

# Ammonia flagged as green shipping fuel of the future

Marine operators are looking to clean up their act

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Adaptive behaviour: the Viking Energy supply vessel which is planned to run on ammonia fuel cells

With a fresh lick of paint the Viking Energy looks like a regular supply ship from the outside. But inside, it harbours the latest zero-emissions technology. Instead of oil, this retrofitted vessel will run on ammonia fuel cells. And when it launches in 2024, it will be the first ship on the high seas to do so.

The goal of the project is to show that long-distance emission-free voyages on big ships are possible. Built by Norwegian shipping company Eidesvik and state-backed oil and gas group Equinor, the Viking is expected to sail

solely on clean fuel for 3,000 hours annually.

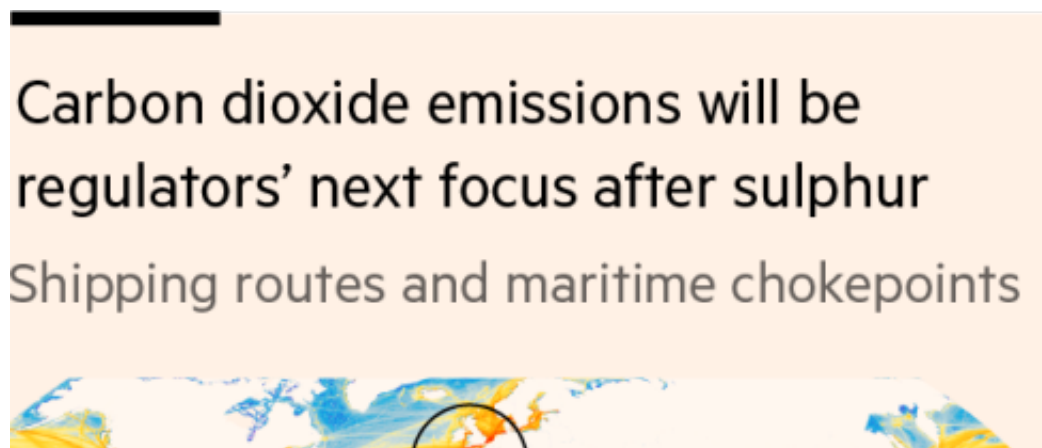
Such an innovation could transform how seaborne freight moves and minimise the need for heavy bunker fuel. Shipping currently contributes up to 3 per cent of greenhouse gases, according to the International Council on Clean Transportation (ICCT).

