New initiatives in international maritime transport

Rapidly evolving over the past decade, international maritime transport contributes significantly to global anthropogenic greenhouse gas (GHG) emissions, exceeding those of the civil aviation sector. The establishment of the European Union MRV Regulation and the agreement adopted within the International Maritime Organization (IMO) can be a indicator of the beginning of a transition, provided that they lead to quantitative results. The past year has seen some interesting technological initiatives, driven by key industry stakeholders in the sector.

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1 • GHG EMISSIONS CONCENTRATED ON SHIPPING ROUTES

• A RECENT INCREASE • Global CO_2 emissions from maritime shipping have been steadily decreasing since 2007, decreasing from 1.1 $GtCO_2$ to 932 $MtCO_2$ in 2015, representing 2.6% of total CO_2 emissions for the same year (compared to 3.5% in 2007). In 2015, emissions from international maritime transport alone accounted for 87% of total CO_2 emissions from maritime shipping, with 812 $MtCO_2$ emitted, a decrease of 8% compared to 2007 (881 $MtCO_2$). Nevertheless, the increase observed since 2013 (+1.4%) and according to unpublished estimates, **international maritime transport emissions should be 847 $MtCO_2$ in 2016 and 859 $MtCO_2$ in 2017, an increase of 5.8% compared to 2015** (Table 1). Regarding fishing vessels, their emissions have halved since 2007, from 86 $MtCO_2$ to 42 $MtCO_2$ in 2015 and stabilised in 2017. Emissions from domestic maritime transport decreased by 41% over the same period, from 133 $MtCO_2$ in 2007 to 78 $MtCO_2$ in 2015, and are also estimated to have stabilised in 2017. Finally, cruise ships emitted 38 $MtCO_2$ in 2015, or about 4% of emissions from the maritime sector (ICCT, 2017).

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016*	2017*
International transport	881	916	858	773	853	805	801	813	812	847*	859*
Domestic maritime transport	133	139	75	83	110	87	73	78	78	78*	78*
Fishing vessels	86	80	44	58	58	51	36	39	42	42*	42*
Total maritime shipping	1100	1135	977	914	1021	942	910	930	932	967*	979*
% global CO_2 emissions	3.5%	3.5%	3.1%	2.7%	2.9%	2.6%	2.5%	2.6%	2.6%		

TABLE 1. CO_2 EMISSIONS FROM GLOBAL MARITIME SHIPPING (SOURCE: ICCT, 2017).

* 2016 and 2017 data are estimates from an internal source of the ICCT (2018).

• EMISSIONS PROFILE OF THE MARITIME SECTOR • Between 2013 and 2015, three classes of vessels accounted for 55% of total GHG emissions from international maritime transport: container ships (23%), bulk carriers (19%) and oil tankers (13%) (Figure 1).

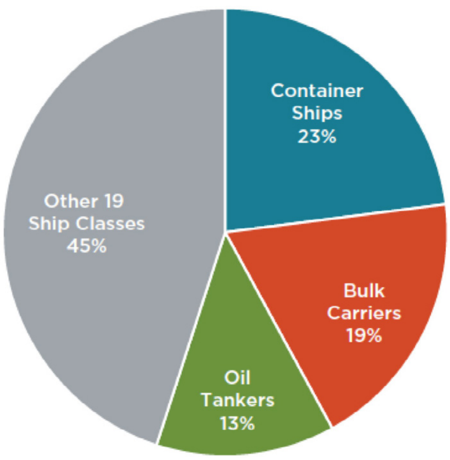


FIGURE 1. SHARE OF CO_2 EMITTED BY CLASS OF VESSEL BETWEEN 2013 AND 2015.

Source: ICCT, 2017

These emissions are defined by the International Maritime Organization (IMO) into four categories. Firstly, there are exhaust emissions, which are the largest volume of GHGs and come from main and auxiliary engines, boilers, and incinerators. Then there are refrigerant emissions, which are essential for refrigeration systems and air conditioners, but which also escape during maintenance operations and dismantling processes (emissions are allocated to the countries carrying out the operations). Then there are various emissions produced during transportation periods, including leaks and releases. In the final category are GHG emissions from testing and maintenance phases (Shi & Gullett, 2018). At the operational level, shipping routes were responsible for the majority of GHG emissions from major vessels in 2015. However, for some vessels (oil and methane tankers), berthing still represents a significant energy expenditure (respectively 17% and 14% of their total GHG emissions). Anchoring represents about 5 to 9% of GHG emissions for each class of vessel.

