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Decarbonizing the Shipping Industry: A Status Report

1. The Problem/Issue in Perspective
2. Economic, Technical and Political Feasibility Issues
3. The Regulatory Response
4. Issues of Implementation and Compliance
5. Outlook

ipcc

INTERGOVERNMENTAL PANEL ON climate change

Climate Change 2021

The Physical Science Basis

Summary for Policymakers

WGI

Working Group I contribution to the
Sixth Assessment Report of the
Intergovernmental Panel on Climate Change

WMO UNEP

Key Findings of the summary for policy makers, Doc.
IPCC AR6 WGI, August 7, 2021

A.1 It is unequivocal that human influence has warmed the atmosphere, ocean and land. Widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred.

A.2 The scale of recent changes across the climate system as a whole and the present state of many aspects of the climate system are unprecedented over many centuries to many thousands of years.

A.3 Human-induced climate change is already affecting many weather and climate extremes in every region across the globe. Evidence of observed changes in extremes such as heatwaves, heavy precipitation, droughts, and tropical cyclones, and, in particular, their attribution to human influence, has strengthened since AR5 [the previous IPCC Assessment Report].

A.4 Improved knowledge of climate processes, paleoclimate evidence and the response of the climate system to increasing radiative forcing gives a best estimate of equilibrium climate sensitivity of 3°C with a narrower range compared to AR5.

B.1 Global surface temperature will continue to increase until at least the mid-century under all emissions scenarios considered. Global warming of 1.5°C and 2°C will be exceeded during the 21st century unless deep reductions in CO2 and other greenhouse gas emissions occur in the coming decades.

B.2 Many changes in the climate system become larger in direct relation to increasing global warming. They include increases in the frequency and intensity of hot extremes, marine heatwaves, and heavy precipitation, agricultural and ecological droughts in some regions, and proportion of intense tropical cyclones, as well as reductions in Arctic sea ice, snow cover and permafrost.

B.3 Continued global warming is projected to further intensify the global water cycle, including its variability, global monsoon precipitation and the severity of wet and dry events.

B.4 Under scenarios with increasing CO2 emissions, the ocean and land carbon sinks are projected to be less effective at slowing the accumulation of CO2 in the atmosphere.

B.5 Many changes due to past and future greenhouse gas emissions are irreversible for centuries to millennia, especially changes in the ocean, ice sheets and global sea level.

C.1 Natural drivers and internal variability will modulate human-caused changes, especially at regional scales and in the near term, with little effect on centennial global warming. These modulations are important to consider in planning for the full range of possible changes.

C.2 With further global warming, every region is projected to increasingly experience concurrent and multiple changes in climatic impact-drivers. Changes in several climatic impact-drivers would be more widespread at 2°C compared to 1.5°C global warming and even more widespread and/or pronounced for higher warming levels.

C.3 Low-likelihood outcomes, such as ice sheet collapse, abrupt ocean circulation changes, some compound extreme events and warming substantially larger than the assessed *very likely* range of future warming cannot be ruled out and are part of risk assessment.

D.1 From a physical science perspective, limiting human-induced global warming to a specific level requires limiting cumulative CO_2 emissions, reaching at least net zero CO_2 emissions, along with strong reductions in other greenhouse gas emissions. Strong, rapid and sustained reductions in CH_4 emissions would also limit the warming effect resulting from declining aerosol pollution and would improve air quality.

D.2 Scenarios with very low or low GHG emissions … lead within years to discernible effects on greenhouse gas and aerosol concentrations, and air quality, relative to high and very high GHG emissions scenarios…. Under these contrasting scenarios, discernible differences in trends of global surface temperature would begin to emerge from natural variability within around 20 years, and over longer time periods for many other climatic impact-drivers (high confidence).

2. The Economic/Technical Issues of Decarbonizing International Shipping

International Chamber of Shipping, *Catalysing the Fourth Propulsion Revolution: The Urgent Need to Accelerate R&D to deliver Zero-Carbon Shipping by 2050*, November 2020

Executive Summary

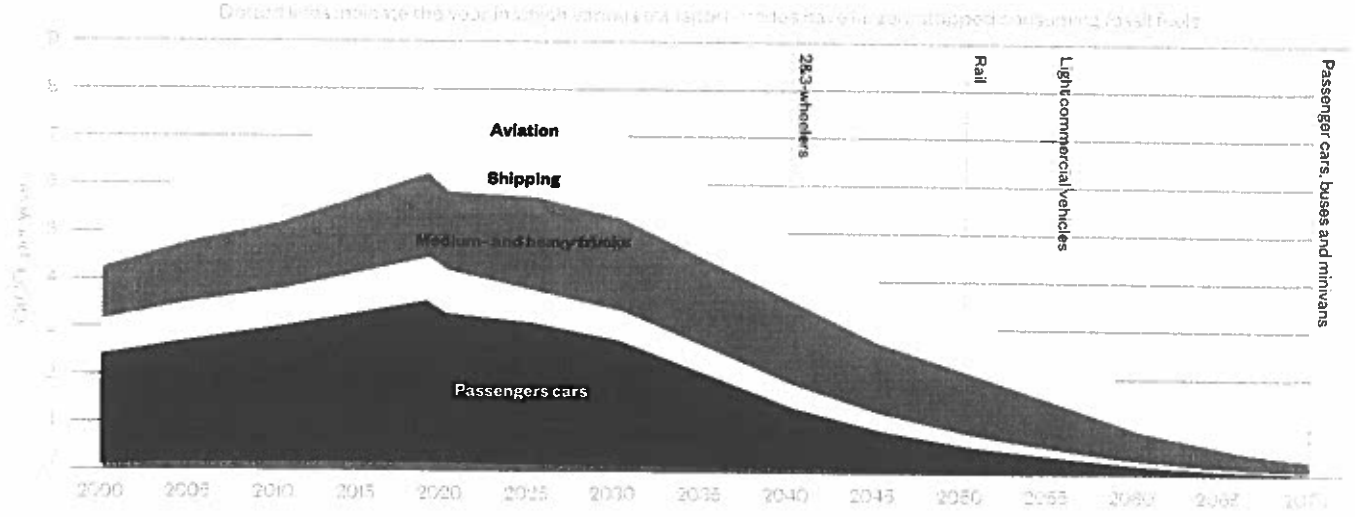
After a long history of wind, coal and oil-fuelled ships, a fourth propulsion revolution is needed if shipping is to decarbonise completely and achieve the stringent greenhouse gas reduction targets established by the International Maritime Organization (IMO).

The challenge is enormous: to move cargo across the oceans, ships require huge amounts of energy and an entirely new generation of fuels and propulsion systems will need to be developed. However, many of the potential zero-carbon fuels such as ammonia and hydrogen present serious operational challenges. In addition to the safety issues that will need to be addressed, they also have low energy density meaning that ships will have to carry much more fuel. The global shipping fleet will need to be modernised and new fuel supply networks developed.

More immediately, zero-carbon technologies can only be introduced if there is a huge increase in global research and development (R&D) spending. Shipowners are prepared to catalyse this by proposing the creation of a US$5 billion research and development (R&D) fund aimed at identifying one or more technical pathways that can lead to the introduction of zero-carbon ships across the maritime sector by 2030 and beyond.

Trillions of dollars of investment will rely on the success of such initiatives to identify the zero-carbon technologies of tomorrow. To address the climate crisis we need to act now.

The industry has proposed a US$5 billion R&D fund to identify pathways to zero-carbon ships by 2030 and beyond



Source: IEA

International shipping is key to the global economy, transporting about 90% of global trade volumes, using 4 million barrels of oil a day – 4% of global oil production – equivalent to over a third of the daily production of Saudi Arabia. The value of cargoes shipped by sea is close to $7 trillion annually, more than the entire GDP of the world's third largest economy, Japan. The sheer size and scale of today's ships and the daily volume of trade they transport requires a colossal power input. The energy used by a typical container vessel crossing the ocean could provide power for 50,000 homes.

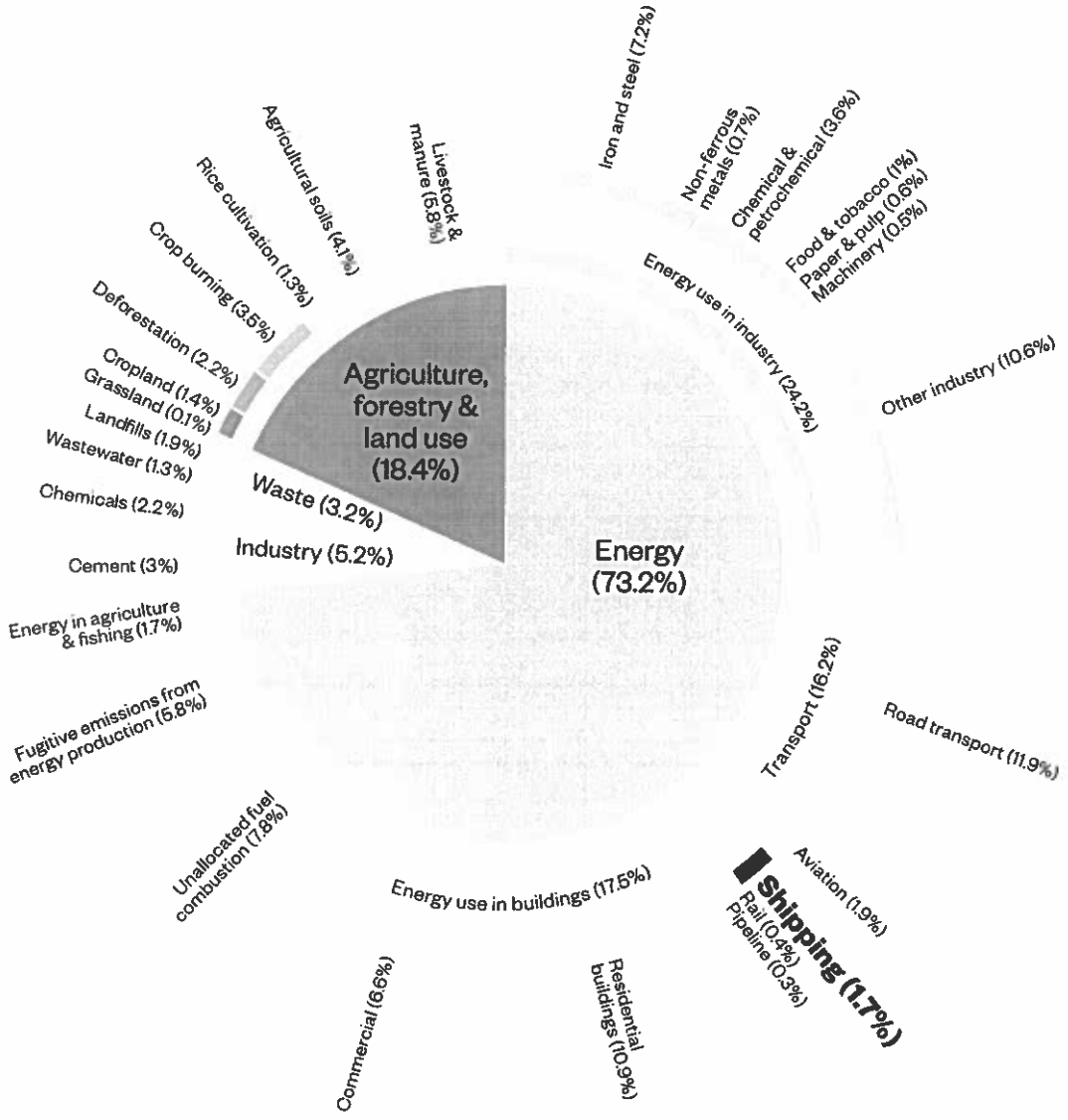
Presently, moving such a huge amount of goods results in significant carbon emissions and the shipping industry produces 0.9 gigatonnes – 2% of the global economy's total CO_2 emissions – similar to aviation but less than the 2.4 gigatonnes of the global road transportation sector. While too high, shipping's carbon emissions are much lower that some other key industries such as the global cement industry that produces more than double the amount of CO_2.

A fourth propulsion revolution to end the shipping industry's dependence on fossil fuels will be required but there are multiple hurdles to be overcome before full decarbonisation can be achieved. New fuels will need to be developed along with novel propulsion systems, upgraded vessels and an entirely new global refuelling network.

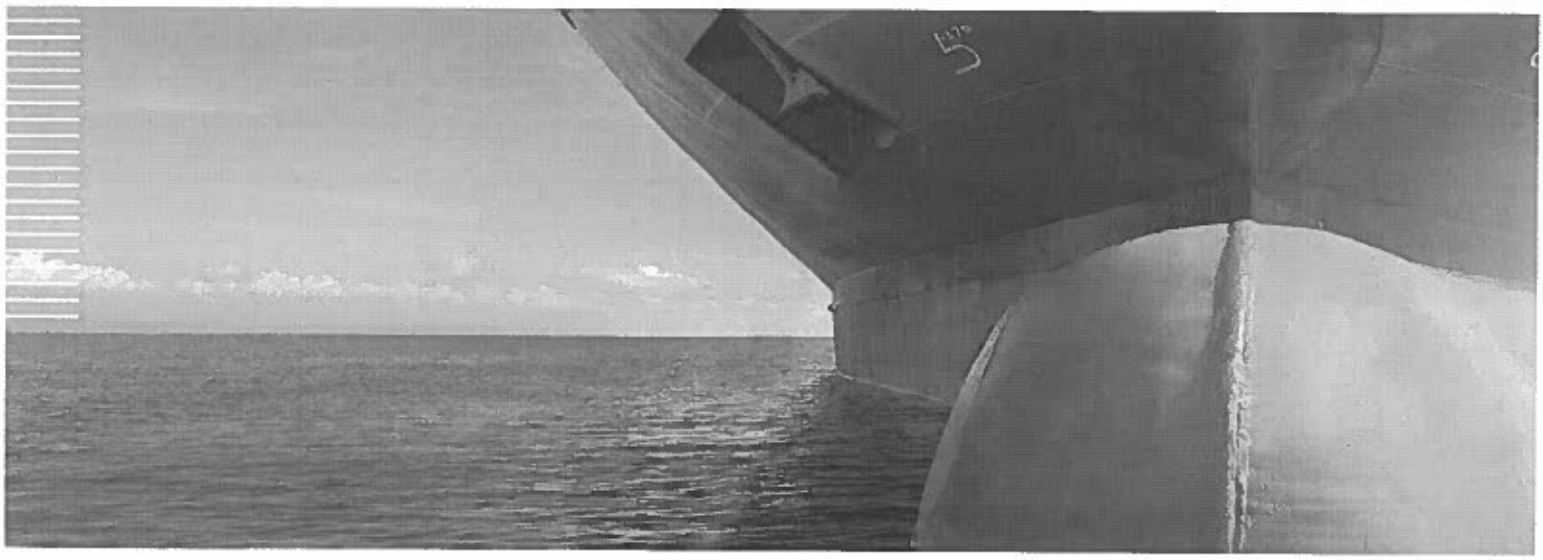
Currently, zero-carbon fuels and technologies do not exist at the size and scale needed to catalyse this revolution. However, there are several promising potential zero-carbon fuels and technologies, including ammonia, hydrogen and electric batteries, but each of these pose specific challenges that require a huge amount of R&D before they can become commercially viable on a global basis.

Ammonia and hydrogen are less energy dense compared to oil meaning that ships will consume up to five times as much fuel by volume. If the global fleet all adopted green ammonia fuel, ammonia production would have to rise by 440 million tonnes – more than treble current production – requiring 750 gigawatts of renewable energy. This means that shipping alone would consume 60% of the world's current renewable energy production of 2,537 gigawatts. The battery challenge is just as great: a typical container vessel would require the power of 10,000 Tesla S85 batteries every single day meaning that it would require 70,000 batteries in order to sail for a week.

In order to turn the fourth propulsion revolution into reality, the industry is proposing the creation of a US$5 billion R&D fund paid for by a levy on marine fuels, to be overseen by the industry's global regulator, the UN International Maritime Organization.



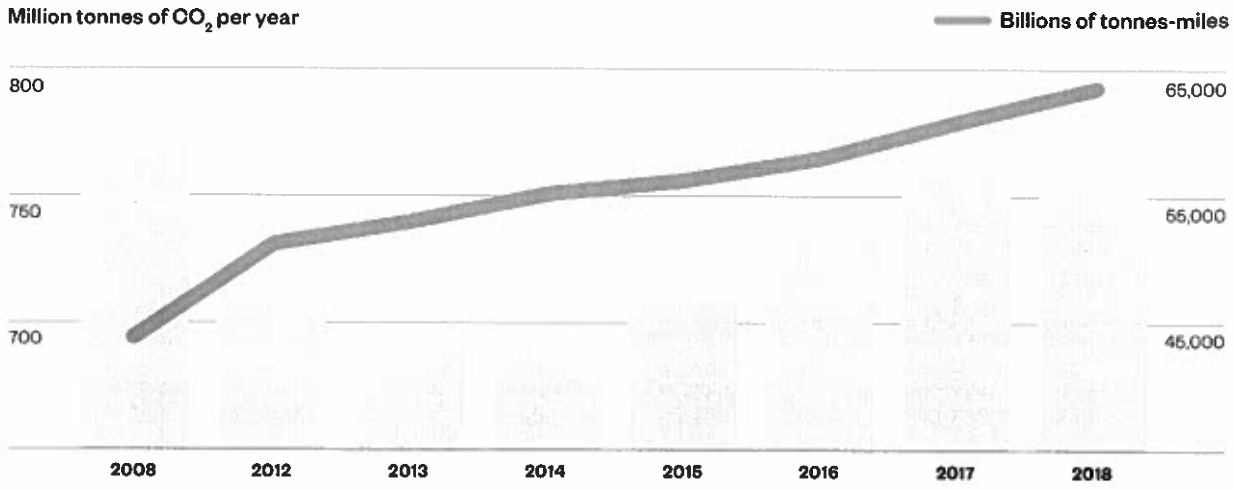
Source: ourworldindata.org, Hannah Ritchie, using data in Climate Watch, the World Resources Institute (2020).



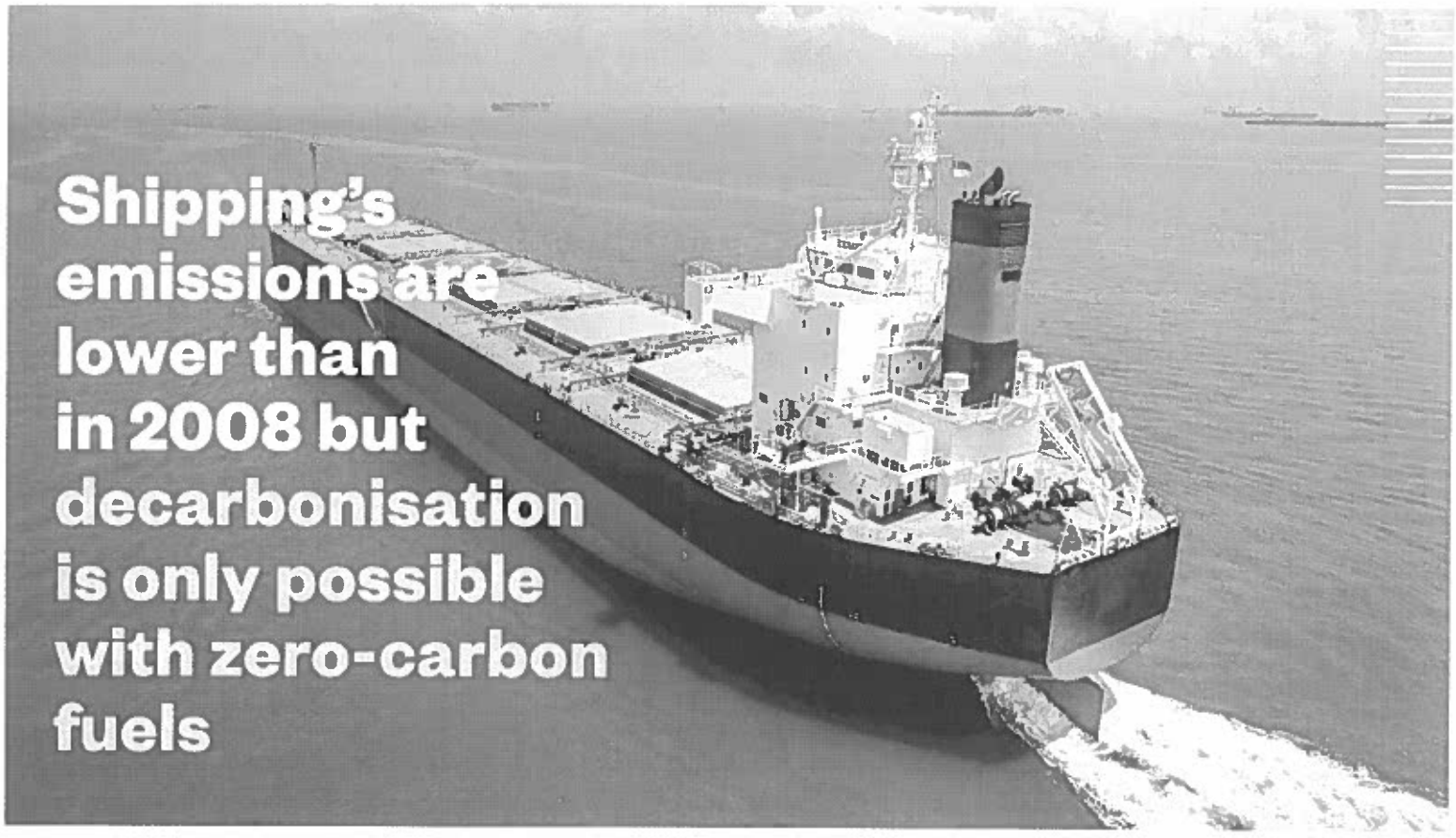
Maritime transport forms the backbone of international trade. It is, by far, the most cost-effective way to move goods around the world. According to World Trade Organization (WTO) data, the value of global trade carried by sea is close to $7 trillion and 90% of traded volumes are transported by way of the global shipping fleet, more than the entire GDP of the world's third largest economy, Japan. So it is not surprising that this is an industry that generates substantial carbon emissions that are similar to those of an industrialised country like Germany. Yet shipowners are keenly aware of the urgent need to aim for carbon neutrality, something that can only be done with the development of a new generation of technologies and new zero-carbon fuels.

