

Written evidence from the Department for Transport

1. What contribution can operational efficiencies make to reduce emissions from aircraft / shipping vessels and over what timescale could these have an effect on emissions?

Aviation

In July, we published the Jet Zero Consultation¹, which sets out our vision for achieving UK net zero aviation by 2050. For this, we modelled scenarios with different technological mixes to illustrate how we could achieve net zero. We modelled system efficiency improvements as a whole - across our aircraft, airports, and airspace - rather than just operational efficiencies. Our modelling shows that moving to best-in-class conventional aircraft, operations (including aircraft ground operations and en-route procedures²) and airspace modernisation could deliver up to 21 Mt of CO₂ savings annually by 2050 (high ambition scenario).

Maritime

The UK is working actively at international level to accelerate efforts to improve the operational and design efficiency of both new and existing vessels. For new ships the International Maritime Organization's (IMO) 'Energy Efficiency Design Index' (EEDI) was developed to improve the design and operational efficiency of ships and their propulsion systems. The EEDI, which entered into force in 2013, has different phases, so the emission reductions for new vessels must improve over time for the ship to be certified. As an example, by January 2025 (under the third phase) larger new vessels will need to be at least 30% more efficient compared to an internationally agreed reference line. The EEDI system also includes operational elements, notably a requirement for larger vessels to have a ship specific energy efficiency management plan in place.

The IMO has also agreed a system of operational energy efficiency for existing vessels due to enter into force on 1 January 2023, with carbon benchmarking and a requirement that inefficient ships improve their performance. DfT has published research on the role of both operational and design efficiency as part of the 2019 Clean Maritime Plan³.

2. How close are zero carbon fuels to commercialisation for aviation / shipping? How effective will the Jet Zero Council be in catalysing zero emissions technologies? What role should transitional fuels such as alternative hydrocarbon fuels play?

¹https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1002716/jet-zero-consultation-a-consultation-on-our-strategy-for-net-zero-aviation.pdf

² En-route procedures include actions by air traffic control to optimise flight profiles, including providing more direct routings, more efficient flight levels and other procedures such as continuous climb and descent approaches. It also includes actions by airlines to optimise their flight planning for efficiency.

³https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/816015/maritime-emission-reduction-options.pdf
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/816018/scenario-analysis-take-up-of-emissions-reduction-options-impacts-on-emissions-costs.pdf

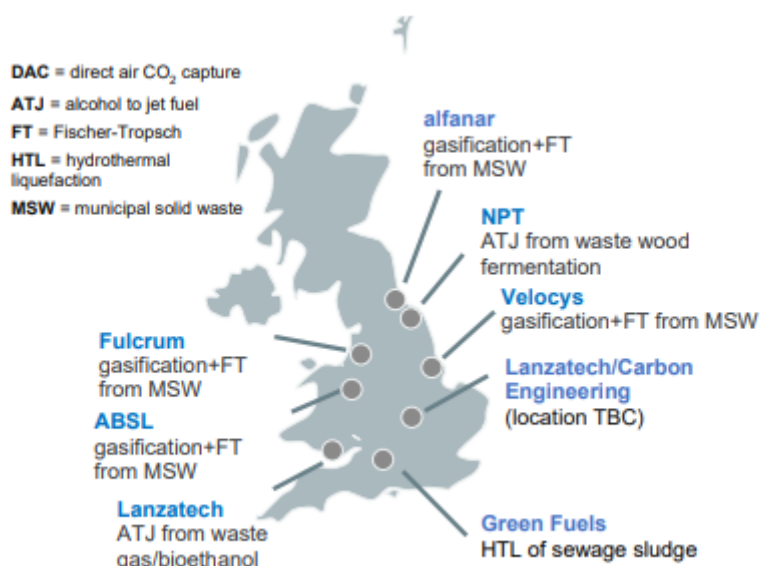
Aviation

Zero emission flight (ZEF) and sustainable aviation fuels (SAF) will both play a key role in ensuring that aviation can reach net zero by 2050. The Government is keen to develop a world leading SAF sector in the UK. We have recently shortlisted eight projects for the £15 million Green Fuels, Green Skies competition⁴ to support the early development of commercial SAF plants in the UK (Figure 1). Whilst the use of SAF is not zero emission, the shortlisted projects have the potential to produce SAF capable of reducing emissions by over 70% on a lifecycle basis when used in place of conventional jet fuel.