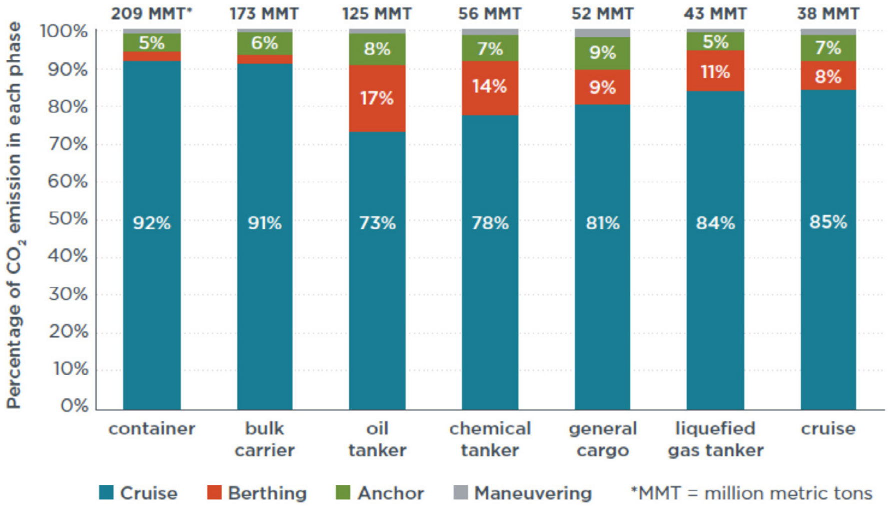


FIGURE 2. CO_2 EMISSIONS DURING THE OPERATIONAL PHASES OF THE MAIN EMITTING VESSELS, 2015.

Source: ICCT, 2017..

Of the 223 countries represented in maritime transport, **52% of emissions in 2015 were attributable to vessels operating under six flags:** Panama (15%), China (11%), Liberia (9%), the Marshall Islands (7%), Singapore (6%) and Malta (5%) (Figure 2). Global CO_2 emissions from the maritime shipping sector are concentrated on well-defined shipping routes around the globe (Figure 3).

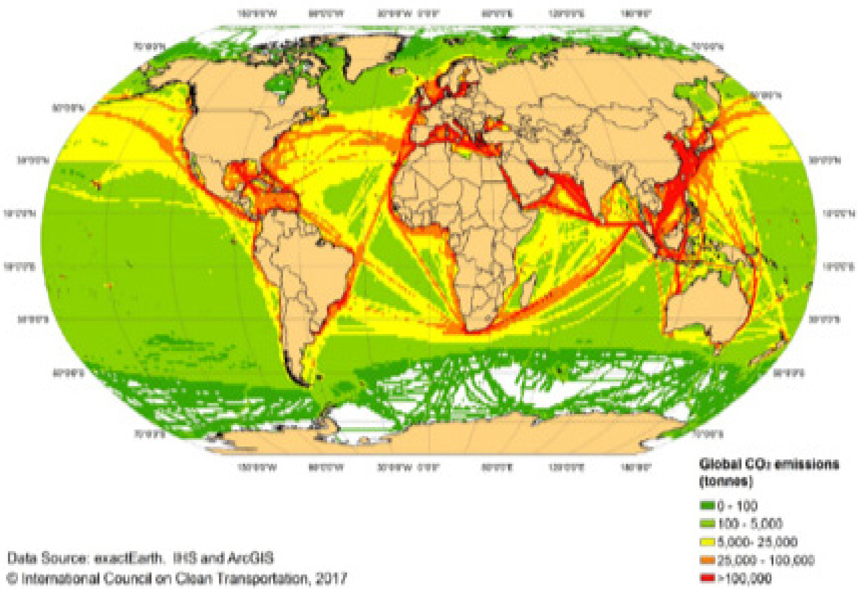


FIGURE 3. GLOBAL DISTRIBUTION OF CO_2 EMISSIONS FROM MARITIME TRANSPORT, 2015.

Source : ICCT, 2017.

• GHG EVOLUTION CORRELATED WITH VESSEL TONNAGE, SIZE AND SPEED • While the decline of CO_2 emissions from maritime shipping during the Kyoto period (2007-2012) is largely attributed to the global financial crisis of the time, an increase is to be expected over the coming years due to the growth of international maritime trade (Shi & Gullett, 2018). Smith et al. (2015) estimated that, as it stands, CO_2 emissions from the maritime sector could increase by anywhere from 50% to 250% by 2050. In the absence of measures, the sector's share could reach 17% of global GHG emissions by that date (Cames et al., 2015). In addition, the recent increase in GHG emissions from the sector comes as the CO_2 intensity of the majority of vessel categories improves, cancelling out these efforts (ICCT, 2017). One reason is the increase in cruising speeds. Indeed, between 2013 and 2015, container ships increased their average speed by 11% and oil tankers by 4% compared to the total average of international transport, leading to an increase in CO_2 emissions per tonnage transported.

