How can international shipping align with 1.5°C?

Focus on 1.5°C alignment in 2030

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Preface

This report has been written by a team of experts from UMAS. The work characterises the ways in which a 1.5-aligned pathway could be achieved, and provides some scenarios for the respective role of fuel substitution and energy efficiency in meeting 2030 reduction targets. Suggestions are also made for the policy steps that would need to be taken to achieve this.

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Disclaimer

About UMAS

UMAS undertakes research using models of the shipping system, shipping big data (including satellite Automatic Identification System data), and qualitative and social science analysis of the policy and commercial structure of the shipping system. Research and consultancy are centred on understanding patterns of energy demand in shipping and how this knowledge can be applied to help shipping transition to a low-carbon future. UMAS is world-leading on two key areas; using big data to understand trends and drivers of shipping energy demand or emissions and using models to explore what-ifs for future markets and policies. For more details visit www.umas.co.uk.

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Acronyms

AER	annual efficiency ratio	**ISWG**	Intersessional working group
BAU	business as usual	**LCA**	lifecycle assessment
CII	Carbon Intensity Indicator	**LNG**	liquified natural gas
CO2e	carbon dioxide equivalent	**LSFO**	low sulphur fuel oil
EEDI	Energy Efficiency Design Index	**MDO**	marine diesel oil
EEOI	Energy Efficiency Operational Index	**MEPC**	Marine Environment Protection Committee
EEXI	Energy Efficiency Existing Ship Index	**NDC**	national determined contributions
ESG	environment, social and governance	**ROI**	return on investment
ETS	Emission Trading System	**SBTi**	Science Based Target initiative
EU	European Union	**TtW**	tank-to-wake
GHG	greenhouse gas(es)	**UK**	United Kingdom
GtZ	Getting to Zero Coalition	**UNCTAD**	United Nations Conference on Trade and Development
HLEG	High-Level Expert Group	**US**	United States
IMO	International Maritime Organisation	**WtW**	well-to-wake
IRA	Inflation Reduction Act		

1 Executive summary

Aligning international shipping's level of ambition with 1.5°C requires significant absolute greenhouse gas (GHG) emissions[1] reduction by 2030 and 2040: 37% and 96% reductions respectively relative to 2008[2]. Efficiency improvements reduce the demand for energy, and in turn, make the transition away from fossil fuels easier. Achieving these reductions requires the parallel activities of maximising energy efficiency and transitioning away from the use of fossil fuels in international shipping. Both of these steps are needed for both the existing fleet and new ships built during this period.

The 2040 target is dependent on the scale-up of new energy supply chains in the next decades thus, developing these supply chains and fostering use of new fuels on ships this decade is important. However, given the short timescale between now and 2030 means, new energy supply chains are unlikely to play a significant role in achieving 1.5°C-aligned 2030 ambitions; therefore, the role of energy efficiency is key in the near-term.

Taking expected growth in demand for international shipping into account, this paper considers four scenarios with relatively low levels of fuel substitution by 2030, and then derives from them fuel substitution scenarios accounting for the amount of energy efficiency improvement required to meet the target of 37% absolute lifecycle emission reduction by 2030 (on 2008 baseline).

This reveals three key findings that frame the policy steps needed:

- The different scenarios of fuel mix create relatively little absolute impact or variation in the WtW GHG emissions of shipping by 2030.
- Approximately 60% efficiency improvement is needed to achieve 1.5°C-aligned GHG reductions, as an average across all international shipping, against a 2008 baseline.
- Many energy efficiency improvements are applicable to the existing fleet, both directly as operational improvements or as retrofits. Regulating these improvements will be critical to enabling a 1.5°C-aligned GHG reduction pathway.

Three options are identified that should each result in 1.5°C-aligned GHG emissions by 2030:

Option 1 – Focus only on short-term measures (e.g. the existing Carbon Intensity Indicator (CII) and Energy Existing Ship Index (EEXI) measures), and no need for mid-term measures (e.g. forthcoming new policies such as carbon pricing and/or fuel standards). Short-term measures need modification to WtW GHG emissions, requires a **12% reduction per annum (p.a.) from 2027** for the International Maritime Organization (IMO)'s CII.

Option 2 – Focus short-term measures on energy efficiency improvements (to achieve a 38% average efficiency improvement 2019-2030), and focus mid-term measures on fuel substitution that lowers fuel GHG intensity ~15% by 2030. Requires a **9% reduction p.a. from 2027** for CII.

