The IMO 2050 agenda

Why the short term for marine fuels will be "lower carbon", not "decarbonisation"

The world is under increasing pressure to decarbonise. Historically, the shipping sector has been somewhat exempt from external pressure to improve emissions, but this is changing fast. Channoil Consulting, in association with Gibsons' Shipbrokers, have investigated the context of decarbonisation in the maritime sector, taken a reality check on the fuelling options and likely short-term solutions, and examined fuel economics for the likely short-term options.

Context of decarbonisation

Up to January 2020, the marine market has been something of a "dumping ground" for low quality heavy oil by-products from refining and furthermore emissions on the high seas have been seen as "out of sight, out of mind".

Policing global quality standards is not easy. Other transport fuels such as gasoline and diesel can be - and have been - regulated at a country or regional level. This can be seen in the successful introduction of higher engine emission standards through the Euro I – VI standards and the associated tighter fuel quality specifications. However, the aviation and shipping sectors have managed to circumvent pressure to increase fuel emissions for two main reasons:

1. The need to impose consistent global standards, without any exceptions or escape options.
2. A conservative approach to the adoption of new fuel emission standards where this would introduce safety risks (aviation) or impose additional capital costs on already capital-intensive industries.

But this historic tendency has now started to change.

For the shipping sector, this commenced with the introduction of specific Environmental Control Areas (ECAs) and now the further tightening of sulphur limits by the International Maritime Organisation; (IMO) 2020.

However, as with other fossil fuels, improvements in emission performance of fuels through reduction of sulphur and other exhaust contaminants, has diverted attention away from the fact that fossil fuels are still being burned and producing undesirable CO_2 emissions.

The next move is now starting to take shape, with the IMO developing the mechanisms for the world shipping sector to achieve a 50% reduction in total greenhouse gas (GHG) emissions by 2050. This will also be coupled with a 70% reduction in the "carbon intensity" of international shipping by the same. Carbon intensity is CO_2 emissions per transport work or shipment. If shipping trade is going to continue to grow, yet at the same time reduce its total GHG emissions by 50%, then the carbon intensity needs to be reduced by more than 50% to allow for the growth, hence the 70% target on carbon intensity.

What is the scale of change required?

On their website, the IMO estimates that global shipping emitted 796 million tonnes of CO_2 in 2014 and that, if unchecked, emissions from global shipping could increase from this level to between 50% and 250% by 2050.

What progress is taking place?

There is a complex set of mandates, targets and guidelines being developed by the IMO to meet the 2050 targets. The baseline used for benchmarking and standard setting is 2008, which on the one hand, allows ship owners to claim efficiency benefits on vessels that have already been achieved since 2008, such as reduced speed and improvements in fuel efficiency; on the other hand, increases in shipping activity since 2008 and the concomitant increase in emissions will have to be accounted for. This is an important point to note - the 50% reduction is not versus where we are today: It is versus 12 years ago, an easier target to reach.

Nevertheless, this is still a major challenge for the shipping industry and it cannot be met by efficiency and operational changes alone. New lower carbon fuelling solutions will be necessary. The IMO has taken a clear stance with this 2050 objective and, whilst some may argue that it is either too little or taking too long, the IMO was very successful in pushing through the 2020 mandates. This despite plenty of challenges and resistance from sector stakeholders.

The IMO is also clear in recognising, in its targeting, that the aim should be to create "a pathway of CO2 emissions reduction, consistent with the Paris Agreement temperature goals". It must be noted that the USA has withdrawn from the Paris protocol in November 2020. As it happens, American flagged ships do not comprise a large percentage of the world's fleet. Whether the President elect Joe Biden will reverse this decision is awaited next year.

To meet this objective, the IMO has established a baseline for each type of vessel and cargo capacity. Ships built in the future will have to beat that baseline target, and by increasingly challenging amounts over time. Existing ships are required to have an energy efficiency management plan in place. This plan will cover metrics such as cargo size optimisation, voyage management and vessel speed, among others.