While a range of potential technological pathways have been identified, no single technology or zero-carbon fuel is ready for widescale implementation. Indeed, almost all are in their infancy and need extensive further development. In order to overcome this challenge, the industry needs to invest heavily in increased R&D and is calling for the creation of a US$5 billion International Research and Development Fund, paid for by the industry via a mandatory levy on maritime fuel.

Overall, shipping is the least energy-intensive way to carry goods: despite the size of its share of total freight transport activity, it is responsible for about one fifth of the energy used for freight transport and just 8% of total transport energy use. At present, the



Sources: Fourth IMO GHG Study and UNCTAD based on data from Clarksons Research



Shipping's emissions are lower than in 2008 but decarbonisation is only possible with zero-carbon fuels

vast majority of energy used in shipping relies heavily on oil-based fuels and is highly carbon intensive. According to the International Energy Agency (IEA), in 2019 maritime shipping consumed 221 million tonnes of oil-based derivatives, mainly heavy fuel oil and diesel, the daily equivalent to almost 4 million barrels per day of crude oil or more than a third of the daily oil production of Saudi Arabia.

Carbon emissions from shipping in 2019 totalled 710 million tonnes – equal to one-fifth of total CO_2 emissions from freight transport, almost 10% of total transport emissions and around 2% of the world economy's total emissions. Even though this is high and needs to be reduced other industries have a substantially bigger carbon footprint. The global cement industry, for example, emits 2.8 billion tonnes, more than three times more than the shipping industry.

The shipping industry accepts that it needs to reduce its carbon footprint. The global industry regulator, the International Maritime Organization (IMO), has set an ambitious target of global emissions in 2050 being half of what they were in 2008 and with the clear objective of eliminating all greenhouse gas (GHG) emissions soon after. It is estimated that achieving this target might cost around a trillion dollars over the next 30 years, a significant but not unrealistic cost in view of the bunkering infrastructure that would need to be rolled-out globally. By comparison, the IEA put global investments in energy in 2018 alone at US$1.85 trillion.

Despite the high costs, the shipping industry itself is committed not just to the delivery of the ambitious CO_2 reduction targets already agreed by IMO Member States but the complete decarbonisation of international maritime transport as soon as possible after 2050.

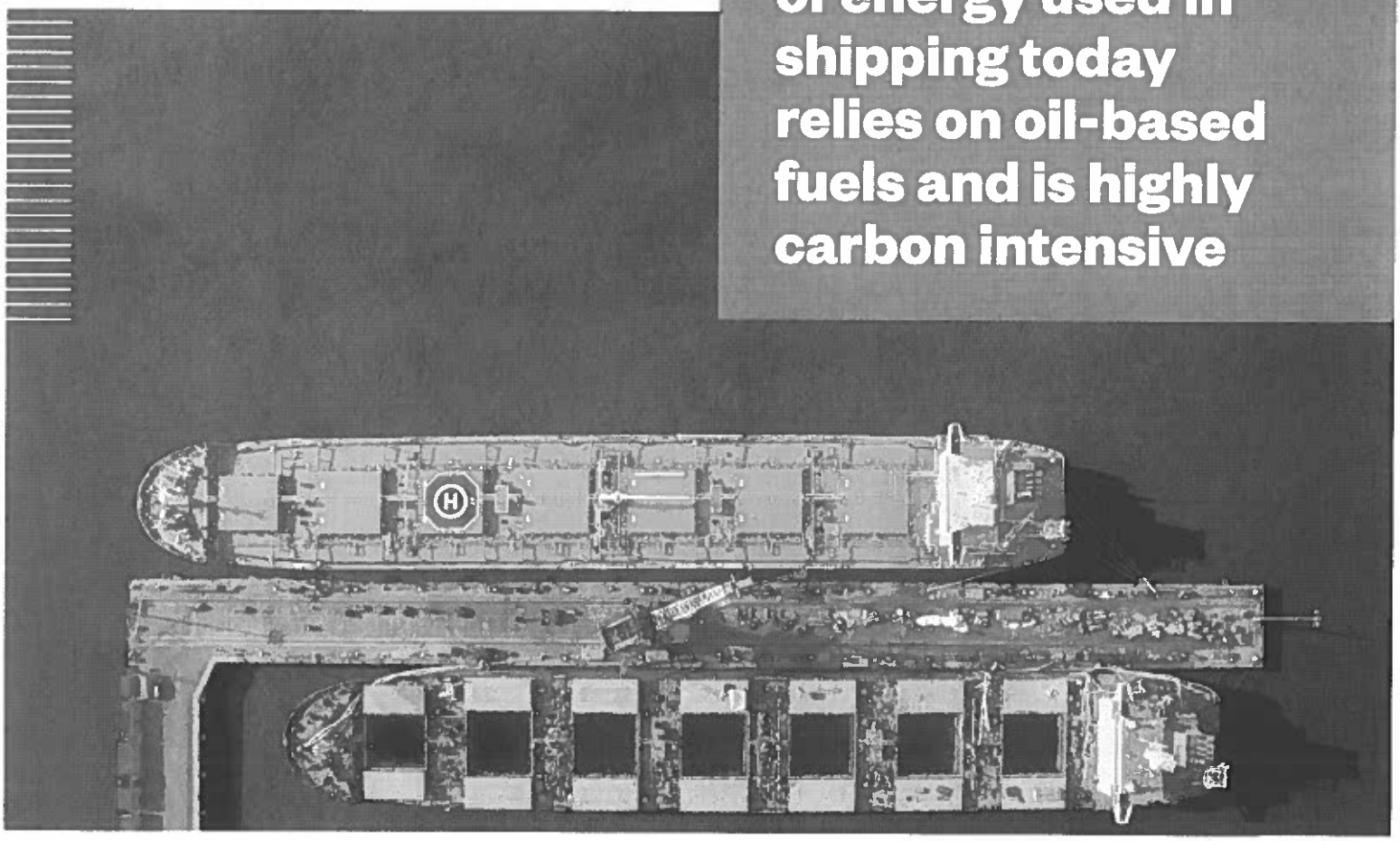
In recent years, in advance of the introduction of zero-carbon propulsion, a number of interim measures have been identified to reduce the industry's carbon footprint including radically improved ship designs, increased operational energy efficiency measures and the introduction of lower-emission fuels such as liquefied natural gas (LNG). In parallel, shipowners have made major strides in improving the fuel efficiency of their fleets leading to significant cuts in GHG emissions. Fuel is, by far, a ship operator's greatest cost meaning there is a huge economic incentive to do so.

Such measures, while not sufficient in themselves to achieve complete decarbonisation, have already had a substantial effect. The latest IMO study on the sector's GHG emissions, published in August 2020,

says CO_2 emissions from shipping in 2018 (prior to any contraction in trade caused by COVID-19) were 7% lower than in 2008. Overall, international shipping emissions remain below 2008 levels – the baseline year agreed for the IMO GHG reduction targets set for 2030 and 2050. This decrease came despite a 40% increase in maritime trade during the same ten-year period and represents a carbon efficiency improvement, as an average across the global fleet, of about 30% since 2008 – a significant achievement.

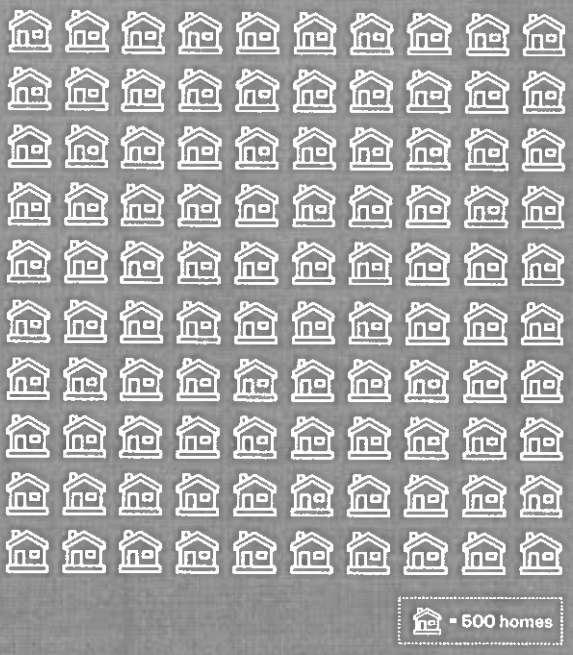
The shipping industry is keenly aware that the existing suite of possible measures to cut carbon emissions is not enough to achieve the IMO targets. Even using conservative estimates for trade growth, a 50% total cut in CO_2 by 2050 can only be achieved by improving carbon efficiency of the world fleet by around 90%. This will only be possible if a large proportion of the fleet is using commercially viable zero-carbon fuels. While not impossible, this will not be easy to achieve as most of these potential zero-carbon fuels are not yet at a sufficient level of technological readiness for application at sea, and will require new propulsion systems that cannot easily be retrofitted into existing ships. But rewards are high: if the 50% target is achieved, with a large proportion of the fleet using zero-carbon fuels by 2050, the entire world fleet would also be using these fuels very shortly after, making the industry's goal of 100% decarbonisation an achievable aspiration. To reach that point, however, there will have to be major investment in maritime R&D to develop alternatives to using fossil fuels.

The vast majority of energy used in shipping today relies on oil-based fuels and is highly carbon intensive



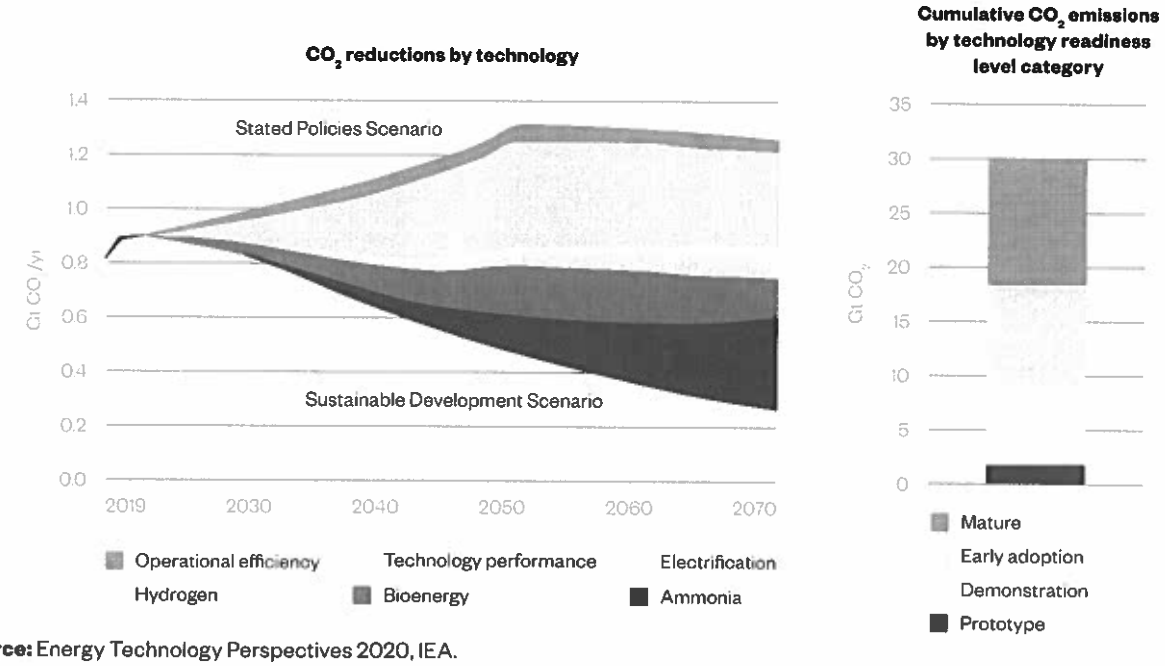
or most of the last century, the technology used by ships has been internal combustion engines and steam turbines using fossil fuels resulting in large emissions of carbon. Oil has major advantages, being energy-dense and easy to handle. Its drawback, however, is the massive amount of carbon emitted during production and combustion, and as shipowners commit to tackling the climate emergency, both fuels and propulsion technologies will have to be targeted in order to achieve zero-carbon transportation of cargo. The technologies necessary to achieve these ambitious goals do not yet exist in a form or scale which is commercially viable for widespread use by international shipping, especially for transoceanic voyages that are typically in excess of 10,000 kilometres. But these ambitions can be realised if the necessary R&D investments in developing low-carbon or zero-carbon fuels and/or propulsion systems are incorporated as part of an integrated IMO strategy.

The energy needed to power one large container ship across the ocean in a single day is the same energy needed to power 50,000 homes

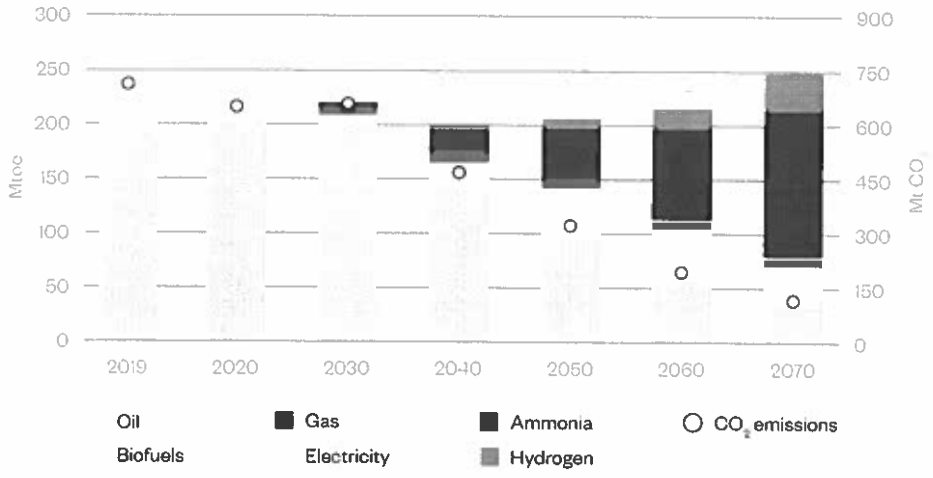


The decarbonisation challenge facing the industry is enormous. The larger ocean-going ships that provide the backbone to international trade, often travelling thousands of miles between ports, can typically have a tonnage in excess of 300,000 gross tonnage. This requires a huge amount of energy and ships need to carry very large fuel stocks for their voyages. Large container ships typically consume over 200,000 litres of fuel a day and carry over 10 million gallons in their tanks. The energy required by a large container ship travelling across the ocean on a single day could provide power for a town of 50,000 homes.

In recent years, there have been significant research breakthroughs in identifying zero-carbon fuels and technologies that have the potential to transform the shipping industry and pave the way for the decarbonisation of the global supply chain. There is a growing list of potential pathways with international organisations such as the IEA pointing to promising zero-carbon fuels such as emissions-free, hydrogen-based fuels (ammonia and hydrogen) for long-range transoceanic travel, and battery electric power for coastal short-distance ships. However, most of this research is nascent, carried out in research laboratories, and a long way from being ready for commercial application. Massive investments in R&D will be required before they can be installed in a new fleet of vessels.



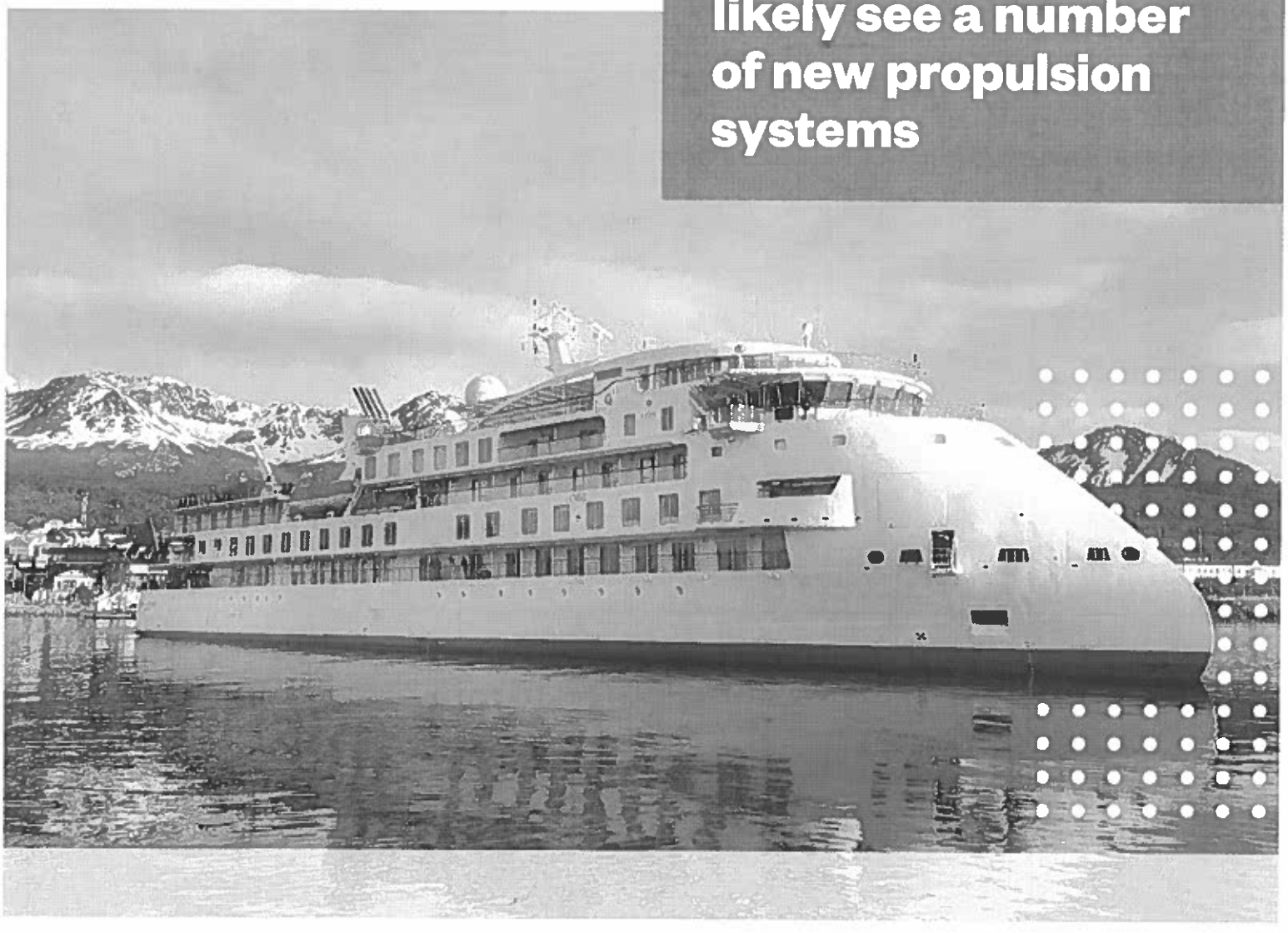
Source: Energy Technology Perspectives 2020, IEA.

