4th IMO GHG Study: Some answers to specific questions

UMAS

Maritime consultancy delivering applied solutions for a carbon constrained future

What are these slides for?

- The 4th IMO GHG Study provides an update on the absolute levels of GHG emissions from total shipping and international shipping (up to 2018), and forecasts of international shipping GHG emissions (up to 2050).
- The detailed data needed to produce these estimations provides insights into some of the key drivers and trends for those emissions. This in turn provides many insights for the market and policy makers.
- The study itself provides policy-neutral interpretation. In these slides, we add an interpretation, especially in the context of the challenge ahead for all sectors to meet the Paris Agreement temperature goals.
- UMAS was lead author of the Third IMO GHG Study, and led the emissions inventory work in the Fourth IMO GHG Study. These questions and answers focus on historical emissions trends, but are not exclusively on this aspect of the report.
- These answers reflect our interpretation only. They build on the work of the whole consortium that undertook the work, but do not presume that they are views shared by those organizations, or by the IMO.

The 4th IMO GHG Study was produced by a consortium led by CE Delft, comprised of 9 organisations from across 6 countries

Questions answered on subsequent slides:

- Are GHG emissions from shipping increasing?
- What is voyage-based emissions allocation for international shipping?
- Emissions in 2018 are still below 2008 levels, can we relax now?
- Why are there two different estimations for the carbon intensity change since 2008?
- What does the study mean for the ongoing IMO debate on technical vs. operational carbon intensity regulation?
- Are shipping's GHG emissions dominated by CO_2?
- Which ship types drive international shipping's demand for marine fuels?
- What does the study tell us about ships being assessed by Poseidon Principles criteria?
- What does the study tell us about AIS data when it is used for estimating GHG emissions

Are GHG emissions from shipping increasing?

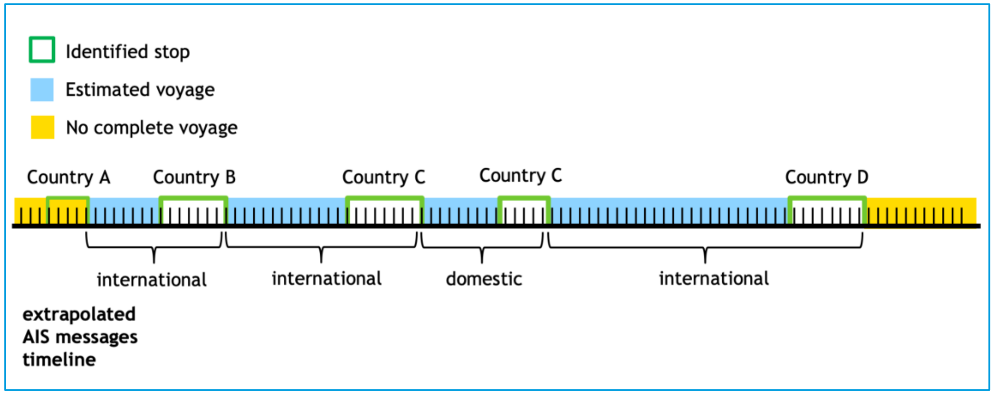
Table 1 - Total shipping and voyage-based and vessel-based international shipping CO_2 emissions 2012-2018 (million tonnes)

Year	Global anthropogenic CO_2 emissions	Total shipping CO_2	Total shipping as a percentage of global	Voyage-based International shipping CO_2	Voyage-based International shipping as a percentage of global	Vessel-based International shipping CO_2	Vessel-based International shipping as a percentage of global
2012	34,793	962	2.76%	701	2.01%	848	2.44%
2013	34,959	957	2.74%	684	1.96%	837	2.39%
2014	35,225	964	2.74%	681	1.93%	846	2.37%
2015	35,239	991	2.81%	700	1.99%	859	2.44%
2016	35,380	1,026	2.90%	727	2.05%	894	2.53%
2017	35,810	1,064	2.97%	746	2.08%	929	2.59%
2018	36,573	1,056	2.89%	740	2.02%	919	2.51%

- **Yes, the general trend since 2013/14 has been for increasing GHG emissions from total shipping and international shipping.**
- 2018 showed a small reduction relative to 2017, but this was not significant relative to the overall upwards trend.
- Between 2018 and 2012, total GHG emissions were 9.6% higher, international shipping GHG emissions were 5.6% higher.

