METHANOL INSTITUTE

MEASURING MARITIME EMISSIONS

Policy recommendations regarding GHG accounting of the maritime industry

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EXECUTIVE SUMMARY

The increased integration of low carbon and net carbon neutral fuels at an accelerated rate is fundamental to attain the targets laid out by the International Maritime Organization, aimed at protecting Earth's climate from harmful greenhouse gas emissions. To effectively stimulate the uptake of fuels that will drive the maritime industry's energy transition, policymakers must employ mechanisms that account for the GHG emissions of the fuel's entire lifecycle. The arguments laid out in this document support the Methanol Institute's policy recommendation of applying a well-to-wake approach in GHG accounting of maritime transport on the basis of three key implications: i) Policy should present investment signals to foster innovation and renewable power generation at scale to address the reduction of GHG emissions based on the entire environmental profile of fuels to avoid incentivizing the large-scale reallocation of GHG emissions to upstream fuel production processes; ii) The burden of decarbonization should belong to the entire maritime sector; iii) The imminent threat of climate change and the associated fast-approaching targets require a mechanism that supports the uptake of sustainable fuels without delay; and iv) Not only should policy present investment signals it should incorporate incentives. It is not sufficient that the IMO includes Well-to-Tank emissions only for information purposes and continues to regulate Tank-To-Wake in isolation. The IMO needs to ensure than emissions in the Carbon Intensity Indicator (CII) must be reported on a Well-to-Wake basis.

True Net Zero; The Practical Target to Chase

International shipping accounts for about 2.5% of global greenhouse gas emissions, emitting more than 940 million tons of CO_2 annually. In the absence of mitigation efforts, the inevitable increase in demand for maritime transport will lead to a steady increase in emissions. Most notably this is because the favored approach to shore-based energy production (power generation) is 'renewable' in nature and, for road transport decarbonization – direct electrification (whether battery electric or hybrid battery electric). However, electrification has only a limited application at sea (short sea shipping or inland waterways), for reasons which are both technical and economic in nature. Thus, the marine sector will continue to remain highly dependent on liquid fuels or fuels which most closely resemble 'drop-in' fuels. The difficulties in decarbonizing the sector may be further highlighted by pointing out that CO_2 emissions in shipping increased by 6% in the 2012-2018 period.

In the interest of simplicity and staying within its scope of operations, existing instruments implemented by the International Maritime Organization refer to the tank-to-wake approach, meaning solely the emissions derived from on-board fuel combustion. The clear limitation of this approach is that all emissions associated with fuel extraction, production, processing, transport, purification, or liquefaction, refining, or transporting and bunkering are left out of the equation.

Emissions from upstream processes in case of the top contenders for the title of maritime fuel of the future, including hydrogen, ammonia, and methanol, often represent a significant share of overall emissions determined on a well-to-wake basis. Furthermore, fuels that are produced using electricity derived from fossil sources are deemed carbon neutral, despite requiring the continued extraction of new fossil uptake for their production. Persisting with a tank-to-wake approach is likely to stimulate the uptake of fuels such as hydrogen and ammonia which have zero operational emissions simply because there is no carbon in the final product molecule, but are produced using pathways with significant upstream emissions, creating a false impression of GHG reduction in maritime transport.

The alternative, more comprehensive approach, is the well-to-wake method of measuring maritime emissions. By considering emissions related to the full production cycles of fuels, policymakers can have a more complete picture of the environmental profile of marine fuels and in doing so determine a path to true, net carbon neutrality. Uptake of low carbon and net carbon neutral fuels can only occur in a market environment where upstream emissions are factored into a well-to-wake analysis which is also incorporated into carbon credits, energy policy, and suitable incentives to encourage ship owners to make a switch. In fact, the scope of IMO regulation clearly affects fuel uptake from production to distribution. By placing the sole emphasis of instruments aimed at GHG reduction on emissions from combustion, propulsion of fuels with low operational emissions, often labelled "zero-propulsion" is rewarded. It is not yet widely recognized that such fuels, namely hydrogen and ammonia produced from natural gas, may well consist of higher carbon intensity than fossil alternatives, due to upstream inputs. Thus, maritime regulations could perversely serve not to decarbonize maritime transport, but to shift emissions to upstream sectors.