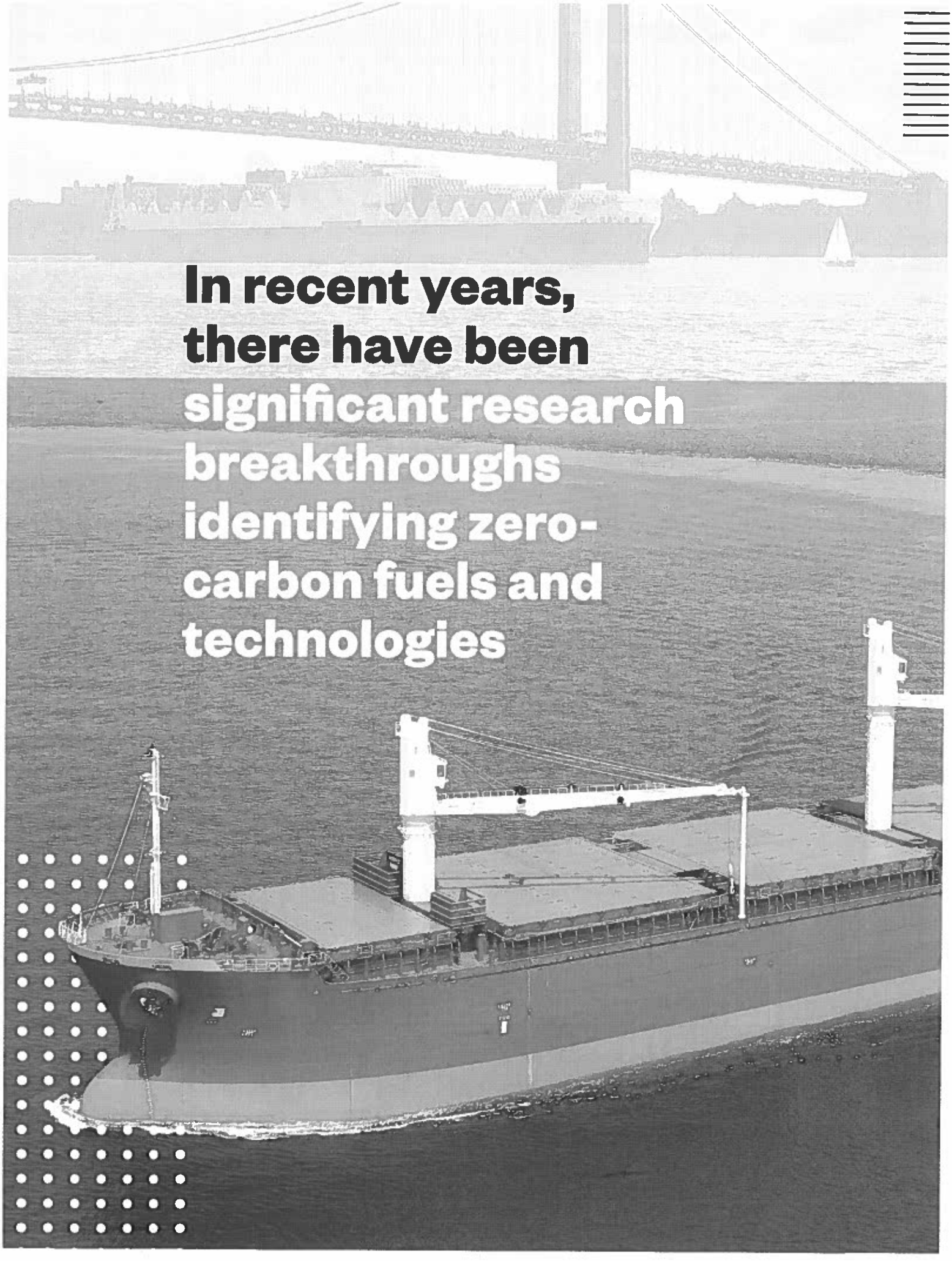


Source: Energy Technology Perspectives 2020, IEA.

The choice of the optimum future fuel will be driven by a range of considerations including the energy density (the amount of energy stored in a given fuel per unit volume), whether the fuel is fully 'green' (some fuels can be emissions-free when used but generated carbon during their production), the need for new propulsion systems and the availability of a global re-fuelling infrastructure. The likely outcome is that there is no single winner. Instead, the future of the global maritime fleet will likely see a number of new classes of vessels each with different zero-carbon fuel and propulsion systems focused on different market segments. The multiplicity of potential pathways represents an added challenge for the industry as each technology option needs to be comprehensively researched before reaching the required technology readiness level or being discarded as inappropriate for further development. A recent report commissioned by the International Chamber of Shipping (ICS) suggests there could be as many as 200 early-stage R&D projects needed to result in just 20 vessel-ready demonstration projects.

The future global maritime fleet will likely see a number of new propulsion systems





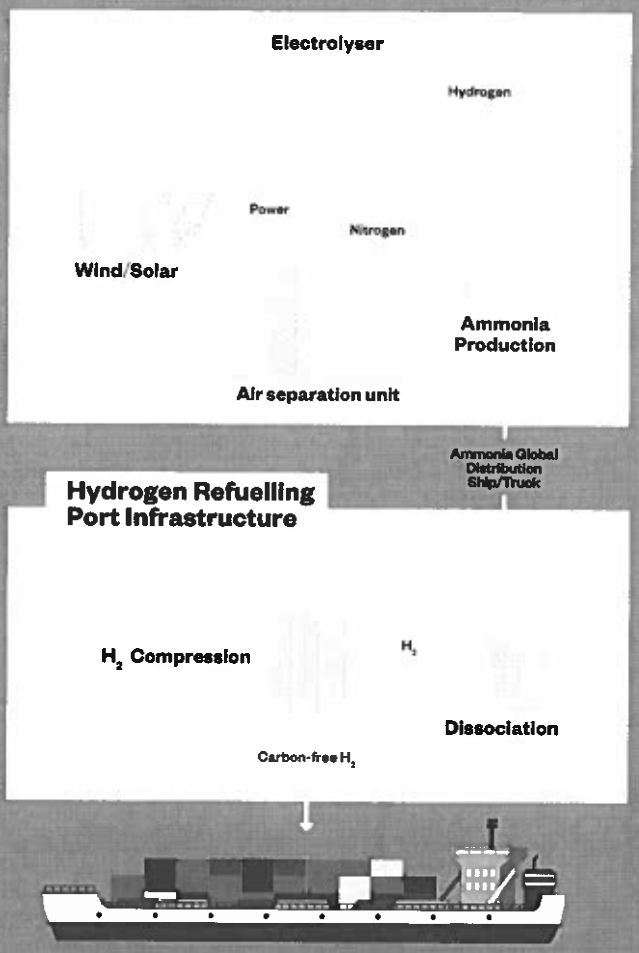
In recent years, there have been significant research breakthroughs identifying zero-carbon fuels and technologies

Green ammonia is one of the most promising low-emission fuels with the IEA predicting that its use for shipping will reach 130 million tonnes by 2070, almost twice as much as was used worldwide for fertiliser production in 2019. Nitrogen oxides – the only greenhouse gases emitted by the combustion of ammonia – could be eliminated by installing catalytic systems. Ammonia has multiple advantages including the fact that it can be used in an internal combustion engine. Already, MAN Energy Solutions, a subsidiary of the German carmaker, plans to have its first commercial ammonia-fuelled engine ready by 2024.

Ammonia is widely produced as a solid for the fertiliser industry but is currently made from natural or liquid petroleum gas which release large amounts of carbon during the production process. Green ammonia can be manufactured using renewable energy in a reaction process that uses hydrogen and nitrogen without the release of any carbon. However, in order to be used as a fuel, the ammonia would have to be stored as a liquid solution and a new bunkering network would have to be developed able to handle safely a new fuel that has very toxic properties. Furthermore, its energy density is relatively low which would mean that ships would have to carry more than twice the amount of fuel to cover the same distance compared to a diesel-power vessel.

According to Britain's Royal Society, 250 gigawatts of renewable energy would produce enough green ammonia for a third of the global fleet. If the entire fleet used ammonia, the power required would be 750 gigawatts – 60% of the current global renewable energy production of 2,537 gigawatts.

A recent study by the Danish catalyst company Topsoe forecasts that the cost of green ammonia from solar and wind energy will be $21.50–45.70 per gigajoule in 2025, dropping to $13.50–15.00 in 2040. By comparison, fuel oil today is priced at $12.50–15.00 per gigajoule. Ammonia can be mixed with the existing fuel mix, enabling its use to be increased steadily.



Saudi Arabia recently announced a $5 billion, 4-gigawatt green ammonia plant to be operational by 2025. The plant will generate four gigawatts of renewable power from solar and wind to produce 650 tonnes per day of hydrogen and 1.2 million tonnes per year of green ammonia. The hydrogen produced is being targeted for commercial trucks. Major R&D will be needed before either ammonia or hydrogen can be used as a zero-carbon fuel for ships. However, Saudi Arabia is located at the centre of the main Asia-Europe shipping lanes meaning that ships could provide a major source of demand for these zero-carbon fuels.

Hydrogen as a fuel is attractive because it emits no carbon or other pollutants when used. At present, most commercially available hydrogen is made from fossil fuels in a process that emits a large amount of carbon, effectively negating its green credentials. However, research is underway to develop energy efficient processes for producing green hydrogen from water via thermochemical processes using renewable energy. For renewable energy producers such as wind and solar, the production of hydrogen by electrolysis is an attractive opportunity to store and transport surplus energy, thereby stabilising the energy output of their power plants.

The energy density of hydrogen gas is relatively low, and it would need to be liquefied and stored under pressure to be viable as a fuel, creating a transportation and storage challenge. A unit of cooled liquid hydrogen has less than half the energy of diesel and requires more than double the space to store it. Furthermore, an appropriate bunkering infrastructure will also be needed. The IEA notes that the role of hydrogen as a fuel for large vessels is more limited than ammonia due to the high costs of hydrogen storage and its lower energy density. Nonetheless, it predicts hydrogen use could reach 12 million tonnes in 2070, equivalent to 16% of 2019 global maritime bunker demand and 16% of today's global hydrogen use.

Hydrogen for shipping will need to come from renewable sources such as solar and wave power

Existing hydrogen manufacturers can produce 'blue' or low-carbon hydrogen by capturing and storing the carbon emitted during the production process. Already, Norwegian company Equinor is leading a project to develop one of the UK's – and the world's – first at-scale facilities to produce hydrogen from natural gas in combination with carbon capture and storage (CCS). Oil and gas companies producing hydrogen close to their oilfields can store the carbon in the underground reservoirs from which the gas was produced.

Another potential approach to produce carbon neutral fuels involves chemically processing green hydrogen together with carbon or nitrogen to produce gaseous or liquid fuel. Carbon-based synthetic fuels have properties similar to the fossil fuels used today but the fact that they use captured carbon means that they are technically carbon neutral.

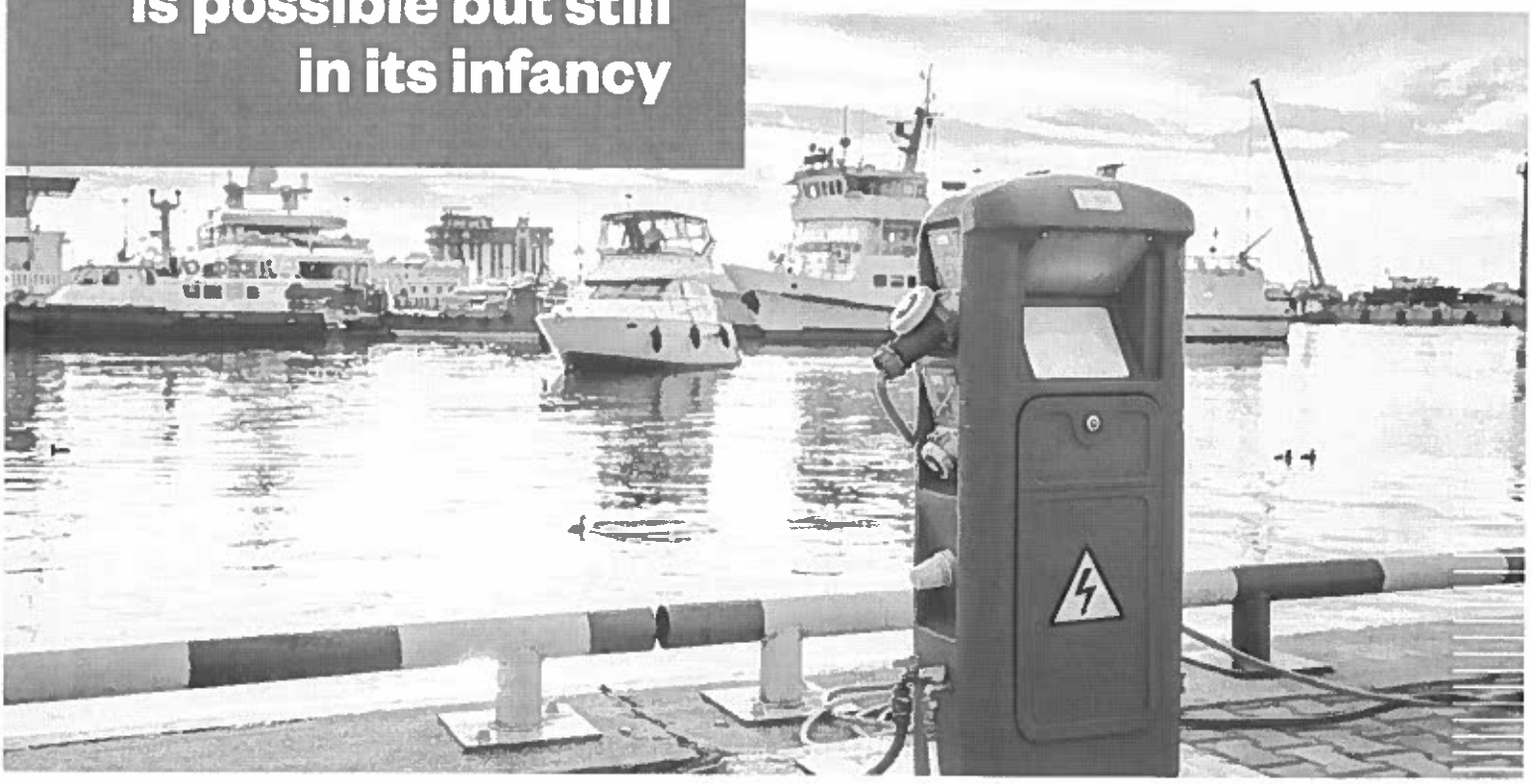
Shipping companies are already working on hydrogen-fuelled vessels. Belgian shipping company CMB recently teamed up with ABC Engines to develop the world's first dual-fuel hydrogen-diesel engine. The joint venture called Behydro has developed a diesel-hydrogen engine that will be able to provide up to 10 megawatts of power. BeHydro has already received its first order for 2 x 2 megawatts dual-fuel engines that will be installed on board the HydroTug. This vessel is the very first hydrogen tugboat in the world and will be deployed by the Port of Antwerp, using a mono-fuel hydrogen engine that will be ready by the second quarter of 2021. However, there is a huge difference between a 300 gross tonnage tugboat that can be refuelled daily and a large 236,000 gross tonnage oceangoing container ship, illustrating the major scale of the challenge and the need for an accelerated R&D programme.

Rather than being combusted as a fuel, hydrogen can be used in fuel cells that turn the chemical energy from hydrogen into electricity through an electrochemical reaction. Fuel cells are considered a potentially promising zero-carbon technology that could be capable of powering ships sailing short distances, as well as supporting auxiliary energy requirements of larger vessels.

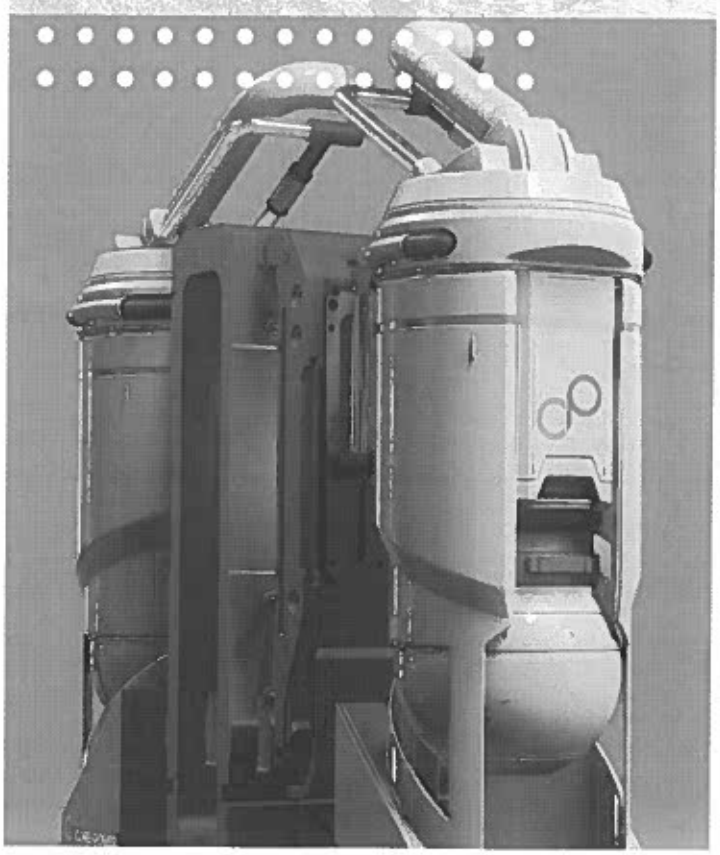
Using batteries to power electric engines in ships is still in its infancy but advances in chemistry and technology could eventually mean that even large ocean-going ships could be powered by batteries using renewable sources of energy. However, achieving this will be a major challenge: a typical large container vessel would require the power of 10,000 Tesla S85 batteries every single day meaning that it would require 70,000 batteries in order to sail for a week.

The current view is that purely electric vessels will only be economically viable for short-distance trips, but this could be changed with increased R&D. The shipping industry is likely to be a big beneficiary of advances in the electric car industry. Much research is already underway to increase the watt-hours per kilogram (Wh/kg), the unit of measurement commonly used to describe the density of energy in batteries. Existing batteries that Tesla uses in its Model 3 are an estimated 250 Wh/kg but some companies believe that they will soon be able to achieve batteries of 1,000 Wh/kg. Achieving increased energy density of batteries will be key.

Using batteries to help power ships is possible but still in its infancy



Harnessing the power of the wind, the shipping industry's oldest propulsion system, is becoming a viable option thanks to new technology. While today's modern ships are unlikely to ever be driven exclusively by the power of nature, wind-assisted propulsion could complement systems that use zero-carbon fuel. Recently developed rigid wing sails and kites as well as the Flettner rotor that use force that derives from vertical rotors, could be further developed to provide a secondary zero-carbon propulsion system for ships or even primary propulsion on some routes. Even though existing retro-fitted wind systems can only currently supply 5–10% of a ship's energy requirements, these are likely to be further optimised and hybrid wind-electric systems are potentially attractive R&D approaches.



Nuclear fuels are a proven technology that could be readily applied to many merchant ships in order to eliminate CO_2 emissions completely. Only a small nuclear reactor would be required, with a life of many years, removing the need for ships to refuel or carry bunkers. Russia successfully operates a number of nuclear ice breaking vessels in the Arctic. However, it is currently assumed that widespread use of nuclear fuels is unlikely to be viewed as politically acceptable by the majority of governments, due to concerns about safety and security.

A quantum leap in decarbonised technology similar to the switch from sail to steam over a century ago is required if shipping's current CO_2 reduction targets are to be achieved. The required carbon efficiency improvement of up to 90% is simply incompatible with the continuing long-term use of fossil fuels by commercial shipping. Already time is short as the IMO 2050 target can only be achieved with the introduction of commercially viable zero-carbon technologies in the 2030s. Furthermore, a new generation of vessels will have to be built as it will take many decades before the existing fleet is fully replaced. Ships typically have a lifespan of 20–25 years.

However, the majority of vessels constructed today run almost exclusively on fossil fuels, and it will not be possible for regulators to mandate their phase-out before 2050 unless zero-carbon fuels and propulsion systems are available on a global basis.

Such zero-carbon technologies do not currently exist in a scale or form that can be applied to large ocean-going ships and the current state of technological readiness of potentially promising solutions such as hydrogen, ammonia and battery systems will require a massive amount of investment in R&D before they can be commercially applied in the global shipping industry. Other challenges will include the anticipated need to create new land-based fuel handling and supply infrastructures as well as the need to embark on training programmes and the development of completely novel safety procedures. The size of the task, while not insurmountable, is enormous for an industry which is dependent on fossil fuels, and

Commercially viable zero-carbon ships need to appear in the 2030s

which mostly comprises small and medium sized enterprises. Furthermore, shipping companies are global transportation enterprises not technology companies. While they can support the technology development process, individual shipping companies cannot be expected to lead the necessary R&D, underlining the need for a global R&D Fund to which the entire industry can contribute.