Option 3 – Focus short-term measures on energy efficiency improvements and mid-term measures on fuel substitution, but using regional regulation and voluntary initiatives to drive compliance beyond the IMO thresholds (e.g. fleet average CII moves to 'A' band). Requires a **4.5% reduction p.a. from 2027** for CII.

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[1] In this paper, any reference to emission reduction is on a well-to-wake (WtW) basis and is inclusive of CO_2, methane (NH_3) and nitrous oxide (N_2O) ie. on a WtW CO_2 equivalent (CO_2e) basis unless stated.
[2] SBTi. (2022). Science Based Target Setting for the Maritime Transport Sector.

2 Interim levels of ambition: 2030 and 2040

Assuming that international shipping's share of total anthropogenic GHG emissions does not increase (MEPC 79/INF.29[3,4], MEPC 79/INF.30[5]), and that the global economy reduces GHG emissions in-line with avoiding temperature rise above 1.5°C (with no/low overshoot), modelling shows that the lifecycle GHG reductions needed on 2008 are (Intersessional Working Group on Reduction of GHG Emissions from Ships (ISWG GHG) 13/3/3[6], ISWG 13/INF.2[7], ISWG GHG 14/2/4[8], ISWG GHG 14/2/9[9]):

- 37% by 2030
- 96% by 2040

Lower absolute lifecycle GHG reductions are required if international shipping's share of GHG emissions increases (relative to other sectors), which would then require countries (in their national determined contributions (NDC)) to achieve higher rates of GHG reduction to compensate for international shipping.

The backdrop to these GHG reductions is a growth in trade, and expected continued growth in trade. Latest United Nations Conference on Trade and Development (UNCTAD) Review of Maritime Transport[10] projected a slight reduction in trade growth relative to earlier projections, due to factoring in the combination of impacts from recent years (supply chain disruption, COVID-19, Ukraine-Russia war, inflation, and recessions). By 2030, demand for international shipping is estimated to have grown by 173%[11] (against 2008 baseline). This level of trade growth means that the GHG intensity of international shipping needs to reduce by larger amounts (on a lifecycle GHG emissions basis, relative to 2008). Therefore, level of reduction needed are:

- 65% by 2030
- 98% by 2040

Deep reductions in GHG intensity of international shipping has two interacting efforts:

- Maximise energy efficiency
- Transition international shipping away from use of fossil fuels

Energy efficiency improvements help to reduce the demand for new fuels, and many efficiency improvements are applicable to existing ships (e.g. retrofits for existing hull and machinery systems). Transitioning the sector away from fossil fuels ultimately requires the development of new fuel/energy supply chains, and ships compatible with these fuels.

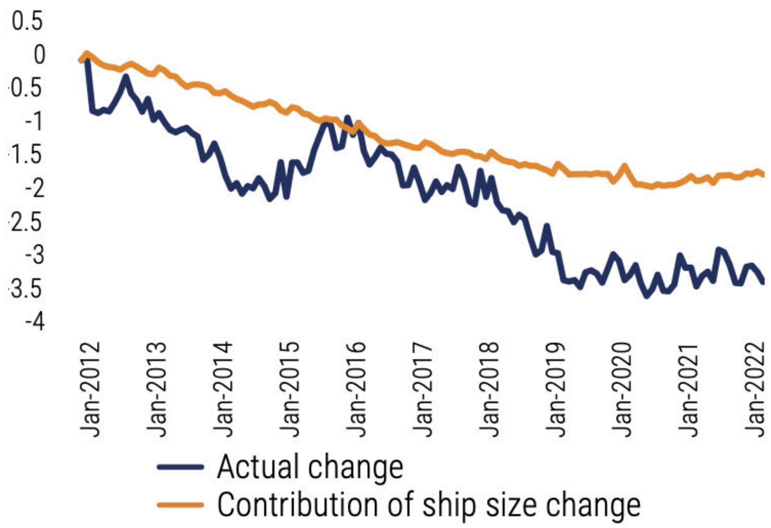
Energy efficiency – the story so far

In the period 2008-2018, large GHG intensity reductions (32% lower intensity using the Energy Efficiency Operational Index (EEOI), vessel-based allocation), were achieved mainly due to speed reductions and changes in fleet composition (MEPC 79/INF.29). The period 2018-2022 has been turbulent in terms of ship operation with COVID-19 and supply chain disruption

