ROYAL AERONAUTICAL SOCIETY

Public attitudes to the decarbonisation of aviation

A Royal Aeronautical Society Report
March 2025

About the Royal Aeronautical Society (RAeS)

The Royal Aeronautical Society is the world's only professional body and learned society dedicated to the entire aerospace communities.

Established in 1866 to further the art, science and engineering of aeronautics, the Society has been at the forefront of developments in aerospace ever since.

The Society seeks to promote the highest possible standards in aerospace disciplines; provide specialist information and act as a central forum for the exchange of ideas; and play a leading role in influencing opinion on aerospace matters. As such we provide authoritative, independent, and evidence-based reports, briefings, opinions and events.

Our global presence is expressed through our divisions and branches across the globe and our expertise is expressed through our 23 Specialist Groups who work across a whole range of areas.

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EXECUTIVE SUMMARY

The aviation industry is firmly focussed on sustainability and reaching Net Zero by 2050. For an industry currently heavily reliant on fossil-based fuels, reducing carbon emissions and then balancing any remaining emissions through their removal or offset to reach a point where the industry is responsible for no net increase in greenhouse gases, is a challenging goal.

Multiple Net Zero roadmaps have been created by different organisations, which while having some differences in both assumptions and conclusions, all share a common understanding of the overall actions which will need to be taken for Net Zero 2050 to become a reality. Some of these actions, such as the use of Sustainable Aviation Fuel (SAF) will not be overtly visible to the flying public, but are likely to make themselves known through higher costs, or impacts on availability of fuel feedstocks or energy for non-aviation uses. Other actions such as the development of advanced technologies and zero carbon aircraft, are likely to be more evident to passengers.

It is generally acknowledged that none of the available paths to decarbonisation are sufficient on their own, and will all be required to varying degrees, so the flying experience will evolve for passengers over the coming decades. It is therefore helpful to understand at an early stage how the public are likely to view the actions the industry takes to decarbonise and how they are likely to respond to the impacts that are most visible to them as airline passengers. A clearer perspective of this will allow the industry to shape how changes to the industry are publicised and ensure that where necessary efforts are made to help educate the public on these matters.

The Royal Aeronautical Society commissioned Ipsos UK to carry out a survey of over 2000 UK adults aged 16-75, asking questions relating to the impacts of decarbonising aviation. The survey yielded some fascinating insights into how the public perceive the probable paths to achieving Net Zero in aviation, and their impact on the flying customer.

A majority of those surveyed considered themselves concerned about climate change, while over half fly at least once a year and therefore it is presumed that the topic is of interest to a significant proportion of the public.

Perhaps most concerning to the industry is that only a minority of respondents say they are willing (8% ‘very willing’, 30% ‘fairly willing’) to pay more in order to reduce their carbon emissions. Much of the work to decarbonise the industry will result in increased costs, either directly or indirectly, at least in the earlier stages of adoption, so it is unlikely that increased costs for passengers can be entirely avoided.

More positively, 80% of those surveyed say that they trust the aircraft manufacturing industry and regulators to ensure that new technologies and fuels are introduced safely (32% said they trust them ‘a great deal’, and 48% said they trust them ‘a fair amount’ to do this).

Although the results here do not provide all the answers and in some cases raise additional questions or a need for further clarification, the report highlights some key findings around how the public feels about decarbonising aviation.

KEY FINDINGS

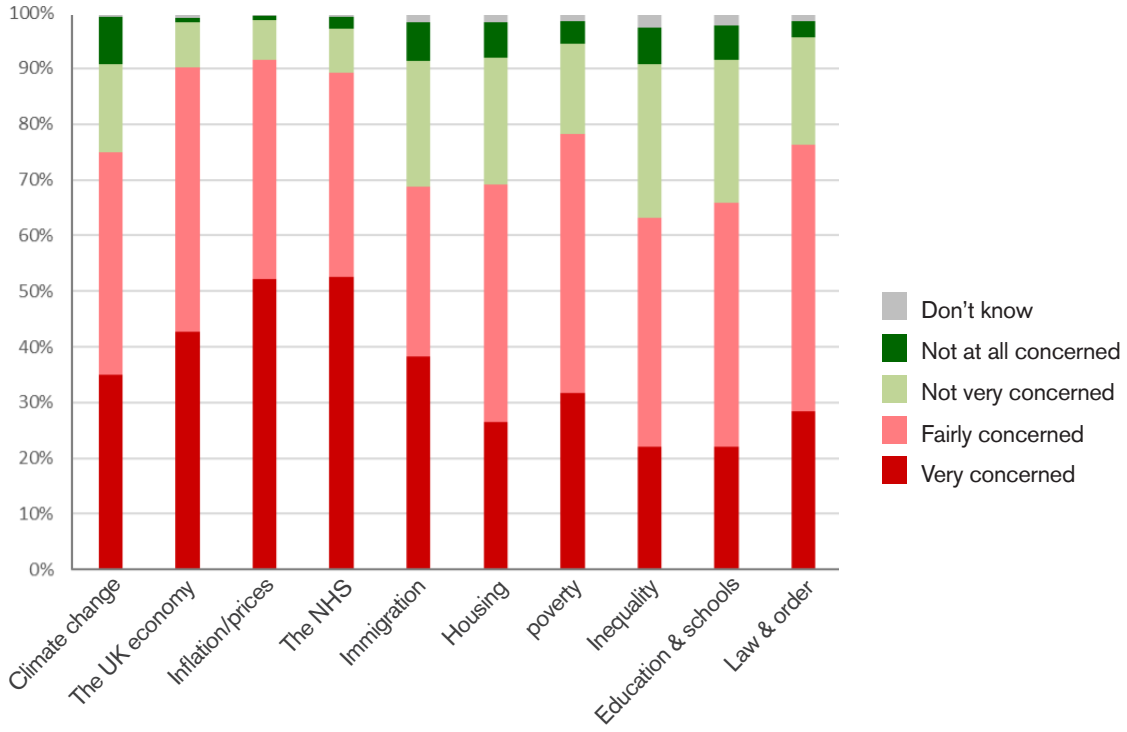
- When shown a list of ten areas and asked to rate their level of concern with each, 75% of respondents consider themselves to be concerned about climate change[1].
- The survey respondents appear to view air transport as producing greater carbon emissions than other forms of transport (road, rail and sea), with 58% selecting 'to a great extent' when asked the extent to which they think air travel produces carbon emissions which contribute to climate change.
- The respondents appear to believe that it will also be the hardest form of transport to decarbonise, with 69% rating it as difficult[2] when asked the extent to which they think it will be easy or difficult to reduce carbon emissions from air travel between now and 2050.
- Only a minority (38%) of respondents say they would be willing[3] to pay more to reduce the carbon emissions produced by their flight.
- Around half of the respondents are willing to have their comfort or convenience impacted in various ways in order to reduce the carbon emissions of their flight[4].
- Over half (57%) of the respondents say they would be willing to use an alternative form of transport in order to reduce carbon emissions produced by their flight[5].
- There is more support than opposition to a frequent flyer tax[6], and also overall support to a lesser degree for increased taxation of aviation when the money raised is invested in decarbonising air travel[7]. However, there is net opposition to increased taxation of airfares used for general government spending[8].
- 80% of those surveyed trust the aircraft manufacturing industry and regulators to ensure continued safety standards while introducing new technologies to decarbonise air travel[9]. They appear to be less confident in the industry ensuring that new technologies will not have a negative impact on comfort, reliability and environmental noise levels.
- The survey respondents generally view SAF as creating fewer carbon emissions than fossil fuels but do not tend to distinguish between the relative sustainability of fuels derived from waste, plants and renewables (ie, Power-to-Liquid SAF)[10].
- Almost half of respondents viewed continued burning of fossil fuels, offset through carbon capture to be on the acceptable end of the scale as a means of reaching Net Zero.
- Only just over a third (36%) of people view current airline carbon offsetting schemes as having a positive impact on the environment[11].
- When asked about the emissions reduction that could be achieved through the use of SAF, 43% of respondents underestimated the emissions reduction, compared with only 11% who overestimated the benefit[12].