Consequently, fleet operators are going to have to meet the 2050 and interim 2030 targets through a portfolio of incremental improvements, rather than a "silver bullet". This is good news for the highly fragmented world of future fuels being proposed, since we are a long way from finding a scalable single low-carbon alternative to fossil fuels, as the technology does not yet exist.

Enforcement will be driven by a focus on the energy efficiency of individual vessels, their design and their operating performance:

- The Energy Efficiency Design Index (EEDI) for new ships is the single most important technical measure and aims at promoting the use of more energy efficient (less polluting) equipment and engines. The EEDI requires a minimum energy efficiency level per capacity mile (e.g. tonne mile for tankers and bulkers) for different ship type and size segments.
- The Ship Energy Efficiency Management Plan (SEEMP) is an operational measure that establishes a mechanism to improve the energy efficiency of a ship in a cost-effective manner.

The IMO will be incrementally raising the standards for both of these efficiency measures. EEDI has been already in force since 2013 for newbuild vessel designs, The Energy Existing Ship Index (EEXI) has been proposed for existing vessels as part of the IMO's latest measures to cut the carbon intensity of shipping. The IMO has also proposed implementing a Carbon Intensity Indicator (CII) for ships over 5,000 gross tonnes. Each ship will be rated A to E, and vessels consistently achieving a D or lower will have to submit a corrective action plan. The amended EEDI, new EEXI and CII could be put forward for adoption next year, with entry into force at a later stage.

Stricter Rules for Europe?

However, the EU has recently announced that it will include greenhouse gas emissions from the maritime sector into the EU's carbon market from 2022.

The EU is therefore requiring the maritime sector, to contribute to its plan, to create a "climate neutral economy" by 2050. The EU's targets are to achieve a 55% reduction in GHG emissions by 2030, well ahead of the IMO 2050 deadline, and to become "carbon neutral" (i.e. net zero carbon) by 2050. The EU has also documented its concern with what it considers to be the slow pace of change proposed by the IMO. So, while the IMO may consider its decarbonisation plan ambitious, the EU is expecting it to move faster.

The result of this EU proposal is that the shipping sector would be required to report its emissions in EU waters and to pay for these emissions by buying pollution permits where necessary. The scheme is popular with member states as it becomes a source of revenue. Simplistically, it is likely to increase the cost of doing business in the EU. In any case, carbon prices under the Emissions Trading System (ETS) are set to rise. In the short term, the EU move is likely to lead to a desire to shift polluting activities to other jurisdictions, a regulatory arbitrage issue already highlighted earlier in this article. There is likely to be some retaliation from other non-EU states if this is perceived to be a protectionist action.

Alternative Fuelling options

Regardless of whether the EU or the IMO timetables rule, the pace of decarbonisation in the maritime sector will increase significantly. As with other energy sectors, there is no apparent silver bullet and the industry is likely to have to adopt to a mix of new and existing options in order to meet the required emission reduction targets.

A range of fuelling options are currently being developed, of which LNG is the most advanced.

LNG

LNG is widely billed as one viable low carbon alternative available today. While this is possibly true, the comment in part, reflects how far behind in their developments the alternatives are. And it is still a fossil fuel. Nevertheless, the ship owner can claim emissions reductions versus Marine Gasoil or Heavy Fuel Oil (HFO).

Adapting LNG engines requires more investment than installing scrubbers (say $8m to $14m for LNG versus $2m to $3m for HFO scrubbers), however, LNG-fuelled engines will very likely offset their capital costs through operating cost advantages over traditional liquid fuels. The savings would depend on the price spread between LNG and fuel oil remaining as wide as today. Recent trends suggest that LNG might become cheaper in the long run as compared to conventional fuels.

