

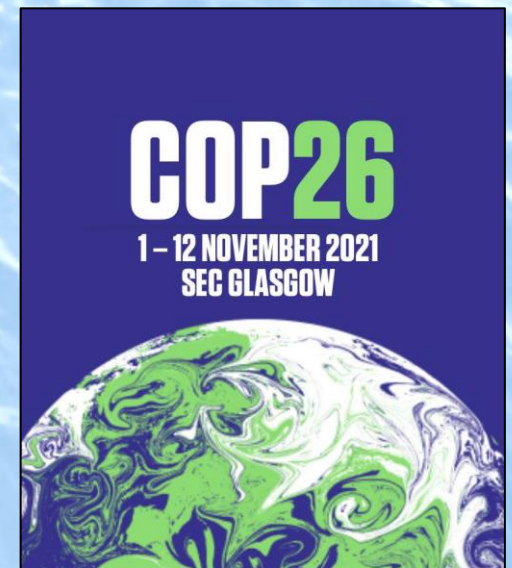
The 4th Propulsion Revolution



SS Great Britain approaching Cape Town, South Africa in 1852

ICS Dry Bulk Commodities Conference 2021

- Industry leaders representing 80% of global shipping met with governments at the ICS organized “Shaping the Future of Shipping” conference on 6 November in Glasgow during COP26.
- **Warning:** Lack of investment in developing green technologies is the biggest threat to achieving decarbonisation.
- Taking into account trade growth, shipping must improve its carbon efficiency by some 90% in order to achieve IMO’s target of a 50% reduction in global GHG emissions by 2050.
- ICS has published “A zero emissions blueprint for shipping” which identifies 265 projects that could help to decarbonize the maritime sector.
- An estimated cost of \$4.4 billion is needed to fund these projects.



- IMO to consider adoption of a \$5 billion Maritime Research Fund (IMRF) at a meeting of MEPC Nov 22-26.
- ICS proposes R&D contributions from shipowners globally, via a \$2 per tonne levy on bunkers to be in place by 2023.
- ICS also proposes a broader carbon levy to help close the price gap between zero-carbon and conventional fuels and help fund new bunkering infrastructure.
- The International Energy Agency (IEA) concludes that under current policy framework scenarios, low and zero-carbon fuels will make up less than 3% of shipping's energy consumption by 2030 and roughly 33% by 2050.
- Given the typical 25 year life of new oceangoing ships, thousands of zero-emission ships will need to be in the water by 2030.





First dual fueled VLCC delivered

- COSCO Shipping VLCC *Yuan Rui Yang* delivered in Sept 2021 by Dalian Shipbuilding
- 2 x 3,500 cbm LNG tanks
- Cost premium \$6million
- Range 12,000 nautical miles on LNG
- Of the 71 VLCCs on order, 44% are either LNG dual-fueled or capable of LNG retrofit
- Three VLCCs ordered in 2021 are equipped with ammonia retrofit capabilities.



How realistic is LNG in the bulk trades?

- Pneumatic cement carrier Greenland built for JT cement (Erik Thun AB & KG Jebsen Cement). Built in 2015, the first LNG fueled dry cargo vessel
- POSCO chartered Capesizes HL Eco & HL Green running coal from Australia to S. Korean steel mills since Jan this year
- Eastern Pacific Shipping and H-Line awarded Rio Tinto's LNG-powered bulk carrier project for 6+6 210,000 DWT Newcastlemax bulk carriers
- NYK building a Capesize for charter to JFE Steel Corp. of Japan. Delivery in early 2024



Japan aiming for 70% reduction in LNG Methane Slip in newbuild coal carrier

- In April 2021, The World Bank dismissed the long term use of LNG as a consequence of methane slip
- Engines using LNG are prone to methane slip, where unburned fuel is expelled in the exhaust
- Hitachi Zosen, Mitsui O.S.K. and Yanmar Power Technology Co. have government support for the project





April 2021: Kira Oldendorff bunkering marine biofuel in Singapore for blending with conventional fossil fuels. Trial conducted in cooperation with BHP & GoodFuels - courtesy Oldendorff Carriers & MPA Singapore

Maersk goes direct to carbon neutral

- Following an order for a methanol powered 2,100 TEU feeder ship, in Aug 2021 Maersk placed an order with HHI for 8 x 16,000 TEU carbon neutral methanol fueled vessels for delivery in 2024. Option for 4 additional vessels for delivery in 2025.
- Unit cost \$175 million - a premium of 10-15% over a conventional newbuild.
- The new vessels will be fitted with engines which can run on both green methanol, which is produced by using renewable sources such as biomass and solar energy, as well as normal bunker fuel if necessary.
- Green methanol can be produced either directly from biomass or via renewable hydrogen combined with carbon from either biomass or carbon capture.



The case for hydrogen

- A Global Maritime Forum study in March 2021 examined 106 projects looking at zero emissions in shipping worldwide and found that nearly half of these initiatives focused on hydrogen as a low-carbon fuel source.
- A key advantage of hydrogen over other fuel alternatives is the ability to retrofit existing ships with hydrogen fuel cells.
- Several maritime sector projects are planned or in the feasibility stage.
- Maritime hydrogen-specific competence is very limited within the industry but also among regulators. Hydrogen specific guidelines and rules are not yet developed for ships