For more details and discussion of the results from the survey, please see the following Appendix.

(1) 35% 'very concerned', 40% 'fairly concerned'.
(2) 30% 'very difficult', 40% 'fairly difficult'.
(3) 8% 'very willing', 30% 'fairly willing'.
(4) For example, when shown 'Have less flexibility in when you fly, due to fewer flights happening each day', 59% said they would be either 'very' (15%) or 'fairly' (44%) willing to do this.
(5) 15% 'very willing', 44% 'fairly willing'.
(6) 53% 'strongly support' or 'tend to support', *vs* 23% 'strongly' or 'tend to' oppose.
(7) 40% selected answers to indicate they support this, with 11% selecting 'strongly support' and 29% selecting 'strongly oppose'.
(8) 39% 'strongly' or 'tend to' oppose this, *vs* 32% 'strongly' or 'tend to' support.
(9) 32% report trusting the industry to do this 'a great deal', and 48% to do so 'a fair amount'.
(10) Similar proportions (between 61% and 65%) rate these as either 'very' or 'fairly' sustainable fuels.
(11) 'very positive impact' (6%) or 'slightly positive impact' (30%).
(12) Underestimate: 'reduced by around half' (16%), 'reduced by less than half' (16%), 'not reduced at all' (10%) and 'increased' (2%) *vs* Overestimate: 'Reduced by 100%' (11%). Most common response: 'Don't know' (37%).

APPENDIX: DETAILED RESULTS

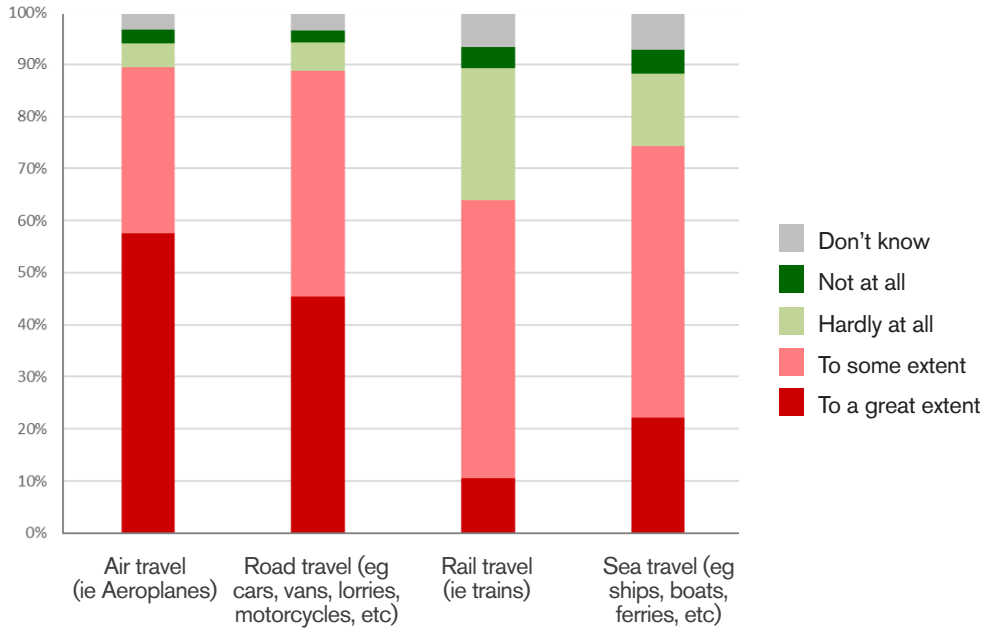
Q1 How concerned, or not, are you about each of the following?



Base: n = 2,105 UK adults aged 16-75, online fieldwork conducted 13-17 December 2024.

The majority of the respondents (75%) reported that they were 'Very concerned' (35%) or 'Fairly concerned' (40%) about climate change. Although it was not among the top three issues which caused concern, it appears to be an issue that most of the survey respondents care about.

Q2 To what extent do you think each of the following forms of transport produce carbon emissions which contribute to climate change?



Base: n = 2,105 UK adults aged 16-75, online fieldwork conducted 13-17 December 2024.

Air travel was identified by respondents as a greater producer of carbon emissions contributing to climate change than other forms of transport (89%, 58%, 'to a great extent', 32% 'to some extent'). This increased to 94% among the n = 1,607 who considered themselves to be 'very' or 'fairly' concerned about climate change.

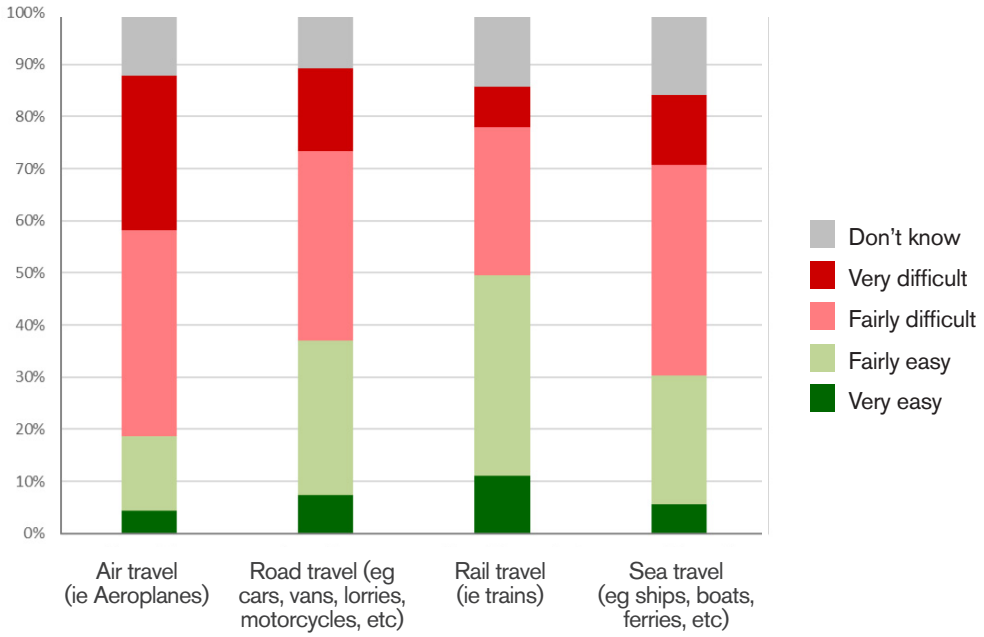
Air travel currently contributes 2-3% of global carbon emissions, which is roughly similar to shipping, but much lower than road travel which contributes around 15% of total CO_2 emissions[13]. The picture is less clear when comparing road and air travel in terms of passenger-kms, since the carbon footprint of air travel varies significantly depending on the length of the flight. However, data from the UK Department for Energy Security and Net Zero shows that journeys by petrol and diesel cars have a greater carbon footprint than short and long-haul international flights, although lower than domestic flights[14].