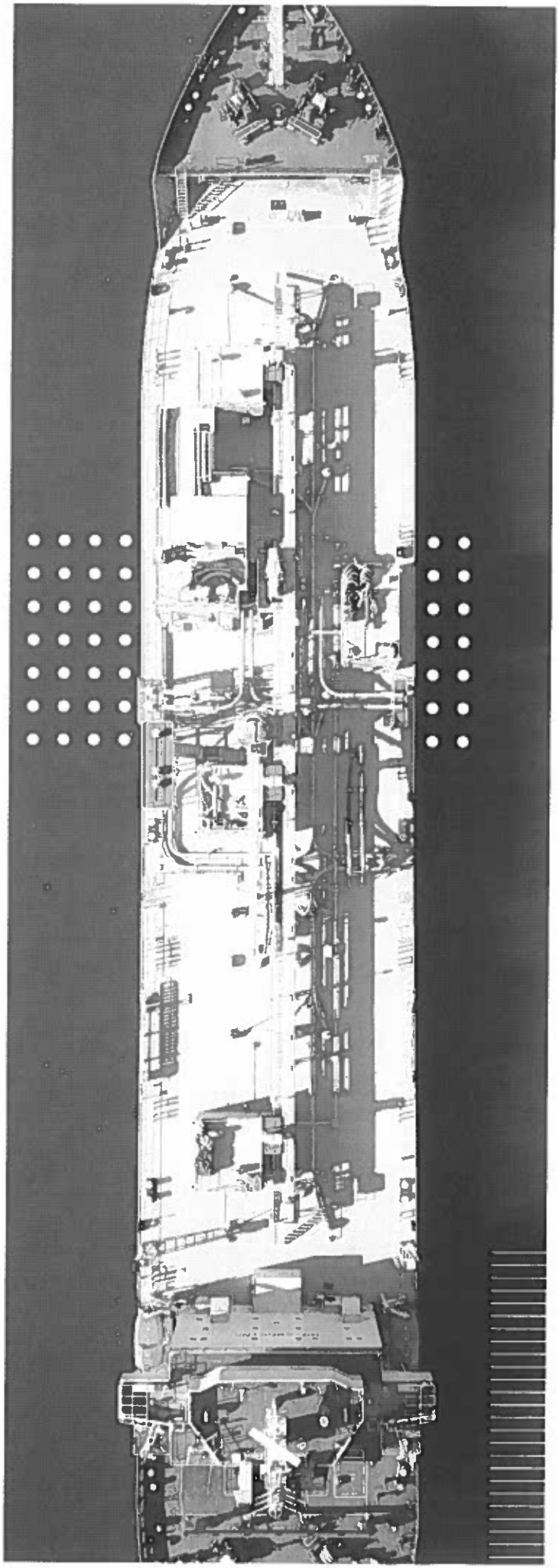
In an attempt to provide a major impetus to global R&D efforts, the global maritime transport industry has submitted a proposal to IMO to form the world's first collaborative shipping R&D programme to help eliminate CO_2 emissions from international shipping. The proposal includes core funding from shipping companies across the world of about US$ 5 billion over a 10-year period.

In order to accelerate the R&D process, the shipping industry proposed, in December 2019, the establishment of an International Maritime Research and Development Board (IMRB), a non-governmental R&D organisation that would be overseen by IMO Member States. Under the proposal, the IMRB will be financed by shipping companies worldwide via a mandatory R&D levy of US$ 2 per tonne of marine fuel purchased for consumption by shipping companies worldwide, which will generate about US$ 5 billion in core funding over a 10-year period.

This US$ 5 billion in core funding to be generated from the industry contributions is critical to accelerate the R&D effort required to decarbonise the shipping sector and to catalyse the deployment of commercially viable zero-carbon ships by the early 2030s.

ICS believes that a global fund, once adopted by the IMO, can be established quickly. Other stakeholders such as energy producers, ship builders and engine manufacturers are likely to want to contribute via co-funded projects supported by this major R&D programme, potentially generating substantial additional funding for R&D for zero-carbon technologies.

In its proposal to the UN IMO, the industry set out details for governance and funding of the coordinated R&D programme, which, with the political support of governments, could be put in place by as soon as 2023 via amendments to the existing IMO Convention for the Prevention of Pollution from Ships (MARPOL).



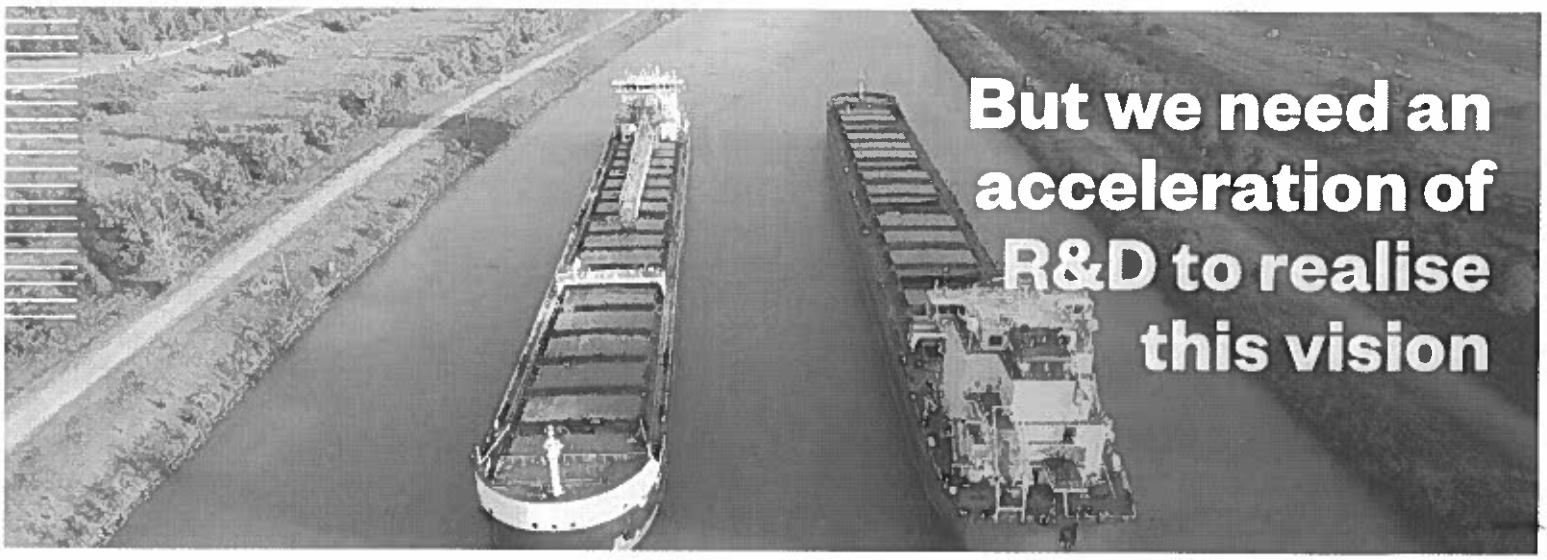
The IEA estimates that by 2070, oil and gas will be responsible for just one-sixth of total shipping fuel consumption. For that, the fourth propulsion revolution will have to have succeeded. However, this will require an enormous effort and a large amount of money. The establishment of an International Maritime Research and Development Board will be a major step in the journey towards ending the use of fossil fuel by embracing zero-carbon fuels.

The global shipping industry has no intention whatsoever of allowing COVID-19, or its attendant economic challenges, to deflect from its efforts to achieve the IMO targets or to fulfil its responsibility to help meet the 1.5-degree Celsius climate change goal that has been set for the global economy by the Paris Agreement. Many companies have begun investing in research into new fuels and technologies, but the $5 billion fund will provide a major boost.

This is a process in which there are winners and very few losers. In addition to the major contribution in the fight against climate change, R&D actions undertaken within the scope of the International Maritime Research and Development Board will almost certainly have wider benefits beyond the shipping industry. For example, hydrogen fuel cells are already being tested in passenger vehicles while green ammonia is also being lined up as a fuel for airplanes. The British aircraft-engine manufacturer Reaction Engines says it is working on a fuel system in which ammonia is exposed to a catalyst that splits it into nitrogen and hydrogen, with the latter burned in the aircraft engine.

Legacy hydrocarbon producers will not necessarily lose out. Indeed, they could end up being major producers of a new generation of zero-carbon fuels. For example, Middle East oil producers could produce blue hydrogen from natural gas or methane while capturing the carbon produced during the process and re-injecting it into the oilfield geological reservoir. Likewise, they could use their abundant solar resources to make green hydrogen by electrolysing water with renewable energy.

Shipowners themselves will be beneficiaries despite the major investments they are prepared to make. As the world moves towards a green economy, charterers will come under pressure from their clients to use ships with green credentials. Likewise, financiers will be more likely to fund green ships than older carbon emitting ships.



3. The Regulatory Response, at global level

- 2018 Initial IMO Strategy on GHG Emissions from Ships

- "Annex 2": IMO's Overview of Activity (as of 2018) related to reducing GHG Emissions from International Shipping, submitted to the UNFCCC Talanoa Dialogue, a process designed to help countries implement and enhance their Nationally Determined Contributions by 2020

- IMO Press Briefing on MEPC 76 outcome related to the reduction of GHG Emissions, June 2021

ANNEX 11

RESOLUTION MEPC.304(72)
(adopted on 13 April 2018)

INITIAL IMO STRATEGY ON REDUCTION OF GHG EMISSIONS FROM SHIPS

THE MARINE ENVIRONMENT PROTECTION COMMITTEE

RECALLING Article 38(e) of the Convention on the International Maritime Organization (the Organization) concerning the functions of the Marine Environment Protection Committee (the Committee) conferred upon it by international conventions for the prevention and control of marine pollution from ships,

ACKNOWLEDGING that work to address greenhouse gas (GHG) emissions from ships has been undertaken by the Organization continuously since 1997, in particular, through adopting global mandatory technical and operational energy efficiency measures for ships under MARPOL Annex VI,

ACKNOWLEDGING ALSO the decision of the thirtieth session of the Assembly in December 2017 that adopted for the Organization a strategic direction entitled "Respond to Climate Change",

RECALLING the United Nations 2030 Agenda for Sustainable Development,

1 ADOPTS the Initial IMO Strategy on Reduction of GHG Emissions from Ships (hereinafter the Initial Strategy) as set out in the annex to the present resolution;

2 INVITES the Secretary-General of the Organization to make adequate provisions in the Integrated Technical Cooperation Programme (ITCP) to support relevant follow-up actions of the Initial Strategy that may be further decided by the Committee and undertaken by developing countries, particularly least developed countries (LDCs) and small island developing States (SIDS);

3 AGREES to keep the Initial Strategy under review, with a view to adoption of a Revised IMO Strategy on reduction of GHG emissions from ships in 2023.

ANNEX

INITIAL IMO STRATEGY ON REDUCTION OF GHG EMISSIONS FROM SHIPS

Contents

1 INTRODUCTION

1.1 The International Maritime Organization (IMO) is the United Nations specialized agency responsible for safe, secure and efficient shipping and the prevention of pollution from ships.

1.2 The Strategy represents the continuation of work of IMO as the appropriate international body to address greenhouse gas (GHG) emissions from international shipping. This work includes Assembly resolution A.963(23) on *IMO policies and practices related to the reduction of greenhouse gas emissions from ships*, adopted on 5 December 2003, urging the Marine Environment Protection Committee (MEPC) to identify and develop the mechanisms needed to achieve the limitation or reduction of GHG emissions from international shipping.

1.3 In response to the Assembly's request, work to address GHG emissions from ships has been undertaken, including inter alia:

.1 MEPC 62 (July 2011) adopted resolution MEPC.203(62) on *Inclusion of regulations on energy efficiency for ships in MARPOL Annex VI* introducing mandatory technical (EEDI) and operational (SEEMP) measures for the energy efficiency of ships. To date more than 2,700 new ships have been certified to the energy efficiency design requirement;

.2 MEPC 65 (May 2013) adopted resolution MEPC.229(65) on *Promotion of technical co-operation and transfer of technology relating to the improvement of energy efficiency of ships*, which, among other things, requests IMO, through its various programmes (ITCP,[1] GloMEEP project,[2] MTCC network,[3] etc.), to provide technical assistance to Member States to enable cooperation in the transfer of energy efficient technologies, in particular to developing countries; and

.3 MEPC 70 (October 2016) adopted, by resolution MEPC.278(70), amendments to MARPOL Annex VI to introduce the d*ata collection system for fuel oil consumption of ships*, containing mandatory requirements for ships to record and report their fuel oil consumption. Ships of 5,000 gross tonnage and above (representing approximately 85% of the total CO_2 emissions from international shipping) are required to collect consumption data for each type of fuel oil they use, as well as other, additional, specified data including proxies for "transport work".

1.4 This Initial Strategy is the first milestone set out in the *Roadmap for developing a comprehensive IMO Strategy on reduction of GHG emissions from ships* (the Roadmap) approved at MEPC 70. The Roadmap identifies that a revised Strategy is to be adopted in 2023.

1 Integrated Technical Cooperation Programme http://www.imo.org

2 Global Maritime Energy Efficiency Partnerships http://glomeep.imo.org

3 Global Maritime Technology Cooperation Centres Network http://gmn.imo.org

Context

1.5 The Initial Strategy falls within a broader context including:

.1 other existing instruments related to the law of the sea, including UNCLOS, and to climate change, including the UNFCCC and its related legal instruments, including the Paris Agreement;

.2 the leading role of the Organization for the development, adoption and assistance in implementation of environmental regulations applicable to international shipping;

.3 the decision of the thirtieth session of the Assembly in December 2017 that adopted for the Organization a Strategic Direction entitled "Respond to climate change"; and

.4 the United Nations 2030 Agenda for Sustainable Development.

Emissions and emission scenarios

1.6 The *Third IMO GHG Study 2014* has estimated that GHG emissions from international shipping in 2012 accounted for some 2.2% of anthropogenic CO_2 emissions and that such emissions could grow by between 50% and 250% by 2050. Future IMO GHG studies would help reduce the uncertainties associated with these emission estimates and scenarios.

Objectives of the Initial Strategy

1.7 The Initial Strategy is aimed at:

.1 enhancing IMO's contribution to global efforts by addressing GHG emissions from international shipping. International efforts in addressing GHG emissions include the Paris Agreement and its goals and the United Nations 2030 Agenda for Sustainable Development and its SDG 13: "*Take urgent action to combat climate change and its impacts*";

.2 identifying actions to be implemented by the international shipping sector, as appropriate, while addressing impacts on States and recognizing the critical role of international shipping in supporting the continued development of global trade and maritime transport services; and

.3 identifying actions and measures, as appropriate, to help achieve the above objectives, including incentives for research and development and monitoring of GHG emissions from international shipping.

2 VISION

IMO remains committed to reducing GHG emissions from international shipping and, as a matter of urgency, aims to phase them out as soon as possible in this century.

3 LEVELS OF AMBITION AND GUIDING PRINCIPLES

Levels of ambition

3.1 Subject to amendment depending on reviews to be conducted by the Organization, the Initial Strategy identifies levels of ambition for the international shipping sector noting that technological innovation and the global introduction of alternative fuels and/or energy sources for international shipping will be integral to achieve the overall ambition. The reviews should take into account updated emission estimates, emissions reduction options for international shipping, and the reports of the Intergovernmental Panel on Climate Change (IPCC), as relevant. Levels of ambition directing the Initial Strategy are as follows:

.1 ***carbon intensity of the ship to decline through implementation of further phases of the energy efficiency design index (EEDI) for new ships***

to review with the aim to strengthen the energy efficiency design requirements for ships with the percentage improvement for each phase to be determined for each ship type, as appropriate;

.2 ***carbon intensity of international shipping to decline***

to reduce CO_2 emissions per transport work, as an average across international shipping, by at least 40% by 2030, pursuing efforts towards 70% by 2050, compared to 2008; and

.3 ***GHG emissions from international shipping to peak and decline***

to peak GHG emissions from international shipping as soon as possible and to reduce the total annual GHG emissions by at least 50% by 2050 compared to 2008 whilst pursuing efforts towards phasing them out as called for in the Vision as a point on a pathway of CO_2 emissions reduction consistent with the Paris Agreement temperature goals.

Guiding principles

3.2 The principles guiding the Initial Strategy include:

.1 the need to be cognizant of the principles enshrined in instruments already developed, such as:

.1 the principle of non-discrimination and the principle of no more favourable treatment, enshrined in MARPOL and other IMO conventions; and

.2 the principle of common but differentiated responsibilities and respective capabilities, in the light of different national circumstances, enshrined in UNFCCC, its Kyoto Protocol and the Paris Agreement;

.2 the requirement for all ships to give full and complete effect, regardless of flag, to implementing mandatory measures to ensure the effective implementation of this strategy;

.3 the need to consider the impacts of measures on States, including developing countries, in particular, on LDCs and SIDS as noted by MEPC 68 (MEPC 68/21, paragraphs 4.18 to 4.19) and their specific emerging needs, as recognized in the Organization's Strategic Plan (resolution A.1110(30)); and

.4 the need for evidence-based decision-making balanced with the precautionary approach as set out in resolution MEPC.67(37).

4 LIST OF CANDIDATE SHORT-, MID- AND LONG-TERM FURTHER MEASURES WITH POSSIBLE TIMELINES AND THEIR IMPACTS ON STATES

Timelines

4.1 Candidate measures set out in this Initial Strategy should be consistent with the following timelines:

.1 possible short-term measures could be measures finalized and agreed by the Committee between 2018 and 2023. Dates of entry into force and when the measure can effectively start to reduce GHG emissions would be defined for each measure individually;

.2 possible mid-term measures could be measures finalized and agreed by the Committee between 2023 and 2030. Dates of entry into force and when the measure can effectively start to reduce GHG emissions would be defined for each measure individually; and

.3 possible long-term measures could be measures finalized and agreed by the Committee beyond 2030. Dates of entry into force and when the measure can effectively start to reduce GHG emissions would be defined for each measure individually.

4.2 In aiming for early action, the timeline for short-term measures should prioritize potential early measures that the Organization could develop, while recognizing those already adopted, including MARPOL Annex VI requirements relevant for climate change, with a view to achieve further reduction of GHG emissions from international shipping before 2023.

4.3 Certain mid- and long-term measures will require work to commence prior to 2023.

4.4 These timelines should be revised as appropriate as additional information becomes available.

4.5 Short-, mid- and long-term further measures to be included in the Revised IMO GHG Strategy should be accompanied by implementation schedules.

4.6 The list of candidate measures is non-exhaustive and is without prejudice to measures the Organization may further consider and adopt.

Candidate short-term measures

4.7 Measures can be categorized as those the effect of which is to directly reduce GHG emissions from ships and those which support action to reduce GHG emissions from ships. All the following candidate measures[4] represent possible short-term further action of the Organization on matters related to the reduction of GHG emissions from ships:

.1 further improvement of the existing energy efficiency framework with a focus on EEDI and SEEMP, taking into account the outcome of the review of EEDI regulations;

.2 develop technical and operational energy efficiency measures for both new and existing ships, including consideration of indicators in line with the three-step approach that can be utilized to indicate and enhance the energy efficiency performance of shipping, e.g. Annual Efficiency Ratio (AER), Energy Efficiency per Service Hour (EESH), Individual Ship Performance Indicator (ISPI) and Fuel Oil Reduction Strategy (FORS);

.3 establishment of an Existing Fleet Improvement Programme;

.4 consider and analyse the use of speed optimization and speed reduction as a measure, taking into account safety issues, distance travelled, distortion of the market or trade and that such measure does not impact on shipping's capability to serve remote geographic areas;

.5 consider and analyse measures to address emissions of methane and further enhance measures to address emissions of Volatile Organic Compounds;

.6 encourage the development and update of national action plans to develop policies and strategies to address GHG emissions from international shipping in accordance with guidelines to be developed by the Organization, taking into account the need to avoid regional or unilateral measures;

.7 continue and enhance technical cooperation and capacity-building activities under the ITCP;

.8 consider and analyse measures to encourage port developments and activities globally to facilitate reduction of GHG emissions from shipping, including provision of ship and shoreside/onshore power supply from renewable sources, infrastructure to support supply of alternative low-carbon and zero-carbon fuels, and to further optimize the logistic chain and its planning, including ports;

.9 initiate research and development activities addressing marine propulsion, alternative low-carbon and zero-carbon fuels, and innovative technologies to further enhance the energy efficiency of ships and establish an International Maritime Research Board to coordinate and oversee these R&D efforts;

.10 incentives for first movers to develop and take up new technologies;

[4] The Initial Strategy is subject to revision based on fuel oil consumption data collected during 2019-2021 and does not prejudge any specific further measures that may be implemented in Phase 3 of the three-step approach.

.11 develop robust lifecycle GHG/carbon intensity guidelines for all types of fuels, in order to prepare for an implementation programme for effective uptake of alternative low-carbon and zero-carbon fuels;

.12 actively promote the work of the Organization to the international community, in particular, to highlight that the Organization, since the 1990s, has developed and adopted technical and operational measures that have consistently provided a reduction of air emissions from ships, and that measures could support the Sustainable Development Goals, including SDG 13 on Climate Change; and

.13 undertake additional GHG emission studies and consider other studies to inform policy decisions, including the updating of Marginal Abatement Cost Curves and alternative low-carbon and zero-carbon fuels.