What is voyage-based emissions allocation for international shipping? Why are international shipping emissions lower in the 4th than in the 3rd IMO GHG Study?

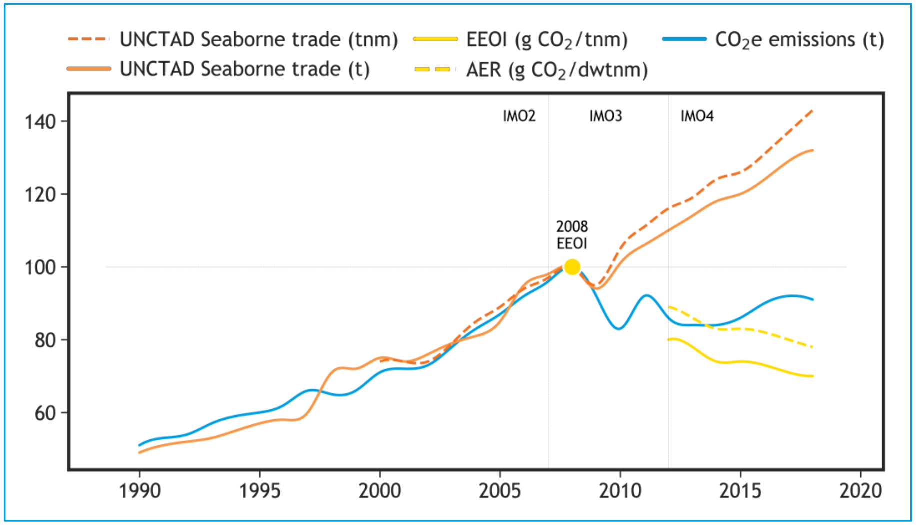
Figure 10 - Allocation of international and domestic nature of shipping according to voyage-based method



- **Voyage-based emissions allocation is the correct way to apportion emissions responsibility, and when it is used shows that we have historically underestimated domestic shipping's GHG emissions, emission which fall within the responsibility of national governments to control. This essentially has lowered the share of total emissions which are labelled 'international' relative to earlier studies.**
- This study used advances in data and methods to calculate international shipping exactly inline with IPCC guidelines for emissions reporting.
- Only voyages between ports in different countries are counted as international shipping.
- This was not possible in earlier studies which assumed different ship type/size categories were either international or domestic, and is shown in this study to have meant that historically we overestimated international shipping and underestimated domestic shipping emissions.
- IMO has responsibility only for international shipping emissions, but its regulations can be applied both to international and domestic emissions.
- Reduction of domestic emissions contribute towards a country's NDC (nationally determined contribution), so this shows there is more responsibility and potential for shipping GHG emission reduction within national emissions accounting, than had previously been thought.

Emissions in 2018 are still below 2008 levels, and future GHG emissions are lower than in Third IMO GHG Study, can we relax now?

Figure 2 - international shipping emissions and trade metrics, indexed in 2008, for the period 1990-2018, according to the voyage-based allocation[2] of international emissions[3].



- **No. Emissions were below 2008 levels, but are rising and were on track to exceed 2008 in ~2019/2020. 2020 will clearly now be impacted by Covid-19, but the long-run trends remain either holding emissions constant or for emissions to increase. This is predominantly because of trade growth exceeding and expected to continue to exceed carbon intensity improvements.**
- These historical and expected future trends are not compatible with the Paris Agreement temperature goals that require rapid GHG reductions this decade – IPCC's 1.5 report recommends a halving of absolute GHG emissions between 2017 and 2030.
- Over this decade, we can expect to hear rapid progress and commitments to decarbonize by a range of economies, and alongside this, experience worsening impacts of climate change. Against that backdrop, shipping GHG emissions increasing, or even flatlining is not likely to escape significant scrutiny and pressure to create major further reductions.

Why are there two different estimates for the carbon intensity change since 2008? Which should we use?

