



Department  
for Transport

# **Jet Zero Consultation: Summary of responses and government response**

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## Introduction

The Government recognises that the fight against climate change is one of the greatest and most pressing challenges facing the modern world.

The UK was the first major economy to pass laws to end our contribution to climate change by 2050 and, in line with recommendations from the Climate Change Committee (CCC), we have set the world's most ambitious climate change target in the [sixth carbon budget \(CB6\)](#), such that by 2035 we will reduce carbon emissions by more than three-quarters, compared to 1990 levels.

The sixth carbon budget will also formally include the UK's share of international aviation and shipping emissions for the first time, which will allow for these emissions to be accounted for consistently with other emissions included within CB6.

It is critical that the aviation sector plays its part in delivering the UK's net zero commitment and, in July 2021, we published the [Jet Zero consultation](#), setting out our vision for the aviation sector to reach net zero by 2050.

The approach set out in the consultation focused on the rapid development of technologies in a way that maintains the benefits of air travel and maximises the opportunities that decarbonisation can bring for the UK.

Alongside the consultation, we published an evidence and analysis document that summarised the evidence used to illustrate different pathways for reaching net zero aviation by 2050.

The initial consultation closed in September 2021 and a [further technical consultation](#) was published in March 2022. This further consultation was limited in scope, focusing specifically and solely on updated analytical information and evidence that informed our illustrative scenarios to reaching net zero aviation by 2050.

The aim of the further technical consultation, which closed in April 2022, was to provide the opportunity for comment on the updated scenarios and how, if at all, they would affect responses to the questions set out in the initial Jet Zero consultation.

The responses to both consultations were considered in the development of our Jet Zero Strategy, which was published on 19 July 2022.

## What the consultation asked

Recognising the important role that will need to be played by the sector, wider industry, academia, innovators and the public in realising our Jet Zero ambitions, our consultation sought views on our proposed strategic framework.

We consulted on a proposed framework underpinned by 3 principles:

- clear goals, with multiple solutions
- international leadership
- delivery in partnership

These principles guided delivery through 5 core policy levers:

- increasing the efficiency of our existing aviation system
- the production and take-up of sustainable aviation fuel (SAF)
- accelerating the development of zero emission flight (ZEF)
- developing and implementing carbon markets and greenhouse gas removal (GGR) methods
- exploring how we can influence consumers to make sustainable travel choices

Underneath each of these core policy levers, we outlined our existing policy commitments and new policy proposals. Some of our key proposals included:

- committing the UK aviation sector to reach net zero by 2050 (page 12 of the Jet Zero consultation)
- setting a net zero emissions reduction trajectory from 2025 to 2050 with interim targets (page 12 of the Jet Zero consultation)
- a 2040 net zero target for domestic aviation (page 12 of the Jet Zero consultation)
- a 2040 zero emission target for airport operations in England (page 25 of the Jet Zero consultation)
- a SAF mandate consultation, setting out our level of ambition for future SAF uptake (page 27 of the Jet Zero consultation)
- an aspiration for ZEF routes connecting the United Kingdom by 2030 (page 31 of the Jet Zero consultation).

Through the initial Jet Zero consultation, we asked 15 questions covering our overall approach, the new proposals, and the illustrative scenarios. These questions are listed in section 2, where the responses are also summarised.

Through the further technical consultation, we asked 3 questions that sought views on the updated illustrative scenarios and possible emissions reduction trajectory based on our 'high ambition' scenario.

We also invited comments through both consultations on how the Jet Zero Strategy could further achieve the objectives of the [Equality Act 2010](#).

## Responses received

We received 1,454 responses to the initial Jet Zero consultation, with the majority of responses from individuals (the online survey asked if respondents were responding as an individual or on behalf of an organisation).

Respondents were UK-wide. However, there were more than 150 responses from each of the following areas:

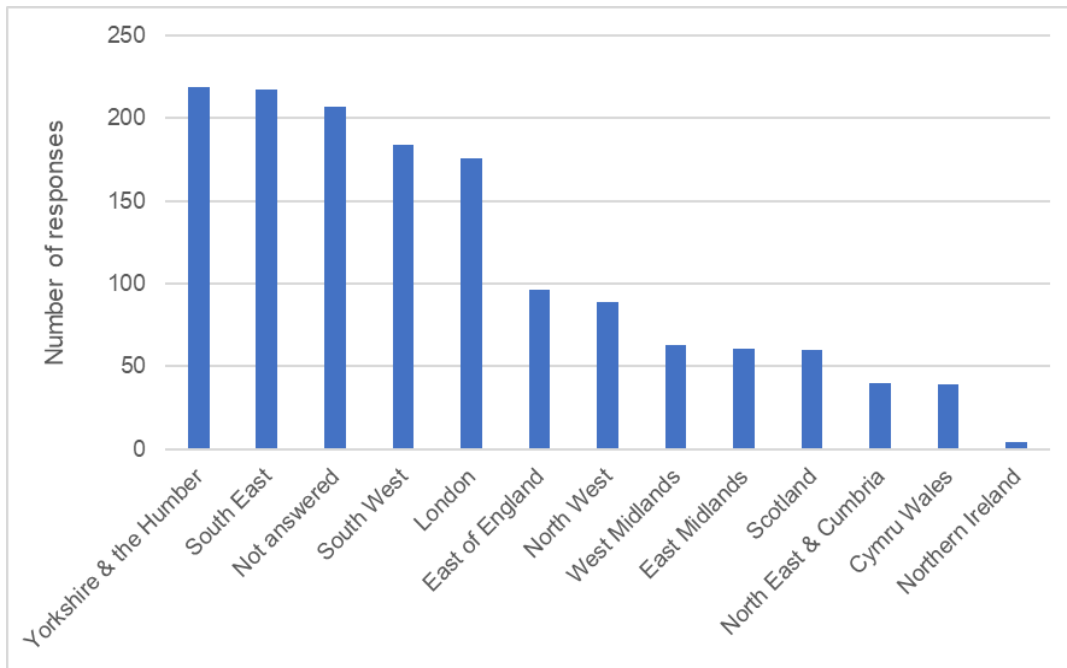
- Yorkshire and Humber
- South West
- South East
- London

We received 175 responses from organisations, including airports, airlines, aerospace manufacturers, non-government organisations (NGOs), environmental groups, energy companies, public sector organisations, consulting companies and trade unions.

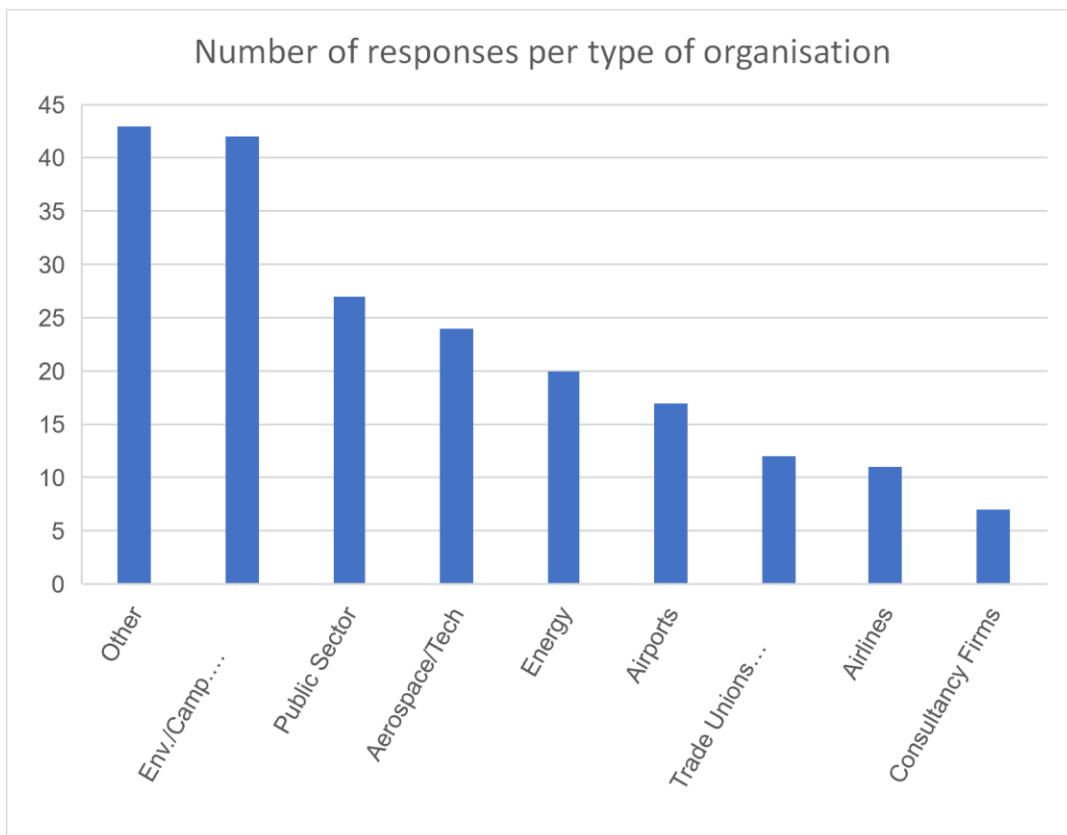
We received 105 responses to the further technical consultation, with 28 responses from organisations, including a similar range to those listed above.

The location of respondents to the further technical consultation was not collected.