This would therefore suggest that the public somewhat overestimates the carbon emissions of air travel compared with road transport (the proportions of respondents rating 'road transport' to 'a great' or 'to some' extent in terms of how much it produces carbon emissions which contribute to climate change was also 89%, although the proportion rating 'a great extent' – 45% – was actually smaller than the proportion who did so for air travel, which was 58%). However, given the likelihood that the road transport industry will decarbonise more rapidly, at some point in the future these comparative levels of emissions will reverse, and it is therefore still important for aviation to prioritise decarbonisation.

(13) Cars, planes, trains: where do CO_2 emissions from transport come from? – Our World in Data (based on emission conversion factors provided by the UK government for organisations reporting their emissions).

(14) Which form of transport has the smallest carbon footprint? – Our World in Data.

Q3 This question is about decarbonisation. 'Decarbonisation' is a term which refers to the reduction or elimination of carbon dioxide (CO_2) emissions released into the atmosphere. For the purposes of the question, we would like you to think about the reduction of carbon dioxide from being released into the atmosphere. To what extent do you think it will be easy or difficult to reduce carbon emissions from each of the following forms of transport between now and 2050?



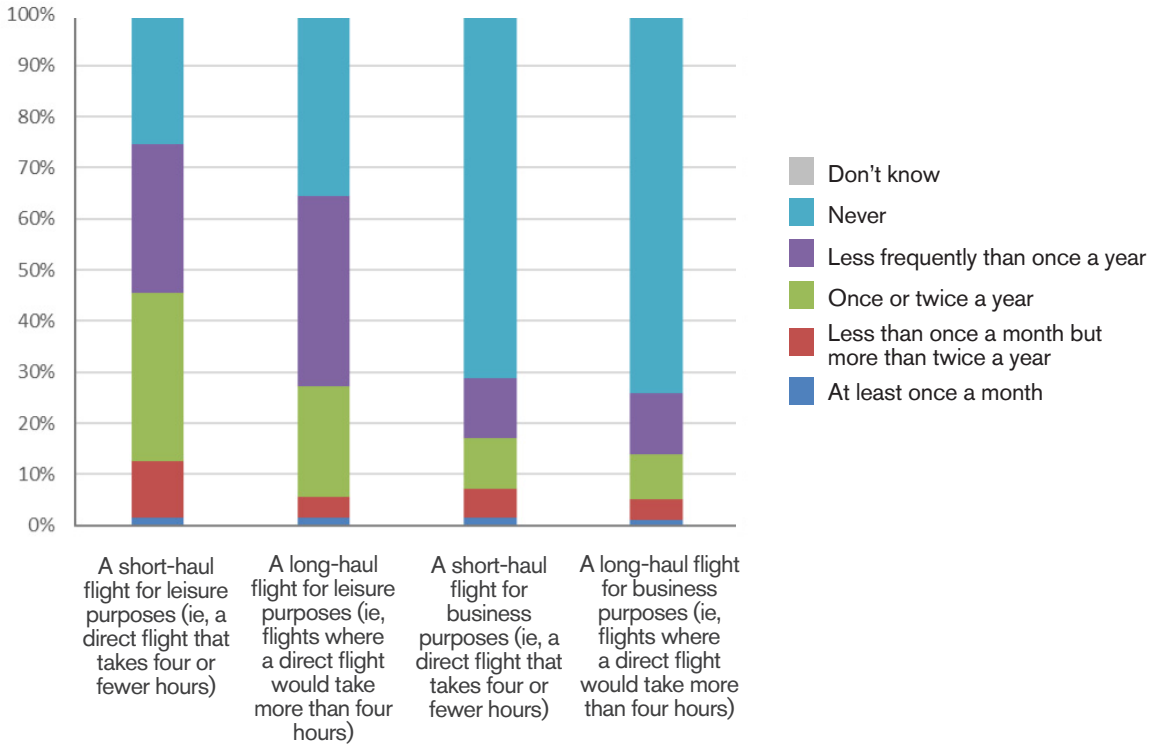
Base: n = 2,105 UK adults aged 16-75, online fieldwork conducted 13-17 December 2024.

Respondents are more likely to view air travel as difficult to decarbonise than other forms of transport. This is representative of the industry view that many easier to implement decarbonisation technologies such as electrification aren't viable for the majority of aviation, increasing the challenge for the sector.

It is likely that the road transport industry will decarbonise significantly more rapidly than the aviation industry is able to do. The maritime industry faces some similar challenges to aviation, and therefore the survey respondents may be underestimating the difficulty of decarbonisation for sea travel.

It is worth noting that more than half of a barrel of oil when processed, becomes petrol and diesel used in road transportation, whereas only 8-10% becomes kerosene used for aviation. As the demand for petrol and diesel reduces with the more rapid decarbonisation of road vehicles, this may have an impact on the production and/or cost of kerosene.

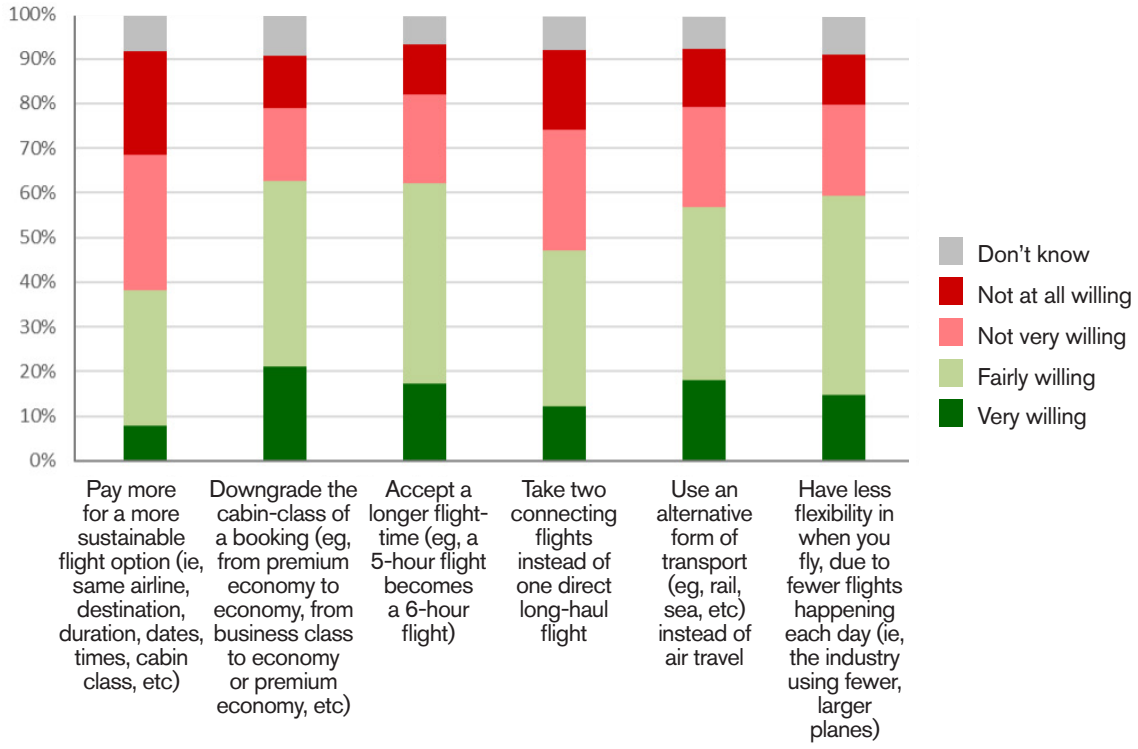
Q4 Typically, how often, if at all, do you travel in each of the following ways?