With a volume approaching 9 billion tonnes of freight transported per year, the seaway is the primary mode of transport for commercial activities. Its share in global commercial transport has reached 80% in terms of volume and 70% in terms of value. **In terms of goods, the main resource transported in 2012 was still crude oil, at 1.863 billion tonnes (see Figure 4).** In terms of evolution, the world fleet of commercial vessels has been on an exponential curve since the 1970s, after a decline in the late 1990s. Representing 289,926 gross tonnes sailing the world seas in 1973, in 2016, it accounted for 6 times more at 1,862,000 gross tonnes. In 2017, it was estimated that 93,000 vessels make up this commercial shipping fleet (Cargill, 2017). The largest are cargo vessels used to transport goods such as bulk carriers (41%), which carry bulk solids (sand, aggregates, cereals), tankers (38%), such as oil tankers, methane tankers or refrigerated cargo vessels carrying liquid foodstuffs and container ships (14%), which, since February 2018, can carry more than 20,000 containers (compared to 1700 in 1970) and the inauguration of CMA CGM Antoine de Saint-Exupéry, the largest vessel of its kind. These three classes account for 84% of the total merchandise supply by seaway. In addition to goods, the world's maritime fleet consists of multipurpose vessels (6%), including all kinds of fishing vessels and large cruise ships belonging to a thriving cruise industry (1%) which carry millions of passengers to tourist destinations (Info Arte, 2016).

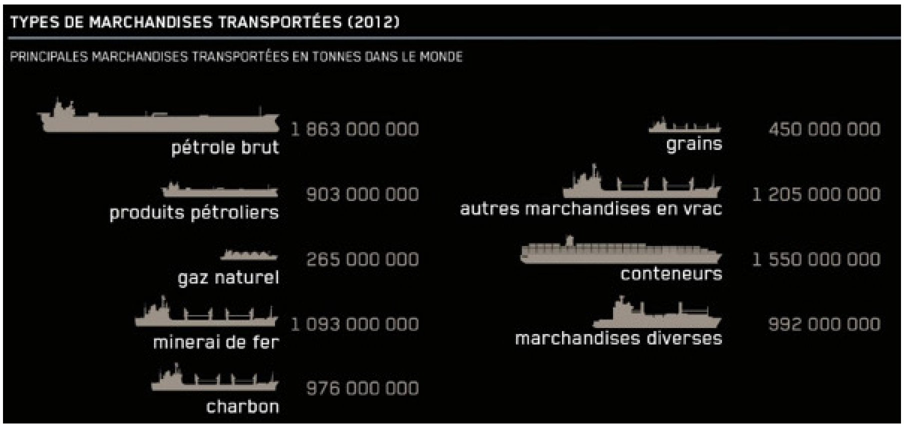


FIGURE 4. MAIN GOODS CARRIED IN TONS WORLDWIDE (2012)

Source: ARTE

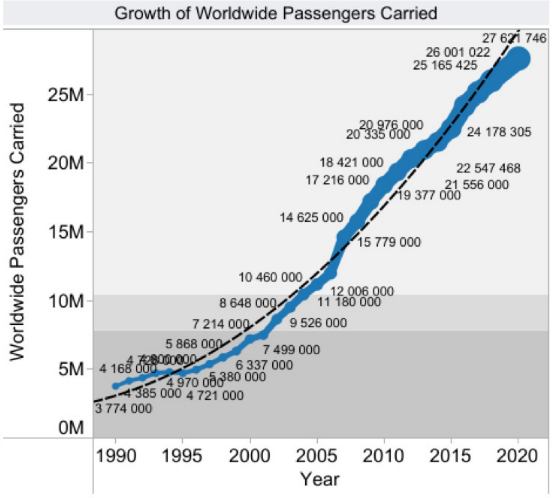
Thus, the regulation of GHG emissions from international maritime shipping is based on a wide variety of vessels and activities. Nevertheless, cargo ships emit far more than other types of boats due to their size and tonnage, while being easier to regulate internationally as a result of their design and the international nature of their journey (Shi & Gullett, 2018). Therefore, reducing emissions can only come from concerted action by stakeholders to improve energy efficiency and develop alternative means of propulsion (ICCT, 2017).

