E. SHIPPING: EMISSIONS OF THE WORLD FLEET

1. Initiatives to reduce carbon emissions from shipping

Member States of IMO agreed in 2018 "to reduce the total annual greenhouse gas emissions by at least 50 per cent by 2050 compared with 2008" as part of the Initial IMO Strategy on reduction of greenhouse gas emissions from ships (IMO, 2018; UNCTAD, 2020c; UNCTAD, 2020d) (see also chapter 5.B. for additional background information).

To help achieve this objective, the International Chamber of Shipping and other maritime industry associations propose the establishment of a research and development fund to help cut emissions (BIMCO et al., 2019). For heavy fuel oil, this would correspond to a carbon price of $0.63 per ton of carbon dioxide. The project would raise about $5 billion over 10 years. This fund is to be financed by a contribution of $2 per ton of marine fuel oil purchased for consumption. The private sector-led Getting to Zero Coalition suggests that "[S]hipping's decarbonization can be the engine that drives green development across the world" (Global Maritime Forum, 2020).

The falling costs of net zero-carbon energy technologies make the production of sustainable alternative fuels increasingly competitive. Determined collective action in shipping can increase confidence among suppliers of future fuels that the sector is moving in this direction. UNCTAD supports the Getting to Zero Coalition and promotes efforts to achieve sustainability, helping developing countries adapt and build resilience in the light of the climate emergency.

According to Parry et al., 2018, "[T]he environmental case for a maritime carbon tax is increasingly recognized". According to the Environmental Defence Fund (2020), "meeting the IMO's 2050 target represents $50 billion to $70 billion per year for 20 years' spending, but this is also a revenue opportunity". Englert and Losos, 2020 (from the World Bank), also a supporter of the Getting to Zero Coalition, state that a large share of this investment opportunity could lie in developing countries. A sizable part of these investments will have to be made ashore, including in energy infrastructure and in seaports. Shipowners will have to invest in the renewal of the fleet and new technologies (UNCTAD, 2020e).

