Maritime ETS public consultation

Detailed T&E briefing on the design options

February 2020

Summary

T&E supports the Commission's initiative to develop a carbon pricing scheme for the maritime sector. Including EU shipping in the ETS will allow for the internalisation of climate externalities. Sending a clear signal to the market that polluters need to pay and that the era of fossil fuels is over is an essential function of the EU ETS. Crucially, the maritime ETS will be raising revenues that would enable the deployment of sustainable zero-carbon technologies and fuels in shipping. Considering that global shipping will require between USD 70-90 billion in annual investments over the next 20 years in order to decarbonise by 2050[1], a dedicated support scheme for the maritime sector should be set up under EU legislation.

The maritime transport does not currently contribute to the EU's decarbonisation efforts while at the same time benefiting from at least €24 billion per year in fossil fuel tax subsidies, in addition to exemptions from ticket taxes (passenger ships), VAT and corporate taxes. It is high time that the sector starts chipping in before it can benefit from additional EU financial support. Therefore, T&E supports the European Parliament's proposal to set up a Maritime Decarbonisation Fund (also dubbed "Ocean" fund) under the ETS.[2]

Such a Fund would have two elements: 1) a 'flow-in' mechanism, which would serve to reduce the administrative burden of the scheme for shipping operators. Through a 'pooling mechanism', regulated entities would be able to 'pay-as-they-go' for their emissions, while delegating the purchasing and surrendering of the ETS allowances to the pooling entity - i.e. the Fund. Under such a scheme, a fixed annual CO_2 price would be established, which could be derived from the highest ETS price in the year preceding the compliance period. 2) A 'flow-out'

[1] Global Maritime Forum. (2020) The scale of investment needed to decarbonize international shipping
[2] European Parliament. (2020) Shipping industry must contribute to climate neutrality, say MEPs

mechanism, which would reinvest collected revenues in deploying, *under contracts for difference*, of sustainable fuels such as green hydrogen and ammonia. This would help to de-risk the initial deployment of the first zero-emission vessels (ZEVs) in commercial operations. A Fund would need to rely on a price signal, which can only be established under a semi-open or open ETS architecture.

In terms of scope, T&E urges the European Commission to rely on the existing Regulation for the Monitoring, Reporting and Verification of EU shipping's emission (MRV) and the improvements to that regulation as proposed by the European Parliament.[3] This means that a maritime ETS should cover both intra- and extra-EU shipping's emissions. A fall-back position would be the inclusion of 50% of emissions from incoming and outgoing voyages, in addition to all intra-EU emissions and emissions at berth. This second best option should only be pursued in conjunction with an enhanced global climate diplomacy to get other countries around the world to implement similar national schemes covering the remainder of the emissions from international journeys.

Looking at the type of emissions that should be covered under the scheme, T&E strongly recommends that the Commission take a future-proof approach and cover all non-CO2 GHG emissions, especially methane (CH4). Analysis of order-books reveal that up to 40%, by capacity, of new vessels will likely come with LNG propulsion systems in the next few years. This demonstrates a faster than expected uptake rate of LNG ships accelerating their impact on global warming. Methane slips from LNG vessels make them equally bad and in many cases worse than the current diesel ships. Therefore, unless CH4 is also covered by the ETS, the EU's carbon pricing scheme would inadvertently promote LNG ships leading to large-scale investment by both public and private entities becoming stranded assets. We also strongly encourage the inclusion of other climate pollutants in the scope of the ETS, especially nitrous oxide (N2O) and black carbon (BC) emissions.

As there would be no 'hard cap' on maritime emissions under a semi-open or open ETS set-up, the EU could tighten the stringency of the scheme by either improving the environmental ambition of the stationary ETS, introducing a limit on the quantity of allowances from the stationary sector that can be used by the maritime industry and/or by introducing a multiplier for shipping emissions. Besides increasing the environmental ambition of the scheme, such a multiplier could also help raise higher revenues that could be used to further bridge the price

[3] https://www.europarl.europa.eu/doceo/document/TA-9-2020-0219_EN.html

gap between fossil marine fuels and sustainable alternatives like green hydrogen and ammonia.

Applying these design elements, the maritime ETS will become an essential tool in the EU's efforts towards full decarbonisation by 2050. However, the ETS can not be a standalone measure. While the Maritime Climate Fund under the ETS would de-risk the deployment of ZEVs, it should be complemented by other measures to drive the widespread uptake of energy efficiency measures and zero-emission fuels. Additional regulatory initiatives should create predictable demand for scalable green marine fuels on the one hand and drive energy efficiency on the other hand. The Commission's FuelEU maritime initiative and the Parliament's 40% vessel carbon intensity improvement target seem to be best placed to fulfill this dual goal.

1. Context and goal of the scheme

European shipping is a large source of greenhouse gas (GHG) emissions and air pollution. EU related CO_2 emissions from maritime transport reached 144 Mt in 2019[4] and analysis has shown that its contribution to air pollution can be larger than those of all passenger vehicles in Europe.[5] In 2018, maritime emissions represented 3.7% of total EU CO_2 emissions, making its climate impact comparable to that of Belgium, and 13% of the EU's transport emissions.[6] In pace with expected growth in global trade, shipping's global emissions are projected to increase by up to 50% between now and 2050.[7]

By signing the Paris Agreement, the European Union has committed to 'economy wide' GHG emission reduction efforts. While ships have been required since 2018 to monitor and report, among other metrics, their CO_2 emissions and operational efficiency, to this day shipping is the only transport sector not subject to GHG emission reduction targets or measures in the EU. As such EU trade related shipping stands in the way of the EU fulfilling its Paris Agreement commitment. When adopted in

[4] This number is based on the EU MRV scope and reflects the 95th version of the 2019 THETIS-MRV database. This database is permanently updated, meaning there might be more recent versions available. Outliers have been filtered out in order to take into account that some ships report their emissions inconsistently. Note that the MRV scope includes less emissions than the UNFCCC scope, with the former based on real life monitoring of emissions and the latter based on fuel sales in Europe.
[5] T&E. (2019) One Corporation to Pollute Them All: Luxury Cruise Air Emissions in Europe.
[6] European Commission. (2020) 2019 Annual Report on CO2 Emissions from Maritime Transport.
[7] International Maritime Organization. (2020) Fourth GHG study.

2015, the idea was that this Monitoring, Reporting and Verification Regulation (MRV) would be the first step of a staged approach for the inclusion of maritime emissions in the EU's climate policy. With the adoption of the European Green Deal in December 2019, the European Commission committed to taking some of the next steps, one of which would be the extension of the European emissions trading system (ETS) to cover the maritime sector.[8] T&E welcomes this commitment.

Including EU shipping in the ETS will allow for the internalisation of climate externalities. Sending a clear **signal to the market** that polluters need to pay and that the era of fossil fuels is over is a crucial function of the EU ETS. The scheme could also give a much-needed push to some technical and operational emissions reduction measures, although barriers other than pricing remain important here and will need to be tackled through other legislative proposals. However important, carbon pricing alone will not be able to bridge the price gap between fossil marine fuels and sustainable alternative fuels (e.g. green hydrogen and ammonia). What the scheme can and will do, is to **raise a sizable revenue stream**. Stakeholders across the aisle agree that such a revenue stream will be essential to support the sector in transitioning to more sustainable propulsion methods and fuels. And considering that EU law currently rewards the maritime sector with €24 billion per year in fossil fuel tax subsidies for international journeys, in addition to exemptions from ticket taxes (passenger ships), VAT and corporate taxes[9] - without asking for any decarbonisation efforts in return - it is clear that the **sector first needs to start chipping in before it can benefit from EU financial support to decarbonise**.