Candidate mid-term measures

4.8 Measures can be categorized as those the effect of which is to directly reduce GHG emissions from ships and those which support action to reduce GHG emissions from ships. All the following candidate measures represent possible mid-term further action of the Organization on matters related to the reduction of GHG emissions from ships:

.1 implementation programme for the effective uptake of alternative low-carbon and zero-carbon fuels, including update of national actions plans to specifically consider such fuels;

.2 operational energy efficiency measures for both new and existing ships including indicators in line with three-step approach that can be utilized to indicate and enhance the energy efficiency performance of ships;

.3 new/innovative emission reduction mechanism(s), possibly including Market-based Measures (MBMs), to incentivize GHG emission reduction;

.4 further continue and enhance technical cooperation and capacity-building activities such as under the ITCP; and

.5 development of a feedback mechanism to enable lessons learned on implementation of measures to be collated and shared through a possible information exchange on best practice.

Candidate long-term measures

4.9 All the following candidate measures represent possible long-term further action of the Organization on matters related to the reduction of GHG emissions from ships:

.1 pursue the development and provision of zero-carbon or fossil-free fuels to enable the shipping sector to assess and consider decarbonization in the second half of the century; and

.2 encourage and facilitate the general adoption of other possible new/innovative emission reduction mechanism(s).

Impacts on States

4.10 The impacts on States of a measure should be assessed and taken into account as appropriate before adoption of the measure. Particular attention should be paid to the needs of developing countries, especially small island developing States (SIDS) and least developed countries (LDCs).

4.11 When assessing impacts on States the impact of a measure should be considered, as appropriate, inter alia, in the following terms:

.1 geographic remoteness of and connectivity to main markets;

.2 cargo value and type;

.3 transport dependency;

.4 transport costs;

.5 food security;

.6 disaster response;

.7 cost-effectiveness; and

.8 socio-economic progress and development.

4.12 The specification for and agreement on the procedure for assessing and taking into account the impacts of measures related to international shipping on States should be undertaken as a matter of urgency as part of the follow-up actions.

4.13 Disproportionately negative impacts should be assessed and addressed, as appropriate.

5 BARRIERS AND SUPPORTIVE MEASURES; CAPACITY-BUILDING AND TECHNICAL COOPERATION; R&D

5.1 The Committee recognizes that developing countries, in particular LDCs and SIDS, have special needs with regard to capacity-building and technical cooperation.

5.2 The Committee acknowledges that development and making globally available new energy sources that are safe for ships could be a specific barrier to the implementation of possible measures.

5.3 The Committee could assist the efforts to promote low-carbon technologies by facilitating public-private partnerships and information exchange.

5.4 The Committee should continue to provide mechanisms for facilitating information sharing, technology transfer, capacity-building and technical cooperation, taking into account resolution MEPC.229(65) on *Promotion of technical co-operation and transfer of technology relating to the improvement of energy efficiency of ships*.

5.5 The Organization is requested to assess periodically the provision of financial and technological resources and capacity-building to implement the Strategy through the ITCP and other initiatives including the GloMEEP project and the MTCC network.

6 FOLLOW-UP ACTIONS TOWARDS THE DEVELOPMENT OF THE REVISED STRATEGY

6.1 A programme of follow-up actions of the Initial Strategy should be developed.

6.2 The key stages for the adoption of a Revised IMO GHG Strategy in 2023 as set out in the Roadmap, are as follows:

Spring 2018 (MEPC 72)	Adoption of the Initial Strategy[5] including, inter alia, a list of candidate short-, mid- and long-term further measures with possible timelines, to be revised as appropriate as additional information becomes available
January 2019	Start of Phase 1: Data collection (Ships to collect data)
Spring 2019 (MEPC 74)	Initiation of Fourth IMO GHG Study using data from 2012-2018
Summer 2020	Data from 2019 to be reported to IMO
Autumn 2020 (MEPC 76)	Start of Phase 2: data analysis (no later than autumn 2020) Publication of Fourth IMO GHG Study for consideration by MEPC 76
Spring 2021 (MEPC 77)	Secretariat report summarizing the 2019 data pursuant to regulation 22A.10 Initiation of work on adjustments on Initial IMO Strategy, based on Data Collection System (DCS) data
Summer 2021	Data for 2020 to be reported to IMO
Spring 2022 (MEPC 78)	Phase 3: Decision step Secretariat report summarizing the 2020 data pursuant to regulation 22A.10
Summer 2022	Data for 2021 to be reported to IMO
Spring 2023 (MEPC 80)	Secretariat report summarizing the 2021 data pursuant to regulation 22A.10 Adoption of Revised IMO Strategy, including short-, mid- and long-term further measure(s), as required, with implementation schedules

6.3 The Marginal Abatement Cost Curve (MACC) for each measure, as appropriate, should be ascertained and updated, and then evaluated on a regular basis.

[5] Initial IMO Strategy is subject to revision based on DCS data during 2019-2021 and does not prejudge any specific further measures that may be implemented in Phase 3 of the three-step approach.

7 PERIODIC REVIEW OF THE STRATEGY

7.1 The Revised Strategy is to be adopted in spring 2023.

7.2 The Revised Strategy should be subject to a review five years after its final adoption.

7.3 The Committee should undertake the review including defining the scope of the review and its terms of reference.

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ANNEX 2

EXISTING IMO ACTIVITY RELATED TO REDUCING GHG EMISSIONS IN THE SHIPPING SECTOR

INTRODUCTION

1 The International Maritime Organization (IMO) was established by Governments as a specialized agency under the United Nations to provide the machinery for intergovernmental cooperation in the field of regulation of ships engaged in international trade. IMO is responsible for the global regulation of all aspects of international shipping and has a key role in ensuring that lives at sea are not put at risk, including security of shipping, and that the environment is not polluted by ships' operations – as summed up in the IMO's mission statement: to promote safe, secure, environmentally sound, efficient and sustainable shipping through cooperation.

2 IMO is the global standard-setting authority for the safety, security and environmental performance of international shipping. Its regulatory framework covers all aspects of technical matters pertaining to the safety of ships and of life at sea, efficiency of navigation, and the prevention and control of marine and air pollution from ships. Following several high profile oil spills, the original focus of IMO's environmental work was on the prevention of marine pollution by oil, resulting in the adoption of the first-ever comprehensive anti-pollution convention, the International Convention for the Prevention of Pollution from Ships (MARPOL) in 1973. This has changed over the last few decades to include a much wider range of measures to prevent marine pollution, and the original MARPOL Convention has been amended to include requirements addressing pollution from chemicals, other harmful substances, garbage, sewage and, under an Annex VI adopted in 1997 by a Protocol to MARPOL, air pollution and control of emissions from ships.

CONTROL OF EMISSIONS FROM SHIPS – MARPOL ANNEX VI: REGULATIONS FOR THE PREVENTION OF AIR POLLUTION FROM SHIPS

3 In November 1991, the IMO Assembly adopted resolution A.719(17) on *Prevention of Air Pollution from Ships*, stating the desire to reduce air pollution from ships by cooperative efforts of Member Governments which may be best achieved by establishing a new annex to MARPOL which would provide rules for restriction and control of emission of harmful substances from ships into the atmosphere.

4 In September 1997, a Conference of Parties to MARPOL adopted the Protocol of 1997 to amend the Convention. The Protocol, which entered into force on 19 May 2005, incorporated in MARPOL a new Annex VI, entitled "Regulations for the prevention of air pollution from ships", with the aim of controlling airborne emissions from ships of sulphur oxides (SO_x), nitrogen oxides (NO_x), ozone-depleting substances (ODS), volatile organic compounds (VOCs) and their contribution to global air pollution and environmental impacts.

5 Eight years after its adoption, but only two months after its entry into force, the Marine Environment Protection Committee (MEPC), at its fifty-third session (MEPC 53 in July 2005), decided that Annex VI should undergo a general revision. The decision was based on new knowledge of the harmful impact that ships' exhaust gases may have on ecosystems and human health and recognized that technological developments would enable significant improvements of the current standards.

6 After three years of intensive work, MEPC 58 (October 2008) unanimously adopted a revised MARPOL Annex VI and the associated Technical Code on control of emissions of nitrogen oxides from marine diesel engines (NO_x Technical Code 2008) for surveying and certifying marine diesel engines, both of which entered into force on 1 July 2010. The revised Annex VI introduced even more stringent limits for the emission of air pollutants from ships, together with phased-in reductions, to be achieved through fuel oil quality and marine diesel engine design or equivalent technologies, in particular for SO_x and particulate matter (PM) and NO_x emissions.

IMO AND THE UNFCCC POLICY FRAMEWORK

7 Prior to the signing in December 1997 of the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC), the aforementioned IMO International Air Pollution Conference in September 1997 adopted conference resolution 8 which recognized that CO_2 emissions, being greenhouse gases (GHGs), have an adverse impact on the environment, and noted that UNFCCC had recognized that GHGs also originate from international shipping and contribute to the global inventory of emissions. The resolution invited the MEPC to consider what CO_2 reduction strategies may be feasible in light of the relationship between CO_2 and atmospheric pollutants, especially NO_x, since NO_x emissions may exhibit an inverse relationship to CO_2 reductions.

8 In December 2003, the IMO Assembly adopted resolution A.963(23) on *IMO policies and practices related to the reduction of greenhouse gas emissions from ships* that urged the MEPC to identify and evaluate mechanisms to achieve the limitation or reduction of greenhouse gas emissions from international shipping and keep the matter under review and that, in doing so, it should cooperate with the Conference of the Parties (COP) to the UNFCCC.

9 Article 2.2 of the Kyoto Protocol states that the Parties included in Annex I shall pursue limitation or reduction of emissions of GHGs not controlled by the Montreal Protocol from aviation and marine bunker fuels, working through the International Civil Aviation Organization (ICAO) and IMO, respectively.

10 No reference to IMO (nor ICAO) is made in either the articles of the 2015 Paris Agreement on Climate Change (the Paris Agreement) or the decisions to implement the agreement, including on the pre-2020 ambition (the period between the Kyoto Protocol commitment period ending on 31 December 2020 and the Paris Agreement entering into effect on 1 January 2020).

11 The forty-third session of the Subsidiary Body for Scientific and Technological Advice (SBSTA), held during COP 21 in Paris in December 2015, took note of the information received from and progress reported by the Secretariats of ICAO and IMO on their ongoing work on addressing emissions from fuel used for international aviation and maritime transport respectively, and invited the Secretariats to continue to report at future sessions of SBSTA on relevant work on this issue.

12 IMO reported to SBSTA 45 at COP 22 in Morocco in November 2016 on progress made subsequent to the Paris Agreement, including the adoption of the data collection system for fuel oil consumption of ships and the approval of the *Roadmap for developing a comprehensive IMO strategy on reduction of GHG emissions from ships.*

13 As requested by Assembly resolution A.963(23), and reaffirmed by MEPC 69 (April 2016), the Secretariat shall continue reporting to UNFCCC SBSTA under the agenda item on "Emissions from fuel used for international aviation and maritime transport" and participate in related United Nations system activities.

IMO GREENHOUSE GAS STUDIES

14 The 1997 Air Pollution Conference resolution 8 on *CO_2 emissions from ships* that initiated IMO's work to address GHG emissions from ships invited IMO to undertake a study of CO_2 emissions from ships for the purpose of establishing the amount and relative percentage of such emissions as part of the global inventory of CO_2 emissions. MEPC 63 (March 2012) noted that uncertainty existed in the estimates and projections of emissions from international shipping and agreed that further work should take place to provide the MEPC with reliable and up-to-date information to base its decisions on. MEPC 64 (October 2012) endorsed, in principle, an outline for an update of the GHG emissions estimate, and an expert workshop in Spring 2013 further considered the methodology and assumptions to be used to update the study. To date, three IMO Greenhouse Gas Studies have been published:

.1 the First IMO GHG Study, published in 2000, estimated that international shipping in 1996 contributed about 1.8% of the global total anthropogenic CO_2 emissions;

.2 the Second IMO GHG Study, published in 2009, estimated international shipping emissions in 2007 to be 880 million tonnes, or about 2.7% of the global total anthropogenic CO_2 emissions; and

.3 the Third IMO GHG Study, published in 2014[6], estimated international shipping emissions in 2012 to be 796 million tonnes, or about 2.2% of the global total anthropogenic CO_2 emissions. The Study also updated the CO_2 estimates for 2007 to 885 million tonnes, or 2.8%.

15 The Third IMO GHG Study 2014 (MEPC 67/INF.3 and Corr.1) employed both top-down and bottom-up (individual ship activity) methods to provide two different and independent analysis tools for estimating emissions from ships. The top-down estimate mainly used data on marine fuel oil (bunker) sales (divided into international, domestic and fishing) from the International Energy Agency (IEA), and is the approach used by the Intergovernmental Panel on Climate Change (IPCC) to calculate CO_2 emissions from international bunkers. However, the top-down method is considered less accurate than the bottom-up method as IEA and the Organization for Economic Co-operation and Development (OECD) identified specific types of error in energy data that involve marine bunkers. The first is allocation or classification error involving imports, exports and marine bunker statistics. The second is country-to-country differences in data quality, specifically related to poor accuracy for international bunkers or stock changes.

16 The bottom-up estimate combined the global fleet technical data from the maritime information provider, IHS Fairplay, with fleet activity data derived from Automatic Identification System (AIS) observations to provide statistics on activity, energy use and emissions for all ships from 2007 to 2012. This approach removed uncertainties attributed to the use of average values and represented a substantial improvement in the resolution of shipping activity, energy demand and emissions data, showing that high-quality inventories of shipping emissions can be produced through the use of quality analysis, such as rigorous testing of bottom-up results against noon reports and Long-range Identification and Tracking (LRIT) and AIS data from a variety of providers, both shore-based and satellite-received data.

17 Although international shipping is already the most energy-efficient mode of mass cargo transportation and carries over 80% of all goods by volume (over 55% in terms of

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[6] The Study can be downloaded online: http://www.imo.org/OurWork/Environment/PollutionPrevention/AirPollution/Pages/Greenhouse-Gas-Studies-2014.aspx

freight activity by tonne-mile[7]), a global approach to further enhance its energy efficiency and effective emission control is needed as, depending on future economic and energy developments, the Third IMO GHG Study forecasted a growth in CO_2 emissions for international maritime transport of 50 to 250% in the period up to 2050.

18 Up-to-date emission estimates are considered necessary, in general, to provide a better foundation for future work by IMO to address GHG emissions from international shipping. Ocean transport is fuel-efficient and without these updated figures it would be difficult to provide a meaningful baseline to illustrate the steadily ongoing improvement in fuel efficiency due to improved hull design, more effective diesel engines and propulsion systems and more effective utilization of individual ships resulting from the introduction of mandatory technical and operational measures. Importantly, the 2012 estimate provides a baseline estimate for international shipping emissions prior to the entry into force of regulations on energy efficiency for ships in 2013.

ENERGY EFFICIENCY OF INTERNATIONAL SHIPPING

19 In July 2011, IMO adopted mandatory measures to improve the energy efficiency of international shipping through resolution MEPC.203(62), representing the first-ever mandatory global energy efficiency standard for an international industry sector, the first legally binding instrument to be adopted since the Kyoto Protocol that addresses GHG emissions and the first global mandatory GHG-reduction regime for an international industry sector.

20 The amendments adopted by resolution MEPC.203(62) added a new chapter 4 entitled "Regulations on energy efficiency for ships" to MARPOL Annex VI. This package of technical and operational requirements which apply to ships of 400 GT and above, are known as the Energy Efficiency Design Index (EEDI), applicable to new ships, which sets a minimum energy efficiency level for the work undertaken (e.g. CO_2 emissions per tonne-mile) for different ship types and sizes, and the Ship Energy Efficiency Management Plan (SEEMP), applicable to all ships. These mandatory requirements entered into force on 1 January 2013. The Energy Efficiency Operational Indicator (EEOI) for monitoring operational energy efficiency of ships also remains available for voluntary application.

21 The EEDI requirement aims to increase the energy efficiency of new ships over time. It is a non-prescriptive, performance-based mechanism that leaves the choice of technologies to use in a specific ship design to the industry. As long as the required energy efficiency level is attained, ship designers and builders are free to use the most cost-efficient solutions in complying with the regulations. It is therefore intended to stimulate innovation in, and continued development of, the technical elements influencing the energy efficiency of a ship. By February 2017 more than 2200 new ships have been certified to the energy efficiency design requirements.

22 The EEDI has been developed for the largest and most energy-intensive segments of the world merchant fleet and, following the inclusion of additional ship types, will embrace approximately 85% of emissions from international shipping. EEDI reduction factors are set until 2025 to the extent that ships constructed in 2025 will be required to be at least 30% more energy efficient than those constructed in 2014. The SEEMP establishes a mechanism for operators to improve the energy efficiency of existing ships against business-as-usual operations, in a cost-effective manner and also provides an approach for monitoring ship and fleet efficiency performance over time.

23 All ships of 400 GT and above engaged in international trade are required to implement and maintain a SEEMP that establishes a mechanism for operators to improve

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[7] International Council on Clean Transportation (ICCT), Long-term potential for increased shipping efficiency through the adoption of industry-leading practices, Wang & Lutsey, 2013.

the energy efficiency of ships. This should be achieved by monitoring the energy efficiency performance of a ship's transportation work, using, for example, the EEOI as a monitoring and/or benchmarking tool and at regular intervals considering new technologies and practices to improve energy efficiency.

24 A study[8] undertaken following the adoption of the mandatory energy efficiency measures indicates that the uptake of SEEMP measures will have a significant effect in the short to medium term, while EEDI measures should have a greater impact in the longer term, as fleet renewal takes place and new technologies are adopted. Estimates suggest that a successful implementation of this energy efficiency framework by 2050 could reduce shipping CO_2 emissions by up to 1.3 gigatonnes per year against the business-as-usual scenario. To put this in context, the Third IMO GHG Study 2014 estimated global CO_2 emissions to be 35.64 gigatonnes in 2012.

25 Four important guidelines have been adopted[9], intended to assist in the implementation of the mandatory regulations on energy efficiency for ships, as follows:

.1 *2014 Guidelines on the method of calculation of the attained Energy Efficiency Design Index (EEDI) for new ships, as amended* (resolution MEPC.245(66));

.2 *2016 Guidelines for the development of a Ship Energy Efficiency Management Plan (SEEMP)* (resolution MEPC.282(70));

.3 *2014 Guidelines on survey and certification of the Energy Efficiency Design Index (EEDI), as amended* (resolution MEPC.254(67)); and

.4 *2013 Guidelines for calculation of reference lines for use with the Energy Efficiency Design Index (EEDI)* (resolution MEPC.231(65)).

26 MEPC 65 (May 2013) agreed to include several additional ship types in the EEDI framework and further guidance was agreed, or existing guidance amended, to support the uniform implementation of the energy efficiency regulations. Furthermore, a work plan was endorsed to continue work on the development of the EEDI framework for ship types and sizes and propulsion systems not covered by the current EEDI requirements and to consider guidelines on propulsion power needed to maintain the manoeuvrability of a ship under adverse conditions.

27 MEPC 69 (April 2016) considered an interim report of its correspondence group conducting a review of the status of technological developments relevant to implementing Phase 2 of the EEDI regulations. This review is required by regulation 21.6 of MARPOL Annex VI, with a further review to take place before Phase 3. Following consideration, MEPC 69 instructed the group to continue considering the status of technological developments for ro-ro cargo and ro-ro passenger ships and to make recommendations to MEPC 70 on whether the time periods, the EEDI reference line parameters for relevant ship types and the reduction rates in regulation 21 of MARPOL Annex VI should be retained or, if proven necessary, amended.

28 MEPC 70 (October 2016) agreed to retain the EEDI requirements for Phase 2 (except for ro-ro cargo ships and passenger ships which will be considered further at MEPC 71) and on the need for a thorough review of EEDI Phase 3 (1 January 2025 and onwards) requirements, including discussion on its earlier implementation and the possibility of

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[8] Estimated CO_2 emissions reduction from introduction of mandatory technical and operational energy efficiency measures for ships, Lloyd's Register and DNV, October 2011 (MEPC 63/INF.2).

[9] Originally adopted by MEPC 63 (March 2012) and subsequently revised and/or amended.

establishing a Phase 4. Phase 3 requirements provide that new ships be built to be 30% more energy efficient compared to the baseline.

29 MEPC 71 (July 2017) approved draft amendments to regulation 21 of MARPOL Annex VI regarding EEDI requirements for ro-ro cargo and ro-ro passenger ships, which were subsequently adopted at MEPC 72 (April 2018).