- **Two of the main ways of measuring carbon intensity have quite different numbers for the change since 2008 – 21% lower (AER), 29% lower (EEOI). Neither number is right, although EEOI is generally considered a better reflection of the actual social cost (gCO2) of transport work (tnm), because it incorporates the actual cargo carried and value to society (AER uses the proxy of a ship's deadweight capacity).**
- The difference between the two metrics' trends since 2008 is mostly explained by the poor quality of data for the baseline year (2008), and therefore the poor reliability of trends estimated from that year. This was known as a poor year to use as a baseline, but ICS and others successfully pushed for its use. It was the year estimated to have the highest emissions in the Third IMO GHG Study.
- AER is much easier to use when designing policy, because it already aligns with the IMO Data Collection System (EEOI would need cargo mass data to be collected/validated). So AER or a similar simplified metric is more likely to be used in any further IMO regulation implemented to reduce GHG emissions – perhaps with variants for different ship types for which transport work is not well captured by the proxy deadweight.
- Those with low ambition on GHG reduction may now point to historical trends in EEOI, and argue that we have already reduced 30% and only have 10% more reduction to achieve this decade.
- Those with higher ambition may now point to the historical trend in AER and that we still have at least 40% to achieve this decade.
- **The climate does not care: absolute GHG emissions are what matter to temperature rise, and these are not on track on a 40% reduction by 2030 with either metric. The IMO urgently needs to reconsider what a proportionate absolute reduction in GHG emissions by 2030 is, what state of preparedness it needs the global fleet to be at by 2030, and build this into regulation that can implement immediate and rapid carbon intensity and GHG reduction.**

What does the study mean for the ongoing debate on technical vs. operational carbon intensity regulation?

- **The fleet's carbon intensity trend continues to be dominated by operational drivers. Control of emissions by policy focused on technical efficiency is unlikely to be as cost-effective, or effective, as policy focused on operational efficiency. Stringent operational carbon intensity regulation is urgently needed, for both domestic and international shipping.**
- Even though this period covers the introduction of the EEDI regulation, the fleet showed very modest 'technical' efficiency improvement during the period 2012-2018, with most ship types improving just 3% or less. The exception being the larger container ships which saw some significant design changes.
- The dominant driver in carbon intensity trends was speed and operation, which also dominated trends in the period 2007-2012. Further average speed reductions occurred across all major ship types during the period 2012-18.
- The total installed power in the fleet has continued to increase, continuing a trend that this is decoupled from the emissions trends. This leaves international shipping with a major risk that if the market trends that have created recent operational and speed trends reverse, that shipping emissions could increase very rapidly. Regulation of operational carbon intensity is essential to prevent this from happening as well as for achieving further carbon intensity reduction this decade.

Figure 74 - Trends across the 7 years in EIV for (a) bulk carriers, (b) containers (c) oil tankers by size category, where (d) and (e) show the difference in EIV between 2012 and 2018, aggregated by ship type, weighted by total voyage-based international shipping fuel consumption

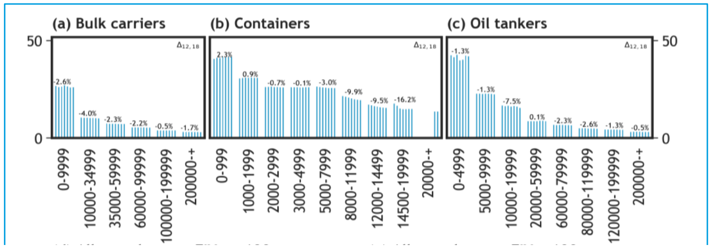
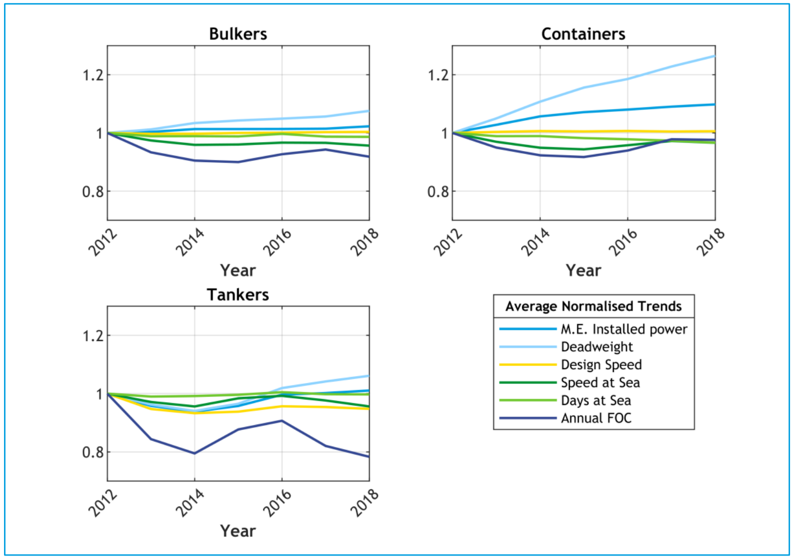