**Figure 1: location of respondents to the Jet Zero consultation**



**Figure 2: number of responses to the initial Jet Zero consultation and further technical consultation per type of organisation**



The following sections summarise the key themes overall and the responses received to each individual question in the initial consultation, and further technical consultation. The themes outlined reflect the views of consultation respondents and are not government policy.



# 1. Summary of main themes

## 2040 domestic aviation target

- 1.1 **Through the Jet Zero consultation we proposed setting an earlier target for UK domestic aviation to reach net zero by 2040 (page 12 of the Jet Zero consultation).**
- 1.2 Most responses from both individuals and organisations were supportive of a 2040 target for domestic aviation to reach net zero. However, some responses called for greater ambition and an earlier target.
- 1.3 To help achieve the target, industry respondents, such as airlines, airports and aerospace manufacturers, favoured utilising existing mechanisms, such as the UK Emissions Trading Scheme (UK ETS), or introducing tax reductions for ZEF.
- 1.4 Suggestions from individuals often focused on demand management measures, including encouraging alternative modes of transport for domestic travel or increased taxation on kerosene. Many respondents suggested an increased focus on the use of ZEF technologies for domestic flights, while others commented that it would be sensible to keep all options open at this stage.

## Illustrative scenarios

- 1.5 **Both consultations set out 4 illustrative scenarios to reach UK net zero aviation by 2050 through different technological pathways (pages 13 to 15 of the Jet Zero consultation and pages 18, 21, 25 and 27 of the further technical consultation).**
- 1.6 The 'high ambition' scenario (scenario 2), and SAF and ZEF breakthrough scenarios (scenarios 3 and 4 respectively) were preferred to the 'continuation of current trends' scenario (scenario 1) with individuals and organisations supportive of more action across the measures set out in the consultation.
- 1.7 These measures included increasing the efficiency of our existing aviation system, developing and deploying SAF and ZEF, utilising markets and removals, and influencing consumers to make sustainable travel choices.

- 1.8 Although the scenarios with a breakthrough on SAF (scenario 3) and ZEF (scenario 4) were supported by some respondents, many others believed that there was currently insufficient evidence to suggest these scenarios are realistic.
- 1.9 Many respondents also suggested that the annual efficiency improvement assumptions were over-optimistic for scenarios 2, 3 and 4. These views were also expressed in response to the further technical consultation, alongside views that the assumptions for 50% uptake of SAF by 2050 (used in the updated scenario 2) are also optimistic.

## CO<sub>2</sub> emissions reduction trajectory to 2050

- 1.10 In both consultations, we proposed to set a carbon dioxide (CO<sub>2</sub>) emissions reduction trajectory for aviation from 2025 to 2050 against which we will monitor progress (page 12 of the Jet Zero consultation and page 32 of the further technical consultation).**
- 1.11 The majority of respondents were supportive of setting a CO<sub>2</sub> emissions reduction trajectory to 2050, with many individuals and organisations preferring the trajectory to be set on an in-sector CO<sub>2</sub> basis (without offsets and removals) rather than a net CO<sub>2</sub> emissions trajectory (with offsets and removals).
- 1.12 Some respondents viewed offsets as distorting the overall picture towards reaching net zero, referencing the advice of the CCC on the sixth carbon budget that credits under the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) should not contribute to meeting carbon budgets.
- 1.13 With respect to GGRs, a commonly expressed view was that these are nascent technologies and as yet untested at the scale required.
- 1.14 When responding to the specific trajectories set out in the initial consultation, the main challenge was that CO<sub>2</sub> emissions were set to increase up until 2030, which was viewed as unacceptable. Some respondents thought that the trajectory could be more ambitious, however, others commented that the trajectories would allow time for industry to develop and implement new technologies.
- 1.15 The trajectory set out in the further technical consultation no longer sees an increase in emissions up to 2030, and the greater ambition was welcomed by some respondents.
- 1.16 Other respondents were concerned whether the measures proposed to achieve the updated trajectory would be available at sufficient scale in the timescales required.

## Five-year reviews

- 1.17 Through the Jet Zero consultation we proposed to review our strategy every 5 years and adapt our approach based on progress made (page 12 of the Jet Zero consultation).**

- 1.18 Respondents were supportive of a review process for the Jet Zero Strategy. However, many viewed five-yearly reviews as not frequent enough, suggesting that annual or biennial reviews could be more appropriate.
- 1.19 Respondents suggested that more frequent reviews with clear targets could drive progress, consider new innovations and enable close monitoring of emissions reductions.
- 1.20 A number of organisations, including airports, aerospace manufacturers, consultancies and NGOs suggested that reviews should be aligned with economy-wide reviews and in the context of carbon budgets, or with Spending Reviews and international review points, so that the Jet Zero Strategy could directly influence funding decisions and global policies.

## System efficiencies

- 1.21 Through the Jet Zero consultation, we proposed a number of policies to improve the efficiency of our existing aviation system, including a target for all airport operations in England to be zero emission by 2040 (page 25 of the Jet Zero consultation).**
- 1.22 Airspace modernisation received strong overall support, especially among organisations, although there were calls for more information on the efficiency savings that can be achieved and clarification on the trade-offs with noise impacts for communities.
- 1.23 The majority of individual respondents suggested that efficiency gains alone would be inadequate to meet our targets and that mandatory targets or agreements could be more effective.
- 1.24 Another dominant view was that the efficiency improvement assumptions used in the illustrative scenarios are over-optimistic compared to efficiency improvements used by the CCC, ICAO and UN Environment Programme.
- 1.25 Within responses to questions 5 and 6, a number of airports commented on the target for all airport operations in England to be zero emission by 2040. These comments were largely around why airports were being treated differently to other similar infrastructure such as shopping centres and rail freight terminals.
- 1.26 Some airports suggested a net zero airport operations target may be more appropriate for 2040 rather than zero emissions, highlighting various infrastructure challenges for industry including the replacement of gas-powered heating.
- 1.27 Organisations such as NGOs, environmental groups and consultancies considered the target could be more ambitious and could include scope 3 emissions (emissions owned and controlled by airport tenants and other stakeholders) such as those created by access to and from airports (surface access).

## Sustainable aviation fuels

### **1.28 Through the Jet Zero consultation, we proposed a number of policies to develop a UK SAF industry (pages 28 and 29 of the Jet Zero consultation).**

- 1.29 The majority of organisations that responded to the consultation agreed with our approach for the development and uptake of SAF in the UK, though subject to some caveats. Individual respondents mostly disagreed with the approach as they viewed SAF as a short-term solution in comparison to zero emission aircraft and didn't believe our proposed approach to the development and uptake of SAF was ambitious enough. It was, however, acknowledged that SAF could form part of the overall strategy.
- 1.30 Numerous individual respondents raised concerns about competing land requirements to produce some types of SAF from crops, whereas industry respondents focused on the benefits of alternative SAF pathways that do not require feedstock, such as power to liquid.
- 1.31 Respondents who were supportive of the approach suggested that the technology for SAF production is already available, so government should work at pace to develop a UK SAF industry through robust policy measures.
- 1.32 Industry respondents, such as airports and airlines, believed that other countries were doing more to develop SAF industries – for example, the US, which has proposed a SAF tax credit – and that financial incentives, such as a price stability mechanism, were required to drive SAF use in the UK.

## Zero emission flight

### **1.33 Through the Jet Zero consultation, we proposed a number of policies to accelerate the development of ZEF (pages 32 and 33 of the Jet Zero consultation).**

- 1.34 Many respondents highlighted that technology development is highly beneficial to the UK, creating jobs and attracting investment, in addition to the environmental benefits.
- 1.35 Respondents who agreed with the overall approach suggested that ZEF was the only way forward for aviation long term, therefore, the targets needed to be ambitious.
- 1.36 However, a large proportion of individual respondents disagreed with the overall approach due to the uncertainty around the viability of the technology at the scale required and the timescales that were given to develop the technology. Some respondents also felt that waiting for the technology to be developed and implemented was not appropriate, and immediate action is required instead.
- 1.37 There were also concerns about the availability of green hydrogen and renewable electricity, plus the viability of ZEF for long-haul flights, and challenges of battery technology, including weight considerations.

1.38 Suggested measures to support the transition towards zero emission aircraft included:

- tax breaks and financial incentives
- research and development (R&D) investment through grant funding and low interest loans
- sector strategies, regulations and legally binding targets
- the use of Public Service Obligation (PSO) routes as procurement levers for early rollout of zero emission aircraft.

1.39 Several organisations called for international cooperation for the development of ZEF through the International Civil Aviation Organization (ICAO). Some responses noted that General Aviation (GA) could play a positive role in the development of new technology.

## Carbon markets and greenhouse gas removals

**1.40 Through the Jet Zero consultation, we proposed a number of policies to develop and implement carbon markets and GGRs (page 37 of the Jet Zero consultation).**

1.41 There was more support for the use of GGRs specifically rather than carbon offsets overall, though a large proportion of individual respondents disagreed with the overall approach to reducing emissions through carbon markets and GGRs.

1.42 The most commonly stated reason for this was that respondents felt carbon markets are ineffective at driving down emissions and that GGRs are unproven technologies. It was suggested that government could do more to support the innovation and testing opportunities for GGRs.

1.43 Where support was given, it was acknowledged that these measures are one part of a wider solution to decarbonising aviation, but argued that the focus should be on reducing in-sector emissions.

1.44 Respondents also commented on different aspects of CORSIA, including support for strengthening the scheme and further exploring how CORSIA could interact with a SAF mandate and the UK ETS.