2. Geographical scope

As illustrated by figure 1, EU shipping's emissions are defined by the MRV regulation as all emissions:

- from voyages between ports within the European Economic Area (EEA)[10],
- from voyages between the last non-EEA port and the next port located within the EEA,
- from voyages between the last EEA port and the next non-EEA port and
- occurring when the ship is at berth.

[8] European Commission. (2019) The European Green Deal.
[9] T&E. (2019) EU shipping's €24 bn a year fossil tax holidays: Maritime ETS is urgent to cut shipping's fuel subsidies.
[10] The European Economic Area (EEA) combines the countries of the European Union (EU) and member countries of the European Free Trade Association (EFTA) to facilitate participation in the EU's single market. The EFTA Member States subject to the regulation are Iceland, Liechtenstein and Norway.

Figure 1: EU shipping's emissions as defined by the MRV regulation

Since all of these emissions result from EU trade-related activity and are already being monitored since 2018, **the most logical scope for a maritime ETS would be the same scope as the existing maritime MRV scope (the so-called 'full scope')**. A 2020 study by T&E has reaffirmed the conclusion of the Commission's 2013 maritime ETS Impact Assessment that such a scope would be very much carbon leakage proof.[11] T&E found that at most 7% of ships calling at EU ports would financially benefit from avoidance at today's carbon price. Any residual evasion risks could be further eliminated with the application of a more stringent port-call definition to the neighbouring EU ports that could be used for potential evasion. Considering that raising revenues to reinvest in the sector is an essential function of the maritime ETS, a full scope ETS would also assure the highest revenue stream.

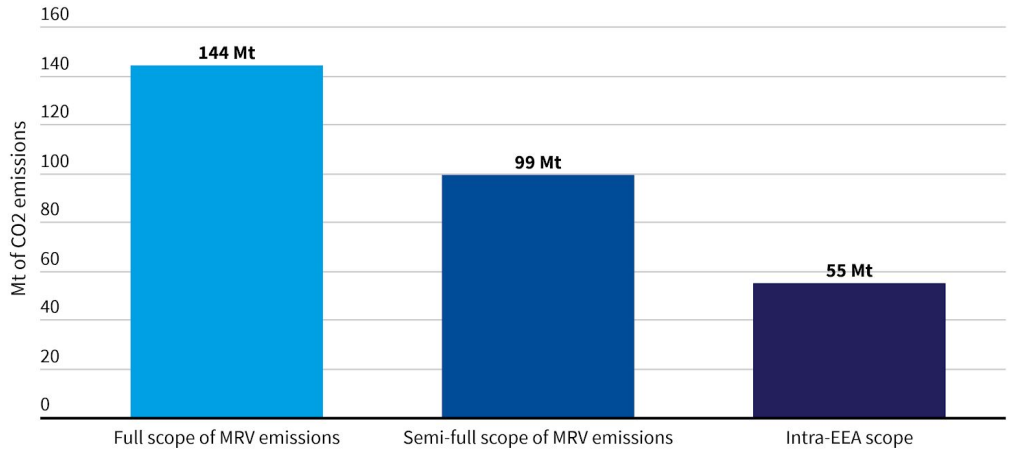
However, there are voices within the shipping industry that would like to see the scheme limited compared to the MRV scope. Figure 2 illustrates the three potential geographical scope options that are being discussed and the amount of emissions that each of those scopes would cover.

- Full scope, the ETS would cover exactly the same voyages as the MRV regulation, meaning 100% of inbound, outbound and intra-EEA voyages, as well as 100% of emissions at berth. Note that with a total of 144Mt of CO_2 emissions in 2019, the MRV scope includes less emissions than the UNFCCC scope, which is based on marine fuel sales in Europe but cannot be attributed to individual ship(owner)s.
- Semi-full scope, the ETS would still cover 100% of emissions from intra-EEA shipping and 100% of emissions at berth. But for both inbound and outbound voyages to and from the EEA, only 50% of their emissions would be covered by the prospective EU ETS. The rationale is that

[11] T&E. (2020) All aboard! Too expensive for ships to evade EU carbon market

the remaining 50% of emissions of these voyages would be covered by third-countries in case they decide to implement similar regional/national regulations. A semi-full scope would cover 99Mt of CO_2, representing 69% of EU shipping emissions (i.e. the emissions covered under the MRV regulation).

- Intra-EEA scope, the ETS would only cover emissions from intra-EEA voyages and emissions at berth. Including merely 55Mt of CO_2 (38% of the EU shipping emissions), such a scope would undermine the effectiveness and the very environmental rationale of the ETS and MRV.



Source: EU THETIS MRV, extract: 2019-v95-05112020-EU MRV Publication of information.xlsx. Outliers have been filtered out in order to take into account that some ships report their emissions inconsistently.

Figure 2: Breakdown of CO_2 emissions from EU shipping in 2019 by potential maritime ETS scope

T&E favors a full scope ETS design, but **a semi-full scope ETS could also be a compromise option especially if the EU could enhance its global climate diplomacy and encourage other regions to propose similar regional schemes.** Assuming other regions/countries would cover the remaining 50% of emissions of these voyages with similar national/regional regulatory measures, within time the majority of global maritime emissions could be covered by carbon pricing schemes. To ensure that this materialises, the EU should actively encourage other countries to put in place national MRV systems, include shipping in their national NDCs under the Paris Agreement and mandate reduction measures, including carbon pricing mechanisms similar to the EU ETS. The Union should review the progress made in other regions, but also other fora, like the IMO, and in the absence of satisfactory progress extend the maritime ETS to the full scope of the MRV emissions.

While the most straightforward version of a semi-full scope ETS would be an even 50-50 split between emissions from incoming and outgoing voyages, there are several variations possible to the semi-full

scope. For example, the EU could opt to include all emissions from incoming voyages but exempt all emissions from outgoing voyages, or the other way around. From an environmental point of view, it would make more sense to include all emissions from incoming voyages in the maritime ETS as these emissions are slightly higher than the outbound emissions and such a scope would thus even cover slightly more emissions than an even 50-50 split. Opting for full inbound emissions might also potentially simplify the enforcement of the maritime ETS. One could also argue that incoming voyages carry goods destined for EU consumption and that its emissions are thus part of the environmental footprint of EU consumers and, by extent, of EU countries. But overall **an even 50-50 split still seems like the more viable political choice**, as it would likely come off as less intrusive to third countries. And as evidenced by a 2020 study by T&E, evasion would not be financially beneficial to any voyages under an ETS covering only half of long-distance voyages.[12]

A last variation to the semi-full scope is the 'EEZ scope'. There are some industry players who would like to see the scheme limited to the EU's exclusive economic zone (EEZ). Apart from limiting the environmental benefits of the ETS, an EEZ-scope would also create new problems as opposed to solving non-existing ones. Ships on extra-EEA voyages could opt to sail parallel to the coast just outside the EEZ and then approach their destination ports at the right angle using the shortest distance. Similar "evasion" happened when California introduced more stringent fuel quality standards in 2014-2015 in its 24nm coastal boundary line.[13] Ship operators diverted the compliance zone to save on fuel costs. **An EEZ-scope ETS would likely also lead to significant rerouting**, thereby increasing instead of reducing emissions. Additionally, such a scope would create demarcation issues, as countries like Italy and Greece have not even established an EEZ.[14]

Past declarations by the European Commission have committed to including at least intra-EU emissions in the ETS. However, the Commission has made clear that this commitment is to be understood as a floor, not a ceiling of environmental ambition. As figure 2 above illustrates, limiting the ETS to **an intra-EEA scope would exempt 62% of all EU trade related maritime emissions** from compliance, thus undermining the effectiveness and the very environmental rationale of the ETS.