2 • THE ONSET OF AWARENESS

• THE ACTION OF THE INTERNATIONAL MARITIME ORGANIZATION (IMO) • The International Maritime Organization (IMO) is the international authority that regulates international maritime transport. The IMO defines international maritime transport as the maritime transport between ports of different countries, as opposed to domestic maritime transport, and excludes military and fishing vessels (IMO, 2014). **Maritime transport is the only sector (together with air transport) whose contribution to climate change mitigation is directly negotiated at the international level, and is not included or mentioned in the Kyoto Protocol or the Paris Agreement** (Wan et al., 2017). Discussions related to this sector, often blocked by several influential countries (China, the country that operates the most vessels), have been left to the IMO, which is expected to promote trade, set emission reduction efforts, and develop strategies to be put in place as a regulator of international maritime transport (Wan et al., 2017).

The future impact of the cruise industry

Although it only represented 4% of the maritime sector's total emissions with 38 $MtCO_2$ in 2015, the growth of international passenger transport has been exponential, and the cruise industry is evolving more strongly than other forms of tourism. Over the past 20 years, the average annual passenger growth has been 7% (Florida-Caribbean Cruise Association, 2015). In 2016, 23 million passengers worldwide were welcomed on cruise ships, most of them from North America. Cruise ships require a lot of energy, both for navigation and for the many services offered on board. For example, the Freedom of the Seas, one of the largest ocean liners in the world, burns 4200 litres of fuel per hour during the navigation period. As a matter of logic, the size, services offered, and cruising speed of the ships affect the GHG emissions. However, the construction of new passenger ships tends to increase their capacity, the diversity of the services offered, and their cruising speed, which cancels out the improvements generated by the new propulsion processes and the installation of electrical systems at the docking ports to encourage them to stop using their generators once at the dock.



Source Region of Passengers

Year	North America	Europe	Other	Worldwide Passengers Carried
2017	14 130 410	6 417 159	4 617 856	25 165 425
2018	14 167 168	6 764 273	5 069 580	26 001 022
2019	14 526 363	6 933 353	5 397 702	26 857 418
2020	14 829 278	7 075 424	5 717 044	27 621 746

FIGURE 5. GROWTH AND FORECAST OF THE CRUISE INDUSTRY BY EVOLUTION OF PASSENGERS TRANSPORTED BETWEEN 1990 AND 2020

(Cruise Market Watch, 2017)

TEXT BOX 1

• REGULATORY TOOLS IN PLACE • To date, there is only one regulation that focuses on the energy efficiency of vessels on a global scale, the Energy Efficiency Design Index (EEDI). Promulgated by the IMO in 2013, the EEDI subjects new vessel designs to requirements for the use of equipment and engines that pollute less (less CO_2 per nautical mile travelled) and more energy-efficient. It is expected that these requirements will be gradually increased every five years to encourage the integration of innovations and the development of new techniques, from the design phase of the vessel to the fuel consumption required for its operation. Vessels built between 2015 and 2019 must be 10% more efficient in terms of grams of CO_2 per tonne per nautical mile than those built over the 1999-2009 period and for those built between 2020 and 2024, the target is 20%, before reaching 30% beyond 2025. However, the EEDI is a non-normative, voluntary performance-based mechanism that leaves the choice of technologies to be used in vessel designs to the industry (ICCT, 2017).

The Ship Energy Efficiency Management Plan (SEEMP) is an IMO operational mechanism aimed at optimising the energy consumed by maritime shipping during the operation of ships. Developed with the World Maritime University, the SEEMP aims to promote energy-efficient technologies for new and existing vessels and to get them to use the Energy Efficiency Operational Indicator (EEOI), which allows for continuous monitoring of the energy consumed during the operation of a vessel. This tool provides an overview of the global fleet in terms of performance while allowing on-board engineers and mechanics to have continuous control of the energy efficiency of vessels during their operation, to report observations, better plan trips, estimate the propeller cleaning frequency, or even evaluate the efficiency of introducing new forms of propulsion (IMO, 2018).

