DECARBONIZATION OF THE SHIPPING INDUSTRY

Professor Martin Davies

Admiralty Law Institute Professor of Maritime Law, Tulane University Law School, Director Tulane Maritime Law Center

Association of American Law Schools, Admiralty and Maritime Law Section

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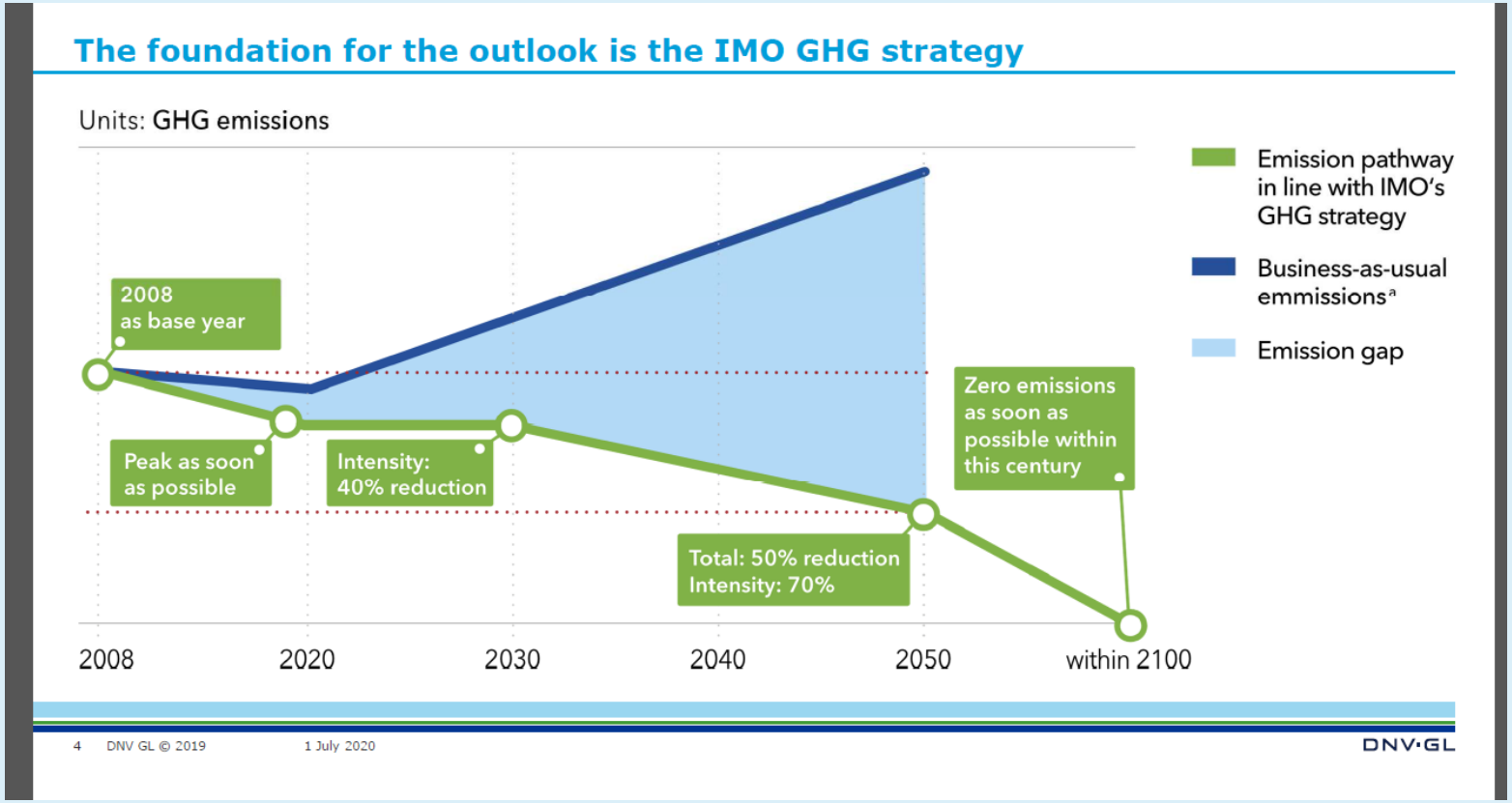
OUTLINE

- New regulations about carbon emissions from ships
  - IMO with effect from 2023
    - Proposals for increased regulation already under consideration
  - EU emission trading system starting in 2023
- Different methods of compliance
  - Alternative fuels
  - Operational measures