1.45 For the UK ETS, some respondents suggested that the free allowances currently allocated to airlines could be withdrawn, in line with recent EU ETS proposals from the European Commission.

## Influencing consumers

**1.46 Through the Jet Zero consultation, we proposed a number of policies to influence consumers to make sustainable travel choices (page 41 of the Jet Zero consultation).**

1.47 Most respondents, including both individuals and organisations, supported the overall approach to influence consumers to make more sustainable travel choices. However,

many respondents also questioned the level of impact these measures would have on reducing overall emissions.

- 1.48 Many individual respondents felt that behavioural change to reduce our reliance on aviation would be key to reaching net zero and were keen for environmental information provision to include comparisons across different modes of transport, such as rail.
- 1.49 A dominant view was that it is important to raise the awareness of the impacts of flying, referencing the success of public campaigns around smoking and food labelling.
- 1.50 The aviation industry emphasised the need to provide comprehensive information so that fair and accurate comparisons can be made, as well as requiring international cooperation to avoid duplication of costs and requirements.

## Addressing non-CO<sub>2</sub>

**1.51 Through the Jet Zero consultation, we set out our ongoing work to address non-CO<sub>2</sub> impacts from aviation (page 42 of the Jet Zero consultation).**

- 1.52 Many respondents suggested that more could be done to tackle non-CO<sub>2</sub> impacts and some suggested that they could be considered in the illustrative scenarios and net zero targets.
- 1.53 Respondents suggested that measures could be implemented to avoid contrail formation, at little cost to industry. It was also suggested that focusing on developing the technological solutions, such as SAF and ZEF, could also reduce non-CO<sub>2</sub> impacts.
- 1.54 There was support for more research into, and modelling of, non-CO<sub>2</sub> impacts to guide future policy development and regulations internationally, as well as calls for improved monitoring and measurement to better understand the impacts.
- 1.55 Respondents also highlighted aircraft noise and suggested more could be done to reduce noise for local communities.

## Demand management

**1.56 There were no direct demand management proposals included in the Jet Zero consultation. However, these measures were raised in response to many of the questions asked.**

- 1.57 Responses from the aviation industry were largely supportive of the proposals set out in the consultation. However, there was significant challenge from individual respondents and some organisations regarding the lack of direct demand management proposals, which were perceived as measures which could have a more immediate effect on reducing emissions from aviation.
- 1.58 The most frequently raised subjects were:

- airport expansion proposals, with references to the Government's [Airports National Policy Statement \(ANPS\)](#) and its [Making best use of existing runways \(MBU\)](#) policy
- a frequent flyer levy
- taxing aviation fuel
- adding VAT to ticket sales

1.59 Encouraging more sustainable modes of transport, such as travelling by rail rather than via domestic flights, was also a common theme. These responses often referenced the CCC's recommendation on demand management and highlighted the [Balanced Net Zero Pathway](#) for aviation, where growth is restricted to 25% by 2050 compared to 2018 levels compared to unconstrained growth of around 65% over the same period.

1.60 Some respondents suggested a further scenario could be included in the final Jet Zero Strategy, which explored the impacts of reduced demand.



## 2. Government response to summary of responses

### Question 1: Do you agree or disagree that UK domestic aviation should be net zero by 2040? How do you propose this could be implemented?

#### Summary of responses:

- 2.1 The majority of respondents agreed with the proposal for domestic aviation to be net zero by 2040. The most common reason cited was the need for government to take action to tackle climate change including aviation's contribution to it.
- 2.2 Some respondents who disagreed with this proposal, expressed views that 2040 was not ambitious enough and that the target could be earlier, with some suggesting that we should be aiming for a zero emission target instead. Others said that the target was unrealistic without the use of demand management measures.
- 2.3 Some parts of the aviation industry had concerns that the target for emissions from domestic aviation would deflect government and industry from efforts to reduce international emissions.
- 2.4 Among airports, airlines, and aerospace manufacturers there was support for the target to be implemented through existing mechanisms such as the UK ETS to reduce administrative burden, through incentives to switch to zero emission aircraft such as loan or guarantee support for fleet upgrades, or by reducing taxation for zero emission flights. Some stakeholders also highlighted that smaller airlines and GA are not subject to the UK ETS and that consideration should be given to how emissions from those groups will be addressed. Industry stakeholders also flagged that government policies should be clear and set clear direction for industry.
- 2.5 A mix of hydrogen and battery power (or a hybrid) zero emission aircraft were viewed as the most viable alternatives to kerosene for domestic flights, with some raising concerns about the availability of SAF to support the target. However, some respondents cautioned against favouring one alternative fuel or technology over others, advising the need to keep all options open.



- 2.6 Increasing taxation on the aviation sector and improving domestic rail travel were also suggested as measures to help achieve the target for domestic aviation to reach net zero by 2040. It was suggested that money raised through further taxation on the aviation sector could fund R&D into the new technologies required to decarbonise the sector.
- 2.7 A minority felt that domestic air travel and private planes could be significantly reduced or banned outright, with France's introduction of restrictions on domestic flights cited.

**Government response:**

- 2.8 Through the Jet Zero Strategy we have confirmed a target for all UK domestic commercial and freight flights to reach net zero by 2040.
- 2.9 Although domestic flights account for only a small proportion of our overall emissions from aviation, we see this target as an important stepping-stone on our way to achieving net zero for all UK aviation. An earlier target for domestic flights could act to incentivise the adoption of low, and zero emission fuels and technology in the UK on these short haul routes, as well as providing an early demand for GGRs from the aviation sector.
- 2.10 The aviation industry is already committed to developing zero emission aircraft and some members of the industry have confirmed their ambition to put these aircraft into service by 2040. For example, earlier this year, Airbus set out their ambition to develop the world's first zero emission commercial aircraft by 2035.
- 2.11 Whilst some responses expressed that an earlier date should be targeted, the majority agreed with our proposal, so we have chosen the 2040 date to give the aviation industry adequate time to prepare for this ambition. In our Jet Zero Strategy we have confirmed the target will be to reach 'net zero', rather than 'zero emission', as this will provide operators with more flexibility to adopt the most effective approach to eliminating emissions. We agree with respondents who suggest all options should be considered at this stage and recognise that a mix of different technologies will be required to meet our Jet Zero targets.
- 2.12 We are considering a number of options to achieve this target, including through the UK ETS, and we intend to consult on our approach in 2023. We will further consider the implementation options suggested by respondents as we develop the specific consultation on how to implement this target, and the scope of the target. The treatment of smaller airlines and GA, will also be considered at this time.
- 2.13 By 2040, we are clear that residual emissions (emissions which remain following in-sector emissions reductions) from domestic flights will need to be eliminated or offset to meet our net zero target. When we have more certainty over the commercialisation of new technologies, we will consider whether it is appropriate to set more detailed targets for certain categories of domestic flights to be zero emission before 2050, for example by route length or flight time.
- 2.14 Some respondents said that we should adopt demand management measures and the Government's response to this can be found on pages 48-49. A small number of

responses suggested that government should ban domestic flights, citing the French domestic flight ban proposal, and encourage use of rail travel instead. The Government understands the role that rail travel has to play in reducing the emissions generated across our transport network. The Williams-Shapps Plan for Rail, published May 2021, contains a number of passenger-focused reforms that will bring in improved services and encourage the use of rail. This includes the creation of a new public body, Great British Railways, which will run the network in the public interest in Great Britain.

- 2.15 There are currently no plans for the UK to introduce similar measures to those proposed in France for domestic air travel as domestic air travel in the UK is vital for the whole of the economy in terms of connectivity, direct economic activity, trade, investment and jobs, particularly where viable alternative modes of travel are limited. The Government is considering the findings of the Union Connectivity Review and expects to publish a response later this year.
- 2.16 This domestic target will not affect governments focus on also reducing international emissions. The Government is clear that international action is essential given the global nature of the aviation sector, and we remain committed to global action through international processes. The UK takes a leading role in the work of ICAO to reduce emissions from international aviation, and we have committed to formally including the UK's share of international aviation and shipping emissions in the sixth carbon budget.

**Question 2: Do you agree or disagree with the range of illustrative scenarios that we have set out as possible trajectories to net zero in 2050? Are there any alternative evidence-based scenarios we should be considering?**

**Summary of responses – initial consultation:**

- 2.17 This question was also asked as Question 1 of the further technical consultation.
- 2.18 There were mixed views on the four illustrative scenarios set out in the initial Jet Zero consultation, although the 'high ambition', 'high ambition with a breakthrough on SAF' and 'high ambition with a breakthrough on ZEF' scenarios were preferred to the 'continuation of current trends' scenario. Respondents felt that the 'continuation of current trends' scenario would not go far enough to meet our targets.
- 2.19 The 'high ambition' scenario was seen by many respondents as the most likely to succeed and the most realistic. Some respondents commented that the ambition in the 'high ambition' scenario in the original consultation was not high enough, noting that it allowed for growth of carbon emissions to 2030. Others suggested that the annual efficiency improvement assumption of 2% per annum used in the 'high ambition' scenario and the breakthrough scenarios were over-optimistic, quoting research showing that the highest rate that could be expected is up to 1.4% year on year.
- 2.20 The 'high ambition' with a breakthrough on SAF' scenario was particularly favourable with aviation industry respondents, who often cited the need for more government investment in SAF and clearer policy signals to secure further private investment.