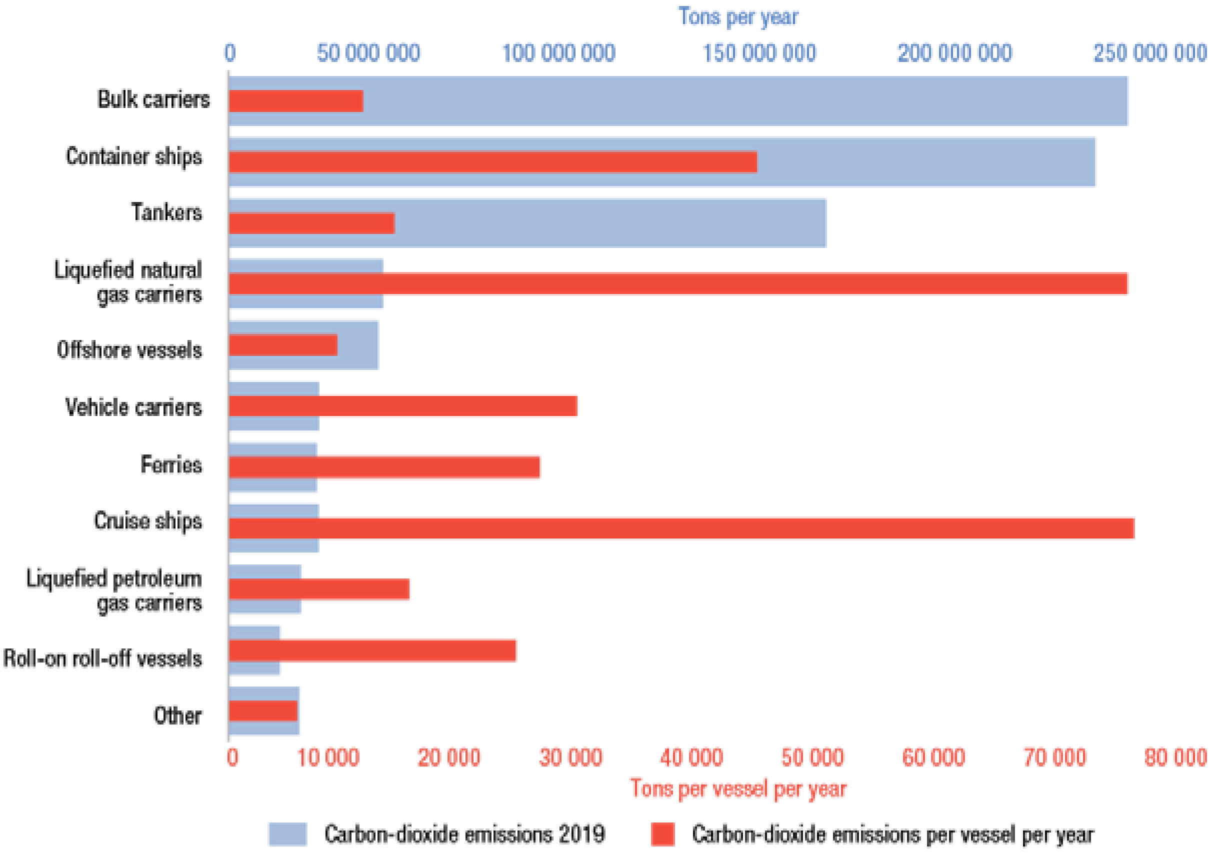
Engine power limit is a short-term measure proposed by Japan that would enable shipowners to meet requirements relating to the energy efficiency index for existing ships and to reach the IMO target in 2030. Engine power limit decreases vessel speed with minimal changes in ship performance, thus reducing fuel use and emissions based on the cube law (relationship between engine load and vessel speed). In a recent study, the systematic assessment of vehicle emissions model of the International Council on Clean Transportation is used to evaluate different scenarios of engine power limit focusing on container ships, bulk carriers and oil tankers, with 2018 automatic identification system data being utilized as a baseline. The study argues that carbon-dioxide "reductions will not be proportional to engine power limit because ship engines are already operating far below their maximum power" (Rutherford et al., 2020). This model shows the negligible effect of engine power limit of less than 20 per cent on a ship's carbon-dioxide emissions. As for an engine power limit ranging between 30 and 40 per cent, emissions reduction is between 2 and 6 per cent. However, the study shows a significant reduction of carbon-dioxide emissions (by 8–19 per cent) for a larger engine power limit of 50 per cent or more.

2. Emissions by vessel type and other determinants

A wide range of parameters influences the amount of carbon dioxide a ship emits per ton-mile. These include vessel type, speed, size, hull design, ballast, technologies and types of fuel used. A larger ship will naturally emit more carbon dioxide per mile, but thanks to economies of scale, it will emit less carbon dioxide per ton-mile; the smallest container ships of up to 999 TEUs emit about twice as much carbon dioxide per container carried as the largest container ships. Container ships tend to transit at higher speeds than dry bulk carriers, thus – all other things being equal – emitting more carbon dioxide per ton-mile than the latter. Liquefied natural gas and cruise ships are on average far larger than offshore or service vessels, such as tugs, and will thus emit more carbon dioxide per ship than the smaller vessels (see figure 3.28).