[3] IMO MEPC. (2022). MEPC 79/INF.29 - Review of evidence on emissions reduction pathways (United Kingdom).
[4] MEPC is the IMO's Marine Environment Protection Committee. .INF documents are 'information' papers
[5] IMO MEPC. (2022). MEPC 79/INF.30 - Review of evidence on emissions reduction pathways (United Kingdom).
[6] IMO MEPC. (2022). MEPC ISWG-GHG 13/3/3 – Why IPCC-derived 1.5 alignment of the revision of the Initial Strategy is necessary and feasible (IMarEST).
[7] IMO MEPC. (2022). MEPC ISWG-GHG 13/INF.2 – Science-based target setting for the maritime transport sector (WWF).
[8] IMO MEPC. (2023). MEPC ISWG-GHG 14/2/4 – Revision of the Initial IMO Strategy on reduction of GHG emissions from ships (Marshall Islands, Solomon Islands and Vanuatu).
[9] IMO MEPC. (2023). MEPC ISWG-GHG 14/2/9 – Refining the levels of ambition in the Revised IMO Strategy on reduction of GHG emissions from ships (Canada, United Kingdom and United States).
[10] UNCTAD. (2022). Review of Maritime Transport 2022. United Nations Conference on Trade and Development.
[11] As measured on the basis of tonne-nautical miles, e.g. demand of moving one tonne of cargo a distance of one nautical mile.

having caused fluctuations in GHG intensity, and in some cases, speed increases, which have reversed GHG intensity reductions.

Fleet composition has continued to change, with ships of higher technical efficiency and larger size offering continued scope for sustained GHG intensity reductions even if the turbulence meant that not all of these have yet been crystallised in practice. Figure 1 from the UNCTAD Review of Maritime Transport 2022 presents results for container shipping, and shows the high significance for this ship type of ship size change (increases in average ship size during the period). The same source shows that average speeds were lowest in Q1 2020 for most ship types, and rose during 2021 and 2022 relative to that minimum.



Source: UNCTAD Review of Maritime Transport 2022, Figure 4.34

Figure 1: Cumulative change from Jan 2012 in CO_2 emission intensity, and contribution of ship size change of container ships, grams per ton-mile.

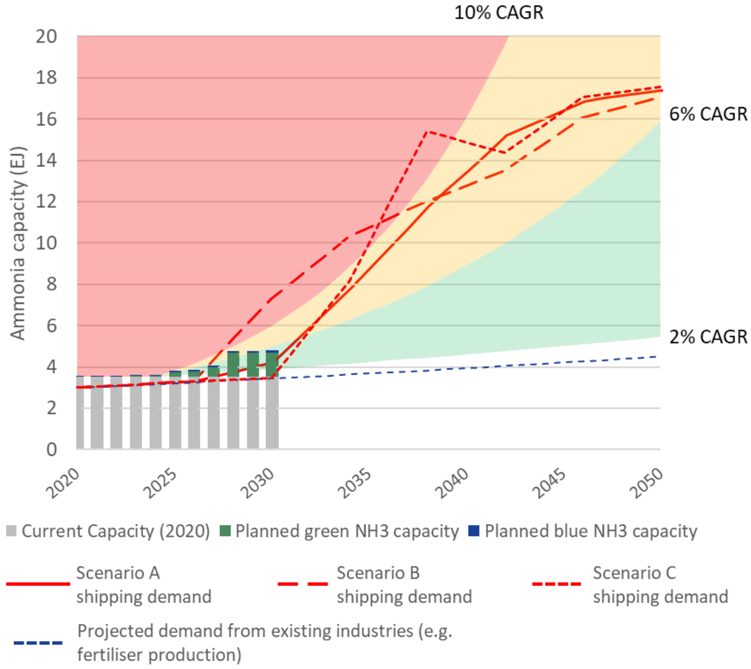
Fuel transition – scale at pace

Analysis in MEPC 79/INF.29 shows that any deep decarbonisation of international shipping is dependent on widescale uptake of scalable zero-emission hydrogen derived fuels (including green ammonia and methanol), with a fleet capable of operating with those fuels.

Evidencing the viability of the 2040 target is dependent on answers to two key questions:

- How can zero-emission hydrogen derived fuel production be scaled up to supply the large majority of international shipping's energy demands by 2040?
- Can the international shipping fleet be made compatible with a cost-effective hydrogen-derived fuel in time?

