Technology: from fuels to vessels

Eric Eyo and Michael Biltoo, at Kennedys, report on the changing landscape when it comes to shipping and fuel

The environmental impact of the continued burning of fossil fuels has not always made the news headlines. However, with the increasing onset of “freak” weather conditions in various parts of the world, together with many other environmental warning signs (such as polar cap melting), the business world is beginning to pay greater attention to the climate challenge. The idea that the world is heading toward a point of no return is now mainstream. It is thought that potential disaster may not be averted unless there is significant reduction in greenhouse gas emissions within the next 25-plus years.

It is widely reported (and generally accepted) that the shipping industry is responsible for approximately three per cent of all greenhouse gas emissions. To keep the earth within what is regarded as a safe temperature range, experts have suggested that the shipping industry (and other industries) will have to fully decarbonise and find replacements for fossil fuels.

The chicken or the egg

We are now faced with the classic scenario: “the chicken or the egg”. Fuel innovators and ship builders are ultimately commercial enterprises. To run a successful business, there needs to be a market or a demand for their product. For example, where that product is green fuel, then there needs to be a consumer or customer for it. If the ship technology develops first, then that establishes the market for the fuel innovator. But by the same token, the ship innovator would want the fuel innovator to move first because that establishes its market. In the event of a stalemate, it is unlikely that either will generate the necessary revenue to re-invest in further innovation and product development.

The compromise is perhaps that both industries should move together, and at the same pace. However, recent market soundings would suggest that the two industries are not moving in lockstep. In September 2023 Lloyd’s List reported these words from Hapag-Lloyd’s chief executive, Rolf Habben Jansen:

“Green ships will be available but what about the fuels? Investment in new ‘green’ containerships is outpacing the likely availability of new fuels for them to use. When you look at the global orderbook, at least in container shipping, we see that more than half the capacity on order can run in future on green fuels. That is definitely more than the volume of green fuels that will be available by the time those ships deliver.”

A common approach

The IMO’s adoption of an initial strategy for the reduction of greenhouse gas emissions from ships includes an enhanced common ambition to reach net-zero greenhouse gas emissions from international shipping by 2050. The speed of the decarbonisation endeavour will depend upon the strength of the regulations brought in to deal with it.

Although common ambition is imperative, regulations such as the IMO’s Carbon Intensity Indicator have arguably achieved the opposite, causing clashes between shipowners and traders as to who should foot the bill for compliance, especially when a vessel is time-chartered to and/or operated by a trader.

The sheer scale of this global issue is a huge problem. Genuine endeavour is often marred by geopolitical sensitivities and concern over the inconsistency of treatment and/or enforcement. Some of the most common approaches to achieving full decarbonisation include:

progressively banning fossil fuels;

imposing taxes on the use of fossil fuels;

incentivising the market for the use/uptake of novel green fuels; or

a combination of the three (in combination with others).

Arguably however, the most effective methodology for change is perhaps for the market to do this independently and without coercion from regulations. The key is attaining a critical mass of like-minded shipping players, each of appreciable size and with some risk appetite, to drive the necessary change from there. Groups like the Getting to Zero Coalition spring to mind here: a group of like-minded shipowners, ports and countries who have pledged to use zero-emission vessels on deep sea routes by as early as 2030.

In September two shipping giants, AP Moller-Maersk and CMA CGM, announced their intention to collaborate to reduce emissions and accelerate the decarbonisation of the industry.

The second and third largest container carriers respectively expressed a shared ambition to support the growth of greener fuels, while also working with regulators and influencing the direction of emerging global efforts by collaborating on the regulations impacting shipping decarbonisation. They also committed to the continued research and development of other alternative fuels, like ammonia, and innovation technology for ships.

There is a prominent school of thought that if the shipping industry really set its mind to it, it could almost completely decarbonise by 2035 using existing technologies. The sad reality is that there is risk and cost associated with such endeavour and a general reluctance to be the “test case”.

Fuels and vessels

In efforts to commit to decarbonisation efforts, some short-sea vessels have already started using four main alternative fuels.

Hydrogen

While nearly all hydrogen is produced using fossil fuels, it can also be produced without. Renewable energy can be used to split water via a process called electrolysis. The drawback is that this process is expensive. It is, however, where the ultimate hope lies for a climate-friendly fuel.

While hydrogen can be burned (causing some air pollutants), hydrogen can also be used in a fuel cell – through which it is converted to electricity without the need for combustion and where the only emission is water.

This “solution” is not without problems however, as fuel cells would take up a significant proportion of the vessel’s payload.

Alternatively, burning hydrogen in a pure oxygen atmosphere (to mitigate pollutants from the combustion process) is not an easy feat. Notwithstanding some novel technologies, hydrogen itself is not an easy fuel to handle. It is highly flammable and requires storage in liquid form at approximately -253°C. Even then, it takes up around eight times the volume of traditional marine gas oil to produce the same amount of energy.

Ammonia

Ammonia can be stored at a lower pressure and higher temperature compared to hydrogen and LNG. It also offers CO2-free combustion and high energy density which is more suitable for long sea passages. However, its main drawbacks include toxicity, nitrous oxide emissions and potential ammonia slip. As such, it requires careful handling during bunkering, storage, supply and consumption. Ammonia’s corrosive nature necessitates careful material selection. It is also flammable and poses risks to the eyes, lungs and skin due to its moisture seeking properties. Additionally, ammonia combustion may produce toxic nitrogen oxides.

Electricity

Electric propulsion employs systems including electric motors that are driven by electricity stored in batteries, fuel cells, or generated aboard using renewable sources such as solar panels or wind turbines.

While they use less energy and lesser pollutants are emitted when compared to combustion engines, safety concerns are present in such systems as they rely on high current. This means that faulty wiring, insulation breakdown, or equipment malfunction can lead to electrical shocks, fires and even explosions.

Where large lithium-ion battery banks are used, the risk of fire and explosion if damaged, overcharged or exposed to extreme conditions is high.

One of the biggest problems with the use of electrical power is range. The low energy density of batteries means that they cannot store enough energy in relation to their size and weight, which makes them unsuitable for long sea passages.

Wind

The eternal problem with wind is that while it blows, it does not do so with consistency of timing, force or direction.

As such, ship design innovators typically look to combine wind technology with other propulsion methods.

Although wind is free, the design, retrofit and installation of wind technology onboard vessels could be extremely costly.

Whether it is fuels or ship design that develop first, one thing is clear: both need to move now – and fast. MRI