Furthermore, there is an LNG bunkering network under active development. Initial investment in LNG use has focussed on short sea shipping and point-to-point operations such as ferries. However, with investment in LNG vessels having recently doubled, the refuelling network is also expanding. The technological challenge for LNG as a low carbon alternative is far less than with fuels such as ammonia and hydrogen: the technology may be expensive, but it is proven and current economics seem favourable.

Biofuels as Marine Fuels

Biofuels could be considered as a carbon reduction alternative, either in a pure form or blended into Marine Gasoil or VLSFO.

The two main options are either FAME or Hydrotreated Vegetable Oil (HVO). However, while FAME is notionally cheaper, it is known to be problematic in a wet environment and is therefore unlikely to be a suitable alternative, unless this can be managed. Technically HVO is a good possibility and it is being actively developed by some bunker marketing organisations and producers. However, the call on HVO into the road diesel market is much stronger, driven by aggressive mandates in Europe and California. Therefore, it is likely to command a much higher price in road transport fuels than in maritime applications, thus rendering it uncompetitive against alternatives. We observe that HVO is currently trading at a premium to road diesel of up to $1000 per tonne on the international markets. There is also increasing demand for HVO into the aviation sector. All these factors will probably eclipse HVO on the Marine Fuel scene.

Additionally, while HVO production capacity is increasing at a fast rate, there is going to be a global shortage of sustainable feedstocks suitable for either biodiesel or HVO production, thus maintaining upward pressure on the prices of HVO and FAME.

It therefore seems likely that biofuels will play a minimal role in decarbonisation of the maritime sector, thanks mainly to it being more attractive for other applications.

However, this is where schemes such as the EU ETS could play a critical role in helping the traded markets to find the most cost-effective home for the scarcer renewable fuels that have many potential deployments.

It has been argued successfully that the production of crop-based FAME produces a higher level of carbon emission when change of land use is included. This fact has not escaped legislators and there is pressure to reduce first generation FAME form the fuel mix.

Liquified Petroleum Gas (LPG)

LPG is increasingly being chosen as a fuel for LPG carriers. The shipping company BW is converting 12 existing Very Large Gas Carriers (VLGCs) to dual fuel LPG engines. Petredec, Equinor, Trafigura (among others) have a number of VLGCs and Mid-size gas carriers (MGCs) on order.

Still, for LPG no notable bunkering infrastructure exists, nor is it being developed, meaning that for now, LPG as a fuel looks to be confined to LPG carriers. It is claimed that duel fuel LPG engines could be converted with relative ease to run on ammonia.

Methanol

Methanol is already in use in the maritime sector and the engine technology is there. There is also an agreed IMO protocol for the use of methanol as a marine fuel. Producers such as Methanex can use it on their fleet. However, current supplies are predominantly from the original carbon-intensive Haber-Bosch (HB) process and green methanol production does not exist at any scale. One option would be to run the HB process using green power.

The Shipowner Hafnia BW has invested in the Northwest Innovation Works Kalama methanol project, but also in dual fuel LNG tankers, highlighting that even companies willing to take plunge into greener fuels are hedging their bets.

Ammonia and Hydrogen

Ammonia is chemically a zero-carbon fuel, but it is currently carbon intensive to produce. It will therefore not score as highly on a holistic assessment of its carbon footprint. Developments are under way to produce ammonia sustainably and commercially at scale, but these are not yet viable. Furthermore, engine technology will have to be adapted to accommodate ammonia.

Finally, hydrogen is widely seen as the long-term fuelling solution for most highly energy-intensive transport applications, but especially road haulage and sea freight. However, yet again there is some way to go before scalable green hydrogen production and supply is established at competitive pricing.

MAN is developing a dual fuel ammonia engine based on the same design as its dual fuel LPG engine. Engine manufacturers are claiming that dual fuel engines could be converted to run on ammonia in the future when market conditions dictate.

Shell is advocating hydrogen, but hydrogen fuelling looks to be some way off and along with ammonia is not currently ready to scale up.