These questions are thoroughly examined and answered thoroughly in MEPC 79/INF.29. The modelled finding in that paper is that ammonia is the least-cost solution for international shipping and dominates the fuel mix by 2040 in all 1.5°C-aligned scenarios. Figure 2 illustrates the existing ammonia production, the current committed projects and the demanded growth rates for clean ammonia production that arise in three 1.5°C-aligned scenarios. Scenario C is closest in practice to achieving a full substitution away from fossil fuel by 2040 and therefore closest to the 1.5°C-aligned pathway for that year. To achieve the 96% reduction target on a WtW GHG basis, this growth rate would need to be achieved with green ammonia (ammonia produced using only renewable electricity).



Source: MEPC 79/INF.29

Figure 2. Comparison between possible industry growth rates (starting 2025, shaded regions), current and planned capacity (bars), and projected demand for the ammonia industry (dotted lines).

However, the framing of the modelling in MEPC 79/INF.29 was constrained on operational (tank-to-wake – TtW) CO_2 emissions resulting in a consequent large growth in LNG use in the short-term (before 2030) with significant WtW GHG emissions in the period to 2030, relative to business as usual (BAU) scenarios. The scenarios therefore do not evidence the viability of a 1.5°C-aligned WtW GHG 2030 target.

Getting to 1.5°C alignment by 2030 – asking the right questions

Therefore, understanding the viability of that target is dependent on answers to the following key questions:

- How much of the fuel transition might happen by 2030 and what will this mean in terms of a fuel mix?
- How much energy efficiency improvement is required to achieve the overall lifecycle GHG reduction?
- How could that energy efficiency improvement be achieved in practice?

To examine these questions, the subsequent sections propose four potential scenarios for what fuel transition might look like by 2030, and show that within the range of these scenarios there is relatively little variation in the energy efficiency increases required. At least in the period to 2030, fuel and efficiency can therefore be treated as relatively independent sets of changes, with a 1.5°C-aligned pathway requiring a large increase in efficiency on 2008 level by 2030, albeit an increase consistent with the progress made in the period 2008-2022.

3 What are the different fuel mix scenarios and what is the complimentary increase in energy efficiency required?

There is uncertainty on how the fuel mix might evolve between now and 2030. However, there is already use of liquified natural gas (LNG) (LNG-dual fuelled ships), and biofuel (drop-in[12] biofuels as replacements to low sulphur fuel oil (LSFO)/Marine Diesel Oil (MDO) in conventional ships). Additionally, methanol and ammonia fuelled ships are also being ordered (fewer ammonia fuelled ships, given machinery development is only being finalised now).

Table 1 and Figure 3 presents four fuel mix scenarios capturing a set of indicative assumptions are derived from the scenarios in MEPC 79/INF.29, and other wider literature. Supply chains for these fuels will still be developing in 2030, and so conservative assumptions are made about the level of WtW GHG reduction (Table 2) for the different fuels even though much greater reductions are expected to be achieved as these new energy supply chains mature.

Table 1: Characterisation of four fuel mix scenarios in 2030 expressed as a percentage (%) of energy requirement for international shipping.

	Biofuel	LNG	Hydrogen-derived fuel	LSFO/MDO
Scenario 1 (BAU)	10%	5%	5%	80%
Scenario 2 (No LNG)	10%	0%	5%	85%
Scenario 3 (High biofuel share)	20%	5%	5%	70%
Scenario 4 (High ammonia share)	10%	5%	15%	70%