30 In addition, MEPC 71 also established a Correspondence Group on EEDI review beyond phase 2, under the coordination of Japan, and instructed it to recommend to MEPC 73 the time period and the reduction rates for EEDI phase 3 requirements, and consider a possible introduction of EEDI phase 4 requirements with associated time period and reduction rates.

Development of further measures to enhance the energy efficiency of ships

31 At MEPC 65 (May 2013) several delegations recognized the importance of enhancing energy efficiency and reducing fuel consumption with subsequent reductions of CO_2 emissions and other pollutants emitted to air. The Committee noted considerable support for the development of further measures to enhance the energy efficiency of shipping and to use a three-step approach, i.e. data collection and data analysis, followed by decision-making on what further measures, if any, are required (the three-step approach).

32 MEPC 68 (May 2015) noted that one purpose of a data collection system was to analyse energy efficiency and that for this analysis to be effective, some transport work data needed to be included. In this regard, the Committee agreed that data collected by IMO, particularly that related to transport work, should be confidential and not publicly available, and that resulting administrative burdens, the impact on industry and variables that influence energy efficiency needed to be addressed.

33 IMO therefore focussed on the development of a data collection system for ships and MEPC 69 (April 2016) reaffirmed that it would follow the three-step approach and agreed that confidentiality of data is crucial and that no third-party access to the data should be permitted.

34 MEPC 70 (October 2016) adopted mandatory MARPOL Annex VI requirements for ships to record and report their fuel oil consumption. Under the amendments, ships of 5,000 GT and above (representing approximately 85% of the total CO_2 emissions from international shipping) will be required to collect consumption data for each type of fuel oil they use, as well as, additionally, other specified data, including proxies for "transport work". The aggregated data will be reported to the flag State after the end of each calendar year and the flag State, having determined that the data have been reported in accordance with the requirements, will issue a Statement of Compliance to the ship. Flag States will be required to subsequently transfer this data to an IMO Ship Fuel Oil Consumption Database. The Secretariat is required to produce an annual report to the MEPC, summarizing the data collected.

REDUCTION OF GREENHOUSE GAS EMISSIONS FROM SHIPS

35 The MEPC has a standing item on "Reduction of GHG emissions from ships" on its agenda. MEPC 69 (April 2016) considered several submissions addressing the issue and, following an extensive debate:

.1 welcomed the Paris Agreement and acknowledged the major achievement of the international community in concluding the agreement;

.2 recognized and commended the current efforts and those already implemented by IMO to enhance the energy efficiency of ships;

.3 widely recognized and agreed that further appropriate improvements related to shipping emissions can and should be pursued;

.4 recognized the role of IMO in mitigating the impact of GHG emissions from international shipping;

.5 agreed to the common understanding that the approval at MEPC 69 and subsequent adoption of the data collection system was the priority;

.6 reiterated its endorsement of the three-step approach; and

.7 agreed to establish a working group at MEPC 70, with a view to an in-depth discussion on how to progress the matter.

Comprehensive IMO strategy on reduction of GHG emissions from ships

36 MEPC 70 (October 2016) approved a *Roadmap for developing a comprehensive IMO strategy on reduction of GHG emissions from ships*, which identified that an initial GHG reduction strategy should be adopted in 2018. The Roadmap contains a list of activities, including further IMO GHG studies and significant intersessional work with relevant timelines and provides for alignment of those new activities with the ongoing work on the aforementioned three-step approach to ship energy efficiency improvements. This provides a way forward to the adoption of a revised strategy in 2023 to include short-, mid-, and long-term further measures, as required, with implementation schedules.

37 To progress the work intersessionally, MEPC 70 agreed to the establishment of an intersessional Working Group on Reduction of GHG emissions from ships.

Initial strategy on reduction of GHG emissions from ships

38 Following two sessional and three intersessional meetings of the Working Group on Reduction of GHG emissions from ships, the *Initial IMO Strategy on Reduction of GHG emissions from ships* was adopted by MEPC 72 (April 2018) in line with the timeline stipulated in the Roadmap (see annex 1 of this submission).

Identification of a list of candidate further measures

39 As identified by resolution A.963(23), the list of further measures could include technical, operational and market-based measures. As the preceding paragraphs indicate, IMO has made significant progress to date on the development and delivery of technical and operational energy efficiency measures for ships, including the adoption of the data collection system for fuel oil consumption.

Technical and operational energy efficiency measures

40 For existing ships, MEPC 67 considered the development of mandatory fleet-wide operational energy efficiency standards but since no clear way forward on the need for such standards for ships could be concluded at that session, the Committee agreed that document MEPC 67/5/4, addressing energy efficiency metric options, should be held in abeyance until a future session, and invited Member Governments and international organizations to submit comments and proposals addressing the questions set out in paragraph 15 of document MEPC 67/5 and in document MEPC 67/5/6 to MEPC 68 (MEPC 67/20, paragraph 5.9). Following further consideration, MEPC 68 agreed that the development of a data collection

system for ships should progress and follow the three-step approach (MEPC 68/21, paragraph 4.8). MEPC 70 identified further possible development of the EEDI framework for new ships (see paragraph 28).

Market-based measures to address GHG emissions from international shipping

41 Resolution A.963(23) urged MEPC to identify and develop the mechanism or mechanisms needed to achieve the limitation or reduction of GHG emissions from international shipping and, in doing so, to give priority to, inter alia, an evaluation of the use of technical, operational and market-based solutions. MEPC 55 adopted a work plan to identify and develop the mechanisms needed to achieve the limitation or reduction of CO_2 emissions from international shipping (MEPC 55/23, annex 9).

42 MEPC recognized that, in view of projected increases in the world's population and trade, market-based measures (MBMs) may be necessary to supplement the adopted technical and operational measures to ensure even further reductions in GHG emissions from international shipping (MEPC 59/24, paragraph 4.92). Several MBM proposals from governments and organizations were received and MEPC 60 established an expert group to undertake a feasibility study and impact assessment of the proposals (MEPC 60/22, paragraph 4.89). The outcome of the study and assessment was subsequently examined by an intersessional working group (GHG-WG 3) in March 2011, which was tasked with providing advice on, among other subjects, the compelling need and purpose of MBMs as possible mechanisms to reduce GHG emissions from international shipping; and with evaluating the outcome of work conducted by the expert group, which had also endeavoured to assess the impact of the proposed MBMs on, among others, international trade, the maritime sector of developing countries, least developed countries (LDCs) and Small Island Developing States (SIDS), as well as the corresponding environmental benefits.

43 Following completion of the expert group's study, some of the proposed MBMs were combined or further developed by their respective proponents and, in examining the proposals, the intersessional working group had an extensive exchange of views on issues related to, inter alia, the desirability of MBMs providing: certainty in emission reductions or carbon price; revenues for mitigation, adaptation and capacity-building activities in developing countries; incentives for technological and operational improvements in shipping; and offsetting opportunities. Based on such policy considerations, the group reported to the MEPC, in accordance with its terms of reference, related to: the grouping of the MBMs; the strengths and weaknesses of the MBM groups; their relation to relevant international conventions; and the aforementioned possible impacts. The report of GHG-WG 3 (MEPC 62/5/1) was held in abeyance by MEPC 62 and considered at MEPC 63 (MEPC 63/21, paragraph 5.7).

44 If an MBM for international shipping was considered further, then part of any consideration could be the possibility of raising funds from the implementation of such a measure. MEPC 63 noted (MEPC 63/23, paragraph 5.34.7) that there were several possible uses for revenues generated by an MBM for international shipping, as identified in the MBM proposals, including:

.1 incentivizing shipping to achieve improved energy efficiency;

.2 offsetting – purchase of approved emission reduction credits;

.3 providing a rebate to developing countries;

.4 financing adaptation and mitigation activities in developing countries;

.5 financing improvement of maritime transport infrastructure in developing countries (e.g. Africa);

.6 supporting R&D to improve energy efficiency of international shipping; and

.7 supporting IMO's Integrated Technical Co-operation Programme (ITCP).

45 Should an MBM be introduced for international shipping, MEPC 63 recognized the need for a continued impact assessment and that its focus should be on possible impacts on consumers and industries in developing countries (MEPC 63/23, paragraph 5.14).

46 Following further consideration at MEPC 64 (October 2012), the Committee agreed to keep the documents presented in abeyance and postpone further debate on MBMs to MEPC 65 (MEPC 64/23, paragraph 5.15). MEPC 65 (May 2013) agreed to suspend discussions on market-based measures and related issues to a future session (MEPC 65/21, paragraph 5.1).

Reduction target for international shipping

47 MEPC 60 noted that there would be a need to consider whether the international maritime sector should be subject to an explicit emission ceiling (cap) or a reduction target comprising the entire world fleet of merchant vessels (MEPC 60/22, paragraph 4.89). The paramount questions would be how and by which international organization such a cap or reduction target should be established. Other questions related to whether a cap or a target line would include the methodology by which the cap/target is set and maintained as well as the possible connection with other transport modes and how they are regulated internationally.

48 MEPC 60 agreed that the debate on reduction targets was a vital part of IMO's GHG work (MEPC 60/22, paragraph 4.93) and the issue of a reduction target for international shipping was included in its agenda item on "Reduction of GHG emissions from ships". However, due to time constraints, the Committee held the matter in abeyance until consideration of MBMs was suspended at MEPC 65.

49 The Paris Agreement identifies a target of global temperature increase above pre-industrial level of "well below 2°C" with an aim of limiting the increase to 1.5°C. Reference is made to the temperature goals of the Paris Agreement in the "Levels of ambition" included in the *Initial IMO Strategy on Reduction of GHG emissions from ships* (see annex 1 of this submission).

CONTROL OF OTHER EMISSIONS FROM SHIPS

50 The adoption of MARPOL Annex VI in 1997, its entry into force in 2005 and its subsequent revision in 2008 represent significant steps towards establishing a robust global regime responsive to the air quality issues experienced in coastal areas. By reducing harmful emissions to air from ships, the measures are expected to have a significant beneficial impact on the atmospheric environment and on human health, particularly for those people living in port cities and coastal communities. As of 18 April 2018, 89 IMO Member States, the combined merchant fleets of which constitute approximately 96.18% of the gross tonnage of the world's merchant fleet, have ratified MARPOL Annex VI.

Sulphur Oxides (SO_x) and Particulate Matter (PM)

51 SO_x and PM emission controls apply to all fuel oils, as defined in regulation 2.9 of MARPOL Annex VI, combustion equipment and devices onboard and therefore include both main and all auxiliary engines together with items such as boilers and inert gas generators. These controls are divided into those applicable inside Emission Control Areas (ECAs) established to limit the emission of SO_x and PM and those applicable outside such areas, and are primarily achieved by limiting the maximum sulphur content of the fuel oils as loaded, bunkered and subsequently used onboard. These fuel oil sulphur limits (expressed in terms of % m/m, that is, by mass) have been subject to a series of step changes over the

years (regulations 14.1 and 14.4 of MARPOL Annex VI). Currently, the sulphur limit outside an ECA established to limit SO_x and PM emissions is 3.50% m/m and will fall to 0.50% m/m on 1 January 2020, following a review of the availability of the required compliant fuel oil completed at MEPC 70 (October 2016) – further information is provided below.

52 Most ships operating both outside and inside ECAs will therefore use different fuel oils in order to comply with the respective limits. In such cases, prior to entry into an ECA, the ship is required to have fully changed over to using ECA-compliant fuel oil and to have onboard written procedures showing how the changeover is to be undertaken (regulation 14.6 of MARPOL Annex VI). Similarly, a changeover from using ECA-compliant fuel oil is not to commence until after exiting the ECA. At each changeover it is required that the quantities of ECA-compliant fuel oils onboard are recorded, together with the date, time and position of the ship when either completing the changeover prior to entry or commencing changeover after exit from such areas. This is to be recorded in a logbook as prescribed by the ship's flag State, and in the absence of any specific requirement in this regard the record could be made, for example, in the ship's Annex I Oil Record Book.

53 The first level of control in this respect is therefore the actual sulphur content of the fuel oils as bunkered. This value is to be stated by the fuel oil supplier on the bunker delivery note and hence is, together with other related aspects, directly linked to the fuel oil quality requirements as covered under regulation 18 of MARPOL Annex VI. Thereafter it is for the ship's crew to ensure, in respect of ECA-compliant fuel oils, that through avoiding loading into otherwise part-filled storage, settling or service tanks, or in the course of transfer operations, such fuel oils do not become mixed with other, higher sulphur content fuel oils, so that the fuel oil as actually used within an ECA exceeds the applicable limit.

54 Consequently, regulation 14 of MARPOL Annex VI provides both the limit values and the means to comply. However, there are other means by which equivalent levels of SO_x and PM emission control, both outside and inside ECAs, could be achieved. These may be divided into methods termed primary (in which the formation of the pollutant is avoided) or secondary (in which the pollutant is formed but subsequently removed to some degree prior to discharge of the exhaust gas stream to the atmosphere). Regulation 4.1 of MARPOL Annex VI allows for the application of such methods, subject to approval by the administration. In approving such "equivalents" an Administration should take into account any relevant guidelines. There are no guidelines in respect of any primary methods. In terms of secondary control methods, guidelines have been adopted and subsequently amended for exhaust gas cleaning systems that operate by water washing the exhaust gas stream prior to discharge to the atmosphere (resolution MEPC.259(68)). In using such arrangements there would be no constraint on the sulphur content of the fuel oils as bunkered other than that given by the system's certification.

55 There are no provisions for PM in regulation 14, but it is recognized that the sulphur content of fuel oil relates to the PM of the exhaust. PM consists of particles of soot or smoke resulting from the burning of, primarily, heavier oils. It is considered to be a major health hazard as particulates may penetrate deep into the lungs and blood and cause cancer (see also Black Carbon discussion below).

56 As indicated, MEPC 70 agreed to "1 January 2020" as the effective date of implementation for ships to comply with global 0.50% m/m sulphur content of fuel oil requirement and, in this connection, adopted resolution MEPC.280(70) on the effective date of implementation of the fuel oil standard in regulation 14.1.3 of MARPOL Annex VI.

57 MEPC 70, in recognizing the concerns expressed regarding implementation, instructed the 4th session of the Sub-Committee on Pollution Prevention and Response (PPR 4) to develop a draft justification and scope for new output on consistent

implementation of the 0.50% m/m sulphur limit. PPR 4 in January 2017 agreed a draft justification and scope for new output on consistent implementation of the 0.50% m/m sulphur limit.

Consistent implementation of regulation 14.1.3 of MARPOL Annex VI

58 MEPC 71 in July 2017 approved the new output on "Consistent implementation of regulation 14.1.3 of MARPOL Annex VI", for inclusion in the PPR Sub-Committee's biennial agenda for 2018-2019 and the provisional agenda for PPR 5, with a target completion year of 2019.

59 MEPC 71 also approved the following scope of work:

.1 **preparatory and transitional issues** that may arise with a shift from the 3.50% m/m sulphur limit to the new 0.50% m/m limit;

.2 **impact on fuel and machinery systems** that may result from the use of fuel oils with a 0.50% m/m sulphur limit;

.3 **verification issues and control mechanisms and actions** that are necessary to ensure compliance and consistent implementation;

.4 **development of a draft standard format (a standardized system) for reporting fuel oil non-availability** as provided in regulation 18.2.4 of MARPOL Annex VI that may be used to provide evidence if a ship is unable to obtain fuel oil compliant with the provisions stipulated in regulations 14.1.3 and 14.4.3;

.5 **development of guidance, as appropriate, that may assist Member States and stakeholders** in assessing the sulphur content of fuel oil delivered for use on board ship, based on the consideration of mechanisms to encourage verification that fuel oils supplied to ships meet the specified sulphur limit as stated on the bunker delivery note;

.6[10] **request to ISO to consider the framework of ISO 8217** with a view to keeping consistency between the relevant ISO standards on marine fuel oils and the implementation of regulation 14.1.3 of MARPOL Annex VI;

.7 **any consequential regulatory amendments and/or guidelines necessary** to address issues raised in items .1 to .6 above or otherwise considered necessary to ensure consistent of regulation 14.1.3 of MARPOL Annex VI; and

.8[11] **consideration of the safety implications relating to the option of blending fuels in order to meet the 0.50% m/m sulphur limit**.

60 Having been forwarded by PPR 5 as an urgent matter, MEPC 72 (April 2018) approved draft amendments to MARPOL Annex VI for a prohibition on the carriage of non-compliant fuel oil for combustion purposes for propulsion or operation on board a ship, with a view to adoption at MEPC 73 (October 2018).

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[10] Completed at MEPC 71 (MEPC 71/17, paragraph 14.27.5). A letter has also been sent to ISO by the Secretariat on 4 September 2017.

[11] Agreed by MEPC 71 (MEPC 71/17, paragraph 14.27.2)

Nitrogen Oxides (NO_x)

61 NO_x can act as indirect greenhouse gases by producing the tropospheric GHG ozone via photochemical reactions in the atmosphere. The control of diesel engine NO_x emissions is achieved through the survey and certification requirements leading to the issue of an Engine International Air Pollution Prevention (EIAPP) Certificate and the subsequent demonstration of in service compliance in accordance with the requirements of regulations 13.8 of MARPOL Annex VI and 5.3.2 of the NO_x Technical Code 2008.

62 The NO_x control requirements of MARPOL Annex VI apply to installed marine diesel engines of over 130 kW output power other than those used solely for emergency purposes, irrespective of the tonnage of the ship on which such engines are installed. Definitions of "installed" and "marine diesel engine" are given in regulations 2.12 and 2.14 of MARPOL Annex VI, respectively. Different levels (Tiers) of control apply based on the ship construction date, a term defined in regulations 2.19 and hence 2.2, and within any particular Tier the actual limit value is determined from the engine's rated speed. The most stringent limit, Tier III, applies only to specified ships while operating in ECAs established to limit NO_x emissions. Outside such areas Tier II controls apply. A marine diesel engine installed on a ship constructed on or after 1 January 2016 and operating in the North American ECA and the United States Caribbean Sea ECA shall comply with the Tier III NO_x standards.

63 The emission value for a marine diesel engine is to be determined in accordance with the NO_x Technical Code 2008 in the case of Tier II and Tier III limits. Most Tier I engines have been certified to the earlier 1997 version of the NO_x Technical Code which, in accordance with the *Guidelines for the application of the NO_x Technical Code relative to certification and amendments of Tier I engines* (MEPC.1/Circ.679), may continue to be used in certain cases until 1 January 2011. Certification issued in accordance with the 1997 NO_x Technical Code remains valid over the service life of such engines.

Emission control areas designated under MARPOL Annex VI

64 MARPOL Annex VI includes provisions to establish ECAs for the control of emissions of NO_x, SO_x and PM. The North American ECA (August 2011) and the United States Caribbean Sea ECA (January 2013) have been designated as ECAs for the control of emissions of SO_x, NO_x and PM. The North American ECA comprises the sea areas 200 nautical miles off the Pacific coasts of the United States and Canada; off the Gulf of Mexico and Atlantic coasts of the United States, Canada and the French territories; and off the coasts of the populated Hawaiian Islands. The United States Caribbean Sea ECA comprises waters adjacent to the coasts of Puerto Rico and the United States Virgin Islands.

65 The Baltic Sea (May 2005) and the North Sea including the English Channel (November 2006) had been designated for the control of SO_x emissions only. MEPC 71 (July 2017) adopted amendments to MARPOL Annex VI to designate the North Sea and the Baltic Sea as emission control areas (ECAs) for nitrogen oxides (NO_x) under regulation 13 of MARPOL Annex VI. Both ECAs will take effect on 1 January 2021, thereby considerably lowering emissions of NO_x from international shipping in those areas.

66 Provisions were approved at MEPC 70 to allow ships fitted with non-Tier III compliant marine diesel engines to be built, converted, repaired and/or maintained at shipyards located in the designated NO_x Tier III ECAs.

Use of gas as fuel for international shipping

67 There is significant interest in the use of gas as fuel for international shipping as its combustion results in less harmful pollutants being emitted than by fuel oil. Depending on the gas used, the emissions can be virtually sulphur-free and there can be reduced emissions of

NO_x (some engines solely fuelled by gas can meet Tier III limits), CO_2 and PM. This development lead to requests for the risks of using gas, and other low flashpoint fuels, to be appropriately regulated. Following several years of work, the International Code of Safety for Ships using Gases or other Low-flashpoint Fuels (IGF Code) was adopted in 2015, along with new SOLAS regulations making the Code mandatory which require ships constructed after 1 January 2017 to comply with the requirements of the IGF Code.

68 Furthermore, to allow the use of gas as a fuel under MARPOL Annex VI, the definitions of "fuel oil" and "marine diesel engine" have been amended and further amendments were made to permit the testing of gas-fuelled and dual fuelled engines to enable them to be appropriately certified under the NO_x Technical Code 2008. One of the current limitations for the use of gas as a fuel is the lack of a global gas bunkering network supporting an international trading fleet of gas-fuelled ships. Other alternative fuels for ships under consideration include methanol (see paragraph 68.5) and hydrogen in fuel cells.