TWO DIFFERENT MEASURES IN CURRENT IMO STRATEGY

- Total greenhouse gas (GHG) emissions
- Carbon intensity – amount of emissions per dwt-tonne-mile
- Even if intensity decreases, total emissions will increase if there are more ships
- There will have to be more ships, so the focus is on carbon intensity
  - More than 80% of the world's trade in goods is carried by sea
  - World population is currently just over 8 billion people
  - UN projects 9.7 billion by 2050
  - (It was 2.8 billion in the year I was born – 35% of what it is now)

TWO DIFFERENT MEASURES IN IMO STRATEGY



MEASURES WILL BE MORE FAR-REACHING

- Regulations initially targeted 50% reduction in total emissions by 2050
- IMO was criticized for not being adventurous enough, particularly after UN Climate Change Conference (COP 26) in Glasgow
- IMO's MEPC 77 (November 2021) agreed to revise the initial strategy to "strengthen the ambition"
- New measures were considered at MEPC 78 (June 2022) and MEPC 79 (December 2022)

MARPOL ANNEX VI

- MARPOL Annex VI, introduced in 2005 and revised in 2010, established a sliding downward scale of permitted emissions of sulphur, nitrogen, and particulate matter (SOx, NOx, PM)
- Concern was air pollution, not global warming/climate control
  - Nitrogen dioxide (NO_2) is not a GHG
  - Sulphur dioxide (SO_2) is not a GHG, but can have indirect effects (aerosolization, etc)
- Significantly lower limits from 1 January 2020
- New GHG regulations are amendments to Annex VI

PERFORMANCE-BASED REGULATIONS

- "Performance based" – different ways of achieving the result
- Regulations entered into force 1 November 2022
- From 1 January 2023, *all* ships of more than 400 grt will have to have an Energy Efficiency Existing Ship Index (EEXI) showing Carbon Intensity Indicator (CII)
  - Required reduction factor of emissions
  - Annual operational CII to be documented and rated (A, B, C, D, E)
  - Poor ratings will have to be corrected
  - Flag state enforcement, but port states (and ports) may decide to bar entry
  - Operators are been considering implementation measures for some time
  - A combination of technical (retrofitting, alternative fuels) and operational measures

LATEST DEVELOPMENTS: GOALPOSTS MOVING ALREADY

- MEPC 77 agreed to initiate the process of revising the initial IMO GHG Strategy of 2018, with a view to approving a strengthened revised Strategy in mid-2023 at MEPC 80
- EEXI and CII now described as a "short term measure"
- MEPC 78 considered "a basket of mid-term GHG reduction measures" recommended by an Intersessional Working Group
  - Technical elements including a GHG fuel standard or enhancement of the CII measures
  - Carbon pricing elements, e.g. market-based measures and/or "feebates" redistributing money from emitters to non-emitters by levy and reward
- MEPC 79 encouraged "voluntary cooperation between the port and shipping sectors to contribute to reducing GHG emissions from ships"

EU EMISSION TRADING SYSTEM

- European Commission announced on 14 July 2021 that shipping would be gradually introduced into the Emissions Trading System (ETS)
- ETS is a carbon market that operates in all EU countries with the aim of achieving climate neutrality by 2050 (more far-reaching than IMO's first effort)
- Starting in 2023, 100% of shipping emissions from intra-EU voyages and 50% from voyages to and from EU will be in the ETS
- Carbon emitters must pay for each tonne of CO_2 by using EU allowances (EUAs)
  - Each EUA is the right to emit GHG equivalent to 1 tonne of CO_2
- "Cap and trade" – overall GHG emissions capped and reduced over time, participants can trade EUAs – if shipowner reduces emissions, it can sell its excess EUAs
- Fines of €100 per kg of excess CO_2 emitted

EU EMISSION TRADING SYSTEM

- Maritime financial research firm Drewry has estimated annual cost on the basis of direct GHG emissions in 2020
  - Maersk about US$407 million (10% of earnings before interest and taxes)
  - CMA CGM about US$280 million (8% of earnings before interest and taxes)
  - Hapag-Lloyd about US$154 million (10% of earnings before interest and taxes)
- These estimates are for 2023, when only 20% of emissions will be liable
- 45% of emissions will be liable in 2024, 70% in 2025, 100% in 2026 and thereafter

ALTERNATIVE FUEL SOURCES

- Liquefied Natural Gas (LNG)
- Ammonia
- Hydrogen
- Biofuels (vegetable-based oils, including recycled cooking oil)
- General expectation seems to be LNG as the medium-term solution, others as long-term necessity