Base: n = 2,105 UK adults aged 16-75, online fieldwork conducted 13-17 December 2024.

Just over half of respondents (53%) stated that they travel by aircraft at least once a year in one or more of the flight categories. When 'frequent flyers' are discussed, this typically refers to those travelling more than once per year, and therefore many of the respondents would fit this description.

Q5 Please imagine a scenario where you were going to book and pay for a flight.
How willing, or not, would you be to take each of the following actions, if you knew it could reduce the total carbon emissions produced by your flight?



Base: n = 2,105 UK adults aged 16-75, online fieldwork conducted 13-17 December 2024.

Decarbonising aviation is likely to result in impacts that will be observable to airline customers, some of which may be more palatable than others.

One likely impact is an increase in the cost of flying, whether this is due to the higher cost of fuels (such as through using SAF instead of fossil kerosene) or increased overall sector costs resulting from the expense of developing and implementing new technologies and infrastructure. However, from the six actions proposed to reduce carbon emissions, paying more appeared to be the least popular action (in terms of willingness). Only 38% of respondents indicated that they would be willing to pay more to reduce their carbon emissions when flying (8% selected 'very willing', 30% selected 'fairly willing'). It is worth bearing in mind that air fares are currently cheap when considered in a historical context, which has made flying more accessible. This is clearly beneficial from a social sustainability standpoint, but may not be maintainable in the drive for environmental sustainability.

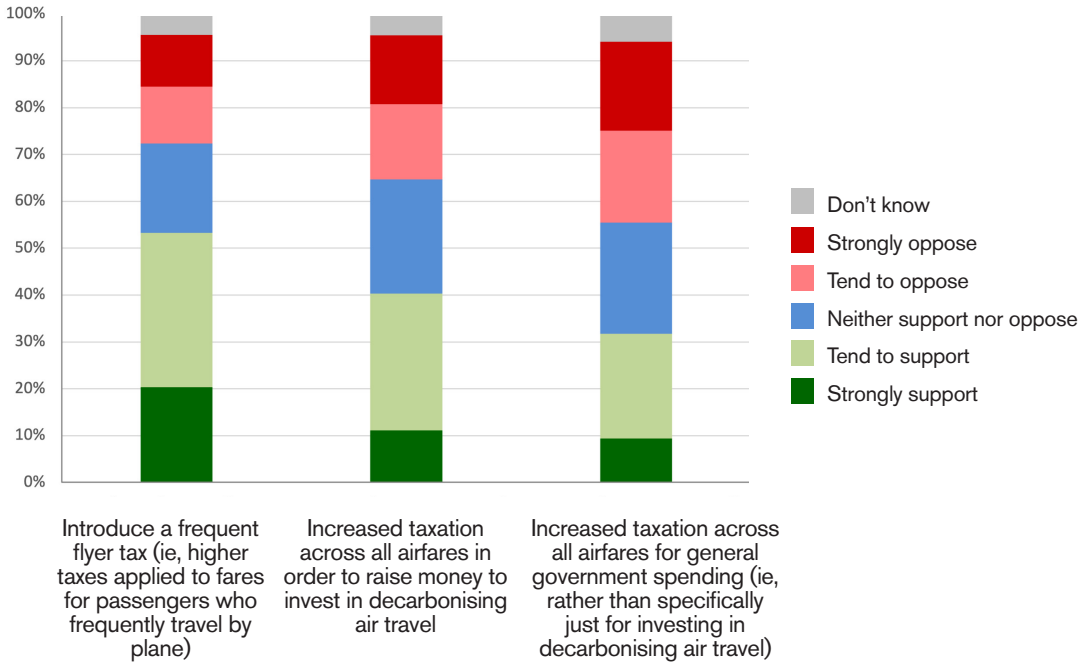
Many air travel booking sites currently offer information on carbon emissions for different cabin classes, with more expensive and luxurious cabins seeing notably higher emissions. 63% of respondents indicate that they would be willing to downgrade the cabin-class they booked in order to reduce their emissions (21% 'very willing', 41% 'fairly willing'). This is a measure which can currently be implemented by customers, and it is not known how this

level of willingness translates to action when booking flights. Although this public sentiment might suggest that airlines could decrease the proportion of less sustainable seat options that they offer, there are multiple factors influencing these decisions. More expensive cabins are often more profitable and sometimes subsidise economy passengers. Improved sustainability must therefore be balanced with economic viability.

There are a number of potential convenience-related actions which could result in lower carbon emissions. Flying slower (particularly where the aircraft is specifically designed with a lower optimum airspeed), taking two connecting flights instead of one long-haul flight (less fuel is burnt to carry the fuel for the later portion of the flight) and flying the same route less frequently with larger planes (carrying the same number of passengers overall) can all reduce fuel burn. The respondents' views on these options were mixed, showing 62% (flying slower), 47% (connecting flights) and 59% (fewer flights) were either 'very' or 'fairly' willing to take these actions. This suggests that the nature of the inconvenience is important to passengers, with needing to transfer between connecting flights having more of a negative impact (ie, a lower proportion – 47% – saying they would be 'very' or 'fairly' willing to do this in order to reduce the total carbon emissions produced by their flight) than the other options. For short-haul flights, using an alternative means of transport can be an effective way to reduce carbon emissions, and 57% of respondents indicated that they would be willing to do this (18% 'very willing', 39% 'fairly willing'). The aviation sector will need to work with other elements of the transport system to explore multi-modal decarbonisation solutions.

Q6 To what extent do you support or oppose each of the following measures that could be taken to help decarbonisation of air travel?

As a reminder, 'decarbonisation' is a term which refers to the reduction or elimination of carbon dioxide (CO_2) released into the atmosphere.



Base: n = 2,105 UK adults aged 16-75, online fieldwork conducted 13-17 December 2024.

Taxes are a highly debated measure by which to curtail growth in the sector, and potentially raise money to be directed into aerospace research and development to accelerate the development of sustainable technologies.

