INSIGHT BRIEFING SERIES

Beyond the colours: Life cycle analysis of marine fuel

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The Getting to Zero Coalition is committed to accelerating shipping decarbonization by getting commercially viable deep sea zero emission vessels powered by zero emission fuels into operation by 2030 to put shipping on a path for full decarbonization by 2050. To unpack the different fuels and technologies options that could support the transition to zero emission fuels, the workstream on Fuels & Technologies has hosted a series of webinars, gathering perspectives from experts across the maritime value chain - shipowners, operators, charterers, financial institutions, classification societies, and NGOs. The insight briefing paper series aims to reach a broader audience and build a common understanding of the fuels, engines, and storage technologies that will enable the decarbonization transition.

The Insight Brief is based on analysis by Global Maritime Forum for the Getting to Zero Coalition, a partnership between the Global Maritime Forum and the World Economic Forum, made possible with funding from Mission Possible Partnership.

Date of the webinar: December 2021

Watch the webinar here.

Panelists:

- Alexandra Ebbinghaus, General Manager Decarbonisation, Shell Marine, Shell
- Freda Fung, Independent Consultant, Fung Research
- Matthew Williams, Decarbonisation Strategy Manager, Lloyds Register
- Ingrid Marie Vincent Andersen, Head of Decarbonisation Targets & LCA, A.P. Møller-Mærsk A/S

Moderator: Randall Krantz, Senior Project Advisor on Shipping Decarbonization, Global Maritime Forum/Getting to Zero Coalition

Executive Summary

Synopsis: Zero emission fuels for shipping and other industries are often referred to simplistically by colour - green for biomass or renewable feedstocks, blue for fossil fuels with carbon capture and sequestration, brown for conventional fossil fuel, etc. The reality is much more nuanced than this, and most fuels won't be entirely one colour of another. Life Cycle Analysis (LCA) can be used to better understand and inform decisions related to shipping's decarbonization transition by quantifying greenhouse gases (GHG) impact from extraction or synthesis, processing and transport of alternative fuel feedstocks, as well as their bunkering and onboard use. Going beyond the different colours of fuels, the limits of this classification, and how to overcome them, this webinar explored the consequences and robustness of the approaches to classify fuels based on their quantified LCA emissions.

Key takeaways:

> Colours create uncertainties. In order to trigger investments, the emission framework needs to be specific, quantified, and granular. Enforceability is needed, and common quantification/analysis set by regulatory authorities need to be aligned on a global scale in order to ensure compatibility across industries and geographies.

> LCA allows the replacement of colours with quantified values on the GHG emissions. Colours imply uncertainty and variability depending on the feedstock and the production process. LCA is standardised by the ISO 14040-series. The

Well-to-Wake (WtW) defines the boundaries of the LCA which should be a minimum.

- A common understanding of both WtW emissions and LCA of different fuels could help to inform investment decisions.

The webinar was attended by participants from the maritime sector such as engine makers, shipowners, cargo owners, ports, classification societies, energy producers, financial institutions, and government representatives. A poll was conducted to better understand the LCA familiarity and experience of the +100 participants that attended this webinar, resulting in a fairly even split of LCA familiarity. This was spread across those already using LCA for investment decisions (23%), exploring how LCA impacts their operations (32%), interested in using LCA for investing-ment decisions (19%), and familiar with LCA in passing only (26%).

Detailed Summary

About life cycle analysis

Shipping's fuel transition needs to mobilise large scale investment into the long-run scalable solutions across the value chain – fuel production, supply chain, bunkering, and use. Over the past few years, synthetic fuels have been referred to as "green" or blue" depending on whether their energy source is from renewable sources or fossil fuels using carbon capture and storage (CCS), respectively. However, this general classification is insufficient in the face of the technical and supply chain complexity of bunker fuel supply. For this reason, an analytical framework on emissions coupled with clear methodology is needed: life cycle analysis. As the transition will likely include a diversity of different fuels, a clear regulatory lead is needed to help make sure exactly how LCA will be deployed and used is critical to enabling effective investment in shipping's decarbonisation.

1. Life cycle analysis and Well-to-Wake approach

Alexandra Ebbinghaus, General Manager Decarbonisation at Shell Marine, acknowledged the colour scheme as an easy way to categorise chemically identical fuels from different production pathways and feedstocks. To bring more precision, LCA allows replacing the colours with an actual value on the greenhouse gases (GHG) emissions. The LCA encompasses the whole production process, starting with the feedstocks, whether the process includes air separation units, renewable energy or grid energy. In addition, LCA can quantify the impacts beyond GHG emissions, since it takes into account direct and indirect effects of the fuel production, such as upstream deforestation. Finally, the LCA methodologies already exist as a standard method for quantifying the sustainability of a product and service defined by the ISO 14040-series.