Electric

This option for now is likely to be only feasible for short sea shipping, with battery range and charging time a key barrier. Again here, how the question is how green is the electricity to charge the batteries. This will be a key consideration in determining if using electricity is a Carbon reducing technology throughout the life cycle of the ship and the production of the batteries and the generation of power.

Transition options and pathway

Whether the IMO or the EU ETS, the industry expects that the decarbonisation targets will be met by a combination of increased vessel efficiency and a combination of various fuelling options, some of which will only play a transition role, until more advanced renewable fuels (such as ammonia, hydrogen or bio-methanol) are widely available.

There are no immediate low carbon fuelling solutions available. Both the fuel and the shipping industries must invest heavily in new technologies and the transition will take time. In the short term, we expect that a substantial proportion of shipping will convert to LNG fuel or other dual fuel options. This will allow ship owners to shift fuel type depending on port availability, regulatory issues and as the bunkering industry builds its supply infrastructure.

We expect LNG to become a dominant interim solution for reasons already mentioned: it is lower carbon than gasoil and fuel oil, it is readily available, and it is currently cheap. However, the higher Capex required to convert engines can be as much as 15-20% on top of a conventionally fuelled engine, meaning that LNG must remain cheap, or carbon taxes must be introduced to make such an investment economically viable.

Vessel and fuel economics

The fuels that are readily available for the maritime sector today are the conventional fuels of VLSFO, or HFO using abatement scrubbing systems, Marine Gasoil, bio-derived fuels using FAME or HVO, and lastly LNG.

We have focussed our assessment on the near term. Prices for most fossil fuels are currently depressed due to lack of demand: VLSFO and Marine Gasoil are at historically low multiples against Brent crude oil. As already highlighted, LNG is oversupplied and priced accordingly. However, it has recently gained ground against the traditional bunker fuel grades, partly because of sharp increases in LNG freight rates. The biofuel grades price higher due to the high costs of production, these costs being supported by demand driven by various mandates on their use.

Using current prices[1] for these grades and the appropriate fuel consumption, based on fuel energy content, allows us to draw a comparison between the various fuel grades as shown below.

Brent $/barrel	$	51.00
Carbon price €/tonne	€	-

Product	Comment	Effective price $/tonne	Tonnes fuel per day	Cost per day	Benefit vs VLSFO
VLSFO	100% GHG	$ 390	55	$ 21,450	$ -
MGO	100% GHG	$ 420	51	$ 21,377	$ 73
LNG	80% GHG	$ 362	47	$ 17,082	$ 4,368
HVO	from UCO	$ 1,220	45	$ 54,811	$ -33,361
FAME	from UCO	$ 1,070	50	$ 53,876	$ -32,426

As of today, there is no carbon levy on the maritime sector. in the current price environment, LNG gives a saving of around $4,400 per day versus VLSFO, based on a VLCC's typical daily consumption, so this could amount to a total saving on fuel of $1,600,000 per year.

A VLCC would need to be making a fuel saving of around $5,000/day to justify the additional $14m investment for dual fuel operation and generate an IRR of 10% over a 15-year period. So, the economics are looking close to being viable. Additionally, the newbuilding premium for dual fuel VLCCs has been reported to be narrowing, which could soon close the gap between fuel savings and additional CAPEX requirements. We would also expect the current LNG price level to soften as freight rates ease and as new bunkering capacity is commissioned at key supply locations.

Unsurprisingly, HVO and FAME are completely uncompetitive against other grades in the absence of a carbon trading scheme.

Using an indicative current value of the EU ETS CO_2 price of €30[2] improves the case for LNG to a level where a dual fuel investment could start to look attractive. LNG benefits from its lower GHG intensity, but HVO and FAME continue to be outcompeted both by LNG and by conventional fossil fuels.