Black Carbon

69 MEPC 62 (July 2011) agreed to the following work plan for the BLG Sub-Committee to consider the impact on the Arctic of emissions of Black Carbon from international shipping (MEPC 62/24, paragraph 4.20):

.1 develop a definition for Black Carbon emissions from international shipping;

.2 consider measurement methods for Black Carbon and identify the most appropriate method for measuring Black Carbon emissions from international shipping; and

.3 investigate appropriate control measures to reduce the impact of Black Carbon emissions from international shipping.

70 The matter is now being considered by the Sub-Committee on Pollution Prevention and Response (PPR) under its agenda item on "Consideration of the impact on the Arctic of emissions of Black Carbon from international shipping". MEPC 68 (May 2015) approved a definition of Black Carbon for international shipping agreed by PPR 2 (January 2015). MEPC 68 also noted that at that stage it was not possible to consider possible control measures to reduce the impact on the Arctic of emissions of Black Carbon from international shipping.

71 PPR 3 (January 2016) developed a measurement reporting protocol for voluntary data collection of Black Carbon and invited interested Member Governments and international organizations to use the protocol and submit data to PPR 4. Voluntary measurement studies using the agreed definition of Black Carbon were reported to PPR 4 (January 2017) and are continuing, in order to identify the most appropriate measurement method(s).

72 PPR 4 noted that some delegations encouraged information on potential control measures to be submitted to PPR 5. PPR 5 (January 2018) agreed the *Reporting protocol for voluntary measurement studies to collect Black Carbon data* as well as most appropriate Black Carbon measurement methods for data collection. PPR 5 encouraged Member States and international organizations to continue to collect Black Carbon data, using the agreed reporting protocol and the agreed measurement methods, and submit relevant data to the next session of the Sub-Committee.

IMO-published technical studies

73 In support of the work of the MEPC and to provide timely information to Member Governments, specifically to support developing countries with the implementation of the provisions of MARPOL Annex VI, and using funds donated by Canada and Norway, the Secretariat has undertaken and published[12] a series of technical studies as follows:

.1 investigation of appropriate control measures (abatement technologies) to reduce Black Carbon emissions from international shipping;

.2 emission control and energy efficiency measures for ships in the port area;

.3 studies on the feasibility and use of liquid natural gas (LNG) as a fuel for shipping;

.4 optimization of energy consumption as part of implementation of a Ship Energy Efficiency Management Plan (SEEMP); and

.5 methanol as marine fuel: environmental benefits, technology readiness and economic feasibility.

PROMOTION OF TECHNICAL COOPERATION AND TRANSFER OF TECHNOLOGY RELATING TO THE IMPROVEMENT OF ENERGY EFFICIENCY OF SHIPS

74 In order to support countries that lack the requisite resources, experience or skills to implement IMO treaties, IMO has developed an Integrated Technical Co-operation Programme (ITCP) which is designed to assist Governments by helping them build the necessary capacity. Through technical cooperation and capacity-building activities, IMO helps to transfer know-how to those countries that need it, thereby promoting wider and more effective implementation of IMO measures.

75 Linked to the implementation of energy efficiency measures, and specifically to regulation 23 of MARPOL Annex VI, MEPC 65 (May 2013) adopted resolution MEPC.229(65) on *Promotion of technical co-operation and transfer of technology relating to the improvement of energy efficiency of ships*, requiring Administrations, in cooperation with IMO and other international bodies, to promote and provide, as appropriate, support directly or through the IMO to Member States, especially developing countries that request technical assistance. It also requires the Administration of a Party to MARPOL Annex VI to cooperate actively with other Parties, subject to its national laws, regulations and policies, to promote the development and transfer of technology and exchange of information to States that request technical assistance, particularly developing States.

76 Pursuant to resolution MEPC.229(65), MEPC 66 (April 2014) established an Ad Hoc Expert Working Group on Facilitation of Transfer of Technology for Ships. MEPC 69 considered the final report of the group and noted the outcome of its work, as follows:

.1 A scoping document on the establishment of an inventory of energy efficiency technologies for ships was forwarded to the GEF-UNDP-IMO project "Transforming the global maritime transport industry towards a low carbon future through improved energy efficiency" (GloMEEP). Using this scoping document, GloMEEP has developed an information portal for energy efficiency technologies for ships[13].

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12 http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Pages/IMO-Publications.aspx

13 http://glomeep.imo.org/resources/energy-efficiency-techologies-information-portal/

.2 Development of a *Model agreement between Governments on technological cooperation for the implementation of the regulations in chapter 4 of MARPOL Annex VI* (MEPC.1/Circ.861).

.3 Recommendations provided to guide and assist Member States, industry and other entities within States in implementing the regulations of chapter 4 of MARPOL Annex VI.

.4 Assessments made to identify barriers to transfer of technology and potential implications and impacts on the implementation of the regulations in chapter 4 of MARPOL Annex VI, in particular on developing States, as a means to identify their technology transfer and financial needs.

77 MEPC 69 also noted that a comprehensive update of the "Train the Trainer" package on "Energy Efficient Ship Operation" had been undertaken to include a new module on the regulatory framework related to the energy efficiency of ships, an EEDI calculator for training purposes, and other related updated information, such as the findings from the Third IMO GHG Study 2014. Member Governments and other interested delegations were encouraged to make use of it. MEPC 69 further noted that IMO's technical cooperation activities would seek to address the specific needs of LDCs and SIDS with regard to the implementation of ship energy efficiency requirements.

78 Building on the success of the cooperation agreement between the Korean International Co-operation Agency (KOICA) and IMO on "Building Capacities in East Asia countries to address Greenhouse Gas Emissions from Ships" undertaken between 2011 and 2013, IMO has engaged in two partnership projects to further technical cooperation and technology transfer: the aforementioned GloMEEP project and the establishment of a global network of regional Maritime Technology Cooperation Centres (MTCCs) (Global MTCC Network (GMN) project).

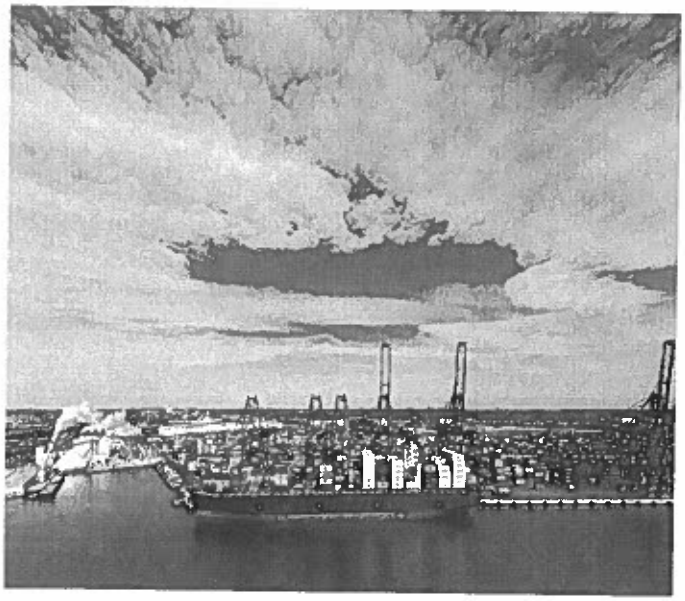
79 The two-year GloMEEP project, an initiative of the Global Environment Facility (GEF), the United Nations Development Programme (UNDP) and IMO, focusses in particular on building capacity to implement technical and operational measures in developing countries, where shipping is increasingly concentrated and controlled. Ten IMO Member States have signed up as lead pilot countries: Argentina, China, Georgia, India, Jamaica, Malaysia, Morocco, Panama, Philippines and South Africa. They are being supported through a series of national and regional workshops and the development of guides in taking a fast-track approach to pursuing relevant legal, policy and institutional reforms, and driving national and regional Government action and industry innovation to support the effective implementation of IMO's energy efficiency requirements.

80 The GMN project aims to form a global network of regional centres of excellence (MTCCs) to promote the uptake of low-carbon technologies and operations in maritime transport. The five target regions, Africa, Asia, the Caribbean, Latin America and the Pacific, have been selected for their significant number of LDCs and SIDS. Three of the five centres, i.e. MTCC-Africa (Kenya), MTCC-Asia (China) and MTCC-Caribbean (Trinidad&Tobago), have now been selected as part of the GMN project, with the remaining (Latin-America and Pacific) expected to be selected during 2017. The four-year project, administered by IMO with €10 million in funding from the European Union, is designed to enable beneficiary countries to limit and reduce GHG emissions from their shipping sectors through technical assistance and capacity building, while encouraging the uptake of innovative energy-efficient technologies among a large number of users through the widespread dissemination of technical information and know-how. This is expected to heighten the impact of technology transfer.

MEPC 76

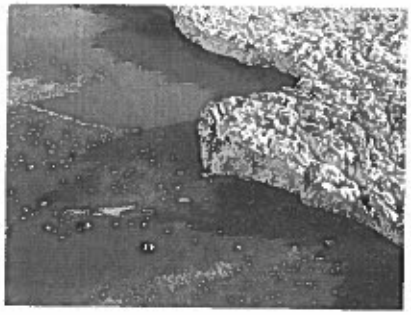
17 June 2021

Further shipping GHG emission reduction measures adopted



International Maritime Organization (IMO) adopts key mandatory measures to reduce ships' carbon intensity; establishes ship rating system.

New mandatory measures to cut the carbon intensity of international shipping have been adopted by the International Maritime Organization (IMO), setting shipping on a course to meet greenhouse gas reduction targets established in the 2018 Initial IMO Strategy for Reducing GHG Emissions from Ships.



The MEPC adopted amendments to MARPOL Annex I to introduce a prohibition on the use and

carriage for use as fuel of heavy fuel oil (HFO) by ships in Arctic waters on and after 1 July 2024.

IMO's Marine Environment Protection Committee (MEPC 76), meeting in a remote session from 10 to 17 June 2021, adopted amendments to the International Convention for the Prevention of Pollution from Ships (MARPOL) Annex VI that will require ships to reduce their greenhouse gas emissions. These amendments combine technical and operational approaches to improve the energy efficiency of ships, also providing important building blocks for future GHG reduction measures.

The new measures will require all ships to calculate their Energy Efficiency Existing Ship Index (EEXI) following technical means to improve their energy efficiency and to establish their annual operational carbon intensity indicator (CII) and CII rating. Carbon intensity links the GHG emissions to the amount of cargo carried over distance travelled.

Ships will get a rating of their energy efficiency (A, B, C, D, E - where A is the best). Administrations, port authorities and other stakeholders as appropriate, are encouraged to provide incentives to ships rated as A or B also sending out a strong signal to the market and financial sector.

A ship rated D for three consecutive years, or E, is required to submit a corrective action plan, to show how the required index (C or above) would be achieved.

IMO Secretary-General Kitack Lim said the adoption of the new measures would build on IMO's previously adopted mandatory energy efficiency measures, to lead shipping on the right path towards decarbonisation.

"The path to decarbonization is a long, but also a common path in which we need to consider and respect each other's views. We have made a considerable amount of progress since the start of our journey," Mr. Lim said, " ... your progress will continue to provide the benefit of experience to be able to make ambitious, and evidence-based decisions for phase 3 of the implementation of the operational measure which will be further strengthened and developed taking into account the review of the short-term measure and the latest climate science," he added.

The amendments to MARPOL Annex VI (adopted in a consolidated revised Annex VI) are expected to enter into force on 1 November 2022, with the requirements for EEXI and CII certification coming into effect from 1 January 2023. This means that the first annual reporting will be completed in 2023, with the first rating given in 2024.

A review clause requires the IMO to review the effectiveness of the implementation of the CII and EEXI requirements, by 1 January 2026 at the latest, and, if necessary, develop and adopt further amendments.

Impact assessment

In adopting the measure, MEPC also considered the outcomes of a comprehensive impact assessment of the measure which examined potential negative impacts on States, and agreed to keep the impacts on States of the measure under review so that any necessary adjustments can be made.

In adopting the amendments, the MEPC agreed in its resolution to undertake a lessons-learned exercise from the comprehensive impact assessment of the amendments to MARPOL Annex VI, with a view to improving the procedure for conducting future impact assessments.

Secretary-General Lim welcomed the approval and consideration of the outcome of the related comprehensive impact assessment and the decision to keep impacts of the measure under review and to initiate a lessons-learned exercise.

MARPOL Annex VI has 100 Contracting States, who between them represent 96.65% of world merchant shipping by tonnage.

The MEPC also adopted a work plan to develop mid- and long-term measures to further cut shipping's GHG emissions, in line with the Initial IMO strategy on reduction of GHG from ships

Guidelines adopted

Alongside the MARPOL amendments, the MEPC adopted related guidelines to support the implementation of the amendments. (full list below)

The guidelines include the 2021 Guidelines on the operational carbon intensity reduction factors relative to reference lines (CII Reduction factor Guidelines, G3). This includes the required reduction (Z) factor, which is set at a rate, relative to 2019, of 11% by 2026. This would be further strengthened after that date, taking into account the review of the measure and latest climate science.

Meeting the initial GHG strategy ambition

The combined technical and operational measures, referred to as short term carbon intensity measures, are in line with the ambition of the Initial IMO GHG Strategy, which aims to reduce carbon intensity of international shipping by 40% by 2030, compared to 2008.

The initial strategy sets out short- mid- and long-term measures. The measures just adopted fall into the short-term measures.

Future work

The MEPC discussed a number of submissions on how to progress the next stages of IMO's work to cut GHG emissions from ships, leading to the revision of the initial GHG strategy in 2023.

The MEPC adopted a work plan on the concrete way forward to make progress with candidate mid- and long-term measures including measures to incentivize the move away from fossil fuels to low- and zero-carbon fuels to achieve decarbonization of international shipping.

A proposal initially considered by MEPC suggested a mandatory levy of $100 per tonne carbon dioxide equivalent on heavy fuel oil. This proposal will be further considered at the intersessional working group meeting in the context of the adopted workplan along with other proposals for mid-term measures.

The work plan envisages three phases:

- Phase I - Collation and initial consideration of proposals for measures (Spring 2021 to spring 2022);
- Phase II - Assessment and selection of measures(s) to further

develop (Spring 2022 to spring 2023); and

- Phase III – Development of(a) measure(s) to be finalized within (an) agreed target date(s).

Mr. Lim welcomed the adoption of the work plan.

"Concessions have been made on all sides in the interest of securing the framework we have in place. Our consideration of mid- and long-term measures will demand even more of us. I am very pleased that the Committee has agreed on a work plan to support carrying out this dimension of our work in a structured way that will keep the membership together," Mr. Lim said.

"Agreement on the work plan sends the signal that the Organization and its Member States are ready to further consider the current and future proposals for mid-term measures. We need to gear up work relating to the various phases of the work plan in order to give efficient and adequate consideration to concrete proposals for the reduction of greenhouse gases in keeping with our goals in the initial strategy. Let us continue to work together on the tasks you have in front of you as we continue to make progress on this common path," he said.

IMRB proposal

The Committee had a non-exhaustive consideration of a proposal to establish an International Maritime Research Board, funded by a tax on oil fuel used by shipping. The discussion will resume at the Committee's next session.

Correspondence Group and Intersessional Working Group

The MEPC approved the terms of reference for a Correspondence Group on Carbon Intensity Reduction and meetings of the Intersessional Working Group on Reduction of GHG Emissions from Ships (ISWG-GHG 9 and ISWG-GHG 10). The ISWG-GHG 9 will meet 15-22 September and ISWG-GHG 10 18-22 October 2021, ahead of MEPC 77, which is scheduled to meet 22-26 November 2021.

MEPC 76 – other outcomes

The MEPC also adopted other amendments.

Prohibiting HFO in the Arctic

The MEPC adopted amendments to MARPOL Annex I (addition of a new regulation 43A) to introduce a prohibition on the use and carriage for use as fuel of heavy fuel oil (HFO) by ships in Arctic waters on and after 1 July 2024.

The prohibition will cover the use and carriage for use as fuel of oils having a density at 15°C higher than 900 kg/m3 or a kinematic viscosity at 50°C higher than 180 mm2/s. Ships engaged in securing the safety of ships, or in search and rescue operations, and ships dedicated to oil spill preparedness and response would be exempted. Ships which meet certain construction standards with regard to oil fuel tank protection would need to comply on and after 1 July 2029.

A Party to MARPOL with a coastline bordering Arctic waters may temporarily waive the requirements for ships flying its flag while operating in waters subject to that Party's sovereignty or jurisdiction, up to 1 July 2029.

The amendments were approved at MEPC 75, see https://www.imo.org/en/MediaCentre/MeetingSummaries/Pages/MEPC-75th-session.aspx.

Amendments to MARPOL Annexes I and IV concerning the exemption of UNSP barges from survey and certification requirements

The MEPC adopted amendments to draft amendments to MARPOL Annexes I and IV concerning the exemption of UNSP barges from survey and certification requirements.

The amendment specifies that the Administration may exempt a UNSP barge from the annual survey and certification requirements, for a period not exceeding 5 years provided that the UNSP barge has undergone a survey to confirm that certain conditions are met.

The amendments also provide the form for the International Oil Pollution Exemption Certificate for Unmanned Non-self-propelled Barges. The MEPC is also expected to approve a related circular on guidelines for exemption of UNSP barges.

The amendments were approved at MEPC 75, see https://www.imo.org/en/MediaCentre/MeetingSummaries/Pages/MEPC-75th-session.aspx.

Amendments to AFS Convention - cybutrene

The MEPC adopted amendments to the IMO Convention for the Control of Harmful Anti-fouling Systems on Ships (AFS Convention), to include controls on the biocide cybutryne.

The AFS Convention already prohibits the use of biocides using organotin compounds.

The draft amendments were approved at MEPC 75, see https://www.imo.org/en/MediaCentre/MeetingSummaries/Pages/MEPC-75th-session.aspx.

Further information

Carbon intensity measures in detail

The short-term measure is aimed at meeting the target set in the IMO Initial GHG Strategy – to reduce carbon intensity of all ships by 40% by 2030, compared to 2008. These will be mandatory measures under MARPOL Annex VI. They will bring in

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Attained Energy Efficiency Existing Ship Index (EEXI) is required to be calculated for ships of 400 gt and above, in accordance with the different values set for ship types and size categories. This indicates the energy efficiency of the ship compared to a baseline. Ships are required to meet a specific required Energy Efficiency Existing Ship Index (EEXI), which is based on a required reduction factor (expressed as a percentage relative to the EEDI baseline).

Annual operational carbon intensity indicator (CII) and CII rating.

The CII determines the annual reduction factor needed to ensure continuous improvement of the ship's operational carbon intensity within a specific rating level. The actual annual operational CII achieved (attained annual operational CII) would be required to be documented and verified against the required annual operational CII.

This would enable the operational carbon intensity rating to be determined. The rating would be given on a scale - operational carbon intensity rating A, B, C, D or E - indicating a major superior, minor superior, moderate, minor inferior, or inferior performance level. The performance level would be recorded in the ship's Ship Energy Efficiency Management Plan (SEEMP).

A ship rated D for three consecutive years, or E, would have to submit a corrective action plan, to show how the required index (C or above) would be achieved.

Administrations, port authorities and other stakeholders as appropriate, are encouraged to provide incentives to ships rated as A or B.

In simple terms, the short-term term measure are aimed at achieving the carbon intensity reduction aims of the IMO initial GHG Strategy.

They do this by requiring all ships to calculate their Energy Efficiency Existing Ship Index (EEXI) and to establish their annual operational carbon intensity indicator (CII) and CII rating

In other words, ships get a rating of their energy efficiency (A, B, C, D, E – where A is the best). A ship running on a low carbon fuel clearly gets a higher rating than one running on fossil fuel.

However, there are many things a ship can do to improve its rating through various measures, such as hull cleaning to reduce drag; speed and routeing optimization; installation of low energy light bulbs; installation of solar/wind auxiliary power for accommodation services; etc.

Guidelines

The following comprehensive set of guidelines, adopted by MEPC 76, support the new requirements:

- 2021 Guidelines on the method of calculation of the attained energy efficiency existing ship index (EEXI);
- 2021 Guidelines on survey and certification of the energy efficiency existing ship index (EEXI);
- 2021 Guidelines on the shaft / engine power limitation system to comply with the EEXI requirements and use of a power reserve;
- 2021 Guidelines on operational carbon intensity indicators and the calculation methods (CII Guidelines, G1);
- 2021 Guidelines on the reference lines for use with operational Carbon Intensity Indicators (CII reference lines guidelines, G2);
- 2021 Guidelines on the operational carbon intensity reduction factors relative to reference lines (CII Reduction factor Guidelines, G3);
- 2021 Guidelines on the operational Carbon Intensity rating of ships (CII rating guidelines, G4).