Ingrid Marie Andersen, Head of Decarbonisation Targets & LCA at A.P. Møller Mærsk, described the scope of a Well-to-Wake (WtW) [exhibit 1] approach as one that encompasses the emissions due to the extraction, cultivation or production of renewable energy feedstocks and their transport. It also takes into account the emissions occurring during the transformation such as the refining or conversion through

carbon capture, electrolysis or haber bosch process. Finally, the WtW considers emissions released during the transport, the distribution, bunkering, and the combustion of a fuel.

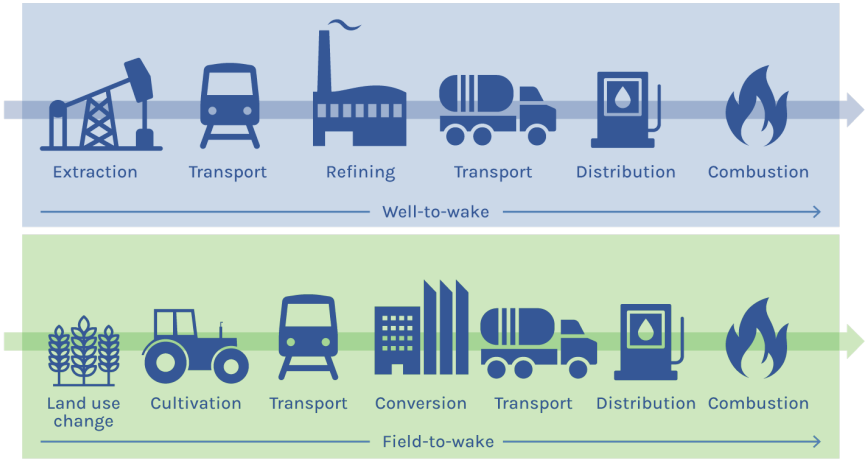


Exhibit 1: *Lifecycle GHG emissions*

Source: *Mærsk, adapted from ICAO*

Adapted from ICAO

As explained during the webinar, WtW and LCA are different and complementary. WtW defines the boundaries of the analysis but not the methodology. An LCA should be carried out over the full WtW footprint, quantifying from the extraction or land use change of the feedstock to the combustion of the fuel. While an LCA for fuels includes many elements, at this stage the environmental footprint of constructing and deploying facilities required to produce renewable energies are not included in the WtW LCA scope.

For Ingrid Marie Andersen at Mærsk, “The challenge in the shipping context remains to apply those standards consistently across different types of fuels.” Indeed, shipping companies would face some challenges if the certification schemes do not follow the same standards globally while the shipping company buys fuels across the world.

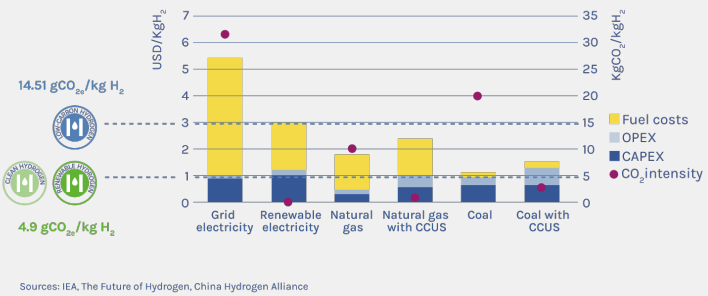
Example of Certification Standards

China Hydrogen Alliance

In China, hydrogen is produced in different ways. By using grid electricity, the carbon intensity is the highest while, when using direct renewable electricity for production, it is unsurprisingly the lowest [exhibit 2]. As Freda Fung, Independent Consultant at Fung Research, mentioned, “LCA can trigger policy makers and investment decisions.” For example, the China Hydrogen Alliance, has developed Hydrogen Certification Standards releasing three labels. The first label, for “Low carbon”, “Clean” and “Renewable” hydrogen, mandate that lifecycle emissions should not go above designated thresholds per kilogram of hydrogen. This example could potentially be used as the CO2 per kilogram metrics. However, it only includes CO2 as greenhouse gases and applies only for hydrogen production.