The impetus of the European Union on the maritime sector

The European Union is keen to integrate the air and maritime sectors into international climate negotiations. Given the reluctance of many countries on the maritime issue, the EU has developed an MRV (Monitoring, Reporting, Verification) regulation for vessels visiting its ports. As such, the EU MRV entered into force on 1 July 2015 and requires shipowners and operators to monitor, report, and verify the CO_2 emissions on an annual basis of vessels of more than 5000 gross tonnage, in any port of the European Union and the European Free Trade Association. Data collection takes place per trip and started on 1 January 2018. The reported CO_2 emissions, as well as additional data, must be verified by independent certified bodies such as DNV GL, a Norwegian certification body, and sent to a central database managed by the European Maritime Safety Agency (EMSA). Aggregated emissions and vessel efficiency data will be published by the European Commission no later than 30 June 2019, then annually thereafter. Regarding the new agreement announced by the IMO, the objective of reducing maritime sector emissions by 50% by 2030 is less ambitious than the European Union wanted, but this timeframe makes it possible to include the maritime framework in line with the objectives of the Paris Agreement. During the discussions prior to this agreement, the European Union was able to play its full weight, using the 41% of the world fleet that it represents through its member countries, but also by relying on its new MRV regulation to encourage it to be applied in the future on a global scale.

TEXT BOX 2

• A RECENT AGREEMENT • At the 72nd meeting of the Marine Environment Protection Committee (MEPC 72) in April 2018, the 170 member countries of the IMO agreed to adopt a resolution codifying a GHG reduction strategy for international maritime transport. The agreement was found despite the reservations expressed by several countries (Saudi Arabia, United States, China) and the disproportionate influence of the five countries under which the majority of commercial vessels are registered (Bahamas, Marshall Islands, Liberia, Malta, Panama), which account for 43% of the total IMO funding. This strategy, which represents the first global climate framework for maritime transport, sets targets for reductions up to 2050 and sets 2023 as the deadline for its revision.

The strategy involves implementing policies to significantly increase the energy efficiency of the global fleet and to promote the deployment of innovative propulsion and alternative fuels in order to achieve:

• The reduction of GHG emissions (per tonne per kilometre) by at least 40% for vessels by 2030, while continuing to reach a 70% reduction by 2050,

• The reduction of emissions by at least 50% in 2050 compared to 2008, while continuing the action towards the total decarbonisation of maritime transport.

A list of short-, medium- and long-term measures to help achieve the objectives was developed by the ICCT (2018). Nevertheless, these measures must be made mandatory by an IMO convention before they become legally binding.

Type	Period	Measure	Target	Current status
Short term	2018-2023	New phases of the EDDI	New vessels	-10% en 2015
				-20% en 2020
				-30% en 2025
		Operational efficiency measures (SEEMP, standards)	Vessels in service	SEEMP planning required
		Existing fleet improvement programme	Vessels in service	-
		Speed reduction	Vessels in service	-
		Measures to combat methane and VOCs	Fugitive emissions and engines	-
Medium term	2023-2030	Alternative low carbon or zero carbon fuel programmes	Fuels - new vessels / vessels in service	-
		Additional operational efficiency measures (SEEMP, standards)	Vessels in service	SEEMP planning required
		Market-based measures [2]	Vessels in service - fuels	-
Long term	2030 +	Development and provision of zero-carbon or non-fossil fuels	Fuels - new vessels / vessels in service	-

TABLE 2. MEASURES WHICH COULD BE INCLUDED IN THE IMO'S INITIAL STRATEGY TO REDUCE GHGS (SOURCE: ICCT, 2018).

(Source : ICCT, 2018).

Beyond these measures, the ICCT (2018) has identified other measures that could indirectly support efforts to reduce GHGs, such as:

• Encouraging the development and updating of national action plans;

• Encouraging ports to facilitate reductions in GHGs from vessels;

• Initiating and coordinating Research and Development activities by setting up an International Maritime Research Board (IMRB);

• Promoting the search for zero-carbon or non-fossil fuels for the maritime sector, and developing robust guidelines on GHG lifecycles for replacement fuel;

• Carrying out additional studies on GHG emissions to inform political decisions and calculate the marginal cost curves of reduction for each measure;

• Encouraging technical cooperation and reinforcing capacity.

These ambitions should encourage ships to use alternative fuels to fuel oil, as the latter releases more than 3500 times more sulphur than the diesel used by road vehicles. On this subject, the OECD suggests a move towards biofuels, hydrogen, ammonia and a growth in the use of sails, with liquefied natural gas remaining a short-term alternative (OCDE, 2018).