Policy recommendation

A maritime ETS should include all of the emissions covered under the MRV regulation. Assuming the EU invests diplomatic capital in actively encouraging other countries to put in place carbon pricing mechanisms similar to the EU ETS, a semi-full scope covering 50% of inbound and 50% of outbound

[12] T&E. (2020) All aboard! Too expensive for ships to evade EU carbon market
[13] ICCT. (2018) Delineating a Chinese emission control area: The potential impact of ship rerouting on emissions
[14] https://webgate.ec.europa.eu/maritimeforum/en/node/4426

emissions could also be considered. The aim would then be to encourage other countries to cover the remaining emissions via their own national/regional schemes.

3. Covered emissions

Limiting the ETS to CO_2 emissions alone would result in a **significant underestimation** of EU shipping's GHG emissions. Equally, the IMO's goal to reach at least 50% emissions reduction by 2050 includes all GHGs and not just CO_2.

Under the EU MRV regulation, commercial ships above 5,000 gross tonnage are currently required to report their CO_2 emissions to the European Commission. CO_2 emissions are determined based on the amount of fuel consumed in combination with the fuel-specific CO_2 emissions factor. A similar **fuel-specific CO_2-equivalent emissions factor** could easily be fixed for methane, nitrous oxide and black carbon, based on the methodology layed out in the International Maritime Organisation's (IMO) 4th GHG study. Under the existing ETS system, land installations producing nitric, adipic and glyoxylic acids and glyoxal are already required to purchase and surrender allowances for their nitrous oxide emissions.[15] While the ETS directive also refers to other GHGs such as methane in its Annex II, companies are not yet required to surrender allowances for their methane emissions.[16]

3.1. Methane

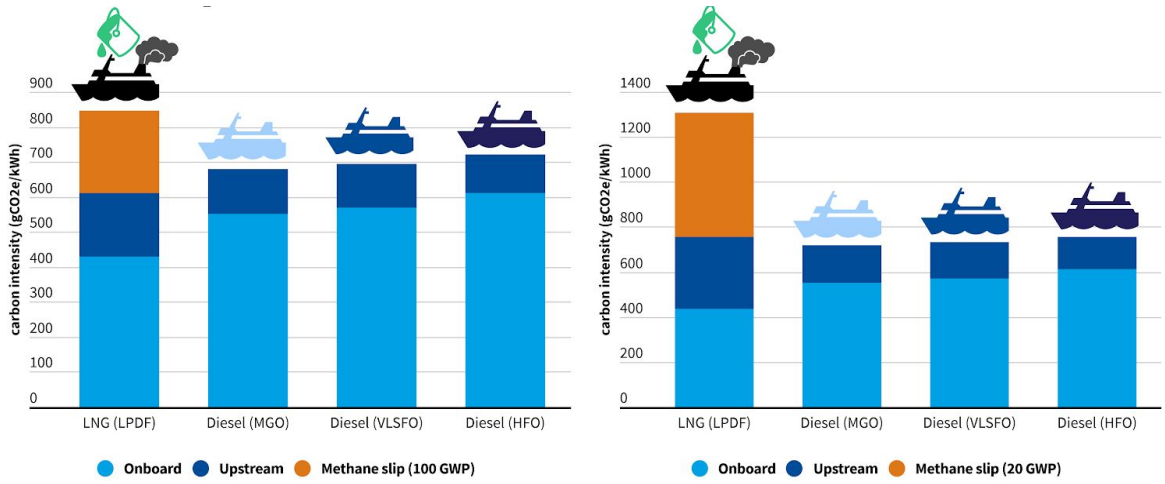
Over a 100-year time horizon (GWP100), fossil methane is 36 times more polluting than carbon dioxide. From a 20-year time perspective (GWP20), it is even **86 to 87 times more polluting than CO_2**. As a result, processes that have high methane emissions (e.g. LNG dual-fuel ships) are perceived as less damaging to the climate than they are in reality, when ignoring methane emissions or when only looking at the GWP100. If and when methane is considered as a transport fuel, dual accounting of both GWP100 and GWP20 is crucial.

Methane (CH4) emissions from global shipping have **increased by 150%** between 2012 and 2018 due to the increased deployment of LNG ships, which are prone to high 'methane slip'.[17] This while the amount of ships running on LNG was less than 1% of the world fleet at the time. Based on T&E analysis of the order books for newly built vessels, almost **40% of new ship capacity planned for 2023 will be**

[15] https://ec.europa.eu/clima/policies/ets_en
[16] EU Directive 2003/87/EC
[17] International Maritime Organisation. (2020). Fourth Greenhouse Gas Study

running on LNG. Without regulatory measures, this rising trend of maritime methane emissions will thus continue and even worsen over the coming years.

According to a 2020 study by ICCT, the most popular LNG marine engine (low-pressure dual fuel, medium-speed, four-stroke) emits 70% to 82% more life-cycle GHGs than MGO based on its 20-year global warming potential.[18] In simple terms, **limiting the ETS scheme to CO_2 emissions alone would give an up to 25% unfair advantage to LNG vessels**, which in practice emit the same or even higher amounts of total GHGs (CO_2+CH4) than diesel vessels.



Source: ICCT, 2020. **Note**: Medium speed, 4-stroke engines, which are the most wide-spread LNG engines among cruise vessels.

Figure 3: Methane slip from LNG ships

Including methane in the ETS would **stop incentivizing LNG ships,** prevent large-scale investment by both public and private entities in (soon to be) stranded assets and help drive futureproof fuels like green hydrogen and ammonia. To come up with fuel-specific CO_2 -equivalent emissions factors, the European Commission can rely on the IMO's 4th GHG study's methodology.

3.2. Nitrous oxide

[18] ICCT. (2020) The climate implications of using LNG as a marine fuel

Nitrous oxide (N_2O) has the highest global warming potential. It is 280 to 310 times more polluting than CO_2, based on respectively GWP20 and GWP100.[19] Additionally, **N_2O emissions could significantly increase in the near future if ammonia (NH3)** is burned in internal combustion engines. This makes the case for the inclusion of N_2O emissions in the maritime ETS. The emission factors reported in the IMO's 4th GHG study can directly be translated into ETS CO_2-equivalent standards.

3.3. Black carbon

The incomplete combustion of fuel leads to emissions of black carbon (BC), a component of fine particulate matter (PM2.5).[20] Black carbon absorbs incoming solar radiation and therefore directly warms the atmosphere. It has a relatively short atmospheric lifetime, depositing on the Earth's surface a few days up to a few weeks after emission. However, when BC deposits onto light-covered surfaces, such as snow or ice, it **reduces the albedo of the surface** and continues to have a warming effect and accelerating ice loss in the polar regions for example. After CO_2, it is the second largest global contributor to human-induced climate change. BC also impacts health, contributing to heart and lung disease.

Black carbon emissions from global shipping grew 12% between 2012 and 2018.[21] On a 100-year timescale, BC emissions from ships represented 5% to 8% of the CO_2-equivalent climate warming impact from shipping in 2015.[22] Looking at a 20-year timescale, that becomes 16% to 23%. Ships using residual heavy fuels oils (HFO) emit more BC than if they operated on cleaner distillate fuels. Global BC emissions from marine vessels are **predicted to nearly triple between 2004 to 2050** due to increased shipping demand. While over the same period emissions from land-based sources are expected to fall due to stricter controls, increasing the relative importance of shipping emissions.

BC is emitted nearly everywhere, even in the Arctic and Antarctic, where it accelerates heating, ice and snow melt. The majority of BC from ships is emitted in the northern hemisphere, some of which is transported to the Arctic. Furthermore, a substantial portion of BC is emitted near the coast, where it can **contribute to local air pollution**.