LNG

- Not a particularly viable option for existing ships (engine modifications, larger bunker tanks), but can be for newbuildings
- LNG is not carbon-free, although it does emit 25-30% less CO_2 than traditional marine fuels – and virtually no SOx, NOx, PM
- 34 LNG bunkering ports in the world in 2019 but 147 in 2022, expected to be 200 by 2024 – a clear indicator of increasing demand
- But, there are drawbacks: "methane slip" means methane entering the exhaust unburned – methane is a much more potent GHG than CO_2

CMA CGM JACQUES SAADÉ

- One of the largest container ships in the world (23,112 TEUs), launched in 2021; largest to be powered by LNG

LNG NOT THE LONG-TERM SOLUTION?

- Doubtful whether switching to LNG will be enough to meet the IMO targets
- First oceangoing LNG-powered ship, *Viking Energy*, an OSV launched in 2003, was converted to a hybrid battery system in 2016, and will be converted to a direct ammonia fuel cell from 2024

AMMONIA

- Low energy density, so it takes up more space than diesel or fuel oil for the same amount of propulsive energy
  - Therefore, retrofitting existing ships would lose cargo space as well as being costly
  - No newbuildings yet, but some in development
- No carbon in ammonia, *but* it needs "pilot fuel" to make it burn, which means that ammonia bunkers would still not be carbon neutral
- Importantly, relatively few modifications are necessary to convert an LNG-powered vessel to ammonia

HYDROGEN

- Carbon-free, so no SOx, NOx, PM
- Plentiful production already *but* almost all global hydrogen production is sourced from the use of fossil fuels ("grey hydrogen" not "green hydrogen")
- Not (yet) plentiful production of *green* hydrogen
- More different from existing fuels than LNG and ammonia, so would create infrastructure costs in relation to storage, transportation and use
- Not easy to retrofit existing ships

BIOFUELS

- Vegetable oils produced from plant oil feedstocks such as rapeseed, soybean and palm oil, also recycled waste such as cooking oil
- Up to 90% reduction in CO_2, no SOx, NOx, PM
- Can be used in existing engines – "drop in" substitute
  - ONE successfully tested biofuel bunkers on *MOL Experience*
  - Eastern Pacific successfully tested biofuel bunkers on *Pacific Beryl*
- Obviously a very attractive alternative
- *But* so far a lack of sustainable supply
  - Current production covers only about 15% of energy demands of shipping

OPERATIONAL MEASURES – SLOW STEAMING AND VIRTUAL ARRIVAL

- Slow steaming reduces emissions – MEPC even considered imposing a speed limit
- Historically, disputes about speed and consumption warranties in time charters were usually claims by charterers that the ship was too slow or used too much fuel to maintain the promised average speed
- Now, it is often the *charterer* who wants the ship to sail slowly, which reduces fuel consumption, and the *owner* who wants to go more quickly to reduce engine problems
- Time charterparties now often include "slow steaming" or "ultra slow steaming" clauses, giving the charterer the right to dictate the ship's speed or engine RPM
- "Virtual arrival" clauses are an agreement to slow ship's speed to arrive at port at a fixed date
  - No point in steaming at full speed to a port where delays are expected