Avoiding 'Burden Shift'

The tank-to-wake approach undisputedly places the burden of greenhouse gas emissions from combustion solely on ship owners, considering carbon on a tank-to-wake basis while disregarding other GHGs. It implies that to achieve decarbonization, ship owners are held wholly responsible for ensuring decarbonization of the sector. A well-to-wake approach is bound to extend the burden to fuel suppliers, power generators, port authorities and national governments, as it recognizes that emissions from the marine sector are derived from elsewhere than aboard the ships themselves. It should be possible to do this without double counting of emissions with the IMO incentivizing emissions reduction through shared responsibility. A holistic approach will further ensure that risks are more evenly spread, allow for carbon offset schemes, deepening collaboration, and will additionally prevent global decarbonization policy from becoming fragmented as vessel owners potentially move outside tightly regulated regions to lower their fuel costs. At the same time, this will ensure that those who are compliant and invest in resources to decarbonize are not rendered uncompetitive – thus a level playing field is ensured.

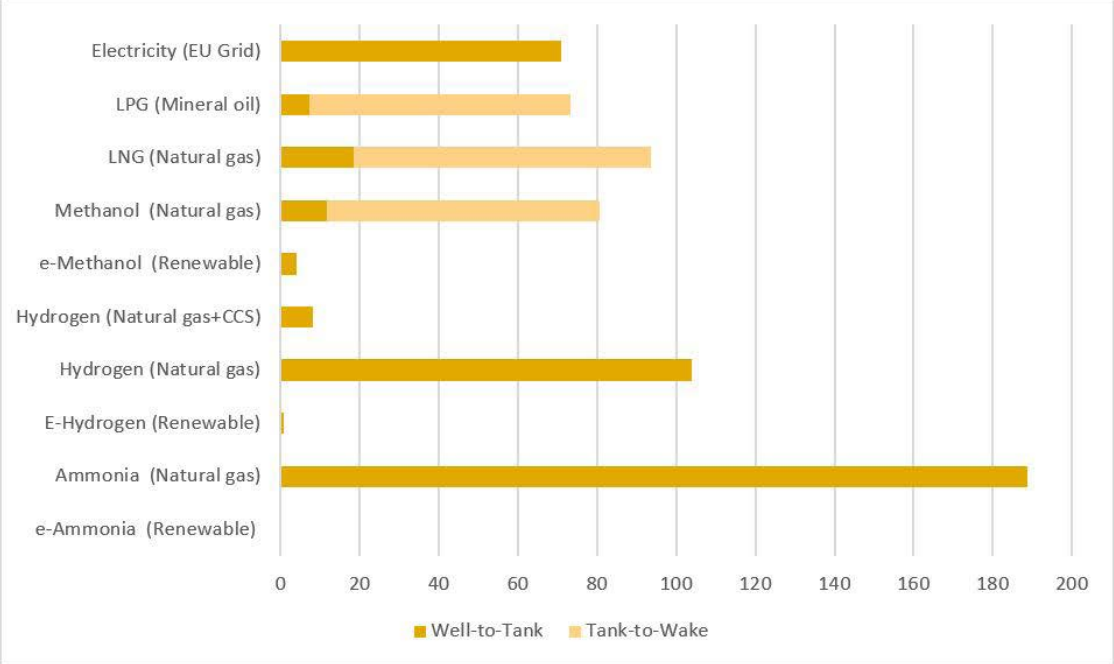
The well-to-wake approach, applied in conjunction with intelligible Life Cycle Assessment (LCA) guidelines, would also accurately establish a comparison of marine fuel performance with regards to emissions of other potent greenhouse gases beyond carbon dioxide such as methane and nitrous oxide. The tank-to-wake approach clearly selects winners from the outset, which is bound to stifle innovation and initiative and hinder actual progress. The well-to-wake approach stimulates the uptake of fuels produced with a reduced carbon footprint but does not eliminate the so called "zero carbon" propulsion fuels currently favored by the tank-to-wake approach.