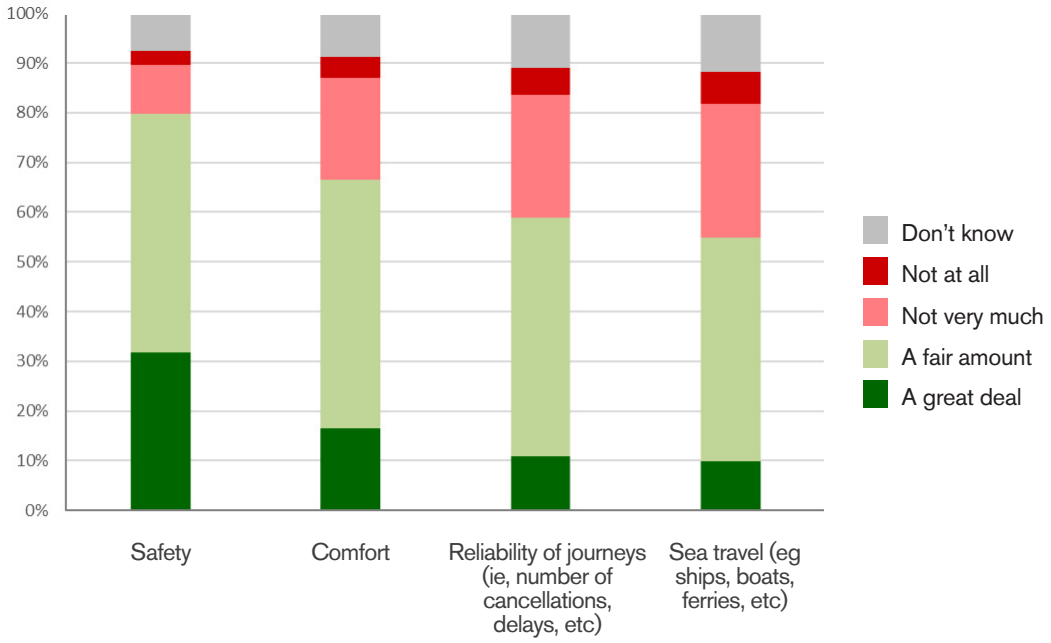
One of the suggestions is a frequent flyer tax, with frequent flyers defined as those who take more than one return flight per year, with proposals suggesting taxing second and subsequent trips. 53% of the respondents indicated that they would support a frequent flyer tax (*vs* 23% who oppose it), dropping to 48% among the n = 1,135 who said they fly at least annually in one or more of the leisure/business short-haul/long-haul categories of flight presented earlier in the questionnaire. Since 'frequent flyer' was not defined in the survey question, it is not known whether all of those in this latter category would have identified with the phrase and therefore considered they may have been directly impacted by the introduction of such a tax themselves.

More universal taxation of air travel was less popular with respondents in terms of the proportion who said they support the idea, although 40% supported increased taxation providing the money was invested in decarbonising air travel, relative to 31% who opposed it. Support dropped further to 32% if the money raised was used for general government spending, versus 39% who opposed it.

It is of interest that with respect to both the frequent flyer tax, and increased taxes used to fund decarbonising aviation, there was greater support than opposition from the respondents. However, the fact that less than half of respondents oppose each of the suggested forms of increased taxation, does not readily correspond with the earlier responses showing that only 38% of respondents were willing to pay more to reduce their carbon emissions from flying.

Q7A When introducing new technologies to decarbonise air travel…

To what extent do you trust, or not, the aircraft manufacturing industry to ensure continued standards in each of the following areas while doing this?



Base: n = 2,105 UK adults aged 16-75, online fieldwork conducted 13-17 December 2024.

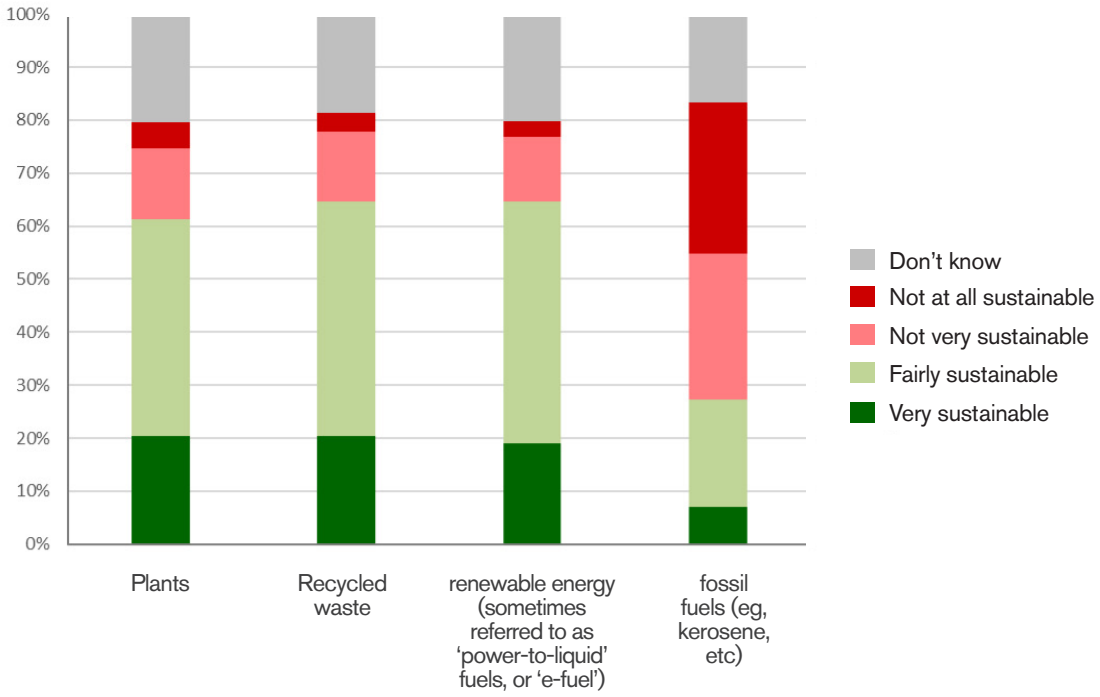
Decarbonising aviation will necessitate the introduction of new technologies and fuels which may be unfamiliar to the flying public, some of which may be more visible than others. Possible new aircraft and engine architectures could include higher aspect ratio wings (possibly strut-braced), open rotor engines or more radically, blended-wing-body aircraft.

In terms of the proportions saying they trust the industry either 'a great deal' or 'a fair amount', respondents were largely positive about the level of trust they had in the aircraft manufacturing industry to enact these changes maintaining safety (80%; 32% 'a great deal', 48% 'a fair amount'), comfort (67%; 17% 'a great deal', 50% 'a fair amount'), reliability (59%; 11% 'a great deal', 48% 'a fair amount') and environmental noise-levels (55%; 10% 'a great deal', 45% 'a fair amount').

This positive perspective on safety in particular may indicate that the general public have been less influenced by well-publicised incidents over recent years than might have been expected, or that they believe lessons have been learned from them.

Respondents were also asked the same question with respect to regulators of the aircraft manufacturing industry, with very similar responses.

Q8 Fuel used in aeroplanes can come from various sources.
How sustainable, or not, do you think each of the following are for fuelling airplanes? Fuels made from…