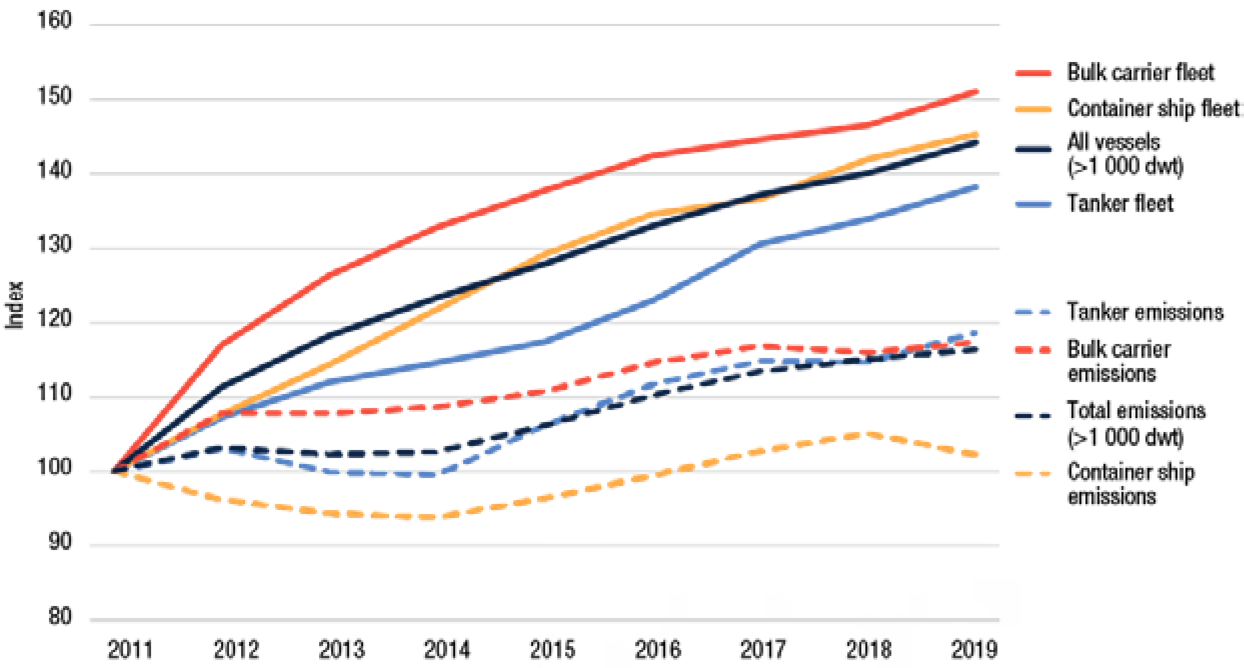
The shift toward larger tankers, bulk carriers and container vessels over the past decade, combined with multiple efficiency gains and the scrapping of less efficient vessels, has meant that carbon-dioxide emissions growth has trailed behind the increase in fleet dead weight. This has been most noticeable for container ships, where modest speed reductions have materially lowered fuel consumption and associated emissions. Whereas container fleet capacity rose by 45 per cent between 2011 and 2019, carbon-dioxide emissions are only 2 per cent higher. Over the same period, carbon-dioxide emissions from tankers and bulk carriers increased by 19 per cent and 17 per cent, respectively, well below the 38 per cent and 51 per cent growth in respective fleet capacity (see figures 3.29 and 3.30).