VIRTUAL ARRIVAL

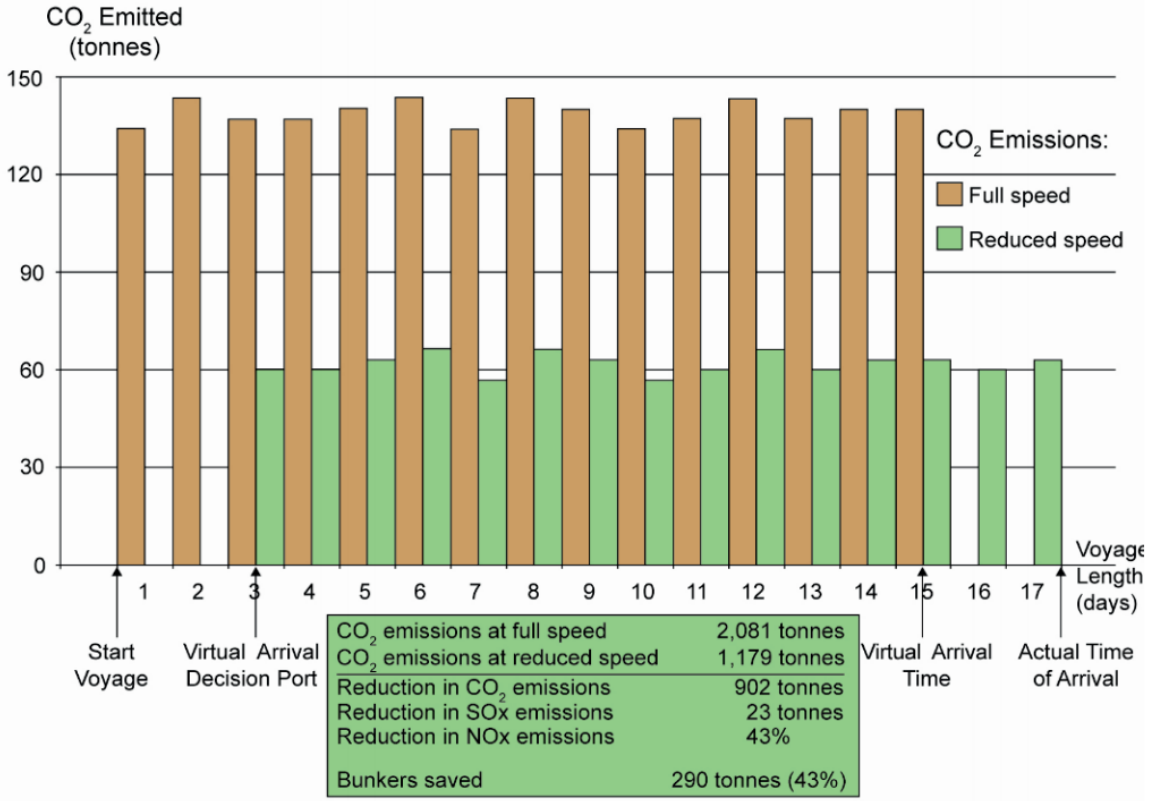


Figure 1: Impact of Virtual Arrival on Reducing Exhaust Gas Emissions

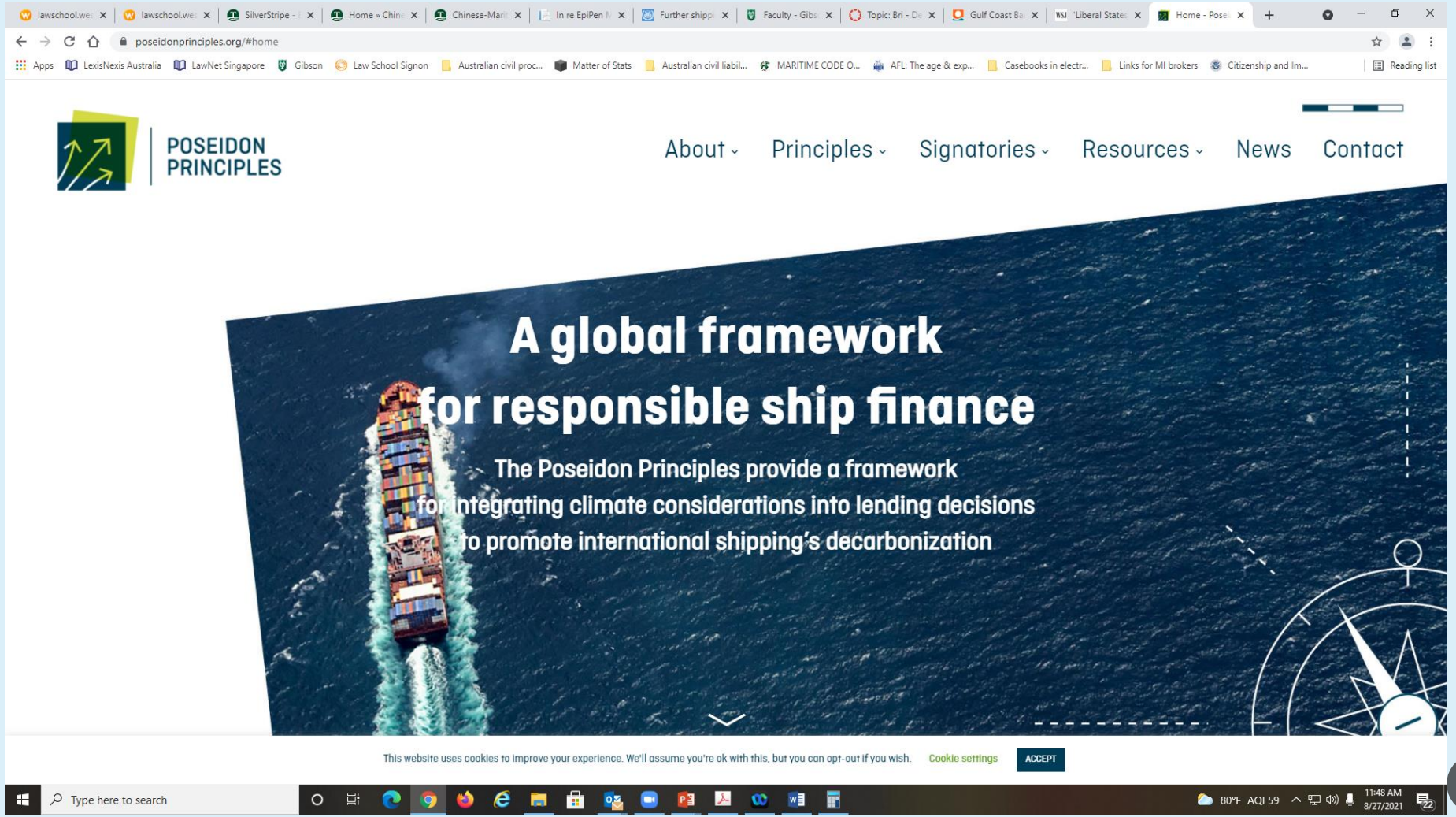
FUNDING

- Estimates are that it will cost a total of $1.4 to $1.9 trillion to achieve the IMO's *existing* goals by 2050
  - Land-based infrastructure as well as modifications to ships
  - $26 million to $36 million for every trading ship in the world today (about 53,000), although land-based infrastructure costs will not be borne by the ships
- Some traditional lenders have been leaving the industry already
  - Between 2008 and 2019, the top 40 shipping finance banks reduced their shipping portfolios by 36%
  - European banks getting out, Asian banks getting in
- Alternatives include ESG financing and carbon taxes

ESG FINANCING

- Environmental, Social and Governance (ESG)
- The Poseidon Principles, developed by shipowners and financiers, provide a framework for incorporating environmental considerations into lending decisions
  - https://www.poseidonprinciples.org/#home
  - Assessment. Lenders will measure carbon intensity relative to established decarbonization trajectories of their shipping portfolios of borrowers
  - Accountability. PP signatories will only use data types, sources, and standards established by the IMO and service providers recognized by the IMO (IMO-Recognized Organizations)
  - Enforcement. Appropriate data and information to be given to shipowners and require consent to be given to sharing the information to promote transparency
  - Transparency. All signatories to publicly state that they are signatories to increase awareness, and will publish the results of their portfolio climate alignment score

POSEIDON PRINCIPLES