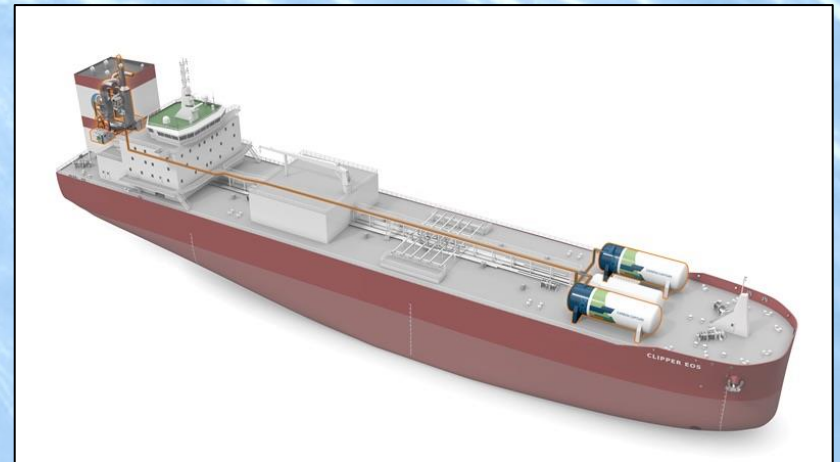
Ammonia ready vessels

- Jan 2021 - Suezmax tanker ordered by Greek owner Avin International, the first vessel of a potential order of three vessels & the first ammonia-fuel ready vessel in the world.
- Feb 2021 - Maersk and DFDS announce support for development of a production facility in Esbjerg to supply CO2-free ammonia as bunker fuel
- Oct 2021 - Mitsui O.S.K. signs an MOU with MAN Energy Solutions and Mitsui E&S Machinery to support an ammonia fueled main engine under development by MAN ES.
- Nov 2021 - Fortescue Metals' is to convert an offshore service vessel to run on green ammonia by end 2022 and has pledged to convert the company's entire fleet of 100 ships to green ammonia within a decade.
- June 2021 - Oceania Marine Energy and Kanfer Shipping AS signed a Letter of Intent (LOI) to bring the world's first ammonia-ready LNG bunkering vessel to Australia.



Pilot Carbon Capture and Storage

- Wärtsilä partnering with Solvang ASA to design and install a full-scale carbon capture and storage system on board the 2019-built ethylene tanker *Clipper Eos* by 2023.
- Wärtsilä initially aiming for a 70% reduction in CO2 emissions at the point of exhaust.
- Project in cooperation with charterers Marubeni Corp

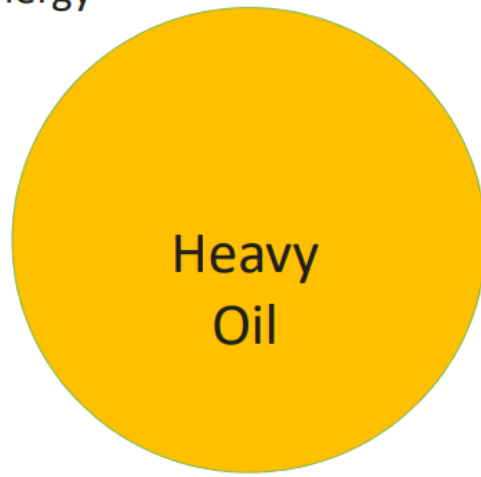


Carbon Capture Utilization and Storage (CCUS) Projects

- Exmar of Belgium, partnering with Lattice, a South Korean tank manufacturer, to develop a new design of Panamax sized CO₂ carrier to carry large quantities of carbon for reuse in industrial applications or storage
- Similar projects:
- Mitsubishi Shipbuilding with TotalEnergies
- POSCO with Korea Shipbuilding & Offshore & Hyundai Mipo
- ABS with Daewoo Shipbuilding & Marine Engineering (DSME)



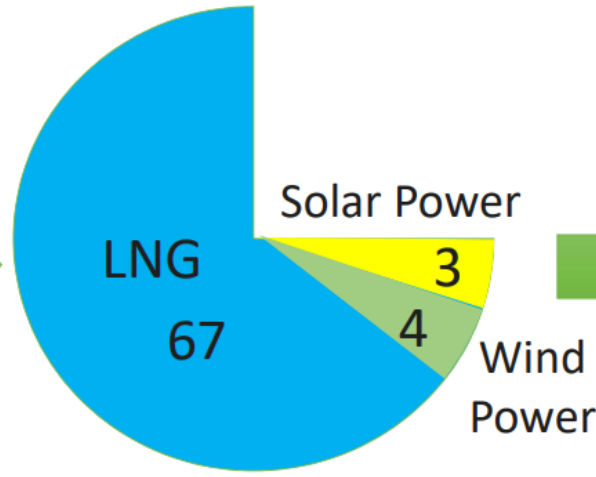
Required Energy 100



2006/2014 Built Vessel (Base Vessel)

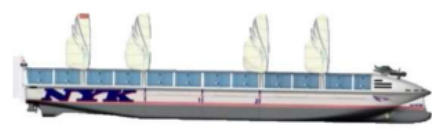


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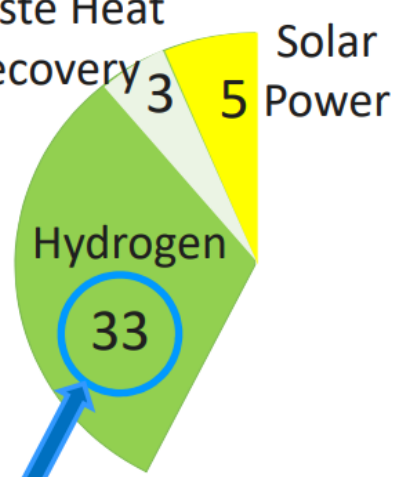


NYK Super Eco Ship 2030

CO₂ Reduction 69%



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NYK Super Eco Ship 2050

CO₂ Reduction 100%



67% reduction in energy derived from fossil fuels*
* Compared with a 2014-built vessel

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