However, some noted that this scenario could be overly ambitious and relies on rapid development of SAF technology and scale up of production facilities.

- 2.21 Some respondents felt that the 'high ambition' with a breakthrough on ZEF' scenario was unlikely to happen by the target date or at all. Responses mainly focused on the feasibility of electric and battery technology and its suitability for long-distance commercial flights, although there was acknowledgement of this technology working on shorter journeys undertaken by smaller aircraft. There was widespread support for increased R&D into ZEF technologies.
- 2.22 One of the most prominent themes that emerged from this question was the lack of any direct demand management in any of the scenarios (outside of carbon pricing), often citing the CCC's [Balanced Net Zero Pathway](#) for aviation. Some also commented to encourage a modal shift away from aviation and onto rail.
- 2.23 Some respondents felt that the scenarios were overly reliant on technology that may not be commercially viable by 2050, were not backed up with sufficient evidence and were too speculative.
- 2.24 Some respondents within the aviation industry were heavily in favour of technological solutions rather than restricting travel.
- 2.25 Some organisations suggested that the use of updated long-term aviation forecasts could generate more robust results (forecasts used in the initial Jet Zero consultation were last updated in 2017) and highlighted the development of updated carbon values produced by the Department for Business, Energy and Industrial Strategy (BEIS).
- 2.26 Respondents suggested a number of alternative scenarios that we could consider, including:
- those that explore the impact of demand management
  - assumptions that include greater social and behavioural change, such as using alternative modes of transport and continuing to make use of technology for virtual meetings
  - a scenario that incorporates both a breakthrough on SAF and ZEF
  - separate scenarios for domestic and international aviation
  - scenarios that include the non-CO<sub>2</sub> impacts from aviation

### **Summary of responses – further technical consultation:**

- 2.27 Responses to the further technical consultation had similar overall themes to the initial Jet Zero consultation.
- 2.28 Respondents who agreed with the updated illustrative scenarios noted that they would require significant policy intervention to achieve the modelled outcomes, but were generally supportive of the greater ambition for in-sector emissions abatement.
- 2.29 There were several comments on the new carbon prices, with similar numbers of responses stating the prices were either too high or too low.

- 2.30 Respondents who disagreed with the scenarios were concerned about the reliance on SAF and ZEF and thought that the updated assumptions were too optimistic. For SAF specifically, some respondents thought that the higher uptake of SAF was unrealistic due to the cost of SAF production, the negative impacts on food production for some SAF production pathways, and the limited supply of sustainable feedstock and renewable energy for other SAF production pathways.
- 2.31 There were also several comments on SAF emissions' accounting in the consultation scenarios. In line with greenhouse gas accounting rules, SAF is presented as delivering 100% direct carbon dioxide equivalent (CO<sub>2</sub>e) savings relative to kerosene in the aviation sector. Some stakeholders argued 100% greenhouse gas emissions savings was inappropriate and overstated the emission reductions that SAF delivers.
- 2.32 For ZEF, some organisations thought that there could be even greater ambition, however, others thought that there was too much emphasis on concepts that are not yet proven. It was also noted that the consultation lacked alternative policy options, such as additional demand management measures, if SAF and ZEF expectations are not met.
- 2.33 A number of respondents were concerned that the scenarios do not include non-CO<sub>2</sub> impacts.

### **Government response**

- 2.34 Through our initial Jet Zero consultation, we received responses which raised issues in relation to aviation forecasts, carbon values, and technology assumptions for SAF and ZEF. After carefully considering these responses, as well as an update of the BEIS carbon values which we used in our initial modelling, we considered it necessary to address these points by updating aviation forecasts, carbon values, and the technological assumptions that underpinned the illustrative scenarios. We then subsequently published the Jet Zero: further technical consultation, where we sought further views on our updated scenarios.
- 2.35 In response to the initial Jet Zero consultation, respondents also suggested a number of alternative scenarios that we could consider. We did not include a scenario that merges breakthroughs on SAF and ZEF, because we regard the individual breakthrough scenarios as extremely ambitious individually - a combined scenario would be extremely speculative.
- 2.36 Further, we did not produce separate scenarios for domestic and international aviation – jet zero requires both domestic and international aviation to reach net zero by 2050, and our illustrative scenarios already incorporate different assumptions about when certain technologies penetrate different parts of the market.
- 2.37 We have also decided not to incorporate direct demand management in any of the scenarios. In our updated 'high ambition' scenario, ETS and CORSIA deliver 27% of abatement in 2050, demonstrating how these schemes deliver significant carbon savings.

- 2.38 The 'high ambition' scenario set out in the Jet Zero Strategy, has residual emissions of 19.3MtCO<sub>2</sub>e in 2050<sup>1</sup>, compared to 23MtCO<sub>2</sub>e residual emissions in the CCC's Balanced Pathway. Our scenarios show that the aviation sector can achieve Jet Zero by focusing on new fuels and technology, with knock-on economic and social benefits, rather than directly capping demand. This approach enables us to preserve the benefits that air travel brings to the UK and its residents, including visiting family and friends overseas and trading with other nations.
- 2.39 Moreover, rather than directly capping demand, we are, instead, encouraging consumers to make sustainable travel choices. Our approach to influencing consumers, which could result in social and behavioural changes, is illustrated in this document under question 13 and 14, however, as these policies are at an early stage of development, we have not been able to incorporate their impact into our current scenarios. A comprehensive response setting out our approach to demand management can be found on pages 48-49.
- 2.40 The updated 'high ambition' trajectory sees aviation CO<sub>2</sub> emissions peak in 2019. In this scenario emissions remain relatively constant until the mid-2030s and then an increase in SAF uptake, deployment of zero emission aircraft, and higher carbon prices lead to more significant emissions reductions from that point onwards.
- 2.41 Both the initial Jet Zero consultation, and the further technical consultation, made use of research by Air Transportation Analytics (ATA), commissioned by government jointly with the CCC in 2018, to model annual efficiency improvements from aircraft and operational measures. Whilst some respondents considered the annual efficiency improvement assumption of 2% per annum, informed by this ATA research, to be over-optimistic, this research has been reviewed since the initial consultation and is still considered to be appropriate for use in the updated analysis.
- 2.42 After careful consideration of the responses to the further technical consultation, we have made one further change to the methodology underpinning the illustrative scenarios. In the illustrative scenarios set out in the Jet Zero Strategy we report the emission savings delivered by SAF, as a percentage of kerosene emissions, in line with the assumed life cycle emission savings relative to kerosene underpinning the 'Mandating the use of sustainable aviation fuels' consultation published by the Department last year. The assumptions vary through time in the range 67-75%.
- 2.43 The levels of emission savings delivered in practice will depend on the type of SAF used in future. While this is subject to high levels of uncertainty, we recognise that presenting SAF as delivering 100% emission savings relative to kerosene in the aviation sector could be misleading and overstate the emission savings SAF delivers. However, to enable comparison with analysis presented elsewhere (for example, in the Net Zero Strategy), we also report the emissions savings from SAF and each of the illustrative scenarios in line with greenhouse gas (GHG) accounting rules consistent with whole economy reporting on net zero in the analytical supporting document.

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<sup>1</sup> Under formal GHG accounting rules, as used by the CCC and in the analysis for the government's Net Zero Strategy, where SAF is presented as delivering 100% emission savings relative to kerosene in the aviation sector, this scenario results in 15.4 MtCO<sub>2</sub>e of residual emissions in 2050. For more details see the supporting analytical document - *Jet Zero illustrative scenarios and sensitivities*.

- 2.44 Through the Jet Zero Strategy we have also confirmed our objectives to increase SAF uptake in the UK, and kickstart private investment into the UK SAF industry. This, coupled with our commitment to implement a SAF mandate of at least 10% by 2030, assures us that the role that SAF will play in our Jet Zero goals is both realistic and achievable. Since the further technical consultation, we have changed our SAF uptake assumptions in the 'high ambition' and 'high ambition with a breakthrough on zero emission aircraft' scenarios to be in line with the at least 10% by 2030 commitment. To receive credits under the proposed mandate, SAF will need to adhere to strict sustainability criteria. Feedstocks that are obtained from land with high biodiversity value or land with high carbon stocks will not be eligible.
- 2.45 Some respondents expressed concern that our ZEF scenarios are too optimistic. The UK is already showing leadership in the development of emerging forms of zero emission aircraft, with small battery electric aircraft already in use in the UK's GA sector. There is also a range of development activity underway globally on the use of hydrogen in commercial aviation.
- 2.46 Some responses to both consultations raised the need to also consider non-CO<sub>2</sub> emissions from aviation. We recognise that both the CO<sub>2</sub> emissions and non-CO<sub>2</sub> impacts of aviation affect the climate, and through the Jet Zero Strategy we have set out our commitments to develop our understanding and potential mitigations of these impacts. Although CO<sub>2</sub> makes up the vast majority of GHG emissions for aviation, the illustrative scenarios presented in the Jet Zero Strategy are expressed as CO<sub>2e</sub> which includes emissions from other GHGs such as methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O).
- 2.47 The analysis does not currently take into account the effects of other non-CO<sub>2</sub> impacts such as contrails and Nitrogen oxides (NO<sub>x</sub>) emissions due to the current uncertainties around their scale, and a lack of a clear methodology to monitor the non-CO<sub>2</sub> impacts of aviation. However, we continue to work closely with academia and industry as the scientific understanding develops in this area, and will consider introducing a methodology to monitor these impacts as the evidence becomes available. As before, our five-year reviews will enable us to update our modelling, which could include analysis of non-CO<sub>2</sub> impacts as and when the science allows.
- 2.48 Some responses considered that our 'high ambition' scenario was not ambitious enough, however, our assumptions are in line with the very latest evidence and technological developments, and therefore after careful consideration of all responses, we have concluded that our 'high ambition' scenario is achievable and reflects the level of ambition expected by industry and the public, and that is required to meet our climate change targets. Recognising that many of the technologies required to decarbonise aviation are at an early stage of development, we will undertake a five-year review of our overall strategy and the underpinning evidence, and will update our modelling and trajectory as new evidence comes to light.

