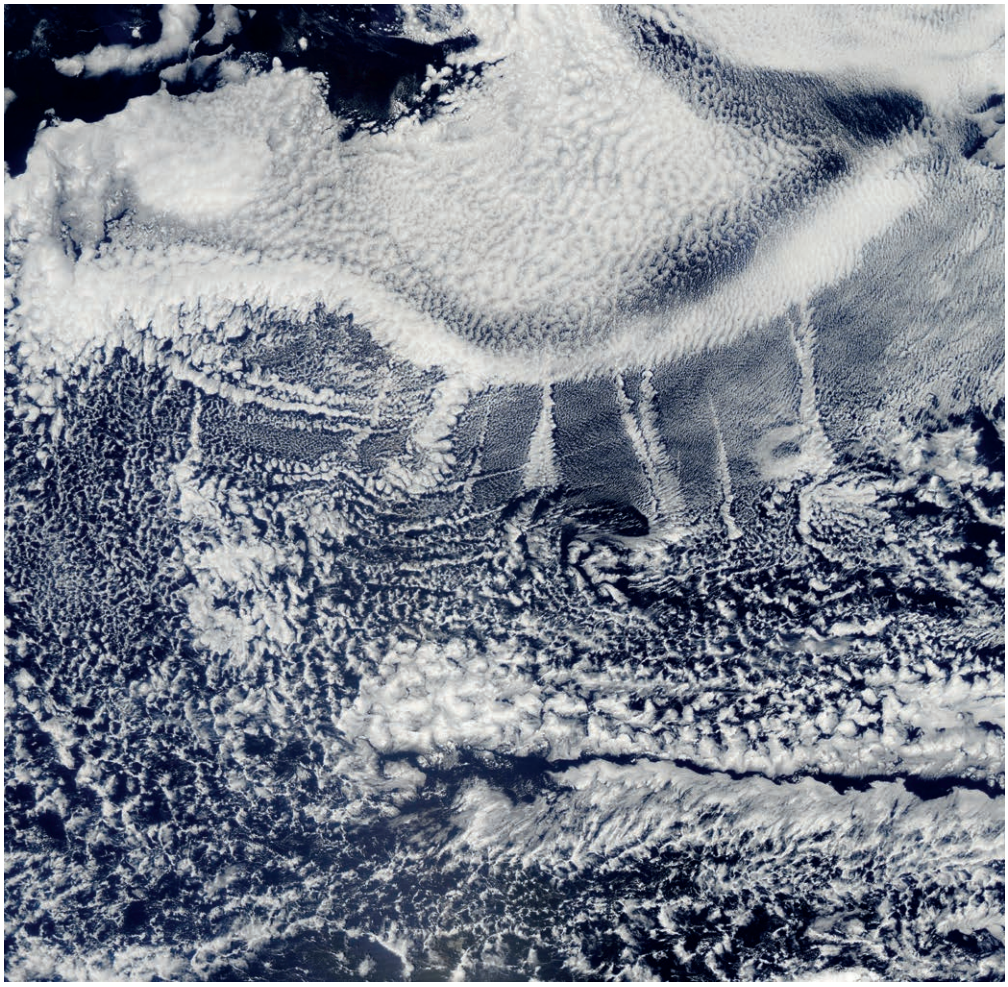
SHIPPING

Shipping industry begins shift to lower-emissions fuels

If the shipping industry were a country, it would be the sixth-largest greenhouse gas emitter. Can new pollution regulations finally impose order on the high seas? *Jennifer Johnson* reports.



Ship tracks – clouds seeded by particles of pollution in ship exhaust – are often visible from space, as in this satellite image captured last August.

Photo: NASA

Ocean shipping carries about 90% of all trade in the modern, globalised world. The majority of goods consumed across the planet are transported along just a handful of major sea routes, which have all had to accommodate increased traffic and larger ships in the past few decades. In the year 2000, the biggest cargo vessels in operation had a capacity of roughly 8,000 containers. Today, the world's largest ships hold almost 22,000.

Increased cargo capacity and more frequent voyages have taken a toll on both human health and the environment, especially in busy port cities and along major shipping lanes. Last year, a study published in the journal *Nature Communications* estimated that 14mn annual cases of childhood asthma are related to global ship pollution using current fuels.

However, the report's authors believe these cases will be reduced by half when the International Maritime Organization (IMO)'s 2020 sulphur regulation forces the shipping industry to switch to cleaner fuels. In the first five years of the rule's implementation, some 40mn childhood asthma cases could be avoided – if the shipping industry fully complies.

From 1 January next year, the limit for sulphur content in fuel oil used on board ships will be reduced to 0.5% from 3.5%. Sulphur oxides (SOx), which are released when heavy fuel oil is combusted in ship engines, are known to cause respiratory issues in humans, and also contribute to acid rain and ocean acidification. It's thought that a majority of shipping companies will simply switch to burning cleaner fuels when the so-called sulphur cap comes into force, though there are a handful of other routes to compliance.

Looking to 2020

Some companies are choosing to install exhaust gas cleaning systems, or scrubbers, on their vessels. These systems effectively remove SOx from exhaust gases by spraying them with seawater. In the case of the most common type of scrubber, the 'open loop' variety, wash water is subsequently discharged into the ocean. The primary advantage of scrubbers is that they'll allow ship operators to continue to burn high-sulphur heavy fuel oil (HFO), which will almost certainly remain cheaper than its low-sulphur counterparts in the short term.

While cost estimates vary, it's widely acknowledged that the shipping industry's fuel costs will increase significantly with the mass shift to 0.5% sulphur bunkers. Analysis by the consultancy Wood Mackenzie, for instance, has found that cleaner fuels could cost the entire sector an extra $60bn annually. Faced with uncertain (but undoubtedly higher) overheads, it's easy to see why some companies prefer the transparent upfront capital cost of a scrubber.