[19] Retrieved from https://unfccc.int/process/transparency-and-reporting/greenhouse-gas-data/greenhouse-gas-data-unfccc/global-warming-potentials
[20] ICCT. (2017) Black carbon emissions and fuel use in global shipping, 2015
[21] International Maritime Organisation. (2020). Fourth Greenhouse Gas Study
[22] ICCT. (2017) Black carbon emissions and fuel use in global shipping, 2015

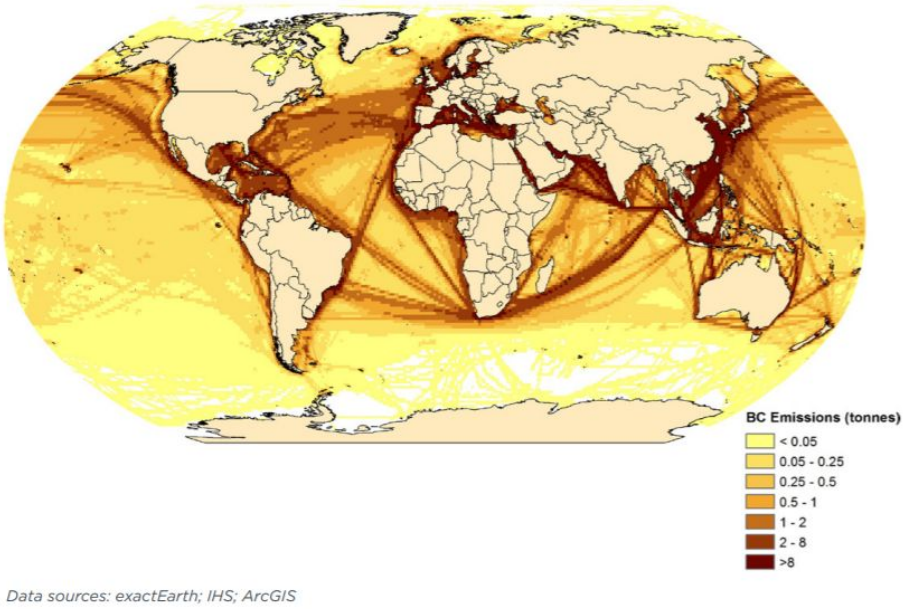


Figure 4: Black carbon emissions from global shipping in 2015[23]

The Intergovernmental Panel on Climate Change (IPCC) states that global black carbon (and methane) emissions should decrease by at least 35% below 2010 levels by 2050 in order to meet the Paris climate Agreement goals.[24] **Including BC emissions in the ETS would thus be aligned with the Paris Agreement**. While black carbon is a bit more difficult to account for than methane and nitrous oxide (as BC is a function of the engine type, engine load and fuel type) a methodology can be found in the Fourth IMO GHG Study.

Policy recommendation

At the very least, a maritime ETS should include both CO_2 and methane emissions. This would prevent large-scale investment by both public and private entities in (soon to be) stranded assets and help drive futureproof fuels like green hydrogen and ammonia. Ideally, the scheme would include all GHGs, as is the case for the IMO's 2050 goal. The EU should however be careful for a scenario where black carbon is incorporated into the ETS and methane is not, as this would further incentivise LNG uptake. T&E would advise to use each pollutant's 20-year GWP as the world is

[23] ICCT. (2017) Black carbon emissions and fuel use in global shipping, 2015
[24] IPCC. (2018) Special report: Global warming of 1.5 °C. Summary for policymakers

already 1.1°C above pre-industrial levels and every effort should be taken to avoid additional near-term warming effects.

4. Regulated entity

Shipping has a quite unique organizational structure, whereby different entities can hold legal responsibility towards a single ship at the same time. For any maritime regulation, the responsible entity should ensure compliance with the regulation's requirements, be in charge of paying the fine in case of non-compliance and, in case of environmental regulations, be able to influence the amount of GHGs emitted.

The regulated entity under the current MRV regulation is defined as the *'company'* or *'the shipowner or any other organisation or person, such as the manager or the bareboat charterer, which has assumed the responsibility for the operation of the ship from the shipowner'*. While this definition has worked perfectly for the obligations under the MRV, it is inadequate for the ETS obligations. T&E believes that there is a need for **different responsible entities for monitoring and reporting on the one hand, and for emissions dues under the ETS on the other hand**. The latter requires a new definition that makes the commercial operator of the vessels, who pays the fuel bill and sets the operational speed, responsible for ETS compliance.

4.1. Tackling split incentives

Emissions reduction measures in the maritime sector struggle with a **problem called 'split incentive'**. Much like in the building sector with its 'landlord-tenants' problem, the entity investing in a ship's environmental performance is not always the entity reaping the benefits of that investment. For example, the commercial operator of a ship could see operating costs (e.g. fuel) decrease, but is unlikely to invest in hardware if he does not own the ship. When a shipowner on the other hand invests in an energy efficiency measure and thus improves the carbon footprint of his vessel, it will likely be the commercial operator that benefits from the lower fuel bill. Meanwhile, the market does not reward these owners of efficient vessels by way of premiums or preferential hiring. According to a 2016 UCL study, vessels with a good GHG rating did not benefit from higher time charter rates than those with bad GHG ratings.[25]

Regulations aimed at reducing the industry's emissions should thus carefully choose the best responsible entity to reduce the risk of split incentives as much as possible. The ideal responsible

[25]https://www.ucl.ac.uk/bartlett/energy/news/2016/aug/ucl-energy-finds-efficient-ships-save-millions-market-fails-reward-owners

entity for paying the ETS dues is the entity that has the **most power to make operational and investment decisions with an impact on emissions**. In the shipping sector this could be either the operators of an individual vessel, or its owners. While the shipowner might be the entity responsible for investments in the ship to reduce its emissions, it is the **commercial operator that is in charge of operational efficiency and thus to a large extent controls the amount of GHG emitted** during a specific voyage. In the time charter market, the commercial operator controls the load-factor, the speed and pays for the fuel bill. There is no reason for not making commercial operations responsible for the ETS dues, too. In the liner market, the influence of the commercial operator (in case not the shipowner) on GHG emissions might reach even further. The world's top 10 liner companies, representing about 80% of the market share by capacity, on average own only 45% of the vessels they operate. The remainder are chartered-in as bareboat and time charter. Given the size of these companies, they can influence the decision of shipowners to invest in technical energy efficiency measures and can sometimes even influence the design of newly built vessels if operating diesel ships get more expensive.

If the goal of carbon pricing is to **unleash these kinds of market forces**, then the obligation of charterers/commercial operators should be well addressed by the ETS directive. However, there needs to be a safeguard mechanism to ensure robust ETS compliance. The shipowner would be the second line of defense, in case of non-compliance or unavailability of the commercial operator.

4.2. Ship sizes and types

Currently all ships above 5,000 gross tonnage (GT) are required under the MRV regulation to report i.a. their annual fuel consumption and associated CO_2 emissions when (un)loading cargo or passengers for commercial reasons. However, as the idea behind the 'polluter pays' principle is that environmental externalities become internalised, **all polluting entities should pay a carbon price for their emissions**.

In terms of ship size threshold under the scope of the maritime ETS, it would thus be more logical to **apply the 400 GT threshold of MARPOL Annex VI** than the current 5,000 GT threshold of the MRV regulation. Additionally, as GHG emissions reductions go hand in hand with reductions in air pollutants and as smaller vessels often navigate near human settlements, including them in the scheme could have a major positive impact on public health. Smaller ships also typically have more immediate decarbonization options than larger vessels. Many demonstration projects use smaller vessels for testing new zero-carbon technologies. As such, some smaller vessels fully operate on hydrogen and batteries and can meet zero-emission goals already today.

From an environmental perspective, it would also make sense to include a couple of ship types that have so far been exempt from the obligations under the MRV regulation. **Fishing vessels** for example

contribute, as evidenced by the Fourth IMO GHG Study, significantly to CO_2 emissions and should therefore be included in the scheme. As these vessels will not have been able to benefit from a phase-in period (during which you are required to monitor, report and verify your emissions under the MRV, but you are not yet required to pay for them), there could first be a phase-in period. After 2 years of successful MRV implementation, fishing vessels could then also become fully part of the ETS scheme. The same phase-in period could apply to **inland waterway transport vessels**.