Figure 7 - Trends for average ships for the three most high emitting fleets over the period 2012 to 2018, where fuel consumption represents international activity according to voyage-based allocation



Are shipping's GHG emissions dominated by CO_2?

- **Yes, depending on whether you count BC, CO2 constitutes either 98% or 91% of shipping's climate impact (as measured by IPCC's Global Warming Potential, GWP)**
- **But besides CO2, other emissions from ship's exhausts which have very important climate impacts are methane (CH4), nitrous oxide (N2O) and Black Carbon (BC).**
- This is the first study to explicitly estimate the contribution of Black Carbon, which was found to be the second most significant emissions species in climate impact terms.
- Methane emissions showed the most remarkable growth trend over the period studied – increasing 151%, far greater than the use of LNG as a marine fuel. This is because of increased use during the period of machinery with high levels of methane slip (increasing use with dual-fuel reciprocating engines).
- The IMO has an ongoing and long-running debate on how to calculate and account for BC, which remains unresolved and which contributes to a failure to regulate this emission species.
- Given the important climate impacts of BC and methane, not regulating these species is a major loophole and shortcoming in current policy. To our understanding no national government has regulated to control either BC or methane shipping emissions.
- **Shippers, shipowners and engine manufacturers should anticipate that these are emissions species that are likely to be controlled in the future and that their optimum fuel choice and machinery may be impacted when this occurs.**

Figure 9 - Emissions species trends, all species 2012-2018, showing both the estimates for voyage-based and vessel-based international shipping emissions

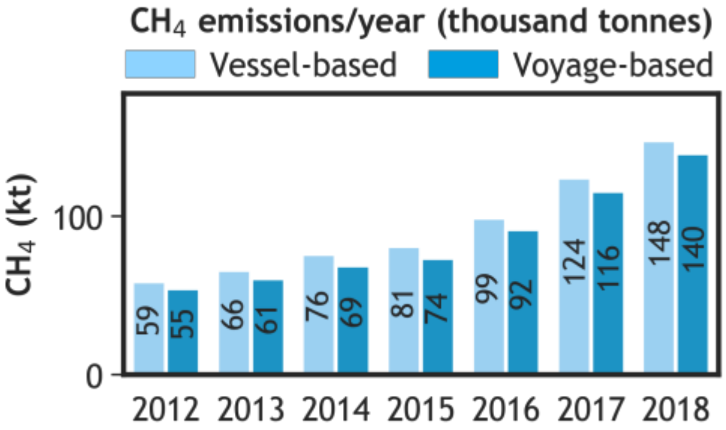
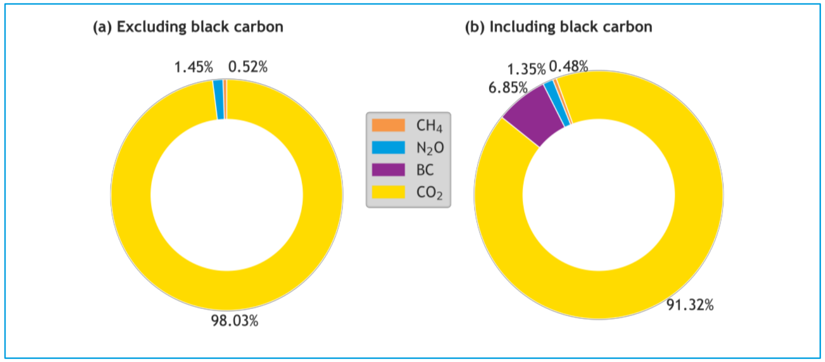


Figure 78 - Comparison of the contribution of individual species to voyage-based international greenhouse gas emissions (in CO_2e) in 2018, highlighting the impact the inclusion of black carbon has.