Recent figures from the International Energy Agency (IEA) have predicted that some 4,000

scrubbers will be installed by the 2020 deadline. However, some serious questions remain about the technology's environmental credentials. In a 2012 study, the Danish Environmental Protection Agency uncovered the presence of pollutants, including heavy metals and hydrocarbons, in scrubber wash water.

Germany's environment agency reached a similar conclusion in a study of its own, which called for restrictions on scrubber wastewater dumping to prevent potential damage to marine organisms in the North and Baltic Seas.

'Scrubbers were proposed as an alternative compliance mechanism because the industry wanted to have some flexibility in choosing its method of compliance, but what we came to realise is that scrubbers were taking the pollutants from the air and putting them in the sea,' said Faig Abbasov, Manager, Shipping, at the Brussels-based NGO Transport & Environment (T&E). 'Now ports and coastal countries, especially in Europe, do not want scrubber water discharged into the marine environment.'

Late last year, the Port of Singapore announced it would ban the dumping of wash water from open loop scrubbers when the 2020 sulphur limit enters into force. The ruling effectively forces ships calling at the port to use low sulphur fuel, though the minority of ships with 'closed loop' and hybrid scrubbers will not be affected. China imposed a similar dumping restriction from 1 January this year.

The carbon question

Amid growing regulatory uncertainty, a small number of major shipping companies have placed their bets on liquefied natural gas (LNG) as a solution to harmful vessel emissions. According to a 2016 study from the IMO, use of LNG reduces emissions of SOx and particulate matter to negligible levels, while reducing carbon dioxide emissions by around 20% when compared to diesel fuel.

In 2017, the French container shipping company CMA CGM announced it would fuel nine giant ships, each with a capacity of 22,000 containers, using LNG. Once they're all operational, the vessels will be among the first to run transoceanic routes on natural gas. As of last year, there are some 125 ships around the world using LNG, according to the classification society DNV GL, with between 400 and 600 expected to be completed by 2020.

There are also lingering doubts about LNG's true environmental footprint – there's known to be some degree of methane leakage across the natural gas supply chain – and during its combustion in ship engines

While this is only a small proportion of the 60,000-strong global commercial fleet, it signals growing faith in LNG as a 'bridge fuel' in the transition to clean shipping. But, as is the case with scrubbers, there are also lingering doubts about LNG's true environmental footprint. There's known to be some degree of methane leakage across the natural gas supply chain – and during its combustion in ship engines. Though the volume of these losses may be relatively small, the fact remains that methane is 28 to 30 times more potent a heat-trapping gas than carbon dioxide.

The LNG debate comes ahead of what is sure to be the shipping industry's biggest challenge yet: decarbonisation in line with international greenhouse gas (GHG) reduction targets. In April last year, delegates at an IMO meeting in London adopted an initial GHG reduction strategy, which calls for emissions from international shipping to peak as soon as possible and asks the industry to reduce its annual emissions by at least 50% of 2008 levels by 2050. Exactly how these targets will be realised – and with what technologies – is not yet clear.

Innovation gap

In November 2018, Transport & Environment published its *Roadmap to Decarbonising European Shipping*, a report which examined potential decarbonisation pathways for the sector. Ultimately, the NGO recommended that batteries, hydrogen and ammonia-based solutions are deployed in tandem to clean up shipping across the EU. Of the three endorsed technologies, batteries are the most mature in terms of their commercial development.

Four years ago, a battery-powered ferry, known as *Ampere*, began transporting cars between two villages on Norway's Sognefjord. In 2017, an almost-identical ship began operating in Finland. The vessels proved themselves to be so dependable and economical across their short routes that shipbuilder Fjellstrand had accepted 53 further orders as of last summer.

In another vote of confidence for electrification, Rolls-Royce now offers a lithium-ion based energy storage system for ships, which can be combined with LNG or diesel engines to create a hybrid propulsion solution. However, Abbasov notes, there are limits to what batteries could foreseeably achieve on the open ocean.

'Batteries will not be viable for large ships or deep-sea shipping because they don't have enough energy density,' he explained. 'So, the use of batteries can be possible for short-sea shipping and we recommend that wherever possible.'

The question of sustainably powering massive oceangoing container vessels must be resolved rapidly if the shipping industry is to align itself with the goals of the Paris Agreement. Organisations including T&E and the OECD's International Transport Forum (ITF) have thrown their weight behind hydrogen – which emits zero SOx or CO2 – as a decarbonisation solution.

In its report *Decarbonising Maritime Transport by 2035*, the ITF suggests that hydrogen could be used on ships in three ways: in fuel cells, in a dual-fuel mixture with conventional diesel fuels and as a direct replacement for heavy fuel oil in an engine. Similarly, the report said, ammonia is a hydrogen carrier that can be used in fuel cells, or as a fuel for direct combustion. However, much research and development is needed before either solution is commercially viable. Then, T&E's Abbasov explained, fuelling infrastructure will have to be rolled out strategically.

'Depending on what technology individual ships choose to decarbonise, we will need to build new ships or retrofit existing ones, plus we will need to have compatible bunkering or charging infrastructure in ports,' he said. 'We need to put infrastructure in place that is compatible with hydrogen and ammonia, for example, as well as charging stations. And it's a big leap from what the industry has been working with in the past 50 to 60 years.'

It's difficult to comprehend the scale of the challenge facing the shipping industry in the coming decades – and there's little time for complacency. It's not enough for companies to plot their route to 2020 compliance: they must also invest serious time and resources in planning for long-term decarbonisation. Until now, the shipping industry has been able to avoid the kind of environmental scrutiny that shore-based sectors have long been subjected to. Now, regulations might just force shipping to clean up its act.