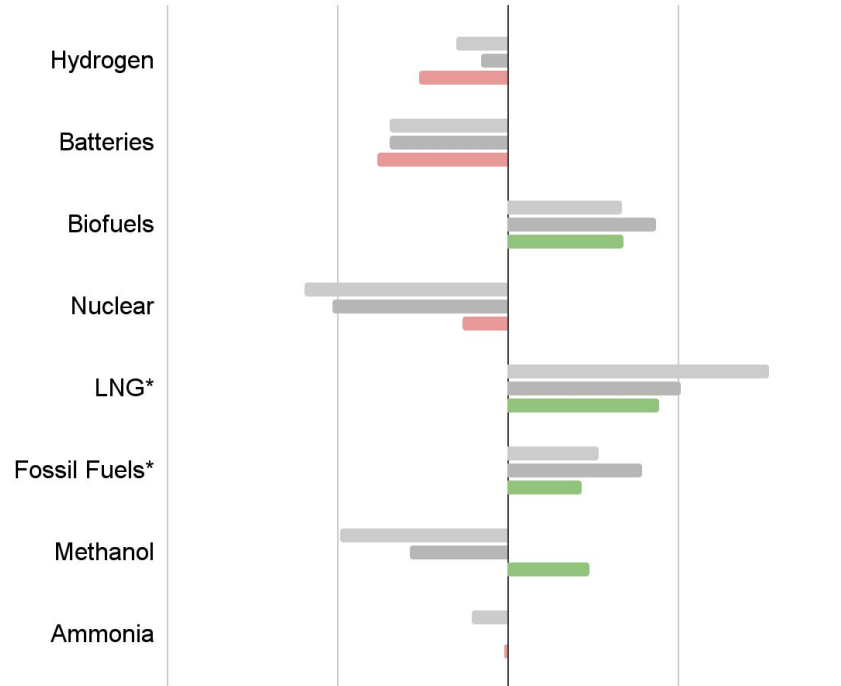
Finland Germany The Netherlands



Deviation from Average Amount of Mentions

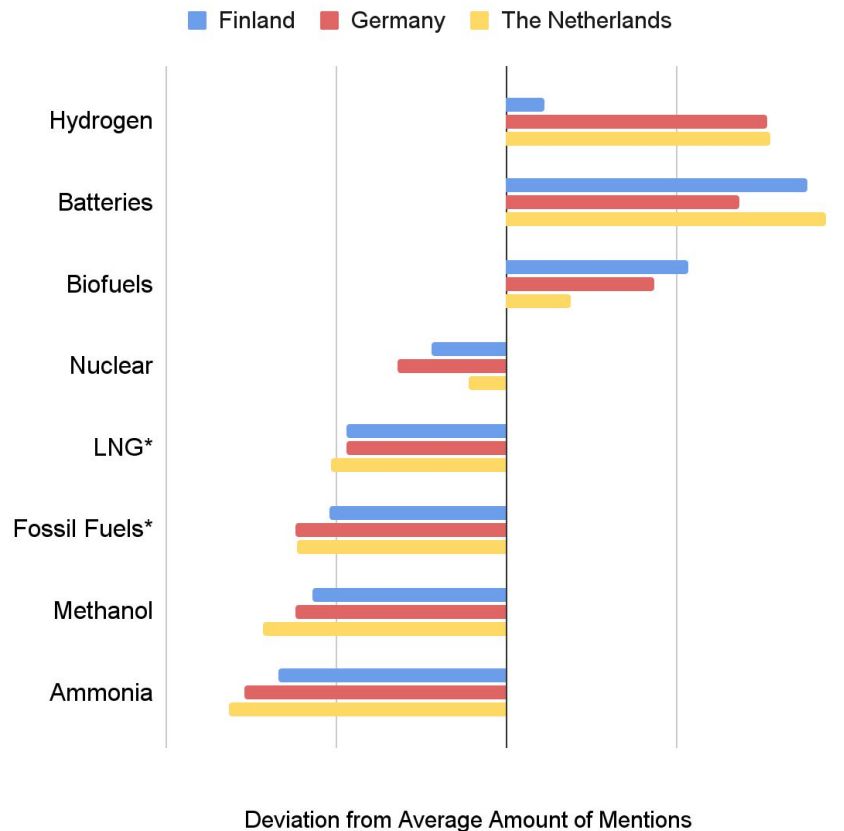
Industry Preference for Marine Fuels on the 2030s (ICS, 11/2024)