Which ship types drive international shipping's demand for marine fuels?

Figure 64 - Average annual HFO-equivalent fuel consumption per ship, split by fuel type, on international voyages only.

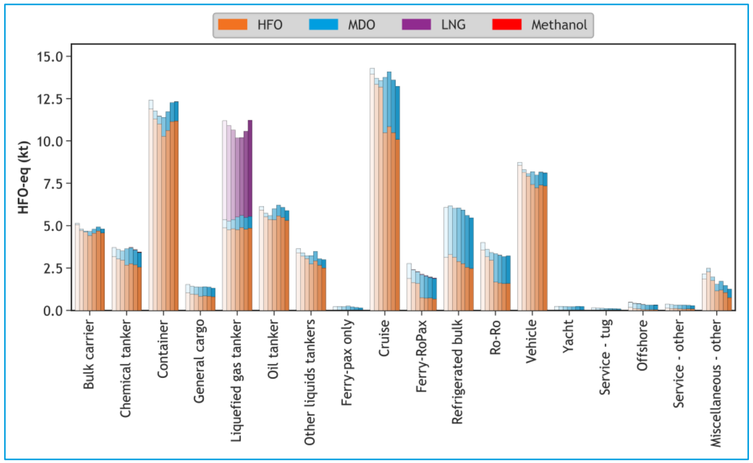
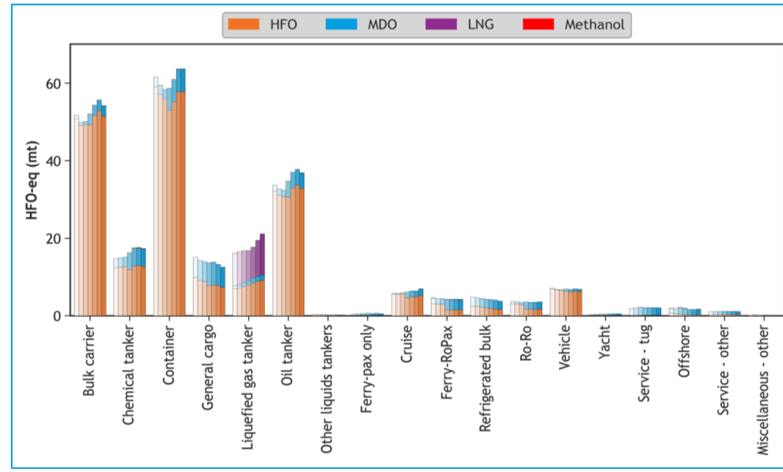


Figure 65 - Total annual HFO-equivalent fuel consumption per ship type, split by fuel type, on international voyages only