3 • THE MOMENTUM OF SHIPPING COMPANIES

• STAKEHOLDER PARTNERSHIP SOLUTIONS • Several initiatives backed by non-state actors have sought to make the maritime sector sounder in terms of GHG emissions. Of these, **the Sustainable Shipping Initiative (SSI) it is backed by an independent body, which brings together shipping**

2- Market-based measures seek to address the market failure of "environmental externalities" by incorporating the external cost of production or consumption activities through taxes or royalties on processes or products, or by creating property rights and facilitating the establishment of an environmental services market. According to this definition, these measures aim to provide polluters (shipowners and economic operators) with an economic incentive to reduce their GHG emissions in line with the "polluter pays" principle (Shi & Gullett, 2018).

companies (shippers, shipyards, equipment) and other stakeholders (banks, technology companies, NGOs) with the aim of creating a more environmentally friendly, socially responsible, safer, and more economically profitable maritime industry by 2040. Members of this network include Maersk Line, Oldendorff and China Navigation, as well as environmental non-governmental organisations (NGOs): WWF and Forum for the Future. The roadmap to 2040 includes six main actions including action 6, which seeks to "Adopt a diverse range of energy resources, using resources more efficiently and responsibly, and dramatically reducing greenhouse gases". The measures put forward to achieve this include the introduction of significant improvements to the energy efficiency of vessel design; rehabilitation and navigation; a search for and use of renewable sources of energy in propulsion systems to improve energy intensity; and the involvement of partners in achieving energy gains in the supply chains.

Four other non-governmental organisations (The Global Maritime Forum, The North American Marine Environment Protection Association (NAMEPA), The Maritime Anti-Corruption Network, and The Women's International Shipping and Trading Association (WISTA)) are involved in an initiative backed by Cargill, a United States company specialising in supplying foodstuffs and trading in raw materials. With the help of these NGOs, Cargill seeks to boost sounder shipping by aiming to reduce GHG emissions from its 650 vessels by 15% in 2020 compared with 2016. **Furthermore, Cargill has announced that it improved the energy efficiency of its fleet in 2017 and reduced CO_2 emissions by 5.7% compared with 2016 on the basis of tonnage of cargo carried per mile (Cargill, 2017).**

• THE INDUSTRY IN SWEDEN LEADING THE SECTOR • The Swedish maritime transport industry is also extremely active in decarbonising its business. Its representative association has announced a zero-emission target by 2050 and several companies are pioneering low-emission maritime transport. Sweden boasts a growing number of initiatives: **Stena Line operates a ferry fuelled by methanol, Sirius Shipping has developed a boat fuelled by LNG, several companies (Terntank, Erik Thun, Rederi Gotland) also have vessels that run on LNG, and HH Ferries and Green City Ferries have launched electric ferries (OCDE, 2018).** This proactive approach is the result of cooperation between decision-makers, financial support from the Swedish government, the European Union, or the Norwegian NOx Fund, depending on the particular project, and support in terms of regulation. This convergence of interests between Swedish shipowners and maritime companies has encouraged other industries, such as energy companies, to embark on long-term partnerships; a factor which is critical to the success of this type of initiative. The best example can be seen in the **"Zero Vision Tool", a collaborative platform, which brings together the maritime transport industry, the government, and the research community with a view to solving the technical issues affecting pilot projects on LNG refuelling or fuelling vessels with LNG or methanol.** Finally, the introduction of sulphur-emission standards has also stimulated requests to convert to propulsion systems with lower GHG (OCDE, 2018).

• SUPPORT NEEDED TO STIMULATE THE MARKET • In France, it is important to note the involvement of the Agency for Environment and Energy Management (ADEME). In the area of Transport and Mobility in the Investments for the Future Programme (PIA), "Vessels of the Future" is a topic that includes some 49 projects to which ADEME makes a financial contribution. In 2017, ADEME launched a call for proposals seeking to fund R&D projects in the naval industry, which could lead to industrialisable products. The call related to boats, vessels and mobile floating platforms used for commercial transport (people, goods), work (fishing, marine energy, surveillance, research, dredging, resource development), or leisure (boating). Of the four thematic areas, Area 1 "Economical Vessels" aims to achieve energy efficiency through reducing resistance to forward motion (shape, materials, structures, hydrodynamics), improving propulsion and energy use (performance, systems), and developing innovative solutions based on renewable energy or through optimisation of the total energy balance by managing on-board needs (water, ventilation, air conditioning, etc.). This area also seeks to improve operational efficiency through optimising navigation operations, port manoeuvres and commercial operations (loading/unloading), optimising the preservation and recovery of cargoes, and enforcing interoperability with other modes of transport and onshore infrastructure.