Figure 3.28 Annual carbon-dioxide emissions per vessel by vessel type, 2019



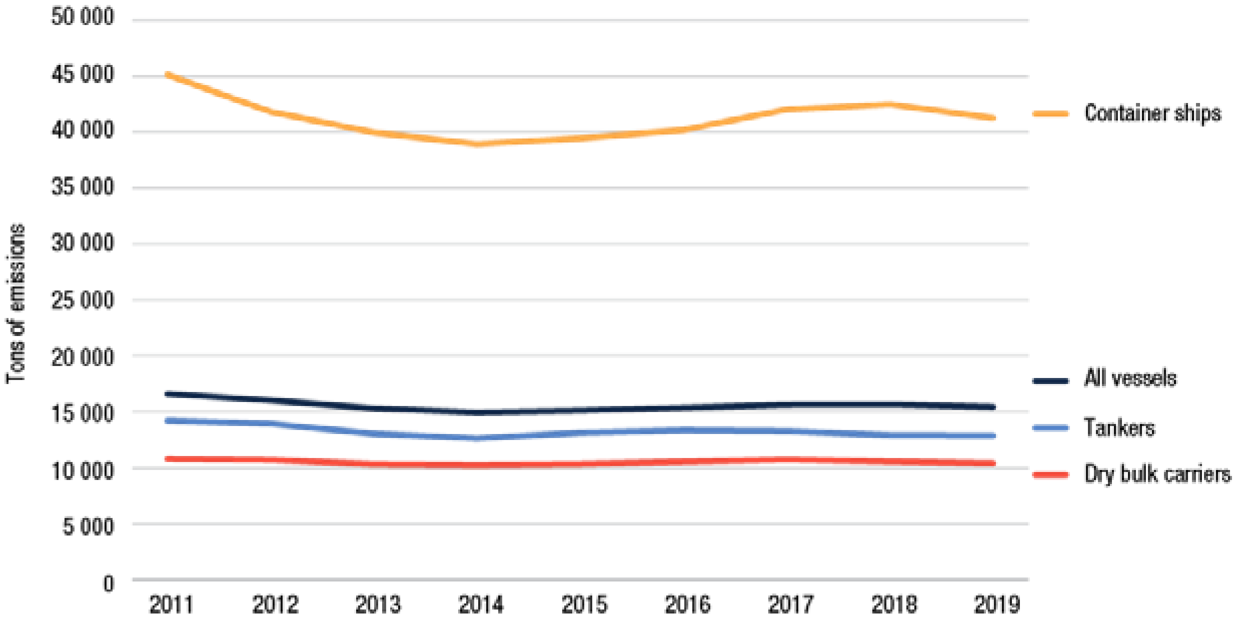
Source: UNCTAD calculations, based on data provided by Marine Benchmark.

Figure 3.29 Comparison of dead-weight tonnage of respective fleet and carbon-dioxide emissions from bulk carriers, container ships and tankers, 2011–2019
(2011 = 100)



Source: UNCTAD calculations, based on data provided by Marine Benchmark.

Figure 3.30 Annual carbon-dioxide emissions per vessel by vessel type, 2011–2019



Source: UNCTAD calculations, based on data provided by Marine Benchmark.

Despite larger average vessel sizes, carbon-dioxide emissions per vessel have declined slightly over the past decade. While further gains can reasonably be expected over the next decade, as modern eco-designs continue to replace older, less efficient designs, and with some further increases in average vessel size likely, these will not be enough to meaningfully reduce overall carbon-dioxide emissions in line with the 2050 targets of IMO. Achieving these targets will require radical engine and fuel technology changes.

According to Shell International (2020), more than 90 per cent of interviewees of a survey on the industrial perspectives of shipping decarbonization stated that such a policy was a main priority of their organization. They also considered the economic disruption induced by the COVID-19 pandemic as an opportunity to accelerate the decarbonization progress. Eighty per cent of the persons interviewed stated that the lack of technology alignment (especially alternative fuels) was a major barrier to decarbonization. Hydrogen and ammonia were considered the most promising long-term fuel alternative, despite its present unviability, due to its significantly lower energy density as compared with heavy fuel oil, challenges relating to its storage and the immaturity of fuel cell technology.

Some shipowners are turning towards liquefied natural gas as an alternative to meet IMO targets for 2030, as liquefied natural gas is 20–25 per cent less carbon-intensive than heavy fuel oil. However, other interviewees are more reserved about the long-term perspectives of liquefied natural gas. Owing to methane slip and other challenges arising during extraction and transport, there is no life-cycle greenhouse gas emission benefit to be derived from liquefied natural gas for any engine technology (Pavlenko et al., 2020).

3. Emissions by flag of registration

Flag States have an important role to play in enforcing IMO rules. They exercise regulatory control over the world fleet, applying the law and imposing penalties in case of non-compliance, on diverse issues. These range from ensuring safety of life at sea to protection of the marine environment and the provision of decent working and living conditions for seafarers.