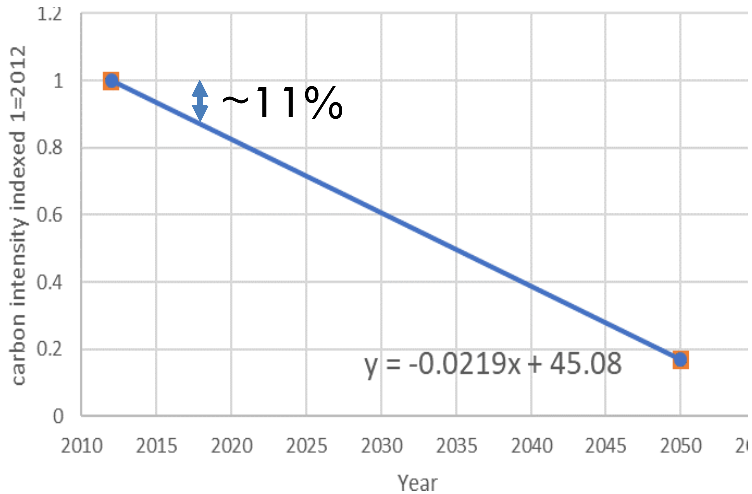


- **Container shipping, liquefied gas carriers and cruise ships have the highest average fuel consumption (per ship).**
- **Container shipping, bulk carriers and oil tankers dominate overall fuel demand (total fuel, all ships). 6 ship types account for over 85% of international shipping fuel consumption.**
- LNG is only a significant fuel for liquefied gas tankers (for which the cargo is often used as the source of energy for propulsion and auxiliary power).
- Several ship types significantly increased MDO use in 2015, when ECA regulations restricted high Sulphur fuel use in NW Europe, North America and the Caribbean. This particularly impacted fuel mixes for cruise and ferry ropax shipping. But HFO still remains overall the dominant marine fuel in 2018.
- Methanol is a new fuel that registers in this study because a very small number of ships have started to use it. However it is not visible on graphs representing overall fuel consumption.

What does the Study tell us about ships being assessed by Poseidon Principles criteria and trajectory

- **Most ships and therefore financiers, are likely to have been able to achieve performance at least as good as the Poseidon Principles criteria in 2018. However, the fleet's rate of carbon intensity improvement is now slowing and so it will become harder to continue to meet the criteria as we move through the 2020s, unless further steps are now taken.**
- The Poseidon Principles (PP) assess whether a portfolio of shipping investments are on track for a constant rate of carbon intensity reduction, in-line with the minimum ambition interpretation of the IMO's 2050 objective.
- The PP carbon intensities are baselined on the international shipping's fleet average carbon intensities in 2012, and track a reduction level which by 2018 should see portfolio average carbon intensity reduced ~11% relative to the baseline.
- The 4th IMO GHG Study shows a reduction of 11% (AER) as an average improvement across all international shipping emissions, which implies that if a bank's portfolio of ships has performance consistent with international shipping's carbon intensities and trends, it should be approximately inline with the trajectory.
- The annual rate of carbon intensity improvement was by 2018 showing signs of reducing, implying that in 2019, 2020, the market trend may start diverging from the PP criteria. However, this will vary depending on the type of ships in a banks portfolio and how its portfolio is managed.
- It should be noted that PP trajectories are not consistent with the Paris Agreement temperature goals, which would require a higher rate of carbon intensity reduction to ensure that shipping contributed a proportionate level of GHG reduction.

Poseidon Principles carbon intensity trajectory



What do the results tell us about AIS data for estimating emissions? can we trust AIS-derived estimates, won't IMO DCS data not be a lot better/more accurate?

- **The results are further evidence that using AIS data in models is a powerful and accurate means to estimate emissions from international shipping: particularly when estimating averages, trends and totals for fleets of ships.**
- **In these applications, the study's quality and uncertainty analysis proves we can trust AIS-derived estimates. IMO DCS data is currently incomplete, and has as yet unproven/qualified accuracy. So whilst measured data could theoretically be more reliable, it is not at all clear this will be the case in practice, and there is already some evidence it will not be.**
- The GHG emissions inventory is built from adding up estimates of every ship's activity and emissions, for every hour of the year.
- The emissions are estimated using satellite reception of data reporting a ship's identity, position, speed (transmitted for safety purposes). These are combined with engineering representations of a ship, to estimate the power required for it to travel at the speed it is observed at, and therefore the fuel consumption and then the emissions.
- The method requires assumptions to be made especially about the detailed technical specification of the ship, the weather, the hull and machinery condition. For any one ship, the estimate can under/over estimate by a significant margin. However, as long as sources of uncertainty are symmetrical (as likely an under or over estimate), then for groups of ships, these uncertainties average out to produce accurate and representative totals and average values.
- The estimated data was extensively quality assured/controlled, including through comparison against over 9000 ships reporting to the EU MRV scheme. The aggregate (e.g. fleet level) uncertianty was estimated to be less than 5% for this comparison.
- The IMO has instigated a Data Collection System, requiring reporting of ship's annual fuel consumption and distance travelled, starting from 2019. These are measured data, not estimated and so in theory should be higher accuracy
- However, this requires that the data is complete and that the data is measured and reported correctly. The IMO DCS, after the deadline for 2019 submissions, had collected less than 90% of the eligible ship's reported data. The data is confidential to IMO and so cannot be independently tested for its quality.

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