The Honfleur project, winner of the ADEME prize

The aim of the HONFLEUR project, which was launched in March 2017 for a period of two years, is to achieve the replacement of the Normandie liner (1992) currently in service between the ports of Caen-Ouistreham (FR) and Portsmouth (UK). Over the next three decades, technological decisions affecting the design of the hull and its appendages, its diesel-electric motors, and devices used to manage and recover energy consumed should allow the HONFLEUR to consume 20% less energy compared with conventional vessels of its kind, and to be less polluting through its use of liquefied natural gas (LNG) as an alternative to oil fuel. This vessel will be the first LNG ferry to operate in the Channel-North Sea sector. The use of LNG allows for a drastic reduction in emissions of sulphur (-99%), fine particles (-90%), and nitrogen oxide (-87%) compared with the same amount of energy provided by marine diesel oil (MDO). It will also lead to a significant reduction in the carbon emissions of the vessel, which is also equipped with devices to manage electrical energy and energy recovery, and has diesel-electric motors. This all adds up to an average of 12,000 tonnes of CO_2 avoided per year compared with a conventional ferry. These environmental gains are important for air quality in port areas, which are generally close to areas with high population density (ADEME, 2018).

TEXT BOX 3

4 • TOWARDS RESPONSIBLE MARITIME TRANSPORT?

• ELECTRIFICATION OF THE SECTOR • Over the last ten years, there have been several initiatives in the engineering and naval construction sector to develop electric means of propulsion. These initiatives cover domestic transport vessels (Port-Liner), electrical cargo vessels (Hangzhou Modern Ship Design & Research Co.) and passenger transport (E-Ferry). These vessels, particularly passenger ships and ferries, are easier than any other type to equip with electrical propulsion due to their short journeys between the same ports. However, these initiatives do not specify the sources of energy used to recharge this new fleet's batteries, so it is difficult to estimate the reduction in GHG emissions attributable to shipping.

In addition to the electrification of vessels, ports have also embarked on electrifying their operations. In 2018, Nidec Industrial Solutions announced an advanced electrical supply system for the Port of Genoa in conjunction with the Western Ligurian Sea Port Authority. This project will enable berthed vessels to connect to a power supply once they have docked, eliminating the need to use their engines. This solution will reduce GHG emissions and limit the exposure of neighbouring residents to the atmospheric pollution and sound pollution produced by the generators normally used. This project follows numerous similar projects implemented in the ports of Livorno (Italy), Los Angeles and San Francisco (California), Juneau (Alaska), Gothenburg (Sweden) and Lübeck (Germany). In France, in 2017, the Port of Marseille Fos and La Méridionale introduced electrification of the quays to allow ferries to connect to an electricity supply from 30 minutes after passenger disembarkation until 2 hours before departure. It is now no longer necessary to use motors running on oil fuel during this period at dock. In 2018, Corsica Linea, a company that provides a regular ferry service between Marseille and Corsica, announced that it planned to equip three of its vessels so that they too could connect to the electricity network when berthed. The introduction of the equipment for this new electrical connection device required an investment of between 3 and 5 million euros per vessel, to which ADEME and the PACA (Provence-Alpes-Côte d'Azur) Region were to contribute.

Burgeoning electrical maritime transport projects

CONTAINER BARGE • Port-Liner, a Dutch shipping company, is due to launch its first electric container barge shortly. Dubbed the "Tesla Ship", this vessel will operate by electric propulsion powered by independent batteries, giving it 15 hours of power in the case of the first model (52 m long and 6.7 m wide with a transport capacity of 24 containers), and 35 hours of power for the second model (110 m long and 11.40 m wide with a capacity of 270 containers.

CARGO SHIP • China launched the first electric cargo ship at the end of 2017. The ship, 70 m long by 14 m wide and weighing 2000 tonnes, was designed by Hangzhou Modern Ship Design & Research Co. The cargo ship can reach a cruising speed of 12.8 km/h and is powered by a series of batteries that generate 2400 kWh and which can be recharged in two hours, which enable it to travel 80 kilometres. In dock, the cargo ship has just the time to fully recharge while its cargo is being loaded and unloaded. The company hopes that this technology will soon be used by passenger vessels.