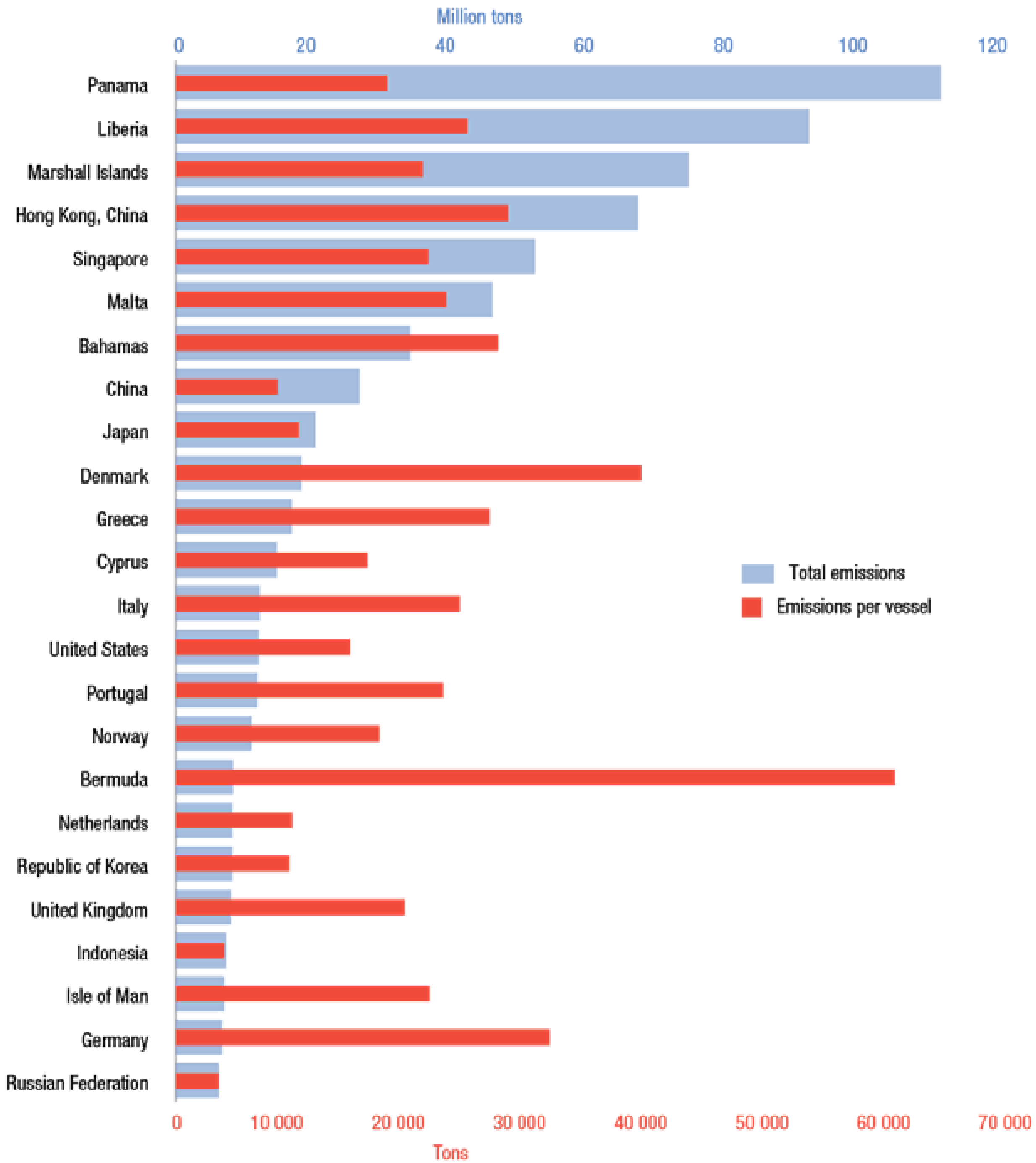
With regard to the implementation of the initial strategy on reduction of greenhouse gas emissions of IMO, flag States will have to ensure that ships are compliant with applicable IMO rules. In addition, they could also provide incentives for the ships registered under their flag to reduce carbon-dioxide emissions and help ensure the collection of future fees or contributions associated with such emissions. For example, the International Chamber of Shipping proposal mentioned above suggests that contributions to the proposed fund will be made commensurate with the ship's annual fuel oil purchased for consumption, as verified by the flag State.