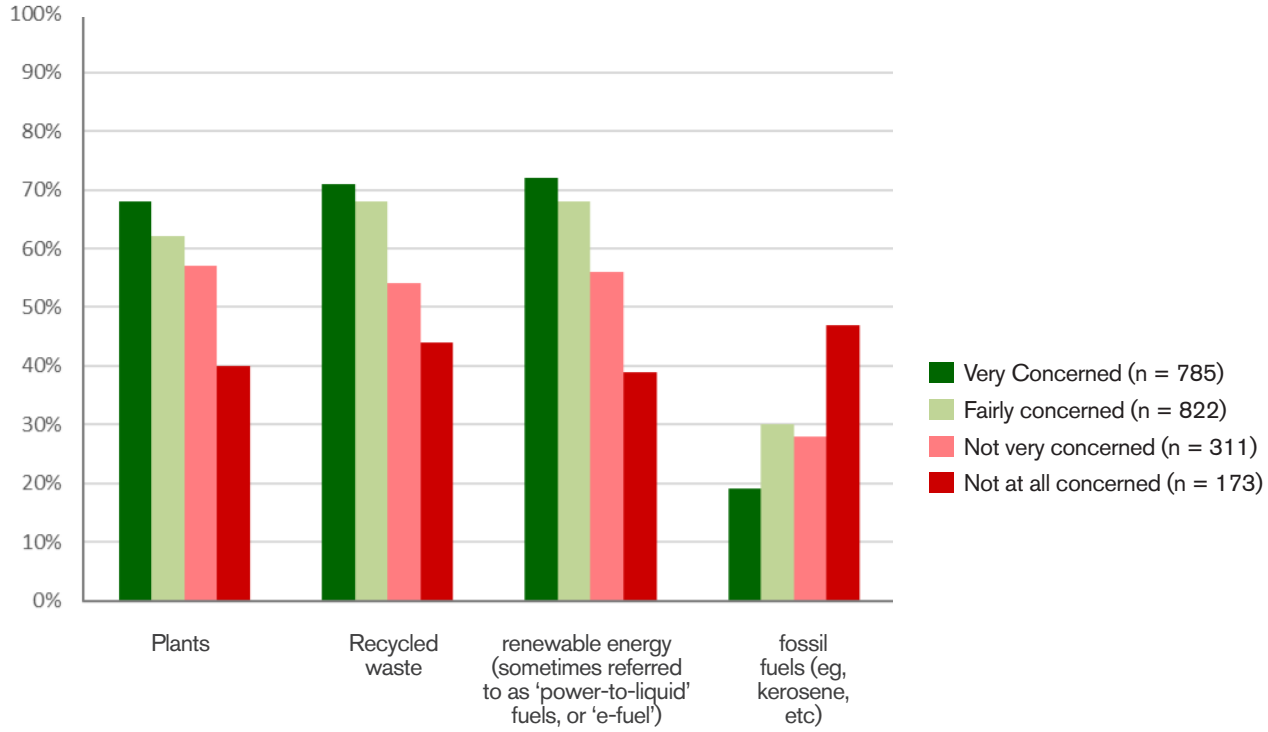
Base: n = 2,105 UK adults aged 16-75, online fieldwork conducted 13-17 December 2024.

Sustainable Aviation Fuels (SAF) are a key component of any roadmap for decarbonising aviation. For larger commercial aircraft, the use of non-carbon emitting fuels is now not predicted before the 2040s and it will take such aircraft much longer to become a significant proportion of the fleet even after they enter service. It is therefore expected that even in 2050, the majority of commercial flights will still be using hydrocarbon-based fuels. The source of those fuels, and thus their net carbon emissions are therefore a critical influence on the ability of the sector to reach Net Zero by 2050.

SAF can be derived through a number of processes and from a variety of feedstocks, with a corresponding range in 'well-to-wake' carbon emissions. Power-to-liquid SAF is often considered the end goal, offering the greatest potential reduction in emissions, but requires significant quantities of green hydrogen and energy and will take time and investment to scale up.

SAF derived from both plants and waste have their own advantages, but also suffer drawbacks, particularly the availability of the feedstocks and the impacts on bio-diversity.

The results from the survey suggest that the public do not significantly distinguish between SAF derived from different sources, but consider all three options presented

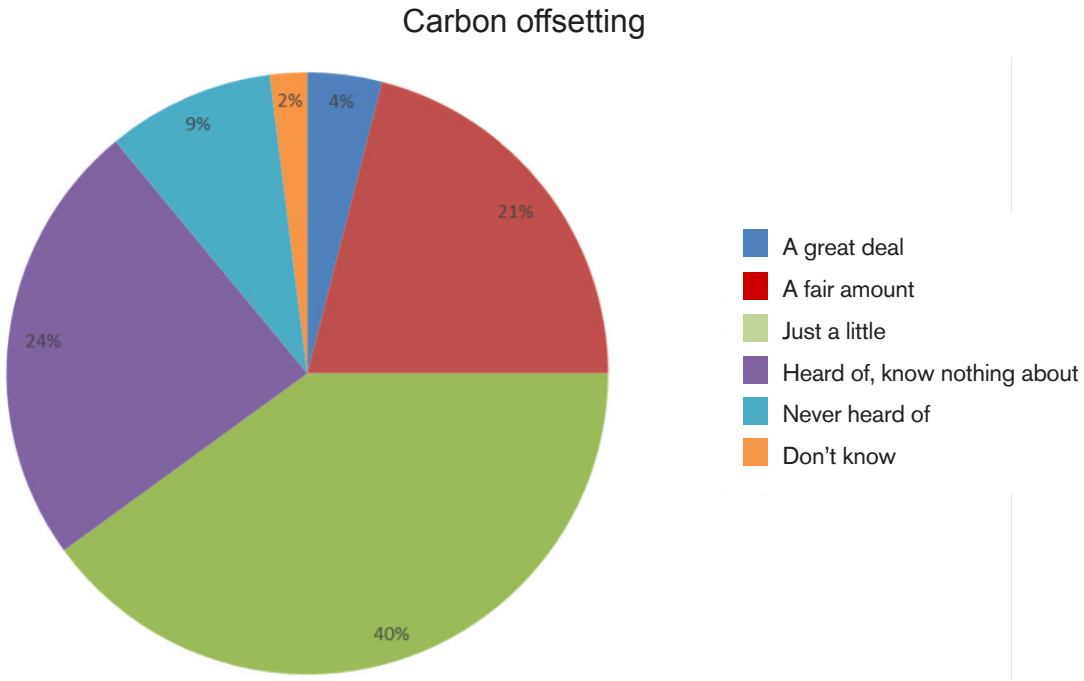


Base: n shown in legend, UK adults aged 16-75 grouped by responses to 'How concerned, or not, are you about each of the following? Climate change (also called global warming)', online fieldwork conducted 13-17 December 2024.

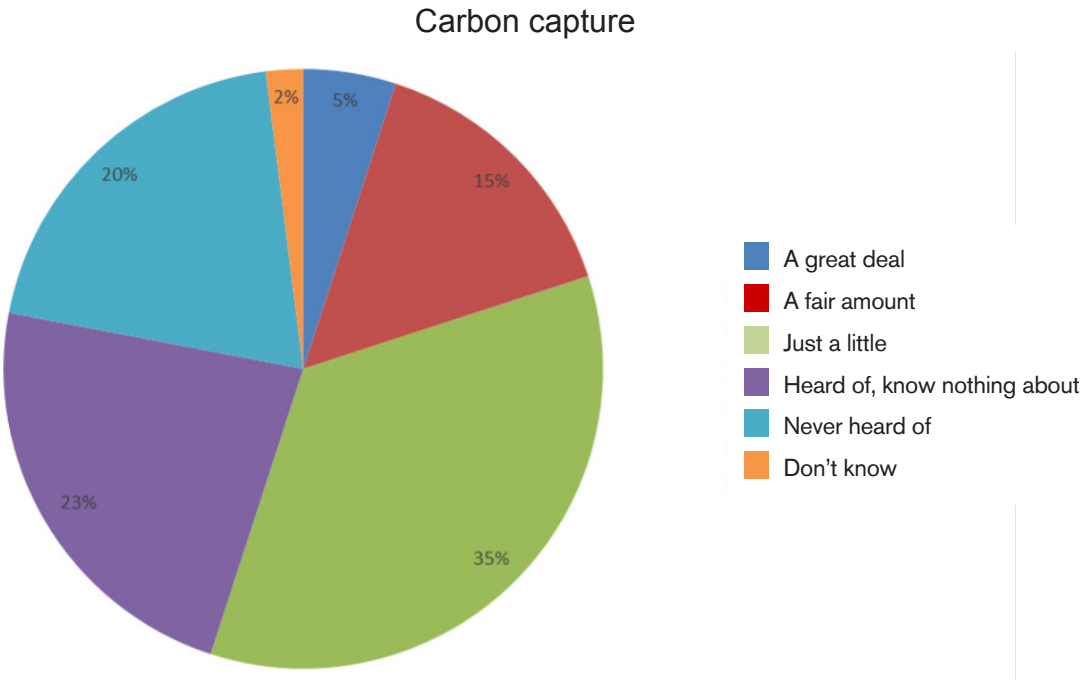
to be significantly more sustainable than continuing to use fossil fuels.

