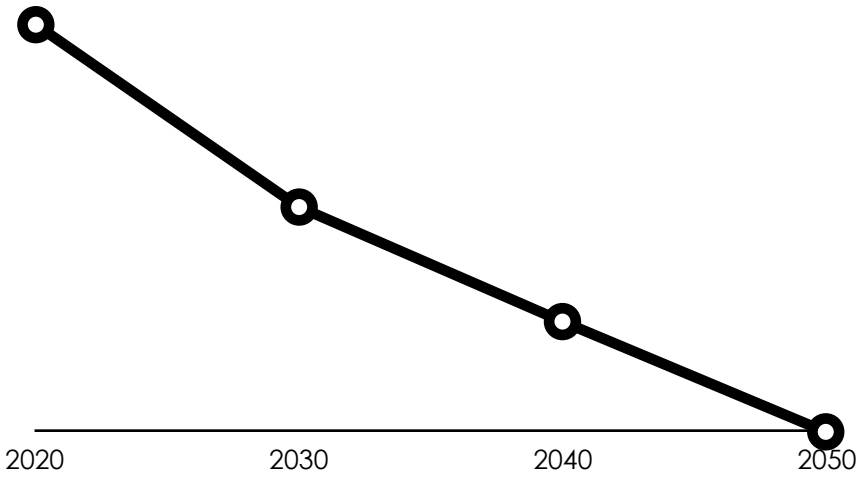
EXPLORING NET ZERO

Energy&Climate
INTELLIGENCE UNIT



Transport: aviation and shipping

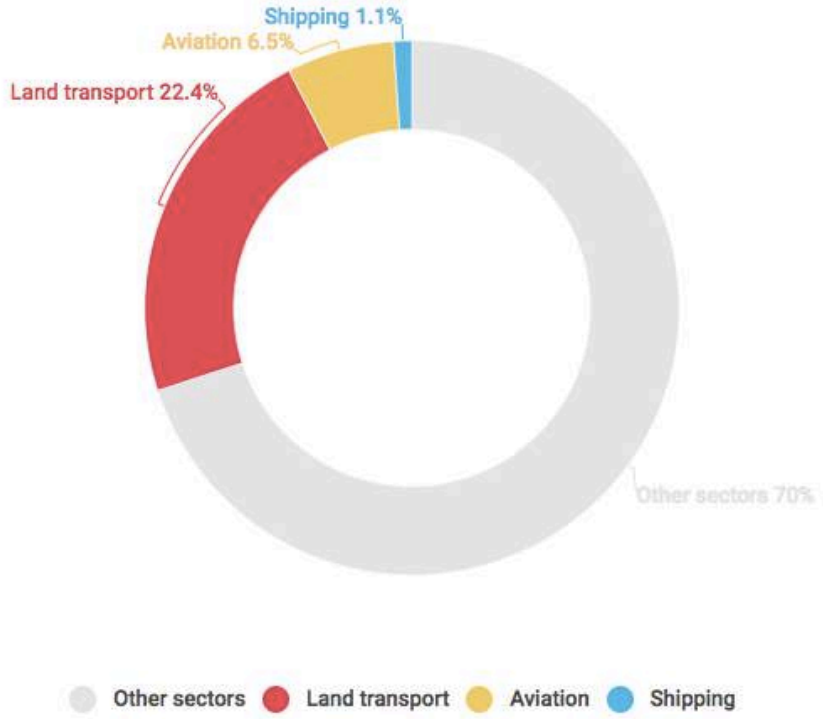
Aviation and shipping pose major challenges to reducing emissions, due to their reliance on oil-based fuels. Although progress is being made on decarbonising shipping, aviation appears set to remain largely reliant on fossil fuels due to the energy needed to get aircraft airborne.

Both sectors have historically sat outside the UN climate convention, mainly because of their international nature and the difficulty of allocating emissions to specific countries. As a result, global progress on tackling emissions from these sectors has been slow.

Aviation in Britain

In 2015, aviation (domestic and international) accounted for 6.5% of total greenhouse gas (GHG) emissions in the UK, with the majority coming from international flights. Together, aviation and shipping accounted for 7.6% of the UK's total emissions in 2015; altogether, transport, including shipping and aviation but also land journeys, accounted for 30%.

Only domestic flights are covered by carbon budgets as set by the Committee on Climate Change (CCC). The CCC does however assume that the UK share of international emissions is included in the overall target under the Climate Change Act, to reduce emissions by at least 80% by 2050.



UK aviation and shipping accounted for 7.6% of total GHG emissions in 2015; total transport including shipping and aviation accounted for 30% of UK emissions.

SOURCE: UK AVIATION FORECASTS, DEPARTMENT FOR TRANSPORT, OCTOBER 2017

Decarbonising flight

The aviation industry and other experts argue that while a small number of flights can currently be decarbonised for the purposes of demonstration, prospects for decarbonising flight overall in the medium term are currently very slim.

Improving the design of planes' wings, fuselage and engines can reduce the amount of fuel burned, as can better managing traffic to reduce flight times.

Biofuels are proven to be technically feasible, blending them with kerosene. The challenge is to reduce their costs through greater uptake, and ensure that they are truly low-carbon and do not compete with land for food crops.

Short-haul commercial electric flights may be possible as batteries become more efficient over the coming decades, though the timeframe for this is uncertain. Norway aims for all short-haul flights to be 100% electric by 2040. Airbus, Boeing and NASA are among organisations developing electric planes. Hydrogen-powered flight is another avenue of research.