Flag States could also consider such involvement a business opportunity, where more transparent and reliable flag States provide better services than others. In addition, many major flag States are affected by the impacts of climate change. For example, the Panama Canal is confronted with a shortage of fresh water; Liberia has developed a national adaptation plan to mainstream climate change adaptation into planning and budgets; and the Marshall Islands are among the low-lying small island developing States most at risk from sea-level rise (UNCTAD, 2020f). Therefore, it should be in these countries' interest to support the reduction of global greenhouse gas emissions, including from shipping (UNCTAD, 2017b).

Data generated from the automatic identification system tracking system for ships, including the above-mentioned information on vessel characteristics, speed, type of fuel and ballast situation, makes it possible to calculate estimates for carbon-dioxide emissions from each ship and aggregate those estimates. On this basis, ships registered in the Marshall Islands, Liberia and Panama accounted for almost one third (32.96 per cent) of carbon-dioxide emissions from shipping in 2019 (figure 3.31).

Using the same metrics, in 2019, ships (commercial vessels of 1,000 dwt and above) registered in the top 10 economies accounted for 67.15 per cent of total maritime carbon-dioxide emissions. As of 1 January 2020, these 10 flags represented 48.52 per cent of the

Figure 3.31 Annual carbon-dioxide emissions per vessel by flag of registration, 2019



Source: UNCTAD calculations, based on data provided by Marine Benchmark.

world fleet and 65.73 per cent of world gross tonnage. World maritime carbon-dioxideemissions rose by 8 per cent between 2014 and 2019, based on the latest analysis by Marine Benchmark.[19]

F. SUMMARY AND POLICY CONSIDERATIONS

The growing availability of port and shipping data helps the maritime industry to monitor and improve its performance. It also allows analysts to compare and report on differences among ports, countries and fleets, which in turn helps Governments and port and maritime authorities to make adjustments to their activities and policies, if necessary. Based on the performance indicators discussed above, the five points set out below would merit consideration by analysts and policymakers:

- **First, economies of scale are important, but they do not benefit all stakeholders.**

  The different data sets covering port and shipping performance all show that larger ports, with more ship calls and bigger vessels, also report better performance and connectivity indicators. Clearly, economies of scale are still relevant to maritime transport and port performance.

  At the same time, for those ports that aim to attract ever larger ships and call sizes, a note of caution is warranted. The economies of scale presented above reflect averages: they do not cover the total costs of door-to-door logistics. While a shipowner will be satisfied if a ships spends less time in port (sections A to D) and is more fuel efficient (section E), the shippers, ports and intermodal transport providers may well be confronted with diseconomies of scale.

  If the average call size goes up without any corresponding increase in the total cargo throughput, the higher call size will lead to more peak demand for trucks, yard space and intermodal connections, with additional investment needed for dredging and bigger cranes. Those costs will have to be borne by shippers, ports and inland transport providers, while shipowners will reduce the number of ship calls to deliver the same volume of trade. The concentration of traffic in fewer major ports may also imply that shippers could suffer from the choice of fewer ports and costs of trucking extra distances.

  All things being equal, the concentration of cargo in bigger ships and fewer ports with a given cargo volume often implies that there is business for fewer companies in the market. The resulting reduction in competition levels may lead to a situation where not all cost savings made on the seaside will be passed on to the clients in terms of lower freight rates, especially in markets with only few service providers to start with, such as in the case of many small island developing States.