It is notable that those who considered themselves not at all concerned with climate change (n = 173) were much more likely to deem fossil fuel 'very' or 'fairly' sustainable (47%, compared with 27% overall). This group (those not at all concerned with climate change) also rated fossil fuel as the most sustainable of all the options presented, which is at odds with all the other groups, who considered fossil fuels the least sustainable fuel source by a clear margin.

Q9 Before taking this survey, how much, if anything, would you say you know about carbon offsetting and carbon capture?



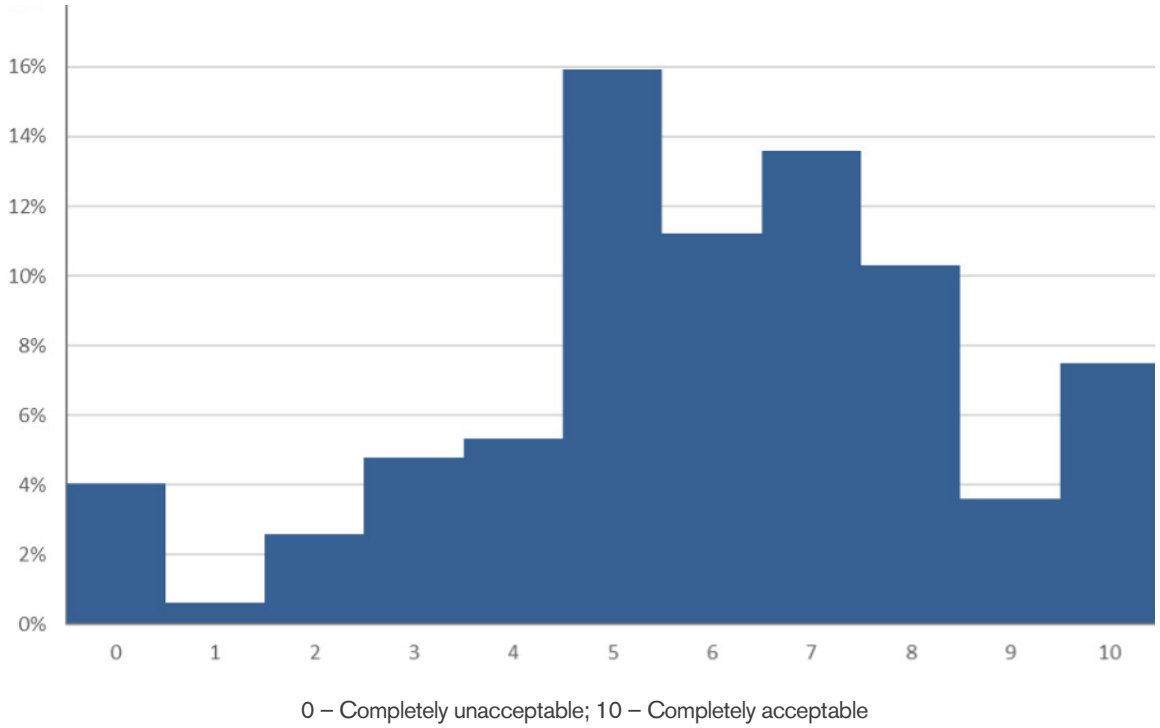
Base: n = 2,105 UK adults aged 16-75, online fieldwork conducted 13-17 December 2024.



Base: n = 2,105 UK adults aged 16-75, online fieldwork conducted 13-17 December 2024.

Q10 For this question, by 'carbon capture', we mean the capture and permanent storage of all carbon dioxide emissions produced from air travel.

How acceptable, or unacceptable, would it be for the air travel industry to power aeroplanes in the future with fossil fuels, if the carbon dioxide (CO_2) emissions are fully offset through carbon capture?



Base: n = 2,105 UK adults aged 16-75, online fieldwork conducted 13-17 December 2024.

Many decarbonisation roadmaps for aviation predict that a majority of aircraft will still be fuelled by hydrocarbon fuels in 2050 and that there will be inadequate SAF supply to fuel all air travel[15]. In addition SAF will not have a 100% Emissions Reduction Factor and there will still be some carbon emissions during the well-to-wake lifecycle of the fuel. As a result, roadmaps show a proportion of residual emissions not addressed by in-sector measures. These residual emissions are often shown as being addressed through carbon capture or greenhouse gas removals, in order for the sector to reach Net Zero.

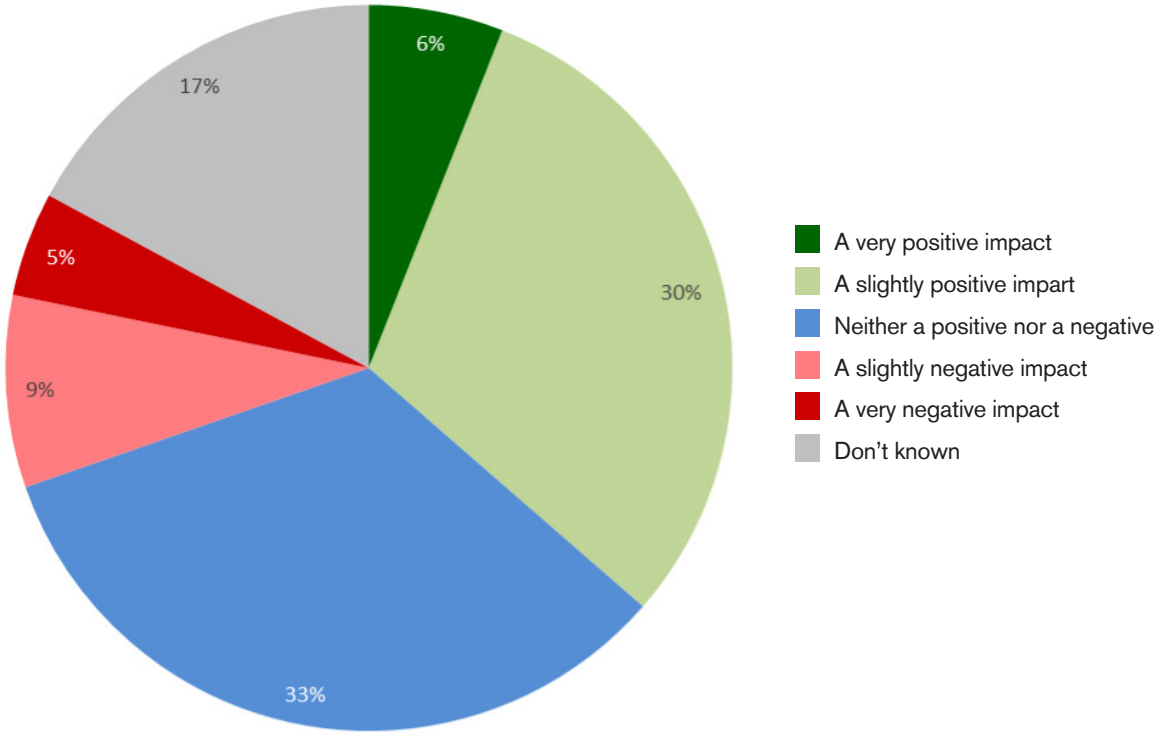
46% of respondents gave a rating towards the acceptable end of the scale when asked about the industry continuing to use fossil fuels, provided the carbon emissions are fully offset through carbon capture acceptable to some degree (6-10 on a scale of zero to ten), relative to 17% who considered the practice to be unacceptable to some degree (0-4 on the scale). A sizeable proportion of respondents (21%) said that they did not know when asked this question.