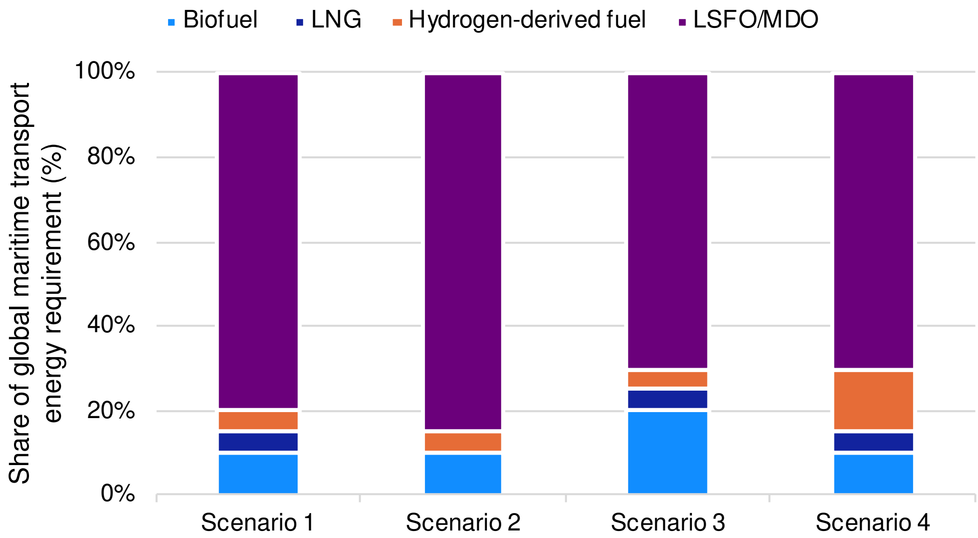


Figure 3: Characterisation of four fuel mix scenarios in 2030 expressed as a percentage (%) of energy requirement for international shipping.

Table 2: Assumption for reduction of GHG emissions for alternative marine fuels on a WtW and TtW basis relative to LSFO/MDO

	Biofuel[13]	LNG	Hydrogen-derived fuel[14]
WtW basis	64%	19%	81%
TtW basis	100%	20%	100%

[12] Drop-in fuels are energy source that can be used with existing infrastructure and machinery without significant modification.
[13] Includes biogas and biomethanol.
[14] Includes green ammonia, hydrogen or synthetic methanol.

The four scenariosFigure 3 result in different average fuel GHG intensity, both on a WtW and TtW basis. Combining the WtW fuel GHG intensity with assumptions about the demand growth and the absolute WtW GHG reduction creates estimates of the energy efficiency improvement that would be needed to achieve 1.5°C alignment of international shipping. The WtW emission factors are derived from the NavigaTE modelling assumptions used by the Maersk Mc-Kinney Møller Centre[15]. These figures are arrived at by assuming that on a TtW basis calculation, both biofuels and a hydrogen-derived fuel (e.g. ammonia) are calculated as having zero GHG emissions, this may not be the case depending on how IMO lifecycle assessment (LCA) guidelines are finalised.

The results are summarised in Table 3 and Figure 4. Energy efficiency improvements are reported both relative to the 2008 baseline, and relative to 2018 baseline (by using 2018 as a baseline, the 32% CO_2e intensity improvement achieved between 2008 and 2018 is factored in).

Table 3: Energy efficiency reductions relative to 2008 baseline needed to achieve 1.5°C-alignment, and associated average fuel GHG intensity.

	Energy efficiency reduction		Fuel GHG intensity reduction	
	on 2008	on 2018	WtW	TtW
Scenario 1 (BAU)	59%	40%	11%	16%
Scenario 2 (No LNG)	59%	40%	10%	15%
Scenario 3 (High biofuel share)	56%	35%	18%	26%
Scenario 4 (High ammonia share)	55%	34%	20%	26%

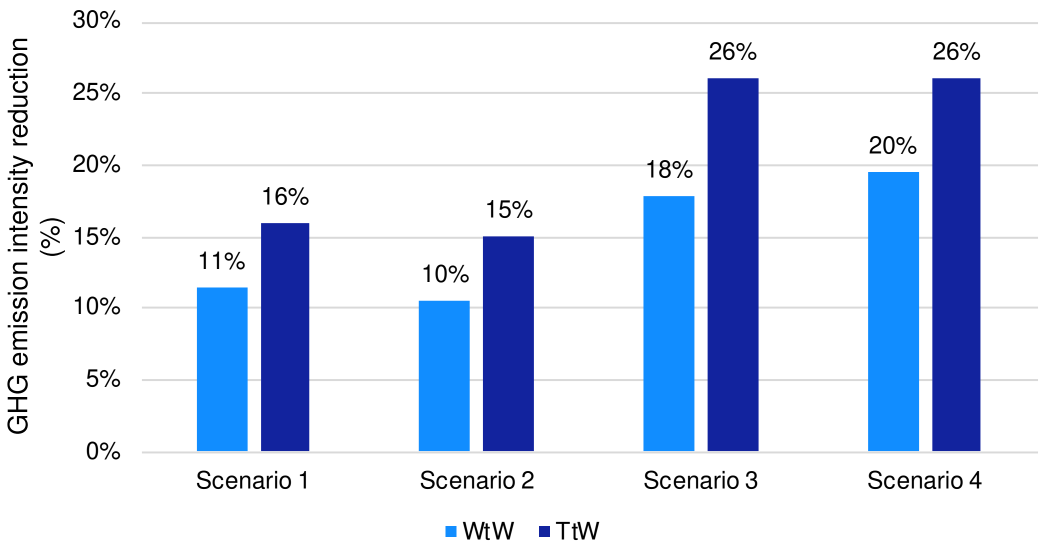


Figure 4: Reductions on GHG intensity of fuel used in international shipping, on a TtW and WtW basis.