In July, we launched a consultation⁵ seeking views on mandating the use of SAF in the UK from 2025. The consultation sets out potential SAF uptake scenarios, with up to 10% SAF by 2030 and up to 75% SAF by 2050. We envisage that an obligation for the use of SAF in the UK, supported by government funding for the projects listed below, will provide the incentive to investors and SAF producers to kick-start the market and build a strong domestic SAF industry.

Accelerating zero emission flight is a key objective of the Jet Zero Council and it will achieve this through the ZEF delivery group that is currently being expanded. This will build on the work on zero emission aircraft led by the Aerospace Technology Institute (ATI) - including their FlyZero project bringing together experts to assess the potential for developing zero-emission aircraft by 2030 – and compliment this with further workstreams looking at the infrastructure, regulation and commercialisation needs of zero emission flight.

Figure 1. SAF projects shortlisted as part of the Green Fuels, Green Skies competition



Maritime

There are a range of promising alternative energy sources for maritime transport, but these are not yet at the stage of commercial deployment. Research carried out in

⁴ <https://www.gov.uk/government/publications/green-fuels-green-skies-gfgs-competition>

⁵ <https://www.gov.uk/government/consultations/mandating-the-use-of-sustainable-aviation-fuels-in-the-uk>

support of the Clean Maritime Plan⁶ suggests that the 2020s will see a focus on research, development and demonstration of maritime alternatives, with take up expected to begin at a commercial level in the 2030s.

Several fuel/energy options that can reduce emissions have been reviewed in DfT commissioned research⁷. These include sustainably produced hydrogen carriers (hydrogen and ammonia in particular) as well as battery technology. Battery systems are closer to market, but are expected to have a limited impact in the decarbonisation of deep-sea shipping because of the lower energy density of battery solutions compared to other alternatives.

In scenarios that achieve deep cuts in greenhouse gas emissions, DfT-commissioned research⁸ estimates that ammonia could become the main component of the maritime fuel mix by 2050, but notes that this is subject to significant uncertainty.

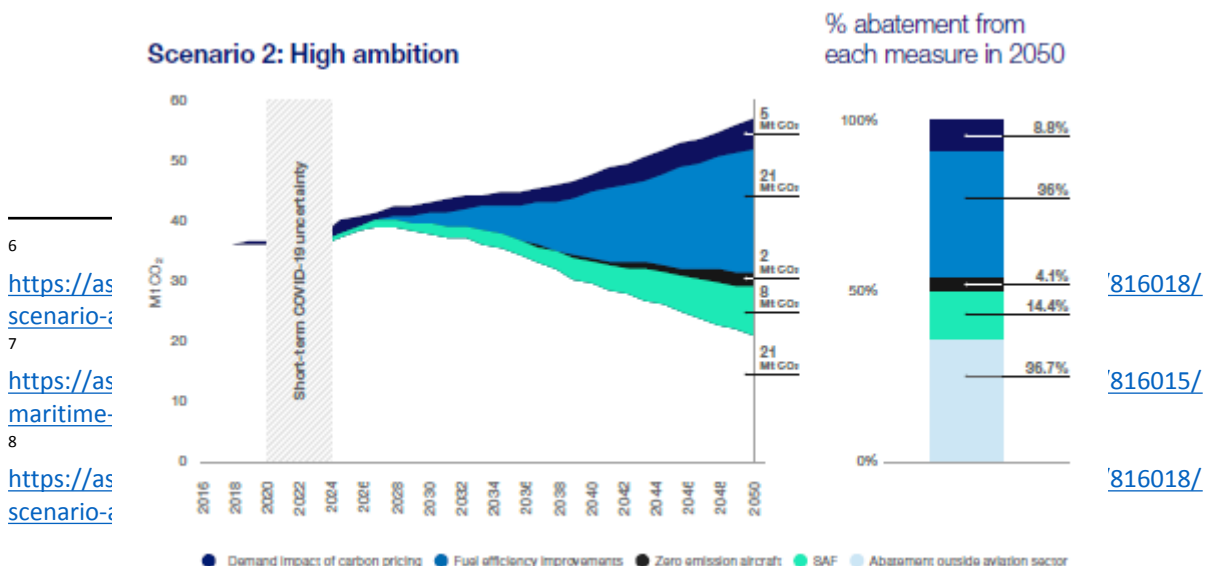
The development of zero carbon shipping fuels is being supported by the Clean Maritime Demonstration Competition, enabling these solutions to reach commercial level faster. The Government is also amending the Renewable Transport Fuels Obligation (RTFO) to support renewable fuels of non-biological origin including hydrogen carriers for maritime use.