Policy recommendation

The current MRV regulation definition is adequate for the monitoring and reporting of emissions, but inadequate for the ETS. A new definition, making the commercial operator of the vessels responsible for ETS compliance (with the shipowner as a second line of defense), is needed.

A maritime ETS should at least include all vessels currently subject to the MRV regulation, and preferable also all vessels below 400 GT. After a phase-in period of 2 years, fishing vessels and inland waterway transport should be included as well.

5. Allocation of allowances

Raising revenues implies that compliance actors must pay an actual price for their pollution. A system defined by free allocation of pollution permits does not meet this criterion.

5.1. A Maritime Decarbonisation Fund

Due to shipping's quite unique organizational structure, a **dedicated pooling mechanism** should be established, where regulated entities could **"pay-as-they-go" for their emissions** to the pooling entity (i.e. the Fund) and delegate the purchasing and surrendering of allowances to the pooling entity. Under such a scheme, a **fixed annual CO_2 price** would need to be established, which could be derived from the highest ETS price in the year preceding the compliance period. The commercial operator would then pay an amount using this fixed CO_2 price and CO_2 emissions from the fuel consumed during the charter-party contract, either at the time when he pays for the fuel bill, at the end of the charterer contract or at the end of the annual ETS compliance cycle, whichever comes first.

As ETS prices tend to fluctuate throughout the year, an annual fixed price poses the risk that there is a deficit in the Fund at the end of the year. To account for this, an "ex-ante" mechanism could be established whereby a buffer could be incorporated into the fixed price, in the form of a surcharge reflecting multi-annual allowance price fluctuations from the previous years. This could help cushion

some of the ETS price fluctuations. In the opposite case, if too much funds are accumulated in the "pay-as-you-go" fund, the savings could be banked to reduce the annual surcharge in the following years. An alternative "ex-post" mechanism could also be explored whereby the difference between accumulated Fund revenues and ETS compliance costs could be carried over to the following year and be socialised among the shipping operators in the form of socialised surcharge per tonne of CO_2.

The Fund **lowers the administrative burden** for commercial operators because they simply pay for the respective amount of emissions according to their CO_2 emissions derived from fuel consumption and cross-check with the fuel bills during the contractual period. The fixed price **allows commercial operators to budget their ETS dues** even before they start emitting and to account for these costs internally for the upcoming years.

Such a pooling mechanism can also help resolve the recurring problem of split-incentives by enabling shipowners to pass on the costs to commercial operators who set the operational parameters (such as sailing speed) that affect ship's GHG emissions and energy efficiency. This is especially the case for charter-party contracts that are shorter than a year. Without a "pay-as-you-go" fund, it could be practically difficult for the shipowners to pass on these costs as the default ETS compliance is only once a year.

The pooling mechanism could be optional, allowing regulated entities to choose at the beginning of a compliance year whether they would like to comply via the fund or by interacting with the auctions themselves. Large commercial operators might prefer to engage in emission trading rather than to pay a fixed amount into a fund.

5.2. No free allowances

A maritime ETS has been a long time coming. The sector has been monitoring its CO_2 emissions since 2018 under the MRV regulation and when adopted in 2015, it was made **very clear that the MRV would be the first step of a staged approach** for the inclusion of maritime CO_2 emissions in the EU's climate policy. With the adoption of the European Green Deal in December 2019, the European Commission committed to taking some of the next steps, namely the extension of the ETS to cover the maritime sector. So the sector both knows exactly how much it emits, what the price levels have been so far under the ETS and that an extension of the ETS to the maritime sector would come sooner rather than later. Therefore, it can not claim to be taken by surprise or to be unprepared for the scheme.

Maritime shipping is the **only transport sector not yet subject to GHG reduction targets or measures** in the EU. While aviation was included in the ETS scheme eight years ago, shipping remained exempt. As a result, the sector has **already benefited from a decade-long grace period**

and should no longer have the right to a pilot phase or free allowances. We should aim to **avoid the mistakes of the past**, when bringing aviation in the EU ETS, where the EU allowed free or low-priced allowances. As a result, even though aviation was added to the ETS in 2012, CO2 emissions from this sector are still growing.

As explained by the European Court of Auditors in their 2020 special report on free allowances, free allowances should be targeted at those industrial sectors least able to pass on carbon costs to consumers in order to avoid windfall profits.[26] This is not the case for the shipping industry where **costs can very easily be passed on to the final consumer**. A recent T&E analysis found that CO_2 costs would add at most 2% to the transport costs of shipping a standard TEU from Europe to East Asia and that would be considerably inferior to natural multi-annual fluctuations in seaborne transport costs.[27]

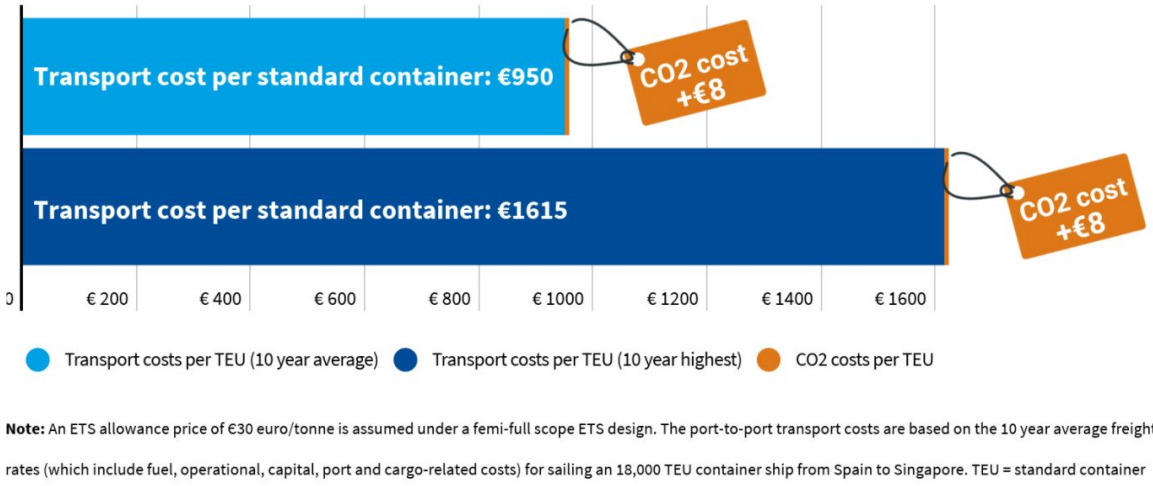


Figure 5: CO2 costs negligible compared to overall transport costs

Earlier T&E analysis calculated that the price increase for a single banana from Ecuador would be limited to 0.55% or +0.007€/kg under an ETS price of 50€/tonne.[28] A single ipad from China would cost 0.003€ more and the price of 1 litre of diesel from the USA or 1 kg of grain from Brazil would increase by 0.001€. This would be comparable for other types of products.