Exhibit 2:
China hydrogen Certification Standard, H2 production costs in China & CO2e intensity

Sources: *IEA, The Future of Hydrogen, China Hydrogen Alliance*



2. Ensuring consistent application using common standards

a. The role of regulatory organisations

Regulatory organisations have a role to play in how LCA is used in order to build a consistent approach. They have the ability to ensure the use of LCA, the scope and climate targets, and to set the rates of carbon intensity.

Matthew Williams, Decarbonisation Strategy Manager at Lloyds Register, mentioned that, “the International Maritime Organisation (IMO) is cognizant of LCA focusing on regulating ship emissions on an operational basis, but recognizes that to avoid consequences upstream, it needs to take into account the LCA of fuels in their production process.” He further added that, “Default values for WtW have been considered and substantial variations should be taken into consideration in terms of production methodologies and geographies”.

Shipping is not specifically part of the scope of the Paris Agreement, and the IMO only regulates ships and the operational domain of ships. In this context, to reach the target of 1.5°C, there is an opportunity for the IMO to work closely with other energy agencies to build a consistent LCA WtW approach. Indeed, if shipping can decarbonize its full value chain, the upstream measures for impact could serve the Nationally Determined Contributions under the Paris Agreement. Different decarbonisation goals are in place. In the view of Ingrid Marie Andersen, once the LCA framework is set up, the scope of the analysis can be defined under one of the current standards and goals such as the Paris Agreement, for instance. For Freda Fung, another target could be to “look at the near and long-term perspective in terms of investments depending on the different milestones (in terms of emission target) needed to achieve the transition”. The transition strategy developed by the Getting to Zero Coalition is a convergence of the scalability of different pathways, the investments and regulations that need to be in place to transition from fossil fuels to zero emission fuels.[1]

1 Getting to zero Coalition. (2021). A Strategy for the Transition to Zero-Emission Shipping

Finally, Matthew Williams pointed out that the European Union (EU) is currently incorporating lifecycle GHG intensity for maritime regulation along with the penalties paid on the basis of the lifecycle performance, which should kick-off by 2025. This same assessment has been proposed to the IMO and its application would bring some consistency from a geographic perspective. “Because colours do not support accounting and cannot be monetized, they cannot be included in regulations. The colours make fuel choices simpler, but they make the risks and opportunities of those choices harder to understand and, with the challenge ahead, this is not very helpful.” Those words were the closing remarks of Matthew Williams. In his view, incentives could change behaviours creating a market for supply and demand with carbon intensity pricing to help players understand the true cost of the life cycle performance and the decisions they are making.

b. Example of financing

There are financial advantages of transparent LCA as well. Ingrid Marie Anderson noted that banks are looking for very detailed descriptions regarding the approach of LCA and WtW emissions, and have been very interested in the methodology and quantification of the impacts on climate as well as on the broader ecosystem and biodiversity. Maersk recently launched its Green Finance Framework, which included a 10-year, €500 million green bond to fund the build of its first feeder vessel and the series of 8 large methanol-powered container vessels. The transaction was met with strong demand with a final coupon price of 0.75%, the lowest coupon ever for Maersk.

c. The timeline

From the webinar, there is a clear appetite for an LCA WtW approach to emerge as a norm for the industry, reducing uncertainty and linking the 2050 objective with quantified impacts of fuel choices. Having clarity on the timeline for the application of global standards could speed up the decision making process for investments.

According to Matthew Williams, the IMO could deploy the LCA WtW taking two different approaches: the first is by giving guidance that could be expected in 2023; the second, by implementing regulations that could be expected around 2026. The outcomes of such regulation will be a standard against which LCA is done. In addition, the EU is working on the incorporation of LCA into the scope of green transport. However, that could change through the negotiations regarding the EU Fit for 55 proposal and the renewable energy directive. Definitive outcomes on the EU side are expected around 2025.

Conclusion

In summary, panellists agreed that while colour coding is useful for general discussions, decision making and investment will require quantified fuel emission values on a WtW basis. Standardisation and enforceability of LCA are needed, and targets set up by regulatory authorities should be aligned on a common standard in order to be

compatible with different industries and geographies. In addition, a common understanding of both WtW emissions of different fuels, and LCA, could help to make better investments. Finally, while awaiting industry-specific standardisation, establishing a carbon intensity pricing system, choosing targets, and developing a methodology are actions that can already be taken to move forward on the pathway to decarbonization.