2021-2022 2022-2023 2023-2024

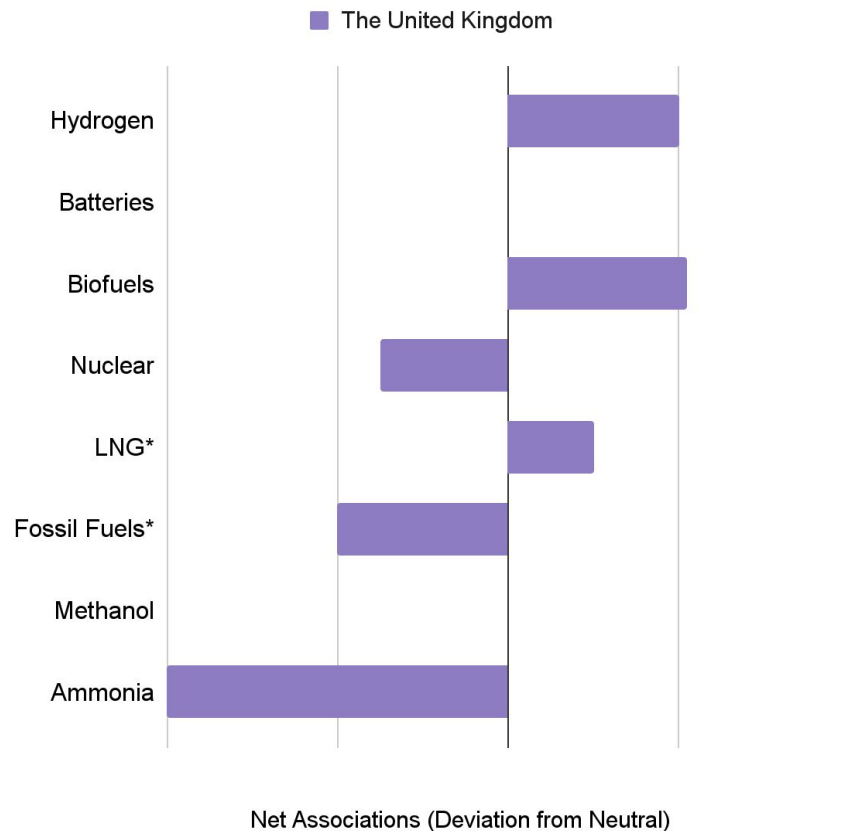


Deviation from Average Amount of Mentions

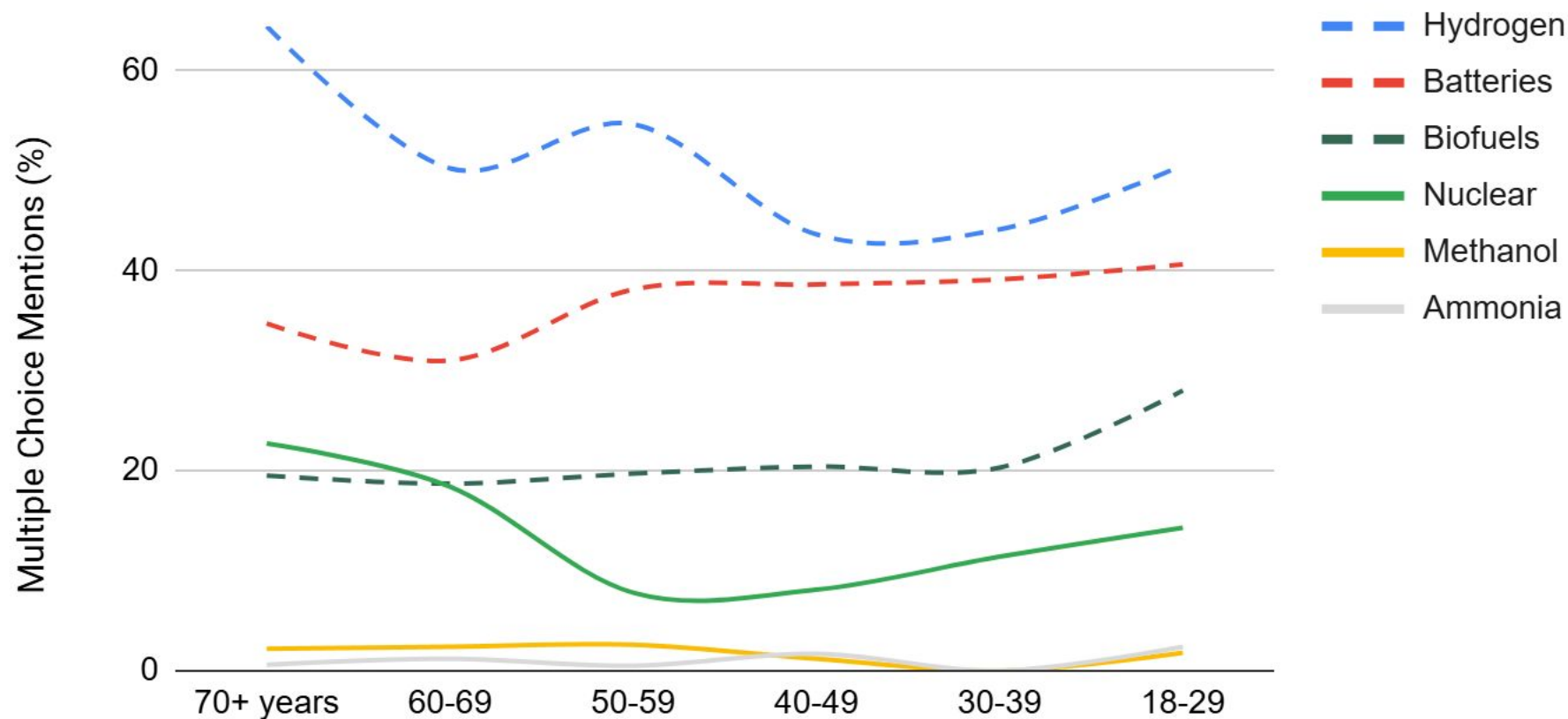
Public Preference for Marine Fuels
(3 countries, 10/2024)



Public Perception of Marine Fuels
(UK only, 11/2021)



Marine Fuels Preference by Age Group (Combined FI, DE, NL)



Preference for Nuclear Propulsion by Age Group

● Finland ● Germany ● The Netherlands