The Time is Now

A key benefit of the well-to-wake approach is that it incentivizes vessel owners and operators to begin using existing fuel alternatives such as methanol, already confirmed by the IMO to deliver immediate climate benefits in the form of reduced SOx, NOx and carbon intensity, in the period leading up to the IMO's first major emissions reduction date of 2030. The industry may adopt existing alternative fuels gradually or partially into their value chains, enabling vessel operators to optimize procurement to reflect sustainability requirements. Once supply of carbon neutral feedstock is more developed, vessel owners could adopt a full share of carbon neutral fuel. This would serve as a more realistic and economically viable approach to decarbonization, compared to the proposals for retrofitting many vessels to use fuels which currently either do not yet exist, are not economically viable, or both. While the large-scale integration of fuels such as biomethane, hydrogen and ammonia into global maritime transport still faces time-consuming technical and economic challenges, the application of the well-to-wake approach would support the immediate uptake of market-ready alternative fuels, such as methanol. With IMO's 40% CO^2 reduction target of 2030 fast approaching, shipping doesn't have the luxury of waiting for as yet unavailable fuel technologies to reach technical readiness, regulatory approval, and availability when clean fuels are already available now for use in existing vessels as well as newbuilds, are readily traded on digital fuel platforms, and are available in low carbon formats.

Quantitative approach - Example

Greenhouse gas performance of marine fuels can be calculated through accounting for all material and energy inputs and outputs in the production and supply chain. The fuel can be produced from multiple feedstocks which each present a different environmental profile. The below graph (Figure 1) illustrates the different emission profiles of marine fuels processes indicating how vital the type of feedstock, conversion efficiencies and energy use during the production process are when determining actual climate impact of marine fuels. All major greenhouse gases are considered (mainly CO_2, CH_4 and N_2O) and expressed in CO_2 equivalent (CO_2e) units.



**The European Sustainable Shipping Forum applies zero emissions to e-fuels when produced from renewable energy. This is not entirely correct because solar PV has a carbon footprint of about 4g CO2e/kwh, wind about 7g CO2e/KWh and hydro about 19g CO2e/kWh. Furthermore, conversion to e-fuels and transport to costumer also involve greenhouse gas emissions*

Figure 2: Well-to-tank and Tank-to-wake emissions. (Source: European Sustainable Shipping Forum and Studio Gear Up)

The graph clearly illustrates the limitations of a sole focus on operational emissions, which would for example grant vessels propelled with ammonia or hydrogen from natural gas a zero-emission status, despite emitting more than any of the other potential alternative fuels. If policymakers truly intend to apply a metric to GHG emissions which reflects reality instead of a false impression of progress, the well-to-wake approach represents the only viable path forward.

LCA Methodology

The approach for calculating well-to-wake emissions based on fuel consumption is well established, as LCA is frequently applied across different sectors to assess the environmental impact associated with all stages of commercial products, processes, or services. In fact, the EU Directive 2018/2001 already has in place an LCA-based GHG emission saving criteria and a GHG methodology for bio-based renewable fuels. A similar threshold exists for synthetic e-fuels. Industry examples of multiple voluntary LCA-based certification schemes, such as the ISCC and ISCC Plus and Redcert, are also readily available for references.

Global Warming Potential 100 (GWP100) is a unit of measurement typically applied to marine fuels to determine how much energy the emissions of a certain fuel will absorb over 100 years relative to the emissions of a ton of CO_2. To take better account of short-lived climate pollutants in marine transport, such as methane, the Global Warming Potential (GWP) should reflect a shorter timeframe of 20 years. For greenhouse gases with a longer lifetime, a GWP of 100 years should be applied. This will produce a CO_2e value which more accurately reflects reality, representing a suitable common scale for measuring climate effects of fuels under the well-to-wake approach.

The Methanol Institute – Requested action

As the trade association for the global methanol industry, the Methanol Institute is a leading source of information on the production and use of methanol as a chemical building block and an energy resource. Since 1989, the Methanol Institute has prepared reports and technology briefs on all aspects of the methanol industry, managed key Internet and social media platforms, and has a professional staff with nearly 200 years of experience in business development, public policy, and communications. Consisting of over 50 methanol producers, technology providers and methanol distributors, the Methanol Institute represents a strong voice in support of a holistic, science based well-to-wake approach to GHG emission measuring in the maritime sector.