POSEIDON PRINCIPLES SIGNATORIES

- ABN Amro, Amsterdam Trade Bank, BNP Paribas, BPI France, CIC, Citibank, Crédit Agricole, Credit Suisse, Danish Ship Finance, Danske Bank, Development Bank of Japan, Den Norske Bank, DVB Bank, Export Credit Norway, Finnvera, ING Bank, MUFG Bank, Nordea Bank, SEB, Shinsei Bank, Société Générale, SpareBank 1 SR-Bank, Sparebanken Vest, Standard Chartered Bank, Sumitomo Mitsui Banking Corp, Sumitomo Mitsui Finance and Leasing, SuMi Trust,
- Mostly European and Scandinavian, some American and Japanese

NEW SOURCES OF CAPITAL

- The traditional model of ship financing has been debt financing secured by a simple ship mortgage from one bank
- Ship financing is diversifying, particularly since the crash of 2008
  - Financial leasing companies - sale and leaseback (particularly from Chinese lenders)
  - Private equity (particularly from US investors)
  - Collateralized loan obligations (common in "green financing") – International Capital Markets Association (ICMA) published Green Loan Principles in 2018

CONCLUSION

- Decarbonization measures in the shipping industry are no longer aspirational
- There are concrete, legally-enforceable, measures now in force that will require substantial changes in the way ships are operated, and they are already being tightened
- Ship operators have to make decisions now for the future life of a ship
  - Ships launched this year will be sailing through increasingly stringent carbon emission regulations as the years pass – 2030 (40% less CII) is less than seven years away (about half the expected life of a trading ship)
- Ship operators are intensely focused on this at the moment but still wary of making the wrong choice, "betting on the wrong horse"