[26] European Court of Auditors. (2020) Special Report: The EU's Emissions Trading System: free allocation of allowances needed better targeting
[27] T&E. (2020) All aboard! Too expensive for ships to evade EU carbon market
[28] T&E. (2019) EU Shipping's €24billion/year fossil tax holidays

Product	Origin	Destination	Distance	Ship CO2 emitted per item	Additional costs with shipping in the ETS with €50/tonne CO2	Old Price in Belgium* without ETS	New price in Belgium* with ETS	Price increase due to ETS
Banana (single)	Ecuador	Netherlands	10464 km	22 g	0.11000 € Cents	1.200	1.207 €/kg of banana	0.5500%
iPad (single)	China	Denmark	19327 km	55 g	0.27500 € Cents	550	550.003 €/iPad	0.0005%
Grain (1 kg)	Brazil	Holland	10416 km	21 g	0.10500 € Cents	0.16	0.161 €/kg of grain	0.6562%
Diesel (1 litre)	USA	Italy	8575 km	24 g	0.12000 € Cents	1.4	1.401 €/litre of diesel	0.0857%

Source: Estimates by T&E based on the product emissions data from Danish Shipping, http://www.navigatingresponsibly.dk/

* Product prices in Belgium were found based on desk research

Figure 6: insignificant impact of ETS on consumer good's prices

Additionally, T&E analysis has reaffirmed the conclusion of the Commission's 2013 maritime ETS impact assessment that the scheme would be **very much carbon leakage proof.**[29] T&E found that at most 7% of ships calling at EU ports would benefit from avoidance at today's carbon price under an so-called 'full scope' ETS (equal to the MRV scope). With an ETS covering only half of long-distance voyages (the so-called 'semi-full scope'), the benefits of evasion are just non-existent.

It would also be very difficult to defend morally that a sector can continue to pollute for free while there is a **climate emergency** at hand.

The arguments from shipping companies asking for free allowances because they proclaim that they are first movers are not compelling because the **ETS system already rewards first-movers** and penalizes laggards. Companies that have invested in energy saving technologies and operational practices benefit because they are required to buy fewer allowances than those who have not. The purpose of carbon pricing is to create an economic incentive for companies to continually invest in emissions reduction technologies and practices, not merely to stagnate. Free allowances do not send the appropriate price signal to justify further investments in decarbonization.

Finally, let's not forget that the **maritime sector benefits from many EU tax benefits**. EU law rewards the sector with €24 billion per year in fossil fuel tax subsidies for international journeys, in addition to exemptions from ticket taxes (passenger ships), VAT and corporate taxes. Considering how long the shipping industry has been benefiting from these EU tax subsidies while not being a part of any EU decarbonization regulations, any transitional period is abundant.

[29] T&E. (2020) All aboard! Too expensive for ships to evade EU carbon market

Policy recommendation

A dedicated pooling mechanism should be established under the maritime ETS, where regulated entities could "pay-as-they-go" for their emissions to the pooling entity and delegate the purchasing and surrendering of allowances to the pooling entity.

As one of the main goals of the maritime ETS is to raise revenues that can be reinvested in the sector, there should be no free allowances.

6. Type of ETS scheme

6.1. Closed scheme

A closed maritime ETS is an emission trading system without links to the rest of the EU ETS or external carbon markets. The only allowances authorized to be surrendered would be the new allowances created specifically for the maritime sector. Such a system would allow for a 'hard cap' on maritime emissions, as commercial operators would not be able to emit more than the amount of allowances available under the maritime scheme. Additionally, given the continued growth in maritime emissions, a closed ETS would likely lead to a much higher price of allowances than those observed under the stationary ETS.

6.2. Semi-open or open scheme

Under an open scheme, the ETS would be extended to the maritime sector without creating specific allowances for the sector. A semi-open scheme would model the aviation ETS. Airlines can use both specific EUAAs (EU Aviation Allowances, unavailable to other sectors) and EUAs (EU Allowances, general ETS allowances) to fulfil their ETS obligations. Under a semi-open scheme, specific allowances for the maritime sector (EUMAs) would be created, while responsible entities could also purchase and surrender EUAs.

Both set-ups **would allow for the creation of a dedicated pooling mechanism** - a Maritime Climate Fund - as explained in section 5.1. In fact, such a pooling mechanism can only be set up under a semi-open or open ETS, as it would then be able to get its price signal from the stationary ETS. A closed scheme would not be compatible with the Fund system as it wouldn't be able to generate a price signal for the Fund to function. If all ships opt for the Fund and decide not to trade emissions

allowances, then there would only be one buyer (i.e. the Fund) in the closed maritime ETS auction and this can't generate a credible market-based price signal for emissions allowances.

However, under a semi-open or open scheme there would be no real 'hard cap' directly limiting shipping's emissions growth under the ETS. Commercial operators and/or the Fund would be free to buy as many emissions allowances from the stationary sector (EUAs) as they'd like, allowing them to exceed the maritime cap under a semi-open scheme. The relative size of the maritime sector compared to the stationary market and the relatively low price elasticity of the seaborne transport demand would mean that shipping would draw on the stationary ETS allowances in the foreseeable future. Under a semi-open set-up, this would create an effect similar to what we have seen in the aviation sector, where around 50% of the surrendered allowances from aircraft operators come from the stationary ETS. Putting a **limit on the quantity of allowances from the stationary sector** that can be used by the maritime industry could be a way to introduce a hard cap on shipping emissions.

6.3. A tax on emissions from the maritime sector

We would strongly discourage a tax system, neither on emissions nor on fuel consumptions/sales, as that would require a unanimity procedure in the Council, which would be a significant roadblock for implementing an ambitious measure. Also, a unanimity tax rule would not give equal opportunity to the European Parliament as co-legislator to express its views and ambition.

Policy recommendation

The EU should opt for a semi-open ETS, as is the case for the aviation sector, in combination with a dedicated pooling mechanism - a Maritime Climate Fund - as explained in section 5.1. The Fund would reduce administrative burden for the shipping operators and also help channel ETS revenues to the deployment of zero-emission vessels and relevant infrastructure.

7. The cap

The EU ETS is a 'cap and trade' system, which works by capping the overall GHG emissions of all participants in the system. The ETS legislation creates allowances which are essentially rights to emit GHG emissions equivalent to the global warming potential of one tonne of CO_2-equivalent. The level of the cap determines the number of allowances available in the whole system.

7.1. Environmental ambition

Ideally, the cap should be set at levels that prevent maritime emissions from exceeding the 1.5°C compatible carbon budget and that set the maritime sector on a course to deliver a **fair contribution to the EU's at least -55% by 2030** target. However, as discussed in section 6, there would be no hard cap on maritime emissions under a semi-open ETS scheme and the maritime sector would receive its price signal from the stationary ETS, rather than from maritime EUMAs alone. Therefore, to **tighten the stringency** of the maritime ETS, the EU could either **improve the environmental ambition of the stationary ETS**, introduce a **limit on the quantity of allowances from the stationary sector** that can be used by the maritime industry (see section 6.2) and/or **introduce a multiplier** for shipping emissions, essentially increasing the price signal for the maritime sector.

Besides increasing the environmental ambition of the scheme, such a multiplier could also help raise higher revenues that can be used to fill the price gap between fossil marine fuels and sustainable alternatives like green hydrogen and ammonia. For example, a multiplier of x2 would require commercial operators to purchase twice as many allowances in order to be able to emit GHG emissions equivalent to the global warming potential of one tonne of CO_2-equivalent. As discussed in section 5.2., this would not significantly increase the price of consumer goods, as seaborn transport contributes only a small percentage to final consumer prices and changes of these prices in either direction do not have huge impacts on trade.

To support the cap set on shipping's emissions under the ETS, a **basket of measures** regulating shipping's emissions should be put in place (see section 10). Finally, a way to ensure lasting environmental ambition of the cap would be through **voluntary cancellation** of maritime and stationary allowances in case of reduced economic demand. Under Art. 12(4) of the ETS Directive member states have the right to voluntary cancel allowances in the event of a policy driven coal phase out. This could be expanded to the shipping sector.

7.2. The baseline year

Based on current ETS rules and other environmental schemes already in place for the maritime sector, there are three options considerable for the baseline year:

- 2018: **The most straightforward choice for a baseline year would be 2018**, as this is the first year where ships above 5,000 gross tonnage have been required to report their emissions under the EU MRV regulation and thus the first year for which we have verified emissions reports from

EU shipping. To ensure that the baseline year is not influenced by some of the reporting entities still getting to know the legislation and possibly making errors in their reporting, the EU could opt for an average of 2018, 2019 and 2020 emissions reports under the MRV. This would also cancel out market fluctuations that might have influenced one specific year's reporting.