- **Second, small island developing States continue to face challenges in maritime trade.**

  Some small island economies are among those with the longest port ship turnaround times and lowest service frequencies, as they may lack infrastructure or specialized port equipment, and they will not attract more ship calls if there is not much cargo to carry. These States are thus confronted with diseconomies of scale and – at the same time – low levels of competition and limited options in choosing their importers and exporters.

  Often there is little small island developing States can do to improve their liner shipping connectivity, owing to their geographic position, lack of a wider hinterland and low trade volumes. At times, it is possible to attract trans-shipment services, and the resulting additional fleet deployment can then be used for shipments of national importers and exporters. A small number of island economies become hub ports for third countries' trade, and the resulting higher connectivity also benefits those countries' own importers and exporters.

- **Third, emissions reductions will require radical technological changes.**

  Larger vessel sizes, combined with multiple efficiency gains and the scrapping of less efficient vessels, has led to lower growth of carbon-dioxide emissions compared with global fleet tonnage. Container ship fleet capacity, for example, increased by 45 per cent between 2011 and 2019, while carbon-dioxide emissions from container ships went up by only 2 per cent during the same period. Despite the trend towards larger container ships, annual emissions per ship have effectively declined.

  Some further gains can reasonably be expected over the next decade, as modern ecological designs continue to replace older, less efficient designs. However, these marginal improvements will not suffice to meaningfully reduce overall carbon-dioxide emissions in line with IMO targets for 2050. Achieving these targets will require radical engine and fuel technology changes.

  As shown in the Review, thanks to new technologies that help track vessels and identify fuels, combined with reporting requirements of vessel operators, it is possible today to assign carbon-dioxide emissions to vessels and flags of registration. The resulting statistics and insights

[19] Data provided electronically on 2 August 2020 by Marine Benchmark (www.marinebenchmark.com/).

may contribute to discussions on market-based measures to reduce carbon-dioxide emissions.

- **Fourth, nowcasts, forecasts and monitoring pandemics have a growing role to play in the maritime industry.**

  Ship movements, schedules and port traffic data are often available at short notice, before official statistics on economic growth or trade are published. There is an opportunity to make use of maritime data to obtain an early picture of physical trade in goods.

  The trends reported above show that during the first quarter of 2020, the total fleet deployment in most economies was still above that of the first quarter of 2019. For the second quarter, carriers started to significantly reduce capacity. China, for example, started with positive growth in the first quarter of 2020, compared with the first quarter of 2019, but then recorded a negative year-on-year growth in the second quarter. Most European and North American countries saw a steep decline between the first and second quarter.

  Such data is being used and analysed by international organizations and professional forecasters aiming to predict the economic and trade growth of upcoming weeks. Ports and shipping companies will at least to some extent plan their fleet deployment for the same upcoming period, based on such predictions. It is important not to fall into circular reasoning, where pessimistic forecasts may lead to a further withdrawal of shipping capacity, which in turn may lead to further worsening predictions of growth.

- **Fifth, there is a need to standardize maritime data.**

  For ports and shipping companies to benefit from benchmarking, data should be comparable. Ship types, key performance indicators, definitions and parameters need to be standardized. In the long run, the UNCTAD port performance scorecard has the potential to become an industry standard and thus, a globally accepted benchmark, helping the port sector to continuously improve its efficiency. For example, a port entity member of the TrainForTrade Port Management network stated that when it prepares or updates a strategic submission to the Government, port performance scorecard values are useful in drawing up baseline metrics for a proof-of-concept appraisal, in particular when forecasting profit levels, wage profiles, employment numbers and revenue profiles.

  UNCTAD is pursuing efforts to include more port entities and countries from the TrainForTrade network that are not yet reporting in the port performance scorecard component and to collaborate with international partners, such as the International Association of Port Authorities, to further contribute to the standardization of data and tracking of port performance.