3. What new technologies are there to reduce emissions from aircraft / shipping vessels and how close to commercialisation are they?

Aviation

Using evidence from government, industry and academic research, we have developed four illustrative scenarios for the Jet Zero Consultation showing the different technological mixes that could be achieved to reach net zero aviation by 2050. Figure 2 shows our high ambition scenario which assumes 2% p.a. fuel efficiency improvement, 30% SAF uptake (as a % of overall aviation fuel use), and that 21% of all air traffic movements are zero-emission by 2050.

Figure 2. Illustrative scenario from the Jet Zero Consultation showing a potential pathway to net zero aviation.



Efficiency improvements through a wide range of technologies play a key part in decarbonising aviation (see Q1) and next generation models of aircraft, such as the Airbus A320neo, typically offer around 20% efficiency gains on their predecessors.⁹

In addition, there are new propulsion technologies that may provide zero-carbon emission energy sources for aircraft. Possible solutions are:

- 1) Electric systems (battery, fuel-cells) for small aircraft. A certified electric training aircraft is commercially available¹⁰, and by 2025 larger (up to 19 seat) aircraft could start to enter the market. However, improvements in the power density and safety of battery technology will be needed to support larger aircraft.
- 2) Hydrogen propulsion systems for larger aircraft could enter the market in the 2030s. For example, last year, Airbus announced its intentions to bring a hydrogen aircraft into service in 2035.

Maritime

DfT commissioned research published in 2019¹¹, highlights a group of technologies that will improve energy efficiency in the near term, and promising alternative fuel technologies that enable the sector to achieve net zero by 2050.

Most of the current focus is on making ships more efficient, with developments in advanced hull, propulsion and rudder designs reducing the vessels drag; while on-board waste heat and energy recovery systems, more efficient heating, lighting etc, limits wasted energy. Wind propulsion is an increasing area of interest (both sails and rotor systems) and experimentation with on-board solar panels becoming more common.

These technologies are largely deployable today but are most suited to new vessels and have significant capital costs. The deployment of these technologies is largely driven by the IMO's work on energy efficiency. As the IMO standards progressively tighten, we expect these technologies to become increasingly common on new ships. IMO's current work on existing ship efficiency may also drive some retrofitting.

In the longer term we expect the sector will need to transition to alternative fuels, with both hydrogen and ammonia being seen as long-term candidates, and current experimentation in-sector is focused on both innovative clean energy sources, and the engine systems, including both modified internal combustion engine and fuel cell systems utilising these fuels. These systems are not available at a commercial scale, and the transition will require significant R&D and capital investment in both vessel equipment and shore fuelling infrastructure.

⁹ <https://www.airbus.com/aircraft/passenger-aircraft/a320-family/a320neo.html#details>

¹⁰ Velis Electro EASA TC – Pipistrel Aircraft (pipistrel-aircraft.com)

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https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/816015/maritime-emission-reduction-options.pdf

4. How should the Government's net zero aviation strategy support UK industry in the development and uptake of technologies, fuels and infrastructure to deliver net zero shipping and aviation?

Aviation

The Jet Zero Consultation will inform the Jet Zero Strategy which is due to be published later this year and is focused on achieving net zero aviation by 2050. Proposals in the consultation include setting a target for UK domestic aviation to reach net zero by 2040, UK airport operations to be zero emissions by 2040,¹² on the potential to use SAF and ZEF on Public Service Obligation routes and working with the Civil Aviation Authority on certification of new aviation technologies to ensure that the UK remains the best location in which to develop and deploy new zero emission aircraft.

Government investment in R&D is already supporting the development and uptake of technologies and infrastructure to meet our net zero goal, including:

- £1.95bn in aerospace R&D from 2013 to 2026, helping the development of new low and zero-carbon aircraft technologies in the UK, which has been match-funded by industry.
- £125m, matched by £175m from industry, to develop future aviation systems in the UK through the Future Flight Challenge.
- £15m Green Fuel, Green Skies competition to support the early development of UK SAF projects.
- £3m in R&D funding in 2021/22 for companies based in the UK to understand the infrastructure needed by airports to handle new forms of zero emission aircraft.
- £3m to establish a SAF clearing house in the UK to support the testing of SAF technologies.

Additionally, we view carbon pricing, including the UK ETS, as an essential lever for reaching net zero. By pricing CO₂ emissions, market-based measures can drive cost-effective and technology-agnostic emissions reductions, making system efficiencies, SAF and ZEF more economically attractive, and influence the travel choices of consumers.