- 2005: ETS emissions from stationary installations have an emissions reduction target compared to 2005 emissions levels. However, there is no data available for EU shipping emissions prior to the start of the EU MRV regulation in 2018.
- 2008: The IMO uses 2008 as the baseline year for the levels of ambition identified in its Initial GHG Strategy. While the IMO didn't require international shipping to start collecting and reporting data under its mandatory Fuel Oil Data Collection System (DCS) until 2019, there are ways to ***estimate*** international shipping's emissions before that date. However, as there is no ***monitored and verified*** data available for EU shipping prior to 2018, the EU would need to extrapolate those estimations to the EU level. One way of doing that would be to look at the share of EU maritime trade in global trade in 2008 and what kind of emissions footprint that represents and to then compare that to current global maritime emissions and the share of EU maritime trade in global trade today. However, that data will come with inaccuracies. Therefore, using the collected EU MRV data would be the best option.

Policy recommendation

As there would be no hard cap on maritime emissions under a semi-open ETS, the EU could tighten the stringency of the scheme by either improving the environmental ambition of the stationary ETS and/or by introducing a multiplier for shipping emissions. Besides increasing the environmental ambition of the scheme, such a multiplier could also help raise higher revenues that can be used to bridge the price gap between fossil marine fuels and sustainable alternatives such as green hydrogen and ammonia.

8. Use of revenues

The creation of a maritime ETS creates an **opportunity to raise revenues** that can be used to help the maritime sector decarbonise. The scale of cumulative investment needed between 2030 and 2050 to fully decarbonise global shipping by 2050 is approximately USD 1.4-1.9 trillion.[30] This translates to between USD 70-90 billion on average annually for 20 years and should be seen in the context of annual global investments in energy, which in 2018 amounted to USD 1.85 trillion. The estimate of

[30] Global Maritime Forum. (2020) The scale of investment needed to decarbonize international shipping

investments required is based on ammonia being the primary zero carbon fuel choice adopted by the shipping industry as it moves towards zero carbon fuels. Under different assumptions, hydrogen, synthetic methanol, or other fuels may displace ammonia's projected dominance, but the magnitude of investments needed will not significantly change for these other fuels. Given this considerable need for investment, T&E supports the European Parliament's September 2020 proposal to **create a Maritime Decarbonisation Fund (dubbed 'Ocean Fund' by the Parliament)** under the ETS scheme.[31] Such a Fund would earmark the revenues raised by the sale of ETS allowances to the maritime sector for reinvestment in the sector.

According to the Global Maritime Forum, based on analytical work conducted by UMAS and ETC, land-based infrastructure and production facilities for low carbon fuels (hydrogen production, ammonia synthesis, storage and bunkering, etc.) make up around 87% of the total investment needs.[32] Only 13% of the investments needed are related to the ships themselves (machinery, onboard storage, retrofitting, energy efficiency technologies, etc.). Therefore, T&E proposes that we use the revenues from the maritime ETS to **help deploy zero-carbon vessels and fuels** (e.g. green hydrogen and ammonia) and their **relevant infrastructure needs in European ports**.

As carbon pricing alone will not be able to bridge the price gap between fossil and sustainable alternative marine fuels (e.g. green hydrogen and ammonia), a **'contracts for difference' support scheme (CfD)** could be set up with the revenues from the maritime ETS. Such a scheme would support either producers of sustainable alternative fuels to lower their market price or ship owners/operators to carry the more expensive fuel bills. The aim would be to allow for a number of initial deployments of zero-emissions vessels by pioneer shipowners providing commercial services. In time, and in parallel with a sustainable fuels mandate creating substantial and predictable demand from shipping for e.g. green hydrogen and ammonia, this would unleash economies of scale and drive down the production costs of these fuels. While it might be easier to subsidise the fuel supplier to supply green hydrogen/ammonia with an equal to fossil marine fuel price, it could be difficult to guarantee that these fuels will end up in a ship as opposed to being used for other sector's needs. Subsidising the shipowners/operators on the other hand might be slightly more complex to set up, but, if well designed, targets ships directly. Fossil based fuels and biofuels would have to be excluded from any support in order to direct limited funds to scalable technologies/fuels, such as green hydrogen and/or ammonia, that would otherwise remain uncompetitive vis-a-vis fossil fuels.

[31] European Parliament. (2020) Shipping industry must contribute to climate neutrality, say MEPs
[32] Global Maritime Forum. (2020) The scale of investment needed to decarbonize international shipping

Policy recommendation

T&E supports the European Parliament's proposal to create a Maritime Decarbonisation Fund (dubbed 'Ocean Fund' by the Parliament) under the ETS scheme. Such a Fund would earmark maritime ETS revenues to the sector and help deploy zero-carbon vessels and fuels (e.g. green hydrogen and ammonia) and their relevant infrastructure needs in European ports. As carbon pricing alone will not be able to bridge the price gap between fossil and sustainable alternative marine fuels, a 'contracts for difference' support scheme (CfD) could be set up with the Fund revenues in order to de-risk the deployment of initial ZEVs.

9. Review clause

Current global climate policies will fail to achieve the aims of the Paris climate agreement, namely to keep global temperature rise 'well below' 2°C, while pursuing efforts towards 1.5°C, and to achieve net zero emissions in the second half of the century. However, the Paris agreement architecture has foreseen a so-called 'ratchet mechanism' that aims to crank up ambition over time.[33] The mechanism requires countries to submit emission reduction targets (so-called Nationally Determined Contributions or NDCs) on a five-year cyclical basis, each of which must be progressively more ambitious than the last. Countries or regions using ten-year targets, like for example the EU, are thus still required to communicate or update their target every five years. The 'ratchet mechanism' also includes a so-called 'global stocktake', which takes place every third year of the cycle. The stocktake assesses collective progress towards achieving the long-term goals of the agreement and identifies the ambition gap. The first of these stocktakes will take place in 2023. As with the facilitative dialogue in 2018, countries must use the stocktake's outcomes to inform their next NDC.

The rules and architecture of the overall ETS scheme should be reviewed every five years, in line with the Paris climate agreement 'ratchet mechanism'. This review should aim to raise global ambition in the lead-up to the 'global stocktake' and reflect Europe's historic responsibilities. Assuming that the legislative process around the current review will take until the end of 2022, it might however make more sense to organise a first review of the renewed ETS architecture in 2024, after the 'global stocktake', but before the EU's updated 2030 target needs to be communicated to the UNFCCC in 2025. As of the second 'global stocktake' in 2028, the ETS review should always come ahead of the stocktaking exercise, in order to take full advantage of the EU's climate leadership.

[33] United Nation. (2015) Paris Agreement

As the maritime ETS will be a new addition to the overall ETS scheme, there needs to be a specific assessment of its architecture after 2 years of implementation. Assuming that the scheme can start on January 1st 2023, that means a first review will be necessary in 2025. The aim of the review should be to increase the environmental ambition and stringency of the scheme. For example, if fishing vessels and inland waterway transport vessels are allowed a phase-in period where they are first required to meet the obligation under the MRV regulation, but are not yet required to pay for their emissions, then these ship types can be included during the first review. The same could be done for the inclusion of additional GHGs, while we would very much advise against not including at least methane emissions from the very beginning of the scheme.