### **Question 3: Do you agree or disagree that we should set a CO<sub>2</sub> emissions reduction trajectory to 2050?**

#### **Summary of responses:**

- 2.49 The majority of respondents agreed with the proposal to set a CO<sub>2</sub> emissions reduction trajectory to 2050. The aviation industry largely agreed with this proposal and noted that the proposed trajectory would provide the necessary lead time to develop and adopt the new technologies needed to decarbonise the sector, as well as highlighting that support and incentives from government would be required to fulfil these goals.
- 2.50 There were many respondents who disagreed with our proposal, stating that the trajectory could be more ambitious and that we should also monitor non-CO<sub>2</sub> impacts such as NO<sub>x</sub> and water vapour and include airport emissions within the trajectory. Some cited the need for a monitoring process for the aviation industry.
- 2.51 Responses also noted that climate change is both an economy-wide and international issue so action will be required across all sectors and at an international level through ICAO to achieve the trajectory.

**Government response:**

- 2.52 Through the Jet Zero Strategy we are setting a CO<sub>2</sub> emissions reduction trajectory for aviation from 2025 to 2050, against which we will monitor the sector's progress. We agree that this trajectory will provide the aviation industry time to develop and adopt the new technologies needed to decarbonise the sector.
- 2.53 This trajectory does not currently include the monitoring of aviation's non-CO<sub>2</sub> impacts due to the current lack of a clear methodology to monitor these impacts. However, we continue to work closely with academia and industry as the scientific understanding develops in this area, and will consider introducing a methodology to monitor these impacts as the evidence becomes available. Our approach for addressing airport emissions can be found in the Government response to Question 5 and 6.
- 2.54 We recognise that many of the technologies we need to achieve our trajectory are at an early stage of development or commercialisation. We will need to work closely with the industry, the Civil Aviation Authority (CAA) and ICAO to ensure that the right regulatory framework is in place to support the development and deployment of these new technologies, and will review our strategy every five years, adapting our approach if necessary.

**Question 3a. Should the trajectory be set on an in-sector CO<sub>2</sub> emissions basis (without offsets and removals) or a net CO<sub>2</sub> emissions basis (including offsets and removals)?**

**Summary of responses:**

- 2.55 There was greater support from individual respondents for the trajectory to be set on an in-sector emissions basis rather than on a net basis.
- 2.56 Respondents thought that an in-sector trajectory would focus industry on the scale of the issue, generate urgency and provide clear, measurable targets and, in turn, that this could help accelerate new innovations for a greener future.

- 2.57 It was also suggested that an in-sector trajectory would make clear what GGR and/or offsetting capacity would be required in 2050 to account for any residual emissions.
- 2.58 On the contrary, most airlines and airports thought the trajectory should be set on a net basis, with high quality offsets included and an increasing requirement for permanent removals.
- 2.59 Some respondents suggested the need for regulations to enforce targets, suggesting that this may help promote new innovations for a greener future, and wanted clarity on how the trajectory would be utilised, including what action would be taken if the sector exceeded the set trajectory.
- 2.60 Others had concerns about the use of offsets, stating that they can be inaccurate, easily manipulated, inefficient and do not go far enough. There was also concern that any reliance on offsets would be unsustainable and that there may not be sufficient availability of offsets to meet our targets. The CCC's advice on the sixth carbon budget, which stated that credits under CORSIA should not contribute to meeting UK carbon budgets, was frequently referenced alongside this view.
- 2.61 A recurring theme was that a reliance on offsets would impede the industry's efforts to reduce in-sector aviation emissions, and some respondents had concerns that it may also hinder the sector and public from making the necessary behavioural changes.
- 2.62 As with previous questions, many respondents suggested the need to reduce demand and limit growth of the aviation sector.

**Government response:**

- 2.63 We will use an in-sector (gross) emissions reduction trajectory based on our 'high ambition' scenario. We agree with views expressed during the consultation process that setting the trajectory on an in-sector emissions basis provides clear messaging on the sector's progress, as well as providing clarity on the GGR capacity required to meet net zero, whereas doing it on a net basis will be less transparent.
- 2.64 We strongly support CORSIA as an effective measure to meet ICAO's medium-term goal of carbon neutral growth for international aviation from 2020, as well as to potentially supplement in-sector measures in contributing towards a long-term decarbonisation goal once this is agreed.
- 2.65 Offsets will be required in addition to in-sector reductions – they are not an alternative. Whilst our priority is to deliver in-sector CO<sub>2</sub> emissions reductions, most projections suggest there will be residual CO<sub>2</sub> emissions from aviation in 2050. Markets can facilitate the offsetting of aviation's CO<sub>2</sub> emissions through investments in robust schemes that remove or avoid an equivalent volume of these emissions elsewhere.
- 2.66 Over time, as easier carbon reduction opportunities through offsetting become scarce and the need for negative emissions becomes greater, we expect schemes that rely on offsetting through avoided emissions to shift to employing GGR methods. These



take an equivalent amount of CO<sub>2</sub> out of the atmosphere in a verifiable and additional manner.

2.67 The 'high ambition' scenario set out in the Jet Zero Strategy, has residual emissions of 19.3 MtCO<sub>2</sub>e in 2050<sup>2</sup>, compared to 23 MtCO<sub>2</sub>e residual emissions in the CCC's Balanced Pathway. Our scenarios show that the aviation sector can achieve Jet Zero by focusing on new fuels and technology, with knock-on economic and social benefits, rather than directly capping demand. A comprehensive response setting out our approach to demand management can be found on pages 48-49.

**Question 3b. Do you agree or disagree with the possible trajectories we set out, which have in-sector CO<sub>2</sub> emissions of 39Mt in 2030, 31Mt in 2040 and 21Mt in 2050, or net CO<sub>2</sub> emissions of 23Mt to 32Mt in 2030, 12Mt to 19Mt in 2040 and 0Mt in 2050?**

### **Summary of responses – initial consultation:**

- 2.68 This question was also updated and asked as question 2 of the further technical consultation.
- 2.69 In line with the previous question, respondents highlighted that the in-sector emissions trajectory was preferred to the net emissions trajectory, and furthermore some respondents thought that we should be aiming for zero emissions by 2050 rather than net zero.
- 2.70 A large number disagreed with the outlined trajectory, suggesting more ambition was needed. Many also felt the increase in CO<sub>2</sub> emissions up to 2030 in the initial consultation was unacceptable and that demand management measures should be put in place to reduce emissions from flights earlier.
- 2.71 Others thought that, with the right policy framework in place, measures such as using SAF, ongoing efficiency improvements and taking the impacts of coronavirus (COVID-19) into account could also ensure that emissions do not increase above 2019 levels.
- 2.72 Several responses stated that it was hard to ascertain how realistic the targets were when many of the technologies are still in the early stages of development. Some cited [Sustainable Aviation's target](#) but noted that it will be updated towards the end of 2022.
- 2.73 Some respondents did not want the aviation industry to rely on offsets from other industries to reach net zero and others disagreed with using a pre-COVID-19 baseline for the trajectories. The inclusion of non-CO<sub>2</sub> impacts in the emissions reduction trajectory was also suggested.

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<sup>2</sup> Under formal GHG accounting rules, as used by the CCC and in the analysis for the overnment's Net Zero Strategy, where SAF is presented as delivering 100% emission savings relative to kerosene in the aviation sector, this scenario results in 15.4 MtCO<sub>2</sub>e of residual emissions in 2050. For more details see the supporting analytical document - *Jet Zero illustrative scenarios and sensitivities*.

**Question 3b further technical consultation: Do you agree or disagree with the possible trajectories we set out, which have in-sector CO<sub>2</sub>e emissions of 36Mt in 2030, 28Mt in 2040 and 15Mt in 2050, or net CO<sub>2</sub>e emissions of 24Mt to 29Mt in 2030, 12Mt to 17Mt in 2040 and 0Mt in 2050?**

**Summary of responses – further technical consultation:**

- 2.74 The updated trajectory was welcomed by some respondents who were positive about the greater ambition.
- 2.75 However, others disagreed with the trajectory, suggesting it is unrealistic. These respondents were generally concerned whether the measures proposed to achieve this trajectory would be available at sufficient scale in the timescales required. For ZEF specifically, the lead-in times for new aircraft to enter into service were highlighted. As with responses to question 2, some respondents thought that non-CO<sub>2</sub> impacts should be incorporated into the trajectory.