Maritime

In the recently published Transport Decarbonisation Plan (TDP), the Government set out the next steps to decarbonise the UK's transport modes, including ways that the Government could support the industry to decarbonise maritime transport. In particular the TDP highlights the need to accelerate the commercialisation and market acceptance of new fuels and its associated infrastructure, and to develop regulatory interventions to underpin the transition over the next 30 years to net zero operations. The Department will consult on which support measures and interventions could be used to decarbonise the maritime sector.

¹² Scope 1 and scope 2 emissions only, which includes emissions owned and controlled by the airport operator and emissions from the off-site generation of energy purchased by the airport operator.

The Government is also supporting the industry in the development of new zero emission shipping technologies through the current £20m Clean Maritime Demonstration Competition.

5. What is the most equitable way to reduce aircraft passenger numbers (e.g. reforming air passenger duty and taxes, frequent flyer levies, bans on domestic flights where trains are available, restrictions on airport capacity)? Are there any policy mechanisms that could reduce our reliance on shipping?

Aviation

We want to preserve the benefits of flying for everyone, to enjoy holidays, visit friends and family overseas and to support our businesses. Our assessment is that the aviation sector can achieve net zero through efficiency improvements, cleaner fuels and new technologies. We recognise that we will need to keep our approach under review and intend to assess progress on the sector's CO₂ emission reduction pathway and update our strategy through five-year reviews.

Where people want to fly, we can do more to help them make the most sustainable choices. We are currently working with the CAA to explore whether mandating the provision of environmental information to customers at the time of booking flights could influence consumer decision-making, helping to recognise airlines that do more to reduce emissions.

Air Passenger Duty (APD) is the UK Government's principal tax on the aviation sector since tickets are VAT free and aviation fuel incurs no duty. The tax raised £3.6 billion in 2019/20 and its primary objective is to ensure that airlines make a fair contribution to the public finances. This revenue funds government priorities, including tackling climate change. HM Treasury recently consulted on aviation tax reform to consider how APD could be reformed to support Union connectivity and our environmental objectives. The consultation also sought views on the Government's initial position that a Frequent Flyer Levy would not be an appropriate replacement for APD, on the basis that it would be significantly more complex to administer and could require the Government to collect and store personal information on each passenger, which may pose concerns around data processing, handling and privacy.

Maritime

The Government does not accept the suggestion that we should work to reduce the UK's reliance on shipping. The UK is an island trading nation with a long maritime history and an extensive maritime sector. In 2017 the sector is estimated to have directly contributed around £17 billion to the UK economy and directly supported around 220,000 jobs in the UK.¹³

Of all transport modes, shipping is one of the lowest emitters of greenhouse gases (GHGs) per "transport work" or unit transported. Our global focus should be on reducing this number still further, towards full decarbonisation of international

¹³ <https://www.maritimeuk.org/media-centre/publications/state-maritime-nation-report-2019/>

shipping, rather than shifting goods and passengers to other transport modes or limiting our ability to export to the world.

Therefore, the Government believes that the UK maritime sector should be championed, while recognising the need to decarbonise and be encouraged by fair and effective climate policies. With a decarbonised maritime sector, our shipping would continue to carry the overwhelming majority of our exports and imports in a way that minimises environmental impacts and GHG emissions.

6. What further action is needed by the International Civil Aviation Organization and International Maritime Organization to drive emissions reductions? What can the UK Government do to drive international action on emissions?

Aviation

The UK makes a significant contribution to the environmental work of the International Civil Aviation Organization (ICAO), including as an active member of the Committee on Aviation Environment Protection and its working groups, and as part of the 36-state executive Council.

We want ICAO to build on its recent successes, such as the CORSIA global offsetting scheme, by agreeing a long-term goal for international aviation CO₂ emissions. A long-term aspirational goal will provide the ambition and direction for global aviation decarbonisation in the years ahead, and ensure the sector contributes to the temperature targets of the Paris Agreement.

We are playing an active role in ICAO's current technical work on the feasibility of this long-term goal, considering all in-sector measures. The UK will also use its COP26 Presidency to bring countries together in calling for adoption of a global net zero aviation goal by ICAO at its Assembly in 2022, in line with growing ambition in the aviation industry.

The UK would expect that agreement to such a goal would be followed by work in ICAO to help deliver it, including strengthening CORSIA, setting standards for advanced aircraft designs, and further supporting the deployment of SAF.