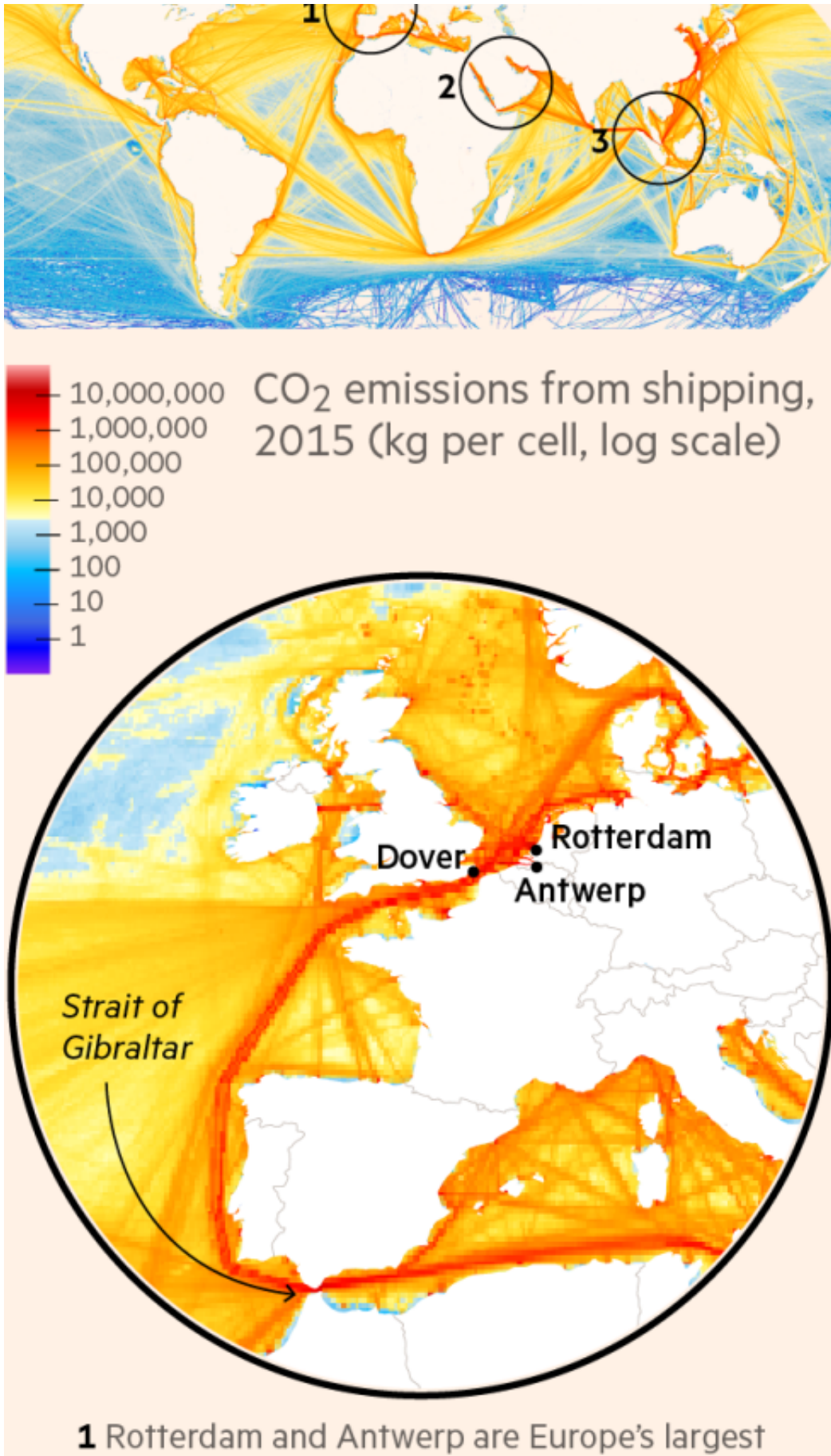
In January, a grouping of Malaysia's MISC Berhad, Korea's Samsung Heavy Industries, the UK's Lloyd's Register and Germany's MAN Energy Solutions also announced a project to produce an ammonia-fuelled tanker in the next three to four years.

The ambition of such projects is to encourage the development of commercially viable