**Government response:**

- 2.76 Following analysis of the responses received to the initial consultation, and in response to an update of BEIS carbon values, we updated our emissions reduction trajectory in our further technical consultation to reflect the very latest evidence. As noted in the Government Response to Question 2 above, after taking on board responses to the Jet Zero: Further Technical Consultation we have made one further change to the assumptions underpinning the illustrative scenarios. The impact of this change has been to increase slightly the emissions modelled for each of the illustrative scenarios. The trajectory set out in the Jet Zero Strategy includes ambitious interim in-sector targets of 35.4MtCO<sub>2</sub>e in 2030, 28.4MtCO<sub>2</sub>e in 2040 and 19.3MtCO<sub>2</sub>e in 2050.<sup>3</sup>
- 2.77 The illustrative scenarios published in the further technical consultation were based on updated passenger forecasts which reflected updated assumptions about economic growth and oil prices. We recognise that there is inherent uncertainty around the impact of the COVID-19 pandemic on future aviation demand.
- 2.78 In the Jet Zero Strategy, we have included the results of a sensitivity test which explores plausible ranges of recovery from the pandemic on the carbon emissions modelled for our 'high ambition' scenario up to 2030. As part of the first five-year review, we will update our underlying forecasts of future aviation demand to ensure that there is a clear understanding of any longer-term changes to the sector in respect of future demand.
- 2.79 The updated 'high ambition' trajectory also sees aviation CO<sub>2</sub> emissions peak in 2019. In this scenario emissions remain relatively constant until the mid-2030s and then an increase in SAF uptake, deployment of zero emission aircraft, and higher carbon prices lead to more significant emissions reductions from that point onwards.

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<sup>3</sup> The equivalent emissions under the whole economy GHG accounting rules used by the CCC and in the analysis for the government's Net Zero Strategy, where SAF is presented as delivering 100% emission savings relative to kerosene in the aviation sector, are 34.4 MtCO<sub>2</sub>e in 2030, 26.6 MtCO<sub>2</sub>e in 2040 and 15.4 MtCO<sub>2</sub>e in 2050.

2.80 Some respondents considered that our outlined trajectory is not ambitious enough. For our response to this point, please see the response we have provided above to Question 2. On our approach to including non-CO<sub>2</sub> impacts in our modelling, please see the response given above to Question 3.

2.81 We recognise that industry have also carried out their own analysis and produced targets and will continue to consider all the latest evidence available as part of our five-year reviews (further information can be found in response to Question 4).

**Question 3 of the further technical consultation: Do you have any other comments in relation to the updated illustrative scenarios?**

2.82 There were no further comments received in response to this question that have not already been summarised as part of other questions. Topics covered included:

- demand management measures
- the dependence on nascent technologies
- concerns on the production, sustainability, price and availability of SAF
- comments around how realistic the updated illustrative scenarios are.

**Government response:**

2.83 Please see our responses above.

**Question 4: Do you agree or disagree that we should review progress every 5 years and adapt our strategy in response to progress?**

**Summary of responses:**

2.84 A large number of respondents stated that annual reviews could be more appropriate or suggested that government undertake the reviews every two or three years.

2.85 Respondents who agreed with the proposal highlighted the need for clear targets to increase accountability while retaining flexibility to adapt targets where necessary. A small number of respondents suggested there would need to be mechanisms in place that would protect long-term investments if any changes are made to the Jet Zero Strategy.

2.86 Some respondents suggested that five-yearly reviews may be an adequate frequency for a major review of the Jet Zero Strategy alongside more frequent minor reviews to take into account new innovations.

2.87 Respondents also suggested emissions reductions should be continually monitored to quickly respond to emerging trends. Others expressed concerns that further measures may be required to meet Jet Zero, that there was insufficient detail of the consequences to industry of not meeting targets and that the five-yearly reviews should also consider policy effectiveness as well as industry's performance.

- 2.88 A number of organisations suggested that the reviews should align with existing industry reporting and policies, such as carbon budget cycles, and that reviews could be undertaken by an independent party or the [Jet Zero Council](#).
- 2.89 These respondents often highlighted the importance of the review process being transparent and that it should minimise the reporting burden on industry.

**Government response:**

- 2.90 Through our Jet Zero Strategy, we have confirmed that we will carry out a major review of our strategy every five years and adapt our approach based on progress made. Many of the technologies needed to decarbonise the sector are at an early stage of development and therefore we consider that a five-year review point is an appropriate frequency for a major review of the strategy.
- 2.91 We recognise and agree with comments received in response to the consultation about the need to protect long-term investments but we are also aware that aviation decarbonisation presents an opportunity for the whole of the economy and presents new investment opportunities. Therefore, we have now added a principle to the Jet Zero Strategy to maximise opportunities, highlighting how we will use the Jet Zero transition to boost our economy, create new jobs, develop new industries, and become a more “energy secure” nation.
- 2.92 We have noted the points regarding more frequent reviews and have also committed to publishing more frequent and timely aviation emissions data. We will work with the CAA and other partners to establish more regular reporting of the sector's emissions on an annual basis and will aim to have a reporting cycle in place by 2025. We will use this reporting to monitor the sector's progress against our emission reduction trajectory on an annual basis. We have also set key performance indicators across the strategy and will be monitoring progress against these annually too.
- 2.93 We will use the 5 yearly review points to take stock of how emerging technologies are developing, whether they are developing at the pace required to decarbonise the sector and if they are being adopted. If we find that the sector is not meeting the emissions reductions trajectory, we will consider what further action may need to be taken including amending our existing policies or developing new ones. The first major review will be published in 2027 and then every five years.
- 2.94 The Government will undertake the review of the strategy and will be responsible for monitoring the sector's emissions reduction trajectory. We have noted suggestions that the review could be undertaken by an independent party or the Jet Zero Council; however, we do not believe this is appropriate. The CCC who are independent of government already review and publish annual reports regarding the UK's progress towards meeting its carbon budgets and net zero target and we will continue to consider and respond to the CCC's annual reports which cover aviation. It is not appropriate for the Jet Zero Council to undertake the reviews as the Council does not have the remit or the power to undertake this work. Furthermore, the Council is comprised of members from the aviation industry and therefore it would be inappropriate for them to track and monitor their own progress.

## Question 5: Do you agree or disagree with the overall approach to improve the efficiency of our existing aviation system?

### Summary of responses:

- 2.95 The majority of individual respondents disagreed with the overall approach to improve system efficiencies, with the most frequent theme being that there was a lack of demand management measures, including restricting airport expansion, encouraging a reduction in flying, and promoting modal shift.
- 2.96 Respondents also noted the CCC's advice and recommendations on demand management of aviation, and that government policy around airport expansion and increased airspace capacity does not align with the need to reach net zero emissions. Other frequent themes cited when voicing disagreement with the approach to improve system efficiencies were that the efficiency improvements assumptions used for the illustrative scenarios are too ambitious and that our proposals for reducing emissions from airports are not ambitious enough. Organisations showed greater support for the overall approach than individuals, although there were some calls for working collaboratively with industry and internationally to avoid competitive distortion/carbon leakage.
- 2.97 Respondents who agreed with the overall approach, stated that it was comprehensive and that every efficiency is needed to decarbonise. Many organisations also highlighted the importance of airspace modernisation in reducing emissions in the short-term.
- 2.98 Many airports commented on the target for all airport operations in England to be zero emission by 2040, suggesting that further clarification is required about the scope of the target, and highlighted the challenge of reaching an absolute emissions target by 2040 citing potential issues with decarbonising heating and some specialist equipment. They also flagged the need to consider other interacting airport policies, such as planning, and raised concerns about airports being singled out for action compared to other comparable industries.
- 2.99 Some respondents suggested that system efficiency measures alone were not ambitious enough and that mandatory targets or agreements could be more effective. For example, respondents suggested that a mandatory agreement or fines for non-compliance would be more effective than a voluntary tankering agreement with airlines. Many individual respondents also commented that the target for English airports should be brought forward and the scope should be widened to include scope 3 emissions.
- 2.100 Many respondents also viewed the 2% annual efficiency improvements used in the illustrative scenarios as being over-optimistic and cited different figures including those used by the CCC (1.4%), ICAO (1.37%), and UN Environment Programme (1.2%).

### Government response:

- 2.101 The Government's response to issues raised in relation to demand management and airport expansion can be found on pages 48-49.

2.102 System efficiencies remain a core part of our strategy, providing short- to medium-term solutions, which will result in a significant proportion of emissions savings prior to 2050. We will continue to support airspace modernisation, providing £9.2 million of funding between 2020-2023 to drive forward progress in redesigning the UK's 'motorways in the sky' with the aim to deliver quicker, quieter and cleaner journeys for those who use and are affected by UK airspace.

2.103 Through our strategy, we are also confirming our ambition for all airport operations in England to be zero emission by 2040. We have noted the concerns of some airports, but given the difficulty of decarbonising the overall sector, we want those parts that can decarbonise more quickly to do so. We will publish a call for evidence later this year to gather more information to help design the final policy including the scope of the target and route for implementation, and we will work with stakeholders to ensure the approach is both ambitious and achievable.

2.104 We remain committed to ensuring fuel tankering – the process whereby excess fuel is carried in order to minimise costs, thus increasing weight and emissions – is minimised wherever possible. There are particular risks of tankering as SAF policy is developed in some states faster than others, potentially creating further fuel price differentials across markets. We will consider whether any specific steps to reduce fuel tankering are required as part of the policy development for the UK SAF mandate; further details on any mechanism to restrict tankering in this context will be provided in the second SAF mandate consultation due later in 2022. We will then revisit whether any further policy mechanisms are appropriate separate to the SAF mandate (voluntary or mandatory). The focus of our policy development in this area will focus on where there is no practical reason to carry additional fuel, including recognising that the flying routes to remote airports can sometimes require additional fuel to mitigate risks around re-routing due to bad weather conditions etc, immovable turnaround times and fuel supply issues.