Read more:
https://www.imo.org/en/MediaCentre/HotTopics/Pages/Cutting-GHG-emissions.aspx

4. A Glance at Issues of Compliance & Implementation

IMO's Data Collection System & the EU System for Monitoring, Reporting and Verification of CO_2 Emissions from Shipping

European Parliament

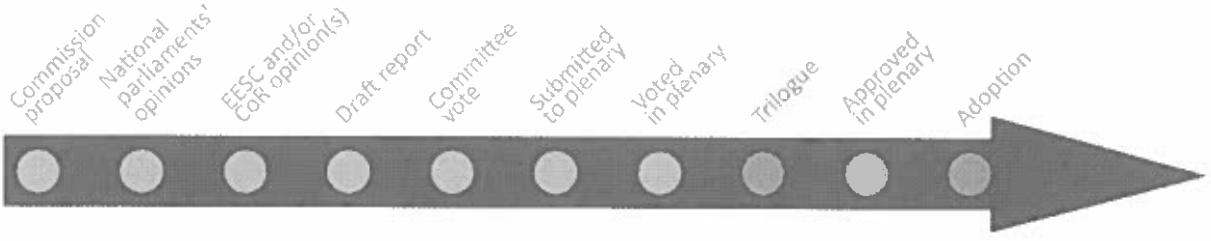
Monitoring, reporting and verification of CO_2 emissions from maritime transport

OVERVIEW

In February 2019, the Commission adopted a proposal to revise the EU system for monitoring, reporting and verification of CO_2 emissions from maritime transport, in order to align it with the global data collection system introduced by the International Maritime Organization (IMO). The existing EU system requires ships above 5 000 gross tonnes using European ports to monitor and report fuel consumption and CO_2 emissions per voyage and on an annual basis, starting with the year 2018. The system entered into force on 1 March 2018, and reporting starts with the year 2019. The proposed revision aims to facilitate the simultaneous application of the two systems, while preserving the objectives of the current EU legislation.

The Council's mandate for negotiations with the Parliament was adopted on 25 October 2019. In the European Parliament, the ENVI committee has appointed Jutta Paulus (Greens/EFA, Germany) as rapporteur for the file. On 16 September 2020, the Parliament adopted its position and gave ENVI the mandate to start trilogue negotiations.

Proposal for a regulation of the European Parliament and of the Council amending Regulation (EU) 2015/757 in order to take appropriate account of the global data collection system for ship fuel oil consumption data		
Committee responsible:	Environment, Public Health and Food Safety (ENVI)	COM(2019) 38 final 4.2.2019
Rapporteur:	Jutta Paulus (Greens/EFA, Germany)	2019/0017(COD)
Shadow rapporteurs:	Pernille Weiss (EPP, Denmark) Jytte Guteland (S&D, Sweden) Catherine Chabaud (Renew Europe, France) Alexandr Vondra (ECR, Czechia) Joëlle Mélin (ID, France) Mick Wallace (GUE/NGL, Ireland)	Ordinary legislative procedure (COD) (Parliament and Council on equal footing – formerly 'co-decision')
Next steps expected:	Trilogue negotiations	



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Introduction

In the context of EU climate policy, the European Commission adopted a legislative proposal related to CO_2 emissions from maritime transport on 4 February 2019. The proposal aims to revise the EU system for monitoring, reporting and verification of CO_2 emissions from maritime transport (Regulation (EU) 2015/757) in order to align it with the global data collection system (DCS) for the fuel oil consumption of ships introduced by the International Maritime Organization (IMO).

International maritime transport is responsible for around 2 to 3 per cent of global greenhouse gas (GHG) emissions, according to the International Maritime Organization. The sector, which has higher emissions than any EU Member State, makes a significant contribution to climate change. EU-related shipping is responsible for about one-fifth of global emissions. In the EU, maritime transport accounted for 13 % of the greenhouse gas emissions from the transport sector in 2015. Maritime transport is not expressly addressed by an EU emissions reduction objective or specific mitigation measures. Likewise, the Paris Agreement, adopted in December 2015, sets the overall goal of limiting the global average temperature to well below 2°C above pre-industrial levels, but does not include specific provisions on reducing emissions from the international shipping sector.

International seaborne trade volumes are expected to grow, which would lead to a significant increase in the associated emissions if mitigation measures are not put in place swiftly. According to IMO scenarios, global shipping emissions could grow by up to 50 % between 2018 and 2050, depending on future economic and energy developments. If left unchecked, these emissions risk undermining the goals of the Paris Agreement and cancelling out the emission reductions achieved in other sectors. Monitoring, reporting and verification of emissions is an important instrument for developing emissions reduction policies and for setting targets.

In 2013, the European Commission formulated a strategy for reducing GHG emissions from the shipping industry, comprised of three consecutive steps:

1. monitoring, reporting and verification of CO_2 emissions from large ships,
2. GHG reduction targets for the maritime transport sector,
3. further measures, including market-based measures (in the medium to long term).

International Maritime Organization (IMO)

The IMO published its first study on GHG emissions from ships in 2000. Measures to limit and reduce GHG emissions from international shipping have been on the agenda of the IMO Marine Environment Protection Committee (MEPC) since 2003. In 2011, the IMO adopted minimum efficiency standards for new ships. The fourth IMO GHG study[1] was published in August 2020.

The 70th MEPC meeting in October 2016 adopted a mandatory data collection system (described in the following section), which requires ships above 5 000 gross tonnes to report consumption data for fuel oil, hours under way and distance travelled. According to the IMO, these ships account for approximately 85 % of CO_2 emissions from international shipping. The system entered into force on 1 March 2018, and reporting starts with the year 2019. The data collection is a prerequisite for the definition of strategies and measures to reduce fuel consumption and the associated CO_2 emissions.

The 72nd meeting of the MEPC in April 2018 adopted an initial strategy on the reduction of GHG from ships, which should peak as soon as possible and fall by at least 50 % by 2050 compared to 2008, while pursuing efforts towards phasing them out entirely. The initial GHG strategy envisages a reduction in carbon intensity of international shipping (a 40 % reduction of average CO_2 emissions per transport work by 2030 and a 70 % reduction by 2050, compared to 2008) and a 50 % reduction in total annual GHG emissions from international shipping by 2050, compared to 2008.The initial strategy includes candidate short-, medium- and long-term measures with possible timelines and their impacts, and identifies barriers and supportive measures. According to the IMO roadmap approved in 2016, the initial strategy is due to be revised by 2023.

The EU, which has consistently pushed for higher environmental ambition in the IMO, had aimed for more ambitious emission reductions, namely 70 % to 100 % by 2050, and urges the IMO to develop and implement short-term measures to reduce emissions before 2023 and to start the development of other candidate measures.

The 73rd meeting of the MEPC in October 2018 approved a programme of follow-up actions on the initial GHG reduction strategy. The 74th MEPC meeting in May 2019 strengthened the existing mandatory requirements for energy efficiency of new ships.

Existing situation

Currently, data related to the GHG emissions of ships above 5 000 gross tonnes calling at ports in the European Economic Area (EEA) must be reported in two separate, but largely overlapping, systems: the EU MRV – which applies since 2018 – and the IMO DCS – which applies since 2019.

EU Monitoring, Reporting and Verification (MRV) system

The EU system for monitoring, reporting and verification of CO_2 emissions from maritime transport (Regulation (EU) 2015/757) requires ships above 5 000 gross tonnes calling at EEA ports to monitor and report fuel consumption, CO_2 emissions and transport work per voyage and on an annual basis, starting in 2018. According to analysis by the Commission, the introduction of the EU MRV system could lead to a 2 % annual reduction in fuel consumption and emissions by increasing transparency and awareness of GHG emissions from shipping.

It covers ships above 5 000 gross tonnes calling at EEA ports for maritime transport purposes. Other ship activities (such as fisheries, dredging, laying pipelines and supporting offshore installation activities) are not subject to monitoring and reporting requirements, for reasons of proportionality. Data on voyages internal to any EU Member State is also monitored and reported, so as to provide Member States' authorities with robust and comparable data of their domestic shipping emissions.

The CO_2 emissions of ships within EEA ports are monitored and reported separately, in order to promote the use of available measures for reducing CO_2 emissions within EEA ports and to raise awareness of these emissions.

The data must be verified by accredited third parties, with the aim of providing comparable data over time and robust information for further decision-making at the EU or the global level.

Shipping companies must submit a monitoring plan for each ship to an accredited verifier. From 1 January 2018, shipping companies must monitor CO_2 emissions, fuel consumption and other parameters, such as distance travelled, time at sea and cargo carried for each of their ships on a per voyage basis. The data are gathered into an emissions report and submitted to an accredited verifier after each calendar year.

On 30 April of each year, companies must submit a verified emissions report for each ship to the Commission and to the flag state where the ship is registered. From 30 June of each year, ships that have performed transport activities in the EEA in the previous reporting period must carry a document of compliance on board whenever they call at an EEA port.

The EU MRV Regulation requires the publication of data on the CO_2 emissions and energy efficiency of individual ships. Such transparency aims to incentivise the uptake of more energy efficient technologies and behaviours in the sector.

The MRV Regulation requires the Commission to review it after adoption of an IMO data collection system, and propose amendments to align the two systems, if appropriate.

The European Maritime Safety Authority (EMSA) operates an IT system (THETIS-MRV) for MRV of shipping emissions. This system enables shipping companies to work together with accredited verifiers to prepare monitoring plans and release emission reports and documents of compliance to the European Commission and national authorities.

In May 2020, the Commission published the first annual report on CO_2 emissions from maritime transport, based on data about CO_2 emissions from more than 11 600 ships operating in the EEA in 2018. The reported data cover around 90 % of CO_2 emissions, but only around 55 % of all ships calling at EEA ports, because ships below 5 000 gross tonnes are not included. Maritime transport was responsible for over 138 million tonnes of CO_2 emissions in 2018 – over 3.7 % of total EU emissions.

IMO data collection system (DCS)

The IMO data collection system requires ships above 5 000 gross tonnes to report consumption data for each type of fuel oil, hours underway and distance travelled, for all international voyages. Unlike the EU MRV, the IMO DCS covers any maritime activity carried out by ships, including dredging, pipeline laying, ice-breaking, fish-catching and off-shore installations. The system, adopted by resolution MEPC.278(70), entered into force on 1 March 2018. Reporting starts with the year 2019.

The Ship Energy Efficiency Management Plans of all ships covered by the IMO DCS must include a description of the methodology for data collection and reporting. After each calendar year, the aggregated data are reported to the flag state. If the data have been reported in accordance with the requirements, the flag state issues a statement of compliance to the ship. Flag states subsequently transfer this data to an IMO ship fuel oil consumption database, which is part of the Global Integrated Shipping Information System (GISIS) platform. IMO will then produce annual reports, summarising the data collected.

Key differences between EU MRV and IMO DCS

While the two systems have the same general objective, there are important differences:

- The IMO DCS comprises any activity carried out by ships in the marine environment, while the EU MRV covers only transport of goods and persons.
- The IMO DCS applies to all international voyages, while the EU MRV applies only to voyages to and from EEA ports, including domestic voyages.
- Emissions in EEA ports are reported separately in the EU MRV system.
- The IMO DCS requires annual aggregated data, while the EU MRV uses data per voyage.
- The IMO DCS requires data on the deadweight tonnage (the carrying capacity of the ship), while the EU MRV requires data related to transport work (weight of actual cargo carried or number of passengers).
- The IMO DCS requires publication of aggregated data, while the EU publishes data on the performance of individual ships.

Parliament's starting position

The European Parliament has consistently pushed for ambitious policies to reduce GHG emissions in international shipping, and sent delegations to important MEPC meetings. The resolution 'Towards a new international climate agreement in Paris' of 14 October 2015, which set out its position before the COP21 climate change conference, called on the Parties to work within the IMO towards an effective response by setting adequate targets before the end of 2016 so as to achieve the 2°C target.

The resolution of 25 October 2018 on the 2018 UN Climate Change Conference in Katowice, Poland (COP24) welcomed the initial IMO strategy on reduction of GHG emissions from ships and called on the IMO to agree rapidly on new mandatory emissions reduction measures needed to deliver on the targets. It urged the EU and its Member States to monitor the impact and implementation of the IMO agreement and to consider additional EU action to ensure that shipping emissions are reduced in line with the Paris Agreement.

Specifically with regard to MRV, the resolution on a European strategy for low-emission mobility of 14 December 2017 called for amendment of the EU MRV system to align it with the IMO DCS, while preserving transparency, verification and the collection of data on real transport work.

Preparation of the proposal

In reaction to the adoption of the guidelines for the global IMO DCS by the MEPC meetings in October 2016 and July 2017, the European Commission carried out the analysis required by the EU MRV Regulation. In order to gather input from stakeholders, a public on-line consultation was carried out from 8 September to 1 December 2017, followed by a targeted e-survey organised by consultants in December 2017 and January 2018. In addition, the Commission considered the feedback received in relation to its inception impact assessment. The responses received are summarised in the 'Stakeholders' views' section below.

The impact assessment analysed three policy options:

- baseline: EU MRV Regulation remains unchanged,
- streamlining of elements for which there is a design difference between the EU MRV and the IMO DCS
- high convergence: the EU MRV Regulation would adopt the requirements of the IMO DCS

The impact assessment recommends option 2, as it safeguards the expected environmental, social and economic benefits of the EU MRV Regulation, while reducing the administrative burden for ship owners.

The Regulatory Scrutiny Board gave a positive opinion of the impact assessment, but notes some opportunities for improvement, including a quantification of the cost of the baseline and the cost savings of the preferred option.

EPRS has carried out an initial appraisal of the impact assessment and identified some shortcomings.

The changes the proposal would bring

The proposed revision of Regulation (EU) 2015/757 aims to facilitate the simultaneous implementation of the two systems, while preserving the objectives of the current EU legislation, i.e. to keep the collection of robust and verified CO_2 emissions data at individual ship level, to stimulate the uptake of energy efficiency solutions and inform future policy-making. By aligning some aspects of the two MRV systems such as specific definitions or monitoring parameters, the proposal aims at reducing the administrative burden and associated costs for ships that have to report under both systems.

Specifically, the proposal amends the EU MRV Regulation to align the definitions of 'company' and 'reporting period' with the global IMO DCS, in order to ensure that the same legal entities monitor and report for similarly calculated reporting periods under both the EU MRV Regulation and the global IMO DCS, for their ships' EEA-related maritime transport activities. Some monitoring and reporting requirements of the IMO DCS will be used in the EU MRV Regulation: 'deadweight tonnage' will become a mandatory parameter, while 'cargo carried' will be retained as a voluntary parameter; 'time at sea' will be replaced with the IMO DCS definition of 'hours underway'; and 'distance travelled' will be calculated according to IMO DCS guidelines.

The content of monitoring plans would be adapted so as to take into consideration the IMO 'Guidelines for the development of a Ship Energy Efficiency Management Plan (SEEMP)', except for those provisions which are necessary to ensure that only EU-related data are monitored and reported under the EU MRV Regulation.

Certain key elements of the existing EU MRV Regulation would be maintained:

- the scope in terms of ships and activities,

- monitoring and reporting of ship's CO_2 emissions in EEA ports and during voyages within EU Member States,
- publication of individual ships' CO_2 emissions and energy efficiency.

Advisory committees

The European Economic and Social Committee, in its opinion of 15 May 2019 (rapporteur: Constantine Catsambis, Employers - Group I, Greece) advocates a complete alignment of the EU MRV Regulation with the IMO system, in order to ensure an international level playing field for the European fleet. It considers that the proposed partial alignment would create ineffective double monitoring and reporting requirements that increase the workload, administrative burden and costs.

The Committee of the Regions decided not to issue an opinion.

National parliaments

Fifteen national parliamentary assemblies scrutinised the proposal; no subsidiarity concerns were raised before the deadline.

Stakeholder views[2]

The Commission's impact assessment provides a summary of the stakeholder input received during the preparation of the proposal. Stakeholders from the shipping industry consider the minimisation of administrative burden as the most important objective, and generally favour the full alignment of the EU MRV with the IMO DCS. Civil society stakeholders generally consider it important to retain the EU system, as it provides better transparency at the individual ship level.

The European Shippers' Association favours a global approach and warns that regional regulation risks a distortion of competition as well as traffic avoidance. However, it considers the transparency of data of utmost importance, and proposes to improve the global IMO system by incorporating the EU proposal on transparency and real energy efficiency of individual ships. AP Moller-Maersk, a container logistics company, calls for retaining cargo carried as a mandatory monitoring parameter, as it is needed to accurately calculate a ship's efficiency by comparing its fuel consumption with the actual transport work.

The European Community Shipowners' Associations, together with other associations representing the shipping industry, calls for the full alignment of the EU MRV with the IMO DCS and opposes the publication of data about voyages from and to EEA ports. The International Chamber of Shipping also calls for full alignment of the EU MRV with the IMO DCS and expresses concerns about the publication of commercially sensitive and potentially misleading information about the operational performance of individual ships under the EU MRV system.

Transport and Environment (T&E), an environmental NGO, supports the Commission's proposal to continue publishing data about the emissions of each ship calling at EU ports, as this would incentivise shipping companies to cut their CO_2 emissions and provide an evidence base informing regulations to reduce emissions. The transparency of the EU system, unlike the IMO DCS, would allow shipping customers to identify the most efficient vessels.

In the view of Julien Dufour, CEO of the verification and auditing agency Verifavia Shipping, the Commission proposal is a welcome step towards simplification that would allow shipping companies to monitor data in the same way for both systems.

Legislative process

The Commission presented the proposal to the Council working party on the environment on 28 February 2019 and to the Environment Council on 5 March 2019. Coreper agreed the Council

mandate for negotiations with the Parliament on 25 October 2019. The Council's text clarifies the provisions applied in case of a change of ownership of a ship; introduces a definition of fuel oil to include gas, distillate and residual fuels; clarifies the definition of 'fuel oil consumer'; and changes 'above 5 000 gross tonnage' to '5 000 gross tonnage and above' in line with the IMO requirements.

In the European Parliament, the proposal has been referred to the ENVI committee, which appointed Jutta Paulus (Greens/EFA, Germany) as rapporteur in July 2019. She presented her draft report on 24 January 2020. The ENVI committee adopted the report on 7 July 2020.

On 16 September 2020, the Parliament adopted amendments requiring shipping companies to reduce on a linear basis their annual average CO_2 emissions relative to transport work, for all their ships, by at least 40 % by 2030 (in line with the stated ambition of the initial IMO strategy), with penalties for non-compliance. In order to obtain data on transport work, the reporting of 'cargo carried' per voyage would remain mandatory. In addition, the amendments introduce environmental performance labelling of ships, and call for the inclusion of methane and other greenhouse gases besides CO_2, and for better supply of shore-side electricity in ports. The Commission would have to review the regulation in light of future IMO measures. The Parliament's position would amend the EU ETS Directive to include maritime shipping from 2022. It also calls for an 'Ocean Fund' for the 2022-2030 period, financed by revenues from auctioning ETS allowances, which would be used to make ships more energy-efficient, to support investment in innovative technologies and infrastructure for decarbonising maritime transport, and to protect marine ecosystems impacted by climate change. The Commission would be required to assess any new global market-based emission reduction measures adopted by the IMO with respect to their ambition and environmental integrity.

The file was referred back to the ENVI committee with a mandate to start trilogue negotiations.

EP SUPPORTING ANALYSIS

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Pape M., Monitoring CO2 emissions in maritime transport, EPRS, April 2015.

Pape M., The IMO – for 'safe, secure and efficient shipping on clean oceans', EPRS, February 2016.

Pape M., The first climate change strategy for shipping, EPRS, May 2018.

Pape M., Decarbonising maritime transport: EU perspective, EPRS, October 2020

Vettorazzi S., Revision of the EU system to monitor, report, and verify CO2 emissions from ships, Initial appraisal of a European Commission impact assessment, EPRS, October 2019.

OTHER SOURCES

Carbon dioxide emissions from maritime transport: global data collection system for ship fuel oil consumption data, European Parliament, Legislative Observatory (OEIL).

Fourth IMO GHG Study, International Maritime Organization, July 2020

Data collection system for fuel oil consumption of ships, International Maritime Organization

New requirements for international shipping as UN body continues to address greenhouse gas emissions, International Maritime Organisation, briefing, October 2016.

Dufour J., EU MRV and IMO DCS – what does the proposed alignment mean?, BLUE Communications, July 2019.

Sheridan P., Jamison O. and Keys V., Shipping and carbon: EU and IMO systems to align, Verifavia, March 2019.

ENDNOTES

[1] The study is available to the public; registration on the IMO website is required for downloading.

[2] This section aims to provide a flavour of the debate and is not intended to be an exhaustive account of all different views on the proposal. Additional information can be found in related publications listed under 'EP supporting analysis'.

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