deep-sea vessels over the next decade that are powered by zero-emission energy resources.

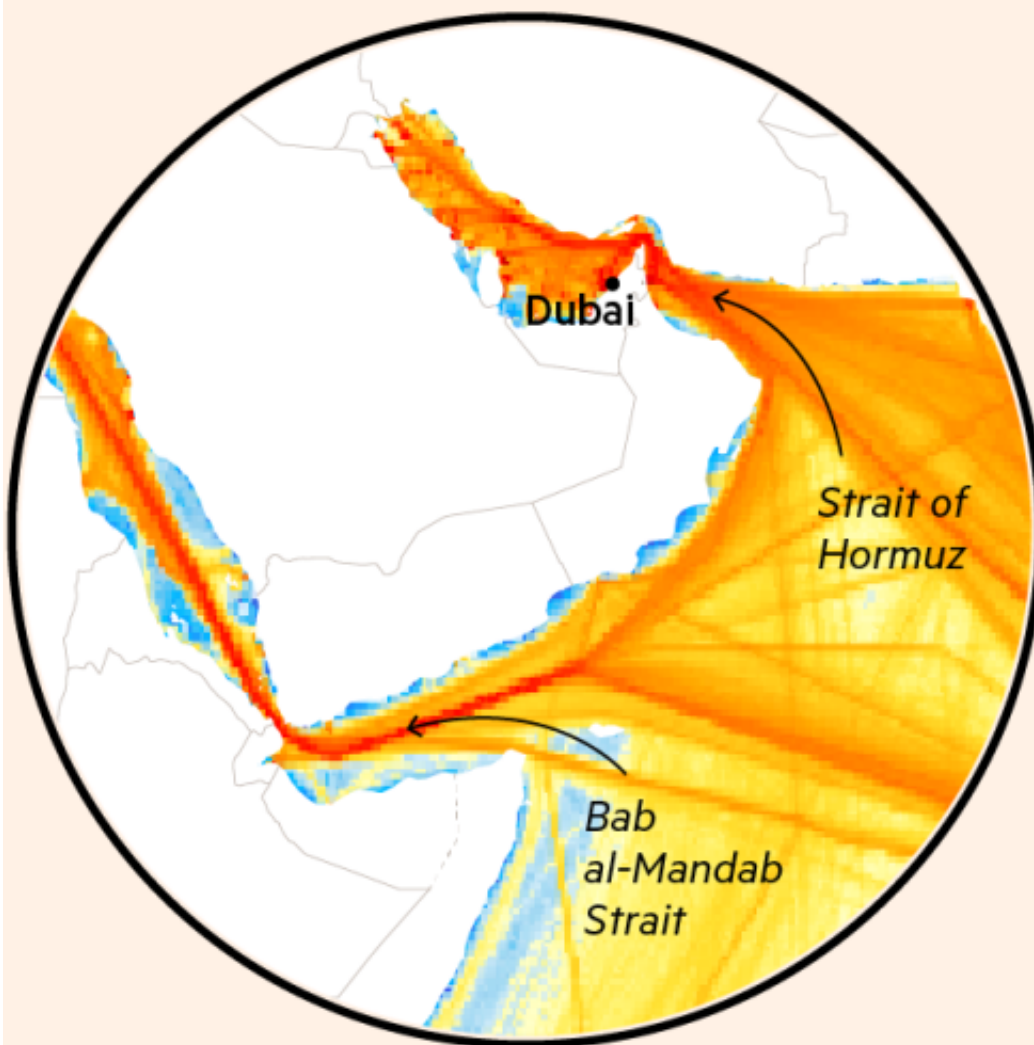
"What's refreshing is that rather than waiting for regulation to drive the change, we're seeing some of the leading stakeholders in the industry accelerate the change," says Nick Brown, marine and offshore director of Lloyd's Register.