2.105 With respect to the annual efficiency assumptions used in the illustrative scenarios, we have noted there was some feedback that the assumptions might be too ambitious; however our scenarios make use of research by ATA, which was commissioned by government jointly with the CCC in 2018. This research has been reviewed and is still considered to be appropriate for use in the updated analysis.

### **Question 6: What more or differently could be done to ensure we maximise efficiency within the current aviation system?**

#### **Summary of responses:**

2.106 Several respondents referred to specific operational improvements that airlines and airports could make, for example:

- making fuel efficiency a key part of pilot training and pilot/crew considerations in-flight
- reducing the amount of time that aircraft operate on the ground with engines on
- towing of aircraft with electric vehicles
- reducing circling when waiting to land
- minimum take-off capacity on planes
- a reduction in tankering, in line with the EU's proposals



2.107 Organisations with a community focus tended to highlight noise and health impacts alongside emissions.

2.108 There were mixed views on changes to slots and airport charging with stronger support for changes that would benefit zero emissions aircraft, but more muted interest in overall changes due to the risk of market distortion.

2.109 Many responses to this question suggested that efficiency gains alone would be inadequate at reducing emissions from aviation and, instead, suggested demand management measures including:

- taxation
- legislation to ban certain types of flight
- restricting airport expansion
- travelling by rail for shorter journeys

2.110 The 'hub and spoke' model was cited several times, where it was suggested that larger flights could operate to fewer hub airports and that onward journeys could be continued by electric aircraft or using SAF.

2.111 Respondents often supported more research into greener aircraft and fuels.

2.112 A number of responses discussed the need to support the development of increasingly efficient aircraft technology alongside the development of SAF, ZEF technology, and wider aviation system efficiencies.

### **Government response:**

2.113 We have noted suggestions for some additional operational improvements that could be made, particularly those at airports, and will continue to track developments in these areas, identifying how we can support if possible, and consider these as part of our five-year review of the Jet Zero Strategy. We will continue to work with Sustainable Aviation, ACOG and the CAA, as well as other appropriate industry groups on these opportunities.

2.114 We have noted concerns that efficiency gains alone would be inadequate at reducing emissions from aviation and that demand management measures should be employed. The Government has been clear that our approach focusses on a combination of measures rather than efficiency gains alone and that net zero will need to be achieved through operational improvements, increased SAF uptake, the adoption of zero emission technologies, UK ETS and CORISA, the development and deployment of GGR technologies and influencing consumer behaviours to choose the most environmentally friendly flight. Furthermore, our analysis shows that the aviation sector can achieve Jet Zero by focusing on new fuels and technology, with knock-on economic and social benefits, rather than directly capping demand.

2.115 The illustrative scenarios included updated airport capacity assumptions consistent with known expansion plans or proposals at UK airports. Our analysis indicates that it is possible for the additional carbon emissions resulting from airport expansion schemes to be accommodated within the planned trajectory for achieving net zero

emissions by 2050 and therefore, we do not consider restrictions on airport growth to be a necessary measure.

- 2.116 The Government continues to be supportive of airport growth where it is justified, to boost our global connectivity and level up in the UK. We want the aviation sector to build back better, alongside supporting a greener future, and more sustainable growth. Our existing policy frameworks for airport planning - the ANPS and MBU - provide a robust and balanced framework for airports to grow sustainably within our strict environmental criteria.
- 2.117 Although our analysis shows that it is possible to achieve our goals without the need to restrict people's freedom to fly, we will continue to review our Jet Zero Strategy every five years and adapt our approach based on progress made.

### **Question 7: Do you agree or disagree with the overall approach for the development and uptake of SAF in the UK?**

#### **Summary of responses:**

- 2.118 Views on the proposed approach to increase the development and uptake of SAF in the UK varied depending on the type of stakeholder.
- 2.119 Most airlines, airports and energy companies welcomed government's commitment to building a UK SAF industry – with particularly positive reactions to the proposed SAF mandate – noting that SAF is the most feasible solution to addressing aviation decarbonisation goals in the short term, with the additional benefit of creating jobs in the UK.
- 2.120 However, while these respondents agreed with the approach, they did so with various caveats, such as the need for further government investment in technology, research and scaling up, and further incentives to encourage private investment to avoid falling behind other countries, such as a price stability mechanism.
- 2.121 Where respondents disagreed with the overall approach, they suggested SAF is only a short-term solution and that there should be more focus on zero emission aircraft and green hydrogen.
- 2.122 There were some concerns with the approach, that were mainly related to the use of land and crops for the development of SAF, rather than alternative SAF pathways.
- 2.123 Many respondents felt that there was not sufficient clarity about how the development and uptake of SAF will be funded in the UK. Some respondents suggested that the aviation industry and frequent flyers should meet the additional cost of using SAF rather than it being funded by taxpayers.
- 2.124 Some respondents also noted that a SAF clearing house is needed in the UK. Some respondents noted our proposal to use SAF on PSO routes and were supportive of this approach.

#### **Government response:**



- 2.125 We have confirmed our objectives to increase SAF uptake in the UK, and kick-start private investment into the UK SAF industry as part of our Jet Zero Strategy. We see SAF having a long-term role in reaching our Jet Zero ambition, given it will be crucial in fuelling the existing aircraft fleet over medium and long-haul routes. The adoption of zero emission flight, particularly on long haul routes will require extensive R&D, whereas SAF is available today.
- 2.126 We will implement a SAF mandate from 2025, which will have at least 10% SAF use in the UK jet fuel mix by 2030. The mandate will be a GHG emissions scheme based on tradable certificates, which will allow suppliers to fulfil their obligation in a flexible and cost-effective manner whilst also encouraging the most significant GHG savings.
- 2.127 We will publish a follow-up consultation in autumn 2022 to refine the practicalities of implementing a mandate, as well as the monitoring and reporting mechanisms the mandate will introduce. To receive credits under the proposed mandate, SAF will need to adhere to strict sustainability criteria. As part of this criteria, all fuels eligible under the mandate must be made from sustainable wastes or residues, recycled carbon fuels (RCFs), Renewable Fuels of Non-Biological Origin (RFNBOs) or nuclear energy (SAF produced from food or feed crops will not be allowed). In addition, feedstocks that are obtained from land with high biodiversity value or land with high carbon stocks will not be eligible.
- 2.128 We are also supporting the development of SAF through advanced fuels grant funding competitions, which will help us to achieve our commitment of having at least five commercial-scale UK plants under construction by 2025. We just launched the £165 million Advanced Fuels Fund which aims to help attract external investment to first-of-a-kind projects, support construction of demonstration plants to encourage innovation, and the development of new SAF pathways.
- 2.129 This funding will be available for three years and will build on the progress made in our previous advanced fuels competitions, such as the Green Fuel, Green Skies (GFGS) competition and the Future Fuels for Flight and Freight Competition (F4C). In addition, £400 million of funding is being made available through a government partnership with Breakthrough Energy Catalyst to drive private sector investment into the next generation of clean energy technologies that will help meet our net zero target by 2050 and drive down the cost of green technologies. SAF projects may seek additional capital through this.
- 2.130 SAF must undergo rigorous and expensive testing before being certified as safe to use in commercial aircraft, which, alongside a global testing and certification bottleneck, can act as a significant barrier to the entry of new fuels to market. Through the Net Zero Strategy, £12 million of new funding was announced for a SAF clearing house. The UK Clearing House will be a national virtual expert testing hub, capable of delivering early stage aviation fuel testing, funding and expert advice for new fuels looking to enter testing at all certification stages/pathways. From this funding, up to £1 million is be available to support the delivery of the first net zero transatlantic flight running on 100% SAF in 2023.
- 2.131 We continue to look at the feasibility of introducing further environmental conditions on PSO routes, such as encouraging operators to use a certain portion of SAF.

However, we are mindful that requiring SAF on a PSO flight might not be logistically possible or may disproportionately impact smaller airports and airlines.

2.132 We recognise and agree with comments received to the consultation stating that aviation decarbonisation presents an opportunity for the whole of the economy. Therefore, we have now added a principle to the Jet Zero Strategy on maximising opportunities, highlighting how we will use the Jet Zero transition to boost our economy, create new jobs, develop new industries, and become a more energy secure nation.

2.133 The Government's stance on demand management, including proposals to introduce a frequent flyer levy and changes to aviation tax reform, is outlined on pages 48-49.

### **Question 8: What further measures are needed to support the development of a globally competitive UK SAF industry and increase SAF usage?**

#### **Summary of responses:**

2.134 Respondents who supported the development of SAF suggested that further financial incentives were required to support private investment and allow SAF to be competitive when compared to kerosene.

2.135 Of these respondents, most suggested a price stability mechanism needed to be in place by the end of 2022, such as a Contract for Difference, or through positive tax incentives, such as ringfencing Air Passenger Duty (APD) or UK ETS auction revenues, to encourage SAF developments and commercialisation.

2.136 Responses from the aviation industry also noted current financial challenges and that further support for R&D was an important aspect of supporting manufacturing and production of SAF and the greening of the industry more generally.

2.137 Most airlines and airports welcomed the proposed SAF mandate, noting that it will provide a strong market signal, and some respondents also highlighted their support for bringing RCFs into the Renewable Transport Fuel Obligation (RTFO).