These results show that despite variations in the fuel mix, there is little variation in the energy efficiency improvement needed. Relative to 2008, this varies from a 59% reduction (worst case on fuel WtW GHG intensity reduction of 9%) to a 55% reduction (best case on fuel WtW GHG intensity reduction of 20%). These energy efficiency improvements are consistent with the reductions achieved in the 2008-2018 period (32%), when looked at as a further reduction in the period 2018-2030 (34-40%, depending on the fuel scenario, baseline 2018). Evidence on the potential to achieve significant further efficiency improvements was most recently discussed in detail in the consideration of the specifications of short-term measures (CII, EEXI), including in the ISWG-GHG 8/3/3[16] submission. That paper derived conservative

[15] MMMCZCS. (2022). NavigaTE well-to-wake Position Paper (Documentation and assumptions for NavigaTE 1.0).
[16] IMO MEPC. (2021). ISWG-GHG 8/3/3 - Guidelines Supporting the CII Framework. Considerations on CII targets (IMarEST).

estimates of carbon intensity reduction achieved solely with energy efficiency measures and technologies (with no change in fuel carbon factor). Although only container shipping, tanker and bulk carrier fleets were examined in detail, the paper estimates ~50% improvement in energy efficiency by 2030, on a 2008 baseline. This is close to but not quite at the level of efficiency improvement listed in Table 3.

4 What needs to change in the supply chain for LNG, biofuel and hydrogen derived fuel?

For the three different fuels, the following changes are required:

LNG

- No changes required. The supply chain is developing under BAU for required volumes. LNG provides a negligible impact on WtW GHG emissions, as shown by the contrast between scenario 1 and 2, and so there is no material change in the overall WtW GHG reduction regardless of the take-up of LNG between now and 2030.

Biofuel

- Supply chains need stimulation to scale-up current volumes. This is already happening under market forces (e.g. market leaders are offering biofuel fuelled services, such as Maersk Line's "ECO Delivery" and CMA CGM's "Cleaner Energy" service). No additional fleet capacity is needed given these are drop-in fuels, though there are also methane and methanol variants which will be compatible with dual-fuel ships.

Hydrogen-derived fuel

- These fuel options require significant stimulation and development and will take time to develop given their comparative lack of maturity (especially ammonia and hydrogen). Several commercial projects have announced intent to use ammonia in coming years (i.e., the Nordic Green Ammonia Powered Ships (NoGAPS) project, ShipFC – Green Ammonia Energy System project by Viking Energy, MOL Group and Mistui), with rapid growth in announcements expected over coming years given it is expected to be the least cost hydrogen-derived fuel for international shipping (MEPC 79/INF.29). Globally, by 2022 there are several commitments for production of green ammonia equivalent to ~30% of international shipping's energy use (MEPC 79/INF.29).

5 What needs to change in the energy efficiency supply chain of shipping?

For energy efficiency supply chains, there are multiple ways that a further 34-40% increase in efficiency can be achieved between 2018 and 2030. Many of these are longstanding solutions that have failed to be taken up because of a sufficient business case. The strengthening of CII (stringency/enforcement) would be an obvious way to make a sufficient business case. Several of these have no specific supply chain development requirements (slow steaming, larger ships), wind assistance and wider energy efficiency interventions can be enabled through minor developments in existing supply chains:

Slow steaming and virtual arrival

- Modest reductions in speed can create large reductions in GHG intensity. Long-running failures to implement virtual arrival and minimise anchoring time are yet to be crystallised. These are widely applicable across existing fleets.

Larger ships

- Across all ship size and types, ship sizes have been continuously increasing. This creates economies of scale as well as efficiency and intensity improvement. This only applies to newbuilds.

Wind assistance

- So far there has been minimal use of wind assistance to date, making it a significant untapped opportunity for intensity reduction. This option can be applied to existing fleet and newbuilds especially (but not limited to) bulk vessels.

Maximal uptake of further energy efficiency technologies

- A long list of technologies can be applied both as retrofits and to newbuilds. Many have become standard in recent newbuilds but remain under-exploited in the existing fleet. These include coatings, air lubrication, ship maintenance for efficiency, propulsion optimisation and waste-heat recovery as examples.