Such a development could bolster the International Maritime Organisation's ambition of halving the industry's 2008 level of greenhouse gas emissions by 2050.

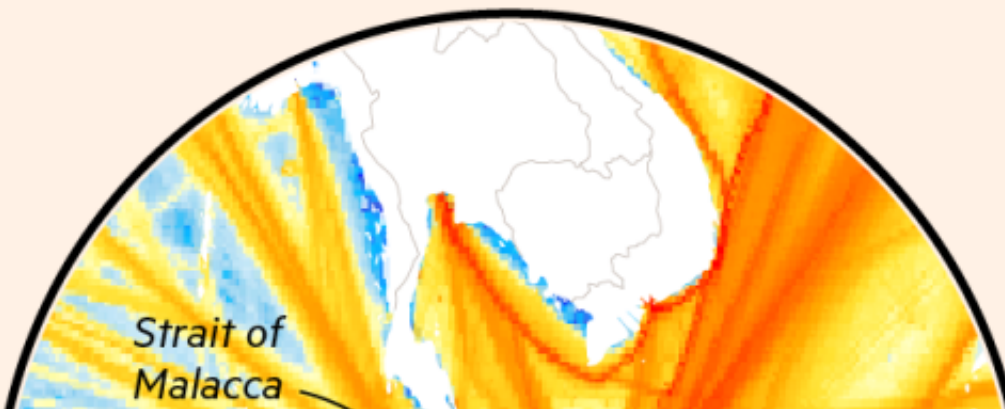


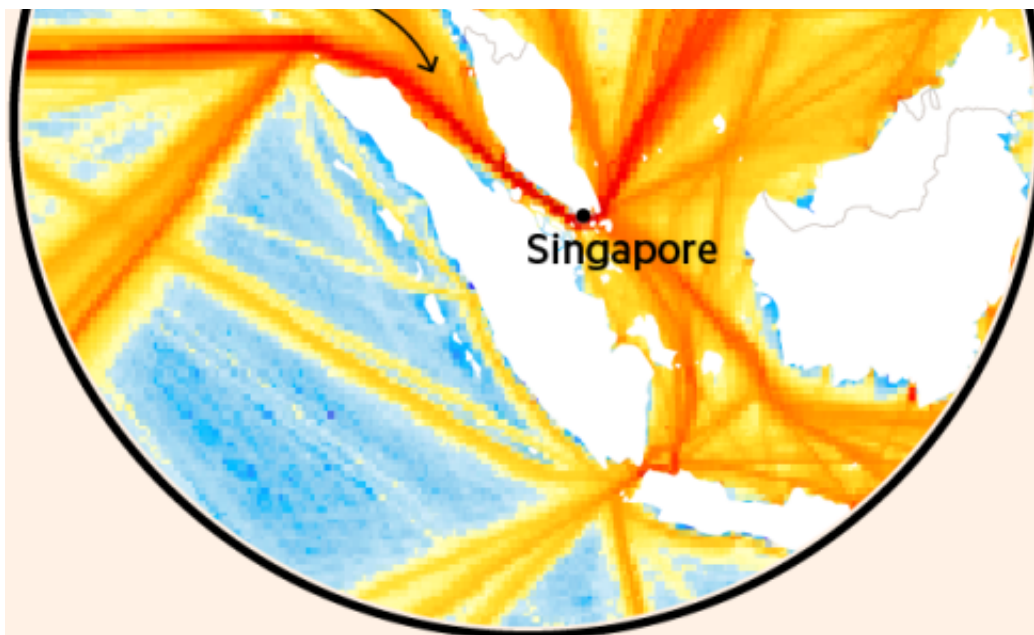


ports. Ships sail to and from the northern ports through the busy Strait of Gibraltar



**2** The EIA estimates that 30% of the world's crude and 30% of the global LNG trade moves through the Strait of Hormuz, making it the world's most strategically vital chokepoint





**3** The Strait of Malacca is the shortest sea route between the Gulf and East Asian ports. Its narrowest point near Singapore is about 1.7 miles wide, creating a natural bottleneck

Based on vessel level modelling of the global fleet using ship transponder data

Graphic: Chris Campbell

Sources: L Johansson, JP Jalkanen and J Kukkonen, "Global assessment of shipping emissions in 2015 on a high spatial and temporal resolution", Atmospheric Environment journal, volume 167; EIA

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Ammonia's potential as a transport fuel has been demonstrated by Nasa in its deployment in rockets. The chemical is toxic: even a small spill could be devastating. When badly burnt, it produces nitrous oxide, a strong greenhouse gas. But when correctly combusted, the chemical creates water and nitrogen. Similarly hydrogen, when burnt properly, simply produces water.

To achieve status as truly sustainable power sources, both these combustible fuels need to be produced from renewable energy sources, rather than — as now — largely carbon-intensive methods.

Today, ammonia's main application is as an industrial fertiliser. The process by which it is normally made, the HaberBosch method, typically absorbs huge quantities of fossil fuel. Ammonia production itself accounts for 1.8 per cent of global carbon dioxide emissions.

But it is the growing potential for the deployment of renewable power in the production of "green" rather than "brown" ammonia that has revived interest in it as both a practical and potential low-carbon transport fuel.

According to the Royal Society, the UK's scientific institute, the chemical has advantages over other low-carbon fuels that could help power cars and aircraft as well as ships.

"We've been going down the wrong road scientifically, says Bill David, professor of chemistry at the University of Oxford. He is co-author of [a report](#) published by the Royal Society last month on green ammonia's potential.

"We have to look at the different options. Ammonia has to be on the table," he adds.

Ammonia has almost twice as much energy as liquid hydrogen by weight and has nine times the energy density of lithium-ion batteries. Others in the shipping industry are keen to examine its potential. "The shipping industry is searching for the fuels of the future," says Bryan Comer, a senior researcher at ICCT. "Ammonia is a zero-carbon fuel that can be liquefied quite easily, has a higher volumetric energy density than liquid hydrogen, and it can be burnt in an internal combustion engine, whereas liquid

hydrogen is expected to be used only in fuel cells for deep-sea shipping."

On a smaller scale, carmakers Toyota and Hyundai have been looking into manufacturing ammonia-hydrogen fuelled cars as an alternative to conventional electric vehicles.

***The UK's Royal Society says green ammonia has advantages over other low-carbon transport fuels***

The Ammonia Energy Association, an industry lobby group, says "green ammonia projects — feasibility studies and pilot plants — are laying the foundation for gigawatt-scale deployment of electrolyzers and the foreseeable phase-out of fossil feedstocks at ammonia plants".

Should ammonia prove itself to be a workable shipping fuel, its widespread adoption would require a huge programme of retrofitting to achieve the industry's self-declared goal.

The capital investment needed to decarbonise the shipping sector, based on the adoption of green ammonia as its primary zero-carbon fuel, would be \$1tn to \$1.4tn from 2030 to 2050 according to [a calculation](#) by the Global Maritime Forum, an industry group backed by shipping and port operators such as Møller-Mærsk and PSA International.

"Under different assumptions, hydrogen, synthetic methanol, or other fuels may displace ammonia's projected dominance," the paper says. "But the magnitude of investments needed will not significantly change for these other fuels."

Without action, greenhouse emissions from shipping could grow by as

much as 250 per cent by 2050, according to studies by the International Maritime Organisation.