The maritime industry needs better information on which alternative fuels provide practical, adoptable choices that comply with prevailing regulation and present manageable investment, operational and financial risks. The Methanol Institute calls on the International Maritime Organization to adopt a mechanism to reflect the benefits of different fuels and provide ship operators with signals upon which to assess their options. The Methanol Institute appeals to the International Maritime Organization to recognize the necessity to:

1. Apply a robust LCA (life cycle analysis) regarding GHG guidelines for all types of marine fuels[1] which will consider CO_2e on a well-to-wake basis, to be used in CII calculations and other relevant regulations such as market-based measures; and[2]

2. Apply a dual-term greenhouse gas accounting standard: 20-year Global Warming Potential (GWP) alongside the presently accepted 100-year GWPs.

[1] ISWG-GHG 6 invited interested Member States and internal organisations to submit proposals for ISWG-GHG 7 to consider regarding the reduction of methane slip as a path forward for the ISWG to then make a recommendation to the Committee (MEPC 75/7/2 paragraph 40)

[2] ISWG-GHG 7/3 includes a proposal to aggregate all GHGs from vessel emissions in the EEDI, from phase 4, to include methane slip, as CO_2e

GLOSSARY

Concept	Definition
Carbon Neutral Propulsion	Net-zero carbon dioxide emissions from vessel propulsion as determined by Life-cycle analysis factoring in upstream emissions
Zero Carbon Shipping	Zero carbon dioxide emissions from combustion of fuel onboard a vessel
CO2e	A unit of measurement for the environmental impact of one tonne of greenhouses gases in comparison to the impact of one tonne of CO_2
GHG Emissions	Emissions of greenhouse gases that cause climate change by creating a greenhouse effect in the Earth's atmosphere
GHG Accounting	A corporate or organisational greenhouse gas (GHG) emissions assessment quantifies the total greenhouse gases produced directly and indirectly from a business or organisation's activities
GHG Savings	The greenhouse gas emission saving (GHG emission saving) denotes the percentage of greenhouse gas emissions (GHG emissions) that could be saved by using alternative fuels instead of fossil fuels
LCA	Life cycle assessment is a cradle-to-grave or cradle-to-cradle analysis technique to assess environmental impacts associated with all the stages of a product's life, which is from raw material extraction through materials processing, manufacture, distribution, and use

GLOSSARY CONTINUED

Concept	Definition
GWP20 and GWP100	The Global Warming Potential (GWP) of a greenhouse gas is its ability to trap extra heat in the atmosphere over time relative to carbon dioxide (CO_2) the 20-year GWP is based on the energy absorbed over 20 years and the 100-year GWP on energy absorbed over 100 years
Well-to-Wake / WtW	Refers to lifecycle assessments of GHG from fuel production (upstream emissions), carriage of the fuel in a ship's tank, to the ship's exhaust (downstream emissions)
Tank-to-Wake/TtW	Refers to lifecycle assessments of GHG from the fuel in a ship's tank to the ship's exhaust (downstream emissions only)
EEDI	The Energy Efficiency Design Index EEDI is the measure of energy efficiency of a ship by design

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THE METHANOL INSTITUTE (MI)

FOUNDED IN 1989

Serves as the global trade association for the methanol industry representing the world's leading methanol producers, distributors and technology companies, the mission of the Methanol Institute (MI) is to serve and provide cost-effective value to its membership from our offices in Singapore, Washington, D.C., Brussels, Beijing and Delhi.

Recent initiatives include: Supporting the development of a methanol economy in India; participation in and co-funding of leading marine pilot programs in Sweden and Singapore; the production of an updated Methanol Safe Handling video; helping to produce industrial boiler and cookstove standards in China; and representing the methanol industry through the International Bunker Industry Association (IBIA) at the International Maritime Organization (IMO) which led to the confirmation of interim guidelines for methanol as a marine fuel.

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