Policy recommendation

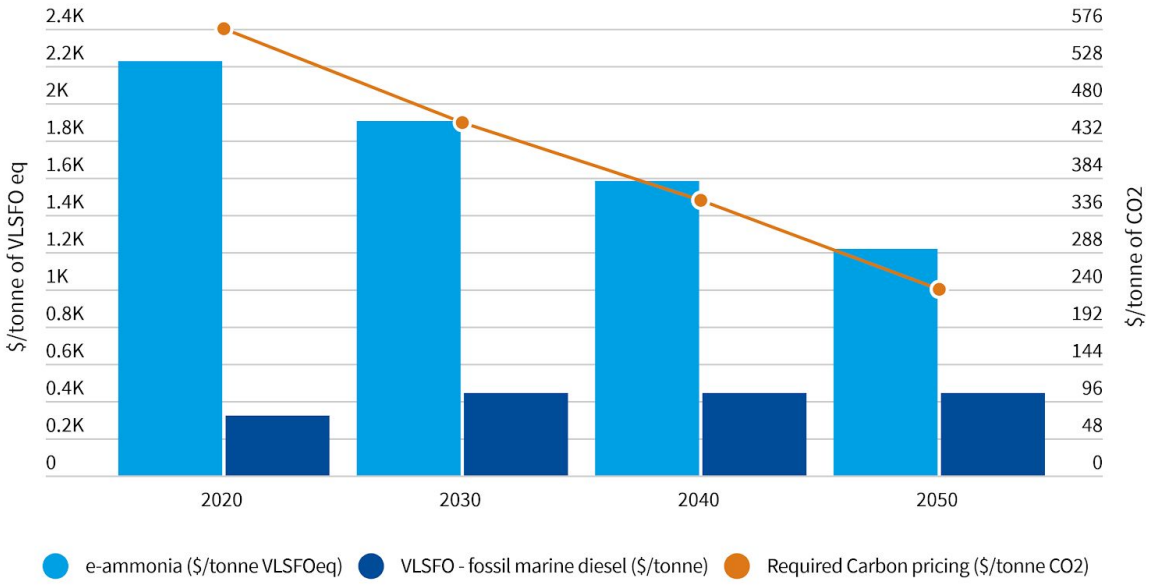
The rules of the maritime ETS should be evaluated after 2 years of implementation, with the aim to increase the environmental ambition and stringency of the scheme. For example fishing vessels and inland waterway transport vessels could be included at that point. Any other gaps in the scheme's ambition (be it on geographical scope, covered emissions, allocation of allowances, cap, enforcement or use of revenues) should be covered at this point.

10. Basket of measures

EU shipping will require a basket of measures to be able to fully decarbonise by 2050, as the ETS price alone will not be able to bridge the price gap between sustainable alternative fuels and fossil fuels, nor will it sufficiently drive energy efficiency. For those technical and operational options that are already cost-effective today but remain inadequately adopted, it is clear that there are **other barriers than pricing** alone at play obstructing their widespread uptake. One such barrier is the 'split incentive' problem, whereby shipowners pay for the technical improvements while charterers benefit from the fuel savings (see section 4). This is a "qualitative problem" and cannot be fully solved via quantitative tools like carbon pricing. The decision on whether or not to operate a ship more efficiently, for example by slow steaming, will depend on a delicate balance of three factors. The first being the baseline fuel prices, the second the earnings of shipowners (i.e. charter or freight rates) and the third carbon pricing. Assuming the carbon price remains constant, high fuel prices and/or lower earnings will incentivise efficiency and vice versa. As today fuel prices are low and shipowners' earnings are high, a very high carbon pricing would be needed to induce efficient ship operation.

For other measures, and certainly for a switch to green hydrogen and ammonia, the level of carbon pricing needed to reach a break-even point with the current fossil fuels is much higher than the price

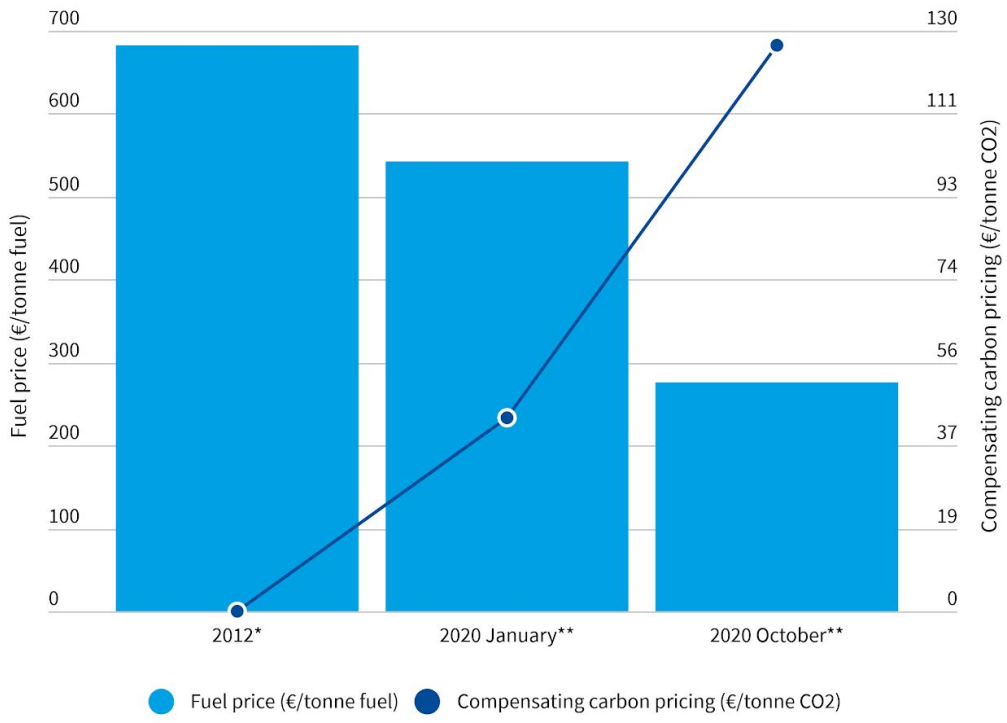
levels we so far have experienced (and expect to see in the near to medium term) under the ETS. This is evidenced by figure 7 below.



Source: UMAS-Lloyd's Register, 2020. Carbon pricing estimated by T&E using 3.197 CO2 emissions factor for VLSFO.

Figure 7: E-ammonia cost projections and required carbon pricing

The rationale of carbon pricing is to make the continued use of fossil fuels expensive. However, that can only be effective if the carbon price is added on top of already high or stable fuel prices. If the fuel prices decline, the carbon price only compensates the reduction in fuel prices, as opposed to adding extra costs to their continued use. For example, in 2012 inefficient ships were using HFO at a fuel price of €680/tonne. In January 2020, fuel prices declined to €540/tonne and dropped even further to €280/tonne in October 2020. To compensate for the decline between 2012 and October 2020, figure 8 illustrates how we would need to have had a carbon price of around €127/tonne CO2, which is already four times higher than the highest ETS price so far. In other words, today's carbon price won't even make HFO as expensive as in 2012, let alone drive further energy efficiency technologies that were not taken up even in 2012.



Note: T&E calculations based on the data from the IMO Fuel Availability Study (2016) and Ship Bunker Prices: https://shipandbunker.com/prices/emea/nwe/nl-rtm-rotterdam. Analysis assumes 3.1968 CO2 emissions factor for marine fuels.

Figure 8: Required carbon pricing level to compensate for fuel price decline

Applying **additional regulatory initiatives, that do not rely on price signals or cost equilibrium**, will thus be essential to ensure the **uptake of energy efficiency measures and zero-emission fuels**, both on the demand and supply side.

Policy recommendation

Carbon pricing is an essential instrument to raise revenues that can be used to help the maritime sector decarbonise. But it should be complemented by other measures to overcome non-price related barriers towards the uptake of energy efficiency measures and a fuel switch to The additional regulatory initiatives should create predictable demand for e.g. green hydrogen and ammonia on the one hand and drive energy efficiency on the other hand. The Commission's FuelEU maritime initiative and the Parliament's 40% carbon intensity improvement target seem best placed to fulfill this dual goal.

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