This would suggest that carbon capture as a means to offset residual emissions and reach Net Zero is likely to be viewed as acceptable if the accounting of the carbon capture can robustly demonstrate that the process is reducing the net CO_2 emissions of aviation. Aviation will not be the only sector reliant on carbon capture to achieve Net Zero, and therefore this practice is likely to become more familiar to the public as we move towards 2050, although it may be expensive.

(15) IATA Net Zero Roadmaps Comparative Review: https://www.iata.org/contentassets/8d19e716636a47c184e7221c77563c93/nz-roadmaps.pdf

Q11 For this question, by 'carbon offset', we mean the mechanism that allows organisations to compensate for cardon dioxide emissions produced by their activities through investing in projects that reduce, avoid, or remove emissions elsewhere.

To what extent, or not, do you think that carbon offset schemes currently operated by airlines have a positive or negative impact on the environment?



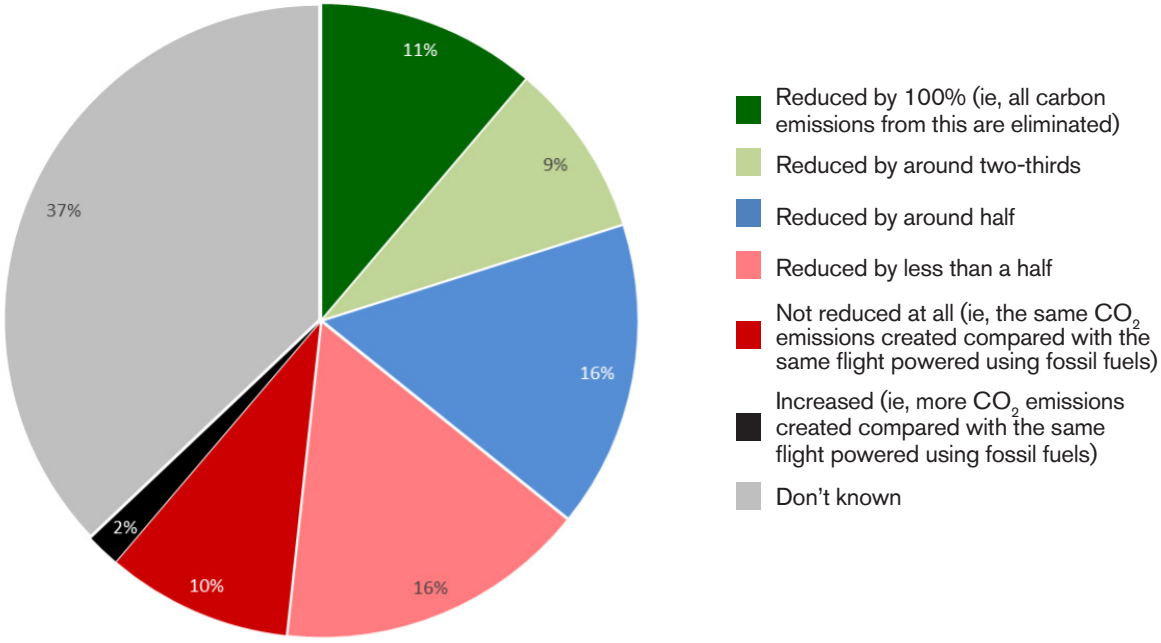
Base: n = 2,105 UK adults aged 16-75, online fieldwork conducted 13-17 December 2024.

Some airlines operate or have operated carbon offsetting schemes, allowing passengers to pay additional fees to offset the emissions from their flight. Take up of these schemes is generally reported to be low (1-3% estimated in 2020[16]), with media attention often suggesting the practice lacks credibility[17/18].

36% of the survey respondents thought that current carbon offset schemes have a positive impact on the environment (6% selected 'a very positive impact', and 30% selected 'a fairly positive impact'), with 46% believing that they have either 'a neither positive nor negative' impact (33%) or a negative impact (13%; 5% selected 'a very negative impact' and 9% selected 'a fairly negative impact'). This would suggest that there is work to be done to ensure that the schemes are robust, and their benefits are well-evidenced and articulated, to improve their credibility.

(16) Aviation Benefits: https://aviationbenefits.org/media/167226/fact-sheet_11_voluntary-carbon-offsetting_3.pdf
(17) Carbon offsets used by major airlines based on flawed system, warn experts | Carbon offsetting | The Guardian
(18) Voluntary carbon offset programs in aviation: A systematic literature review – ScienceDirect

Q12 If a flight is described as using '100% Sustainable Aviation Fuel (SAF)' … by how much, if anything, do you think any CO_2 emissions created from powering the flight would be reduced, compared with the same flight powered using fossil fuels (ie, kerosene), or would they not be reduced at all, or increased?



Base: n = 2,105 UK adults aged 16-75, online fieldwork conducted 13-17 December 2024.

The phrase 'Sustainable Aviation Fuel', and how it is understood, is debated within the aviation industry, amid concerns from some that it may be interpreted as enabling air travel without any climate impact. Industry estimates of emissions reductions for SAF vary due to the range of different feedstocks and production pathways which can be used, but typically suggest up to 80% emissions reduction is possible for the most sustainable types of SAF[19].

The UK Department for Transport (DfT) used an assumption of an average 70% greenhouse gas emissions reduction when developing the recently launched SAF mandate[20]. This indicates that when an aircraft is flying entirely on SAF (ie, 100% Sustainable Aviation Fuel, not a blend), the lifecycle emissions reduction for that flight would be estimated as 70%.

Respondents asked how they understood the phrase '100% Sustainable Aviation Fuel' were most likely to say that they didn't know (37%). 11% understood the phrase to mean that all carbon emissions from the flight had been eliminated. Only 9% of the respondents opted for the answer 'reduced by around two-thirds' which is the closest of the available options to the SAF emissions reduction factor assumed by the DfT (as described previously). 43% of the respondents underestimated the potential benefit of using SAF (16% – reduced by around half, 16% – reduced by less than half, 10% – no emissions reduction at all and 2% – an increase in emissions), which equates to approximately four times more than the 11% of respondents who overestimated the benefit.

The results suggest that the impact of SAF use on carbon emissions is not well understood by the public in general, and that the impact of better education on this point may result in a net more favourable perspective of this path to decarbonisation.

(19) Net zero 2050: sustainable aviation fuels
(20) The SAF Mandate: an essential guide – GOV.UK

APPENDIX: METHODOLOGY

The Royal Aeronautical Society aimed to explore the perceptions of decarbonising aviation among the British public who are outside of the industry and gain an understanding of how they feel regarding the probable impacts of actions taken by the industry to decarbonise aviation. The RAeS contracted Ipsos UK to survey a representative quota sample of 2,105 adults aged 16-75 in the United Kingdom using its online i:omnibus between 13 and 17 December 2024. The sample obtained is representative of the population with quotas on age, gender, region and working status. The data has been weighted to the known offline population proportions for age, working status and social grade within gender, and for government office region and education, to reflect the adult population of the United Kingdom. Full tables of results can be found here.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