Maritime

The UK remains committed to addressing emissions from international shipping through the IMO and its Initial Strategy for Reduction of GHG Emissions from Ships. The IMO is now working through the short-, mid- and long-term measures needed to drive emissions reduction in the sector. As discussions on middle and long-term measures begin in 2021, the UK will be an ambitious voice for robust and stringent policies to reduce emissions from ships, including consideration of market-based measures.

The Initial Strategy is due to be revised in 2023. During this review, we will press for greater ambition and urge accelerated decarbonisation. We will promote close alignment with the Paris temperature goals and challenge the international community to deliver on the initial strategy commitment to 'phase out' emissions from the international sector as soon as possible.

In terms of the UK driving international action on maritime emissions, this year as the UK hosts COP26 in Glasgow, we aim to showcase ambitious maritime initiatives demonstrating the potential for maritime decarbonisation.

Further, the UK will participate in Mission Innovation's Zero Emission Shipping Mission as a core member, contributing to the work of the Mission to scale up zero emission shipping by 2030. The UK will collaborate with other participants on pushing to make international shipping emission-free and will contribute to the Mission's ambitious programme through its work on international green shipping corridors.

7. How effective will the global offsetting scheme for international airlines (ICAO's CORSIA) and the UK and EU ETS be at stimulating technology improvement and/ or behaviour change to reduce emissions from aviation / shipping?

Aviation

Market-based economic measures will play an important part in reducing the emissions from the aviation sector in a cost-effective way, as well as incentivising uptake of green technologies. Schemes which place a price on carbon, via tradeable permits or offsetting obligations, improve the economic case for low or zero emission technologies. Airlines may pass some of these costs on to consumers which may reduce demand for air travel and in turn reduce emissions.

The UK ETS will be the world's first net zero carbon cap and trade market, delivering a robust carbon price signal which gives businesses the confidence to mobilise the scale of capital investment necessary. Through the UK ETS Authority we are working to ensure that aviation is appropriately considered as we consult on amending the cap to align with net zero, reviewing the sector's free allocation, exploring expanding the pollutants covered, and making any changes that may be required to account for CORSIA.

CORSIA is the first worldwide scheme of its kind to address CO₂ emissions in any single sector. 106 states (including the UK) have already volunteered to join the scheme,¹⁴ representing more than 76% of international aviation activity.¹⁵ The UK was instrumental in the development and agreement of CORSIA and remains a strong supporter. We recognise the significant success that such a global scheme represents but want to build further on this achievement. Periodic reviews of CORSIA will begin from 2022 and we believe that these reviews should be used to improve the operation of the scheme and increase its environmental integrity. For example, ICAO should consider aligning the environmental ambition of the scheme with any new long-term goal, and we expect there to be a shift from using offsets to greenhouse gas removals as such technologies develop.

¹⁴ https://www.icao.int/environmental-protection/CORSIA/Documents/CORSIA%20States%20for%20Chapter%203%20State%20Pairs_2Ed_FINAL_wit_h%20cover.pdf

¹⁵ https://www.icao.int/environmental-protection/Documents/EnvironmentalReports/2019/ENVReport2019_pg207-210.pdf

Maritime

Research commissioned by DfT to inform the UK's 2019 Clean Maritime Plan suggests that economic instruments like carbon pricing could be an effective means of reducing GHG emissions from shipping by incentivising zero emission and low emission fuels, while disincentivising traditional fossil fuels.

Domestically, the Department has pledged in the recently published Transport Decarbonisation Plan to assess how economic instruments could be used to accelerate the decarbonisation of the domestic maritime sector.

8. How should the UK define its ownership of international aviation and shipping emissions (i.e. arrivals, departures or both) in order to include them in legislative targets?

The Government has legislated for the UK's Sixth Carbon Budget, setting a world-leading target to reduce greenhouse gas emissions by 78% by 2035 compared to 1990 levels.¹⁶ This is in line with the latest science as the level recommended by our expert advisers at the Climate Change Committee. We have committed to formally include the UK's share of International Aviation and Shipping (IAS) emissions in the Sixth Carbon Budget. IAS emissions are an important part of our overall decarbonisation efforts and this change allows for them to be accounted for consistently within the Sixth Carbon Budget. In June, we confirmed our aim to legislate to include IAS emissions within one year, by regulations under section 30 of the Climate Change Act 2008. When developing these regulations, the Government will carefully consider how best to measure IAS emissions when including them in our legislative targets.

September 2021

¹⁶ S.I.2021/750 came into force on 24 June 2021.