Therefore, as these supply chains are broadly considered mature, lack of availability of technologies or interventions are not risks preventing up-take. Instead, long-running market barriers and failures created by a fragmented and siloed international shipping industry that only take a short-term view on return on investments (ROI) associated with efficiency (Getting to Zero (GtZ) Transition Strategy[17]), or those that have yet to be removed by effective regulation on efficiency.

[17] Smith, T., Baresic, D., Fahnestock, J., Galbraith, C., Velandia Perico, C., Rojon, I., & Shaw, A. (2021). A Strategy for the Transition to Zero-Emission Shipping. UMAS, Getting to Zero Coalition.

6 What does a policy package that helps achieve these changes look like?

Maximising energy efficiency

Maximising energy efficiency, up to a further 34-40% reduction (on 2018 baseline), could be achieved with a combination of the following:

- The Energy Efficiency Design Index (EEDI) stringency can be further increased (e.g. phase 4), but will have little impact on the fleet's overall intensity because it only drives technical efficiency (the potential efficiency, not the actual measured efficiency), and only affects newbuilds (which are projected to be a small proportion of the overall fleet in 2030).
- CII (or equivalent national/regional action) needs to have significantly increased stringency. The current annual 'ratchet' for reduction in CII is ~2% p.a. for the period 2023-2027 which has received widespread criticism and is tabled for review by 2026. This would need to be approaching ~5% p.a. for the regulation to drive 1.5°C-aligned reductions. In the event the current 2% p.a. increase is held until 2027, then the ratchet would need to be 9-12% p.a. to achieve 1.5°C-alignment, depending on whether CII drives all the WtW GHG reduction needed (i.e., 12% p.a.), or just the energy efficiency improvement (i.e., 9% p.a.).
- Furthermore, CII (or equivalent national/regional action) needs to have a clear enforcement mechanism. At present, failure to achieve compliance with the required CII requires an action plan to be submitted. This provides a weak incentive to comply and does not create a strong business case for the changes and investments needed to further achieve significant efficiency improvements.
- As an alternative to IMO taking steps to address the shortfalls in the existing CII regulation (especially prior to review in 2026), states (or a coalition of states) can take unilateral action on incentivising efficiency improvements. Using the CII framework (e.g. the metric and data system). The significant share of ships with port calls at EU, UK and US ports suggest higher stringency and more strongly enforced actions of only a small group of countries (e.g. specifying as a minimum the calling of A-rated ships), can apply significant additional pressure to achieve efficiency reductions this decade.
- The EU's fit for 55 package of policy does not directly incentivise/regulate efficiency improvement. Strengthening the package to include an efficiency regulation could be done by leveraging the existing IMO's CII regulatory framework, this would create a strong stimulus for efficiency improvement.
- There are currently a number of voluntary but widely subscribed-to initiatives that leverage the CII framework in a private standard. The majority of global shipping's debt finance is covered by the Poseidon Principles, the majority of insurance is covered by the Poseidon Principles for Marine Insurance, and many of the multinational charterers are members of Sea Cargo Charter. These initiatives all use transparency and reporting against the CII metrics (Annual Efficiency Ratio (AER) and EEOI) to evidence environment, social and governance (ESG) relevant performance. Greater scrutiny and regulation on commercial and financial transaction's alignment with the 1.5°C aligned reduction requirement set in the Paris Agreement (e.g. greater use of the Science Based Target initiative (SBTi) and High-Level Expert Group's (HLEG)[18] recommendations on voluntary carbon reduction commitments), all drive further increases in efficiency.

[18] UN High-Level Expert Group. (2022). Integrity Matters: Net Zero Commitments by Businesses, Financial Institutions, Cities and Regions.

Motivating fuel transition

The levels of fossil fuel substitution described in scenarios 1-4, in parallel with increases in energy efficiency can be achieved through a combination of IMO, EU and state/bilateral actions. These are all in process but require alignment to maximise their potential.