FERRIES • In 2018, the Havyard shipyard (Norway) announced that it had won a contract to build seven battery-powered ferries for the Norwegian transport company Fjord1. This news comes at a time when the operators of the first electric ferry in Norway, Ampere, announced their statistics with savings of up to 80% of energy and a 95% reduction in GHG emissions after two years in service. This vessel, which was brought into operation in 2015 as a result of a partnership between Norled AS (shipping company and ferry operator), Fjellstrand (shipyard), Siemens AS and Corvus Energy, is equipped with a battery with a capacity of 1 MWh. These economies of scale have triggered a series of orders to build new electric ferries or to convert ferries currently running on diesel. This announcement also comes at a time when Fjord1 is in the process of modernising its fleet following a request from the Norwegian authorities to achieve a zero-emission fleet. In parallel, Stena Line (a Swedish company) announced that it would convert Stena Jutlandica, a 185 m-long vessel which operates between Frederikshavn (Denmark) and Gothenburg (Sweden), to be powered by electricity, which would make it the largest electric boat in the world.

THE E-FERRY PROJECT • The E-ferry project (E-ferry – prototype and full-scale demonstration of next generation 100% electrically powered ferry for passengers and vehicles), funded by the EU, it is about to launch a fully electric, medium-sized ferry designed to transport passengers, cars, lorries and goods. Targeting medium-haul vessels, it should be able to travel distances of more than 20 NM between each charge with a large battery pack of 4 MWh. It is to be brought into service on lines between the Danish towns of Soeby and Fynshav (10.7 NM), and between Soeby and Faaborg (9.6 NM). The current E-ferry project was developed so that a recent design concept for high-energy performance could be applied. There were also plans to develop a case study and a commercial model, and prepare the concept before its forthcoming market launch, after a demonstration period. The aim, beyond the immediate duration of the project, is to bring into service each year around ten additional E-ferries in Europe and in the world to reach a total of ten or more by 2020, 100 or more by 2030, and thereby avoid emitting 10 to 30,000 tonnes of CO_2 per year by 2020 and 100 to 300,000 tonnes of CO_2 per year by 2030.

TEXT BOX 4

• OTHER TRENDING SOLUTIONS • In addition to electrification projects, there are also other types of solutions, such as incentives for better navigation. Consequently, the slowing down of vessels at the entrance to ports (or slow steaming) is one solution advocated in Long Beach and Los Angeles Port, which offers a reduction of 25% in demurrage charges in exchange for reduced speed when berthing. More effective and fuel-efficient navigation, and a reduction of speed at sea are therefore encouraged. There are further measures for managing vessels to reduce GHG emissions during navigation, such as reducing speed over journeys, reviewing the cladding of the hull, developing systems to recover lost heat, working on optimising the envelope and the ballast, regularly reviewing propeller polishing, reviewing the setting of the main motor on each new trip and updating autopilot upgrades (ActuEnvironnement, 2018).

The SeaWing project

The SeaWing project, which was launched in June 2016 for a period of 3.5 years with support from ADEME, consists of developing and marketing an auxiliary vessel towing system using an automated kite. The project was developed by the Toulouse AirSeas start-up comprising former Airbus employees and brought together marine architects, LMG Marin, the French Maritime College and MaxSea, the world leaders in marine navigation software. Technically, the idea was to assist the propulsion of a vessel by towing it using an immense wing. Inspired by kite surfing, this 1000 m2 wing attached to the end of a 400 m cable should be able to reduce a vessel's consumption by 20%. Another advantage of the procedure is that it is automated; the wing, folded on the deck of the ship, can be hoisted on a collapsible mast and deployed to the end of its cable by a single automated command, which includes the reverse procedure of folding it again. In addition to this wing, AirSeas is working on a project for decision-making software to help captains find the optimal route for their vessel depending on wind and ocean conditions, alert them to the opportunity to use the wing, and help them find the most effective position for it (La Croix, 2017).

TEXT BOX 5

CONCLUSION

Actors in international merchant shipping have, with the new IMO resolution on the GHG emissions-reduction strategy, at least demonstrated their desire to meet the challenge posed by the GHG emissions caused by shipping. Given these innovations, particularly in the area of electricity, maritime companies and shipyards will, in the coming years, have at their disposal a wide range of technological options to modify the means of propulsion of their vessels. The IMO is an important coordinator on a global scale in ensuring the deployment of partnerships between state and non-state actors needed to achieve the ambitious objectives of an international maritime transport industry that is in step with the Paris Agreement. The increase in the size of vessels and their cruising speed are also challenges that must be part of the IMO's new GHG reduction strategy if it is to achieve a successful energy transition for the international maritime sector, a sector that constantly faces major issues in international commerce; its strategic importance for major exporting countries, first and foremost China, makes defining a binding regulatory framework a complex task.

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REFERENCES

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