In Britain, the Government is supporting advanced fuels under the Future Fuels for Flight and Freight Competition. Ministers also recently announced £343 million Government and industry investment for research and development of electric

aircraft and hybrid-electric propulsion systems such as the E-Fan X project being developed by Airbus, Rolls-Royce and Siemens.

Negative emissions and flying less

The more flights increase, the more 'negative emissions' will be required to cancel them out.

Flying less would help reduce emissions and, with 70% of all flights in Britain being taken by just 15% of adults, the evidence suggests this would not be a widespread inconvenience. Only 10% of airport passengers are people living in Britain doing business abroad.

NASA is among organisations developing electric airplanes. Image: NASA, creative commons licence

A third runway at Heathrow could push aviation emissions beyond what our current targets can accommodate. The CCC has said that given the limits of cuts achievable by other sectors, aviation emissions can be no higher than 37.5 Mt in 2050, equivalent to their level in 2005 and representing about a quarter of the total allowable UK emissions by 2050. This would allow passenger growth of around 60%.

But according to the Aviation Environment Federation, figures from both the Airports Commission and the Government indicate that emissions will overshoot this level even without expansion, and will be higher still with a new runway. The Government has committed to publish a new Aviation Strategy in 2019.

Shipping

Shipping has long been placed in the 'hard to abate' category. But technological developments in the last few years have enabled 'net zero' emissions from the maritime sector to become a politically possible goal, with many countries calling for it and taking action towards it.

Battery electric propulsion systems in the maritime sector are evolving rapidly, and are being deployed in the inland, coastal and ferry transport sectors.

International maritime trade on the other hand will almost certainly require zero-emission liquid fuels, which are further away from commercialisation. Pilot projects are underway in the UK using renewably generated hydrogen and ammonia - fuels that emit no CO2 when burned, as they contain no carbon.

International progress

Shipping and aviation were excluded from the Paris Agreement's national accounting, due to the difficulties of attributing emissions from complex international supply chains to individual countries.

Instead, responsibility for dealing with shipping sector emissions has been delegated to a specialist UN agency – the International Maritime Organisation (IMO).

While progress at the IMO has been slow, in the last few years many countries have publicly supported a net zero target.

Going into the IMO negotiations in April 2018 in London, EU member states agreed a common position of supporting a 70-100% reduction in shipping's greenhouse gas emissions worldwide by 2050, compared with 2008 levels.

Ultimately the wording that came out of the IMO negotiations was 'at least' a 50% reduction by 2050, while 'pursuing efforts towards phasing them out entirely' on a trajectory consistent with the Paris Agreement.

The political will to put an earlier time-stamp on net zero for international shipping remains strong, driven by Pacific Island states and EU countries including the UK.

Technological solutions

Is this achievable? Yes, according to the OECD's International Transport Forum, which found that zero-carbon shipping is possible by 2035 based on current technology.

Zero-emission vessels already exist – the problem is one of scaling up from the predominantly inland and coastal routes which they currently ply to the vast ocean-going vessels that carry 80% of global trade.

At present ferries, of both the tourist-carrying and Roll-On Roll-Off (RORO) car-carrying variety, are at the forefront of maritime electrification. The Indian state of Kerala hosts Asia's first solar-electric ferry; the 'Aditya' has been in commercial operation for 18 months now, the first of 10 such vessels, driven as much by concerns over air pollution as climate change.

Norway's two fully operational electric-powered ferries will be joined by another 10 by the end of 2018, reaching 60 by 2021. By 2023 the country's entire ferry fleet will either be all-electric or, for the longer routes, equipped with hybrid technology.

More importantly for visiting cruise ships, this year the Norwegian Parliament decided that the Norwegian fjords would be a 'zero emission zone' from 2026.

Viking Cruises is developing a 900-passenger zero-emission hydrogen cruise ship, building on the successes of trial vessels in Belgium and Finland (an Arctic research vessel).

The world's first commercial car-carrying ferry powered solely by renewable hydrogen is being built in Scotland, for delivery in 2020 and use in the Orkneys. (The UK has been an early supporter of maritime hydrogen: a smaller scale zero-emission hydrogen vessel journeyed around the Isle of Wight in 2016.)

Freight shipping

Turning to larger vessels, a Chinese company lays claim to have built the world's first battery electric cargo ship (ironically, to carry coal), while the first battery electric and autonomous container ship, the YARA Birkeland, is being built in Norway.

Decarbonising freight shipping is a major challenge - and opportunity. Image: Tom Driggers, creative commons licence

Reducing emissions by cutting fuel consumption can save a shipping company millions of dollars a year. For this reason Maersk, the world's largest shipping company, this year fitted its first wind-propulsion Flettner rotors to two of its tankers, with plans to expand across the fleet if the trials are successful.

While wind-assisted technology will likely expand in a cost-saving peripheral role, the tight schedules of container shipping will ultimately require zero-emission renewable fuels to fully decarbonise. It is here that further research, funding, and collaboration to scale up is needed to bring lab and trial versions to the mass market.

The shipping industry currently spends well over $100 billion a year on its fuel bill. This market is the prize for innovators once the price of renewable energy falls into a comparable range as its fossil-fuel competitors, perhaps helped by the tougher sulphur emission standards coming into force globally in 2020, and at some point, a carbon price.

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