- Adopting a target for the use of fuels with low/zero WtW GHG emissions, whilst not a regulation in itself, will help to ensure further incentives and regulatory developments that can achieve initial volumes of hydrogen-derived fuel use by 2030, and the development of the supply chains and infrastructure for their scaling to 2040 objectives (GtZ Transition Strategy). The recent FuelEU Maritime regulation presents an example of how uptake of low/zero WtW GHG emission fuels uptake can be introduced into regulation unilaterally[19]. Although the levels of ambition are not compliant to 1.5°C-alignment, it is a clear way of how interim targets and ratcheting up can be used as a mechanism to accelerate fuel transition.
- A package of mid-term measures adopted by 2025 can directly regulate/incentivise both biofuel and hydrogen-derived fuel use. Although the timescale to 2030 is short, the expectations of the need for these fuels, and the opportunities for early adopters, is already creating investment, so setting fuel WtW GHG intensity reduction objectives for 2030 of the magnitudes specified in Table 1 (10-15% as an average) is feasible. (GtZ Transition Strategy, MEPC 79/INF.29).
- There is currently a misalignment between EEDI/EEXI/CII, which all regulate on a TtW basis grams of carbon dioxide emitted per nautical miles (gCO_2/tnm), and the least cost fuel transition (MEPC 79/INF.29). Under the current fossil fuel energy mix, these regulations primarily drive energy efficiency improvement. However, as fuels offering lower GHG intensity enter use, depending on how these new fuels are evaluated by these regulation's metrics, there can be significant unintended and perverse consequences or assistance to efforts to achieve GHG intensity reduction. Avoiding the risks and securing assistance can be addressed either by converting these regulations into pure energy efficiency metrics e.g. energy per nautical miles (J/tnm), or into WtW GHG intensity metrics.
- The WtW GHG intensity of alternatives to fossil fuels are critical for maximising the effect that substitution to these fuels have on overall GHG emissions (MEPC 79/INF.29). Reductions in-line with or exceeding those assumed in scenarios 1-4 rely on maximising the clarity and stringency of WtW reduction incentivisation in the Lifecycle Assessment (LCA) guidelines, as well as any operationalisation of these guidelines in mid-term measures.
- EU fit for 55 policy is intended to drive changes in the fuel/energy mix, such as through regulation on GHG intensity of fuels (fuel standard), and the Emissions Trading System (ETS). The fuel standard is hoped to include a significant e-fuel subtarget[20], which explicitly stimulates hydrogen-derived fuel production and use. Following the Clydebank Declaration, the concept of green corridors has gained significant traction, and provides a framework that has been further enhanced through the Green Shipping Challenge etc. These actions and the unilateral/bilateral support/incentivisation and competition to develop fossil fuel substitution outside of the framework of IMO regulation, has been estimated to achieve up to 10% fossil fuel substitution to a mix of biofuel and hydrogen-derived fuels (GtZ Transition Strategy).
- Land regulations to ensure that the supply scale-up of fossil fuel alternatives develops at the required speed is important. Inflation Reduction Act (IRA) in the US, EU regulation and national hydrogen strategies are all key enablers for ensuring investment flows into renewable energy and hydrogen supply chains this decade.

[19] https://www.consilium.europa.eu/en/infographics/fit-for-55-refueleu-and-fueleu/
[20] https://www.transportenvironment.org/wp-content/uploads/2022/06/Joint-letter_FuelEU-Maritime-and-AFIR_TE_vf.pdf.

Three ways forward

Three options can be derived from this information, all three options are designed to reach at least 37% WtW GHG emissions reduction by 2030 (baseline 2018). However, these do so with changes to IMO short-term measures and developments of mid-term measures. Additionally, the requirements for a significant improvement in CII during its 2026 review are reduced, if strong regional regulation and voluntary action drive efficiency improvements, in addition to IMO regulation.

Option 1 – Set only short-term measures (no dependency on mid-term measures)

- Modify existing measures to act on WtW GHG reduction to achieve 65% reduction by 2030 against 2008 baseline.
- Set CII stringency and enforcement to 12% reduction per annum from 2027.

Option 2 – Set short-term measures as well as mid-term measures

- Existing measures are focused on improving energy efficiency, and achieving 38% further improvement on 2018 efficiency level by 2030.
- This option requires CII stringency and enforcement to 9% reduction per annum from 2027.
- Mid-term measures focused on achieving bioenergy and hydrogen-derived energy substitution that lowers WtW GHG emissions ~15% by 2030.

Option 3 – Set short-term measures and mid-term measures that are both enhanced by regional regulation and voluntary initiatives

- Existing measures are focused on improving energy efficiency, mid-term measures incentivise fuel transition.
- Regional regulation and voluntary initiatives drive fleet average performance to CII ‘A’ rating and enhance fuel substitution above levels of IMO regulation, lowering WtW GHG emissions ~15% by 2030, achieving 38% further improvement on 2018 efficiency by 2030.
- Requires CII stringency and enforcement to 4.5% reduction per annum from 2027.