[1] As of Tuesday 22nd December 2020

[2] ICE December 2020 EUA contract – 3rd December 2020

Brent $/barrel	$ 51.00
Carbon price €/tonne	€ 30.00

Product	Comment	Price $/tonne	Carbon charge	Effective price $/tonne	Tonnes fuel per day	Cost per day	Benefit vs VLSFO
VLSFO	100% GHG	$ 390	$ 115	$ 505	55	$ 27,760	$ -
MGO	100% GHG	$ 420	$ 115	$ 535	51	$ 27,236	$ 524
LNG	80% GHG	$ 362	$ 90	$ 453	47	$ 21,340	$ 6,420
HVO	from UCO	$ 1,220	$ 18	$ 1,238	45	$ 55,601	$ -27,841
FAME	from UCO	$ 1,070	$ 19	$ 1,089	50	$ 54,840	$ -27,080

It is also worth noting that the trends for both the carbon costs and VLSFO/MGO prices are to increase, the former as and when the price of crude oil recovers, the latter as decarbonisation agendas build momentum, whilst the trend for the relative LNG price is to stay low, as there is oversupply for the next 10 years. So, the fuel cost benefit for dual LNG fuel ships could increase further.

Trafigura has recently proposed an industry levy of $250-$300 per tonne of CO_2 emitted, on high GHG fuels as a means of accelerating the decarbonisation transition in Marine. This is the level required to make the biodiesel HVO and FAME grades competitive against fossil fuels, as shown below:

Brent $/barrel	$ 51.00
Carbon price €/tonne	€ 250.00

Product	Comment	Price $/tonne	Carbon charge	Effective price $/tonne	Tonnes fuel per day	Cost per day	Benefit vs VLSFO
VLSFO	100% GHG	$ 390	$ 956	$ 1,346	55	$ 74,031	$ -
MGO	100% GHG	$ 420	$ 959	$ 1,379	51	$ 70,204	$ 3,827
LNG	80% GHG	$ 362	$ 753	$ 1,115	47	$ 52,563	$ 21,468
HVO	from UCO	$ 1,220	$ 146	$ 1,366	45	$ 61,390	$ 12,641
FAME	from UCO	$ 1,070	$ 160	$ 1,230	50	$ 61,910	$ 12,122

But the high carbon price, while bringing HVO and FAME more on a par with fossil fuels, would also provide a huge incentive to LNG.

Conclusions

We have focussed our analysis of current fuel alternatives. When considering lower carbon options, the likes of blue or green ammonia, hydrogen or methanol are simply not a realistic option at present. This then leaves LNG and biodiesels as alternatives to fossil fuels.

In the absence of a carbon levy, LNG offers some attractive daily savings, but the savings may be insufficient to justify investment in dual fuel technology. This is not helped by the current high freight rates on LNG vessels, although this is likely to be just a seasonal factor. However, with a carbon scheme in place and at current EU ETS levels, LNG looks more attractive and the daily benefits are likely to support dual fuel vessel investment plans.

As and when the maritime sector is brought into the EU ETS, it would take a huge increase in the current carbon price for ship owners to deviate from their current fuel mix. A higher carbon levy could provide an attractive additional boost for LNG.

However, the ETS covers many consumption sectors, including heavy industry and commerce, all of which can be served by green energy options that require a lower carbon price than that needed to make HVO or FAME compete against fossil fuels.

The consensus for an effective carbon price for the maritime sector appears to fall somewhere in the \$100 to \$150 per tonne CO_2e range. We think it unlikely that a carbon price in the EU ETS would move high enough to support the introduction of HVO or FAME at any significant level for Marine use. This sector would require its own separate approach, as advocated by Trafigura. What this analysis further shows us clearly, is that HVO and FAME are among the most expensive green fuels, which should in the long term restrict their use to sectors where there is no feasible alternative. Shipping is not one of these sectors in the long run.

Finally, investors in an LNG bunkering facility or a dual fuel vessel are likely to be considering a 20-year time horizon. An important consideration will be how these assets can be recycled for use with future fuels such as ammonia and hydrogen once they become available at scale and at a cost-effective price.

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December 2020