2.138 There were many respondents who did not support the development of a globally competitive UK SAF industry, suggesting that there is not sufficient time to rely on the development of SAF to tackle climate change and instead suggested the use of demand management measures.

2.139 Another prominent theme was that the focus should be on truly zero emission solutions rather than SAF.

2.140 Responses also viewed international agreement and alignment on SAF standards as critical to ensure that the UK is not disadvantaged. A small number of respondents argued that countries such as France and the US have taken greater steps toward developing a domestic SAF industry and that, without immediate action, the UK could be left behind.

## **Government response:**

- 2.141 We recognise that there remain calls for us to go further given the scale of the challenge, to accelerate the pace at which the UK SAF market grows to deliver a UK SAF industry. To strengthen our SAF programme even further and given our commitments, we have established a core team working in partnership with industry and investors. This includes airlines, SAF producers, UK Infrastructure Bank, UK Export Finance, and NGOs to gather key evidence and determine what further actions, industry or government might be able to take to help the growth of a UK SAF industry.
- 2.142 Over summer 2022 we will continue to work with all these stakeholders on how to create the long-term conditions for investable projects in the UK through a series of workshops and bilateral meetings, followed by a call for evidence this year, if necessary. This evidence will inform where the market failures are in the SAF investment lifecycle, the best timing and form of any potential complementary support, possible unintended consequences, and interactions with UK SAF policy. We would like to reach a preferred government position on how to further stimulate investment in a UK SAF industry by the end of the year.
- 2.143 We are also committed to maintaining the integrity of the UK ETS for aviation in supporting decarbonisation activities and are currently exploring the potential for the UK ETS to go further in supporting the decarbonisation of aviation.
- 2.144 We recognise that most forms of SAF are not zero emission. However, we expect SAF to deliver at least 70% GHG emission savings on a lifecycle basis compared with conventional jet fuel, depending on the type of fuel used, and so can play an important role in decarbonising aviation.
- 2.145 Some respondents to the consultation expressed concerns that there is not sufficient time to rely on the development of SAF to tackle climate change. We recognise that our plans for SAF are ambitious, however we are putting mechanisms in place, such as the SAF mandate and government funding to ensure our goals are achievable. Moreover, industry is already making progress to increase SAF use. For example, British Airways (BA) recently signed a multi-year supply agreement with Phillips 66, who started supplying SAF from their Humber Refinery to the BA fleet in March 2022. Our analysis suggests that we can achieve Jet Zero by focusing on SAF, as well as other technologies, rather than limiting aviation growth through demand management. Our stance on demand management is set out on pages 48-49.
- 2.146 We will continue to negotiate in ICAO for comprehensive SAF sustainability standards and to work towards a future global SAF objective. In November 2021, ICAO adopted a comprehensive set of sustainability criteria for SAF meaning that from 2024, SAF will need to meet social, economic, and environmental sustainability criteria to be eligible for use by airlines under CORSIA.

## Question 9: Do you agree or disagree with the overall approach for the development of zero emission flight in the UK?

### Summary of responses:

- 2.147 The majority of respondents thought that there is too much uncertainty around the viability of the technology needed to adopt ZEF at a commercial scale, including the timescales needed to develop the technology and the viability of ZEF for long-haul flights. It was also however noted by some respondents that disruptive companies are undertaking development activity at present and intend to bring small passenger aircraft into commercial service this decade.
- 2.148 Suggestions were made that restrictions can be placed on flying quicker than technology can be developed for ZEF.
- 2.149 Other respondents had concerns about an adequate supply of electricity from renewable sources both for battery electric aircraft and for the production of low carbon hydrogen at scale. Issues were also raised regarding the lack of energy density that batteries could provide and therefore, the potential weight of battery-powered planes.
- 2.150 Respondents who agreed with the overall approach suggested that ZEF was the only way forward for aviation in the long term and, therefore, the targets needed to be ambitious. However, many of these also expressed doubts over whether the targets were achievable.
- 2.151 ZEF was referred to by a number of respondents as the primary effective action that can be taken to reduce both carbon dioxide and non-carbon dioxide-based pollutants emitted from aircraft.
- 2.152 Respondents highlighted that historically resistance to embracing new and more environmentally friendly aircraft fuels has widely existed. This could only be rectified now with urgent and ambitious action.
- 2.153 Some respondents highlighted that technology development is highly beneficial to the UK, creating jobs and attracting investment in addition to the environmental benefits.

### Government response:

- 2.154 Through the Jet Zero Strategy, we have confirmed our overall approach to develop and bring into commercial service novel exciting forms of aircraft that offer the potential for zero carbon tailpipe emissions.
- 2.155 The UK is already showing leadership in the development of emerging forms of these aircraft, with small battery electric aircraft already in use in the UK's GA sector. There is also a range of development activity underway globally on the use of hydrogen in commercial aviation.
- 2.156 We acknowledge that the adoption of novel new technology, such as hydrogen aircraft, will require the production of low carbon hydrogen at scale plus the

establishment of ground infrastructure at airports to handle new types of aircraft and fuel. Our advisory body, the Jet Zero Council, including its new Delivery Group (DG) on ZEF, has a wide membership across industry and academia to identify barriers and solutions to the commercial adoption of zero emission aircraft.

- 2.157 The British Energy Security Strategy (April 2022) set out our ambition for UK hydrogen production of up to 10GW by 2030 with at least half of this from electrolytic hydrogen.
- 2.158 We recognise and agree with comments received to the consultation stating that aviation decarbonisation presents an opportunity for the whole of the economy. Therefore, we have now added a principle to the Jet Zero Strategy to maximise opportunities, highlighting how we will use the Jet Zero transition to boost our economy, create new jobs, develop new industries, and become a more energy secure nation.

### **Question 10: What further measures are needed to support the transition towards zero emission aviation?**

#### **Summary of responses:**

- 2.159 To support the transition towards zero emission aviation, respondents detailed further measures covering R&D, airport infrastructure investment and new regulations to enable ZEF.
- 2.160 Whilst not directly relevant to this question, demand management measures were also a dominant theme, with some respondents suggesting a public information campaign to enable people to make informed choices about their travel plans or linking airport expansion to use of low carbon technologies.
- 2.161 There was strong support for further R&D investment through grant funding, low interest loans and tax relief, both for ZEF and national infrastructure via UK Research and Innovation, the Catapult Network, small and medium enterprises (SMEs) and Centres of Excellence. Funding for further research into electric vertical take-off and landing (eVTOL) aircraft was also suggested.
- 2.162 Respondents proposed infrastructure investment included funding the development and delivery of supporting technology, such as ground operations vehicles, charging and refuelling infrastructure and developing power supplies.
- 2.163 Respondents also highlighted the important role that policy and decision-makers can play through regulation of legally binding targets, sector strategies and utilising PSO routes as procurement levers for early rollout of zero emission aircraft, although some thought that PSO routes' low frequencies and load factors might limit their impact.
- 2.164 Several organisations called for:
- a detailed roadmap for the use of hydrogen in aviation including a supply strategy
  - international cooperation for the development of ZEF through the ICAO

- extending and expanding support for the Aerospace Technology Institute (ATI)

2.165 Other, less dominant views included using the GA sector to pilot new technologies, the importance of the circular economy and whole-life emissions and investing in training to ensure a suitably qualified and experienced workforce, including retraining current employees in the aviation sector.

**Government response:**

2.166 We will continue to support R&D through the ATI Programme, informed by the [UK Aerospace Technology Strategy](#) which highlighted zero emission aircraft technologies as one of three priority areas. In March 2022, we committed to providing £685 million over the next three years to the ATI Programme which is a 50% increase on the previous three years.

2.167 We will also continue to work closely with industry including through the newly established Jet Zero Council ZEF DG and will bring together stakeholders and activities across aviation, aerospace and the energy sector to consider the barriers for the development of zero emission aircraft and the ground infrastructure and regulatory requirements to support ZEF. As our understanding of the requirements for ZEF adoption develop we will consider any needs for government intervention that arise.

2.168 The new DG will build on the work from the ZEF Infrastructure Project where 15 R&D projects received government funding to support the development of the infrastructure required to aid electric and hydrogen aircraft, and the Fly Zero project which set out the potential for liquid hydrogen to be used for future zero emission commercial aircraft.

2.169 We recognise that GA can be a critical enabler and test bed for the development and implementation of new, greener technologies across all forms of aviation. We will encourage the adoption of innovative zero emission aircraft and aviation technology in GA, and use newly commissioned research, which aims to provide an evidence baseline in carbon emissions emitted by GA operations, to support the development of ambitious new policies in this sector.

2.170 Our response in relation to demand management measures can be found on pages 48-49; however, in relation to helping consumers to make informed choices, the Government has committed to working with the CAA to consult on our proposal to provide consumers with environmental information at the time of booking a flight by the end of 2022.

**Question 11: Do you agree or disagree with the overall approach for using carbon markets and greenhouse gas removal methods to drive down CO<sub>2</sub> emissions?**

**Summary of responses:**

2.171 Many individual respondents and some organisations suggested that carbon markets are ineffective at reducing emissions and that GGRs are unproven, nascent technologies and, therefore, disagreed with the overall approach to using markets

and GGRs as key levers to reduce emissions. However, it was suggested that government could do more to support the innovation and testing opportunities for GGRs.

- 2.172 Many respondents felt that use of carbon markets and GGRs shift responsibility and allows for continued emissions from aviation, and that the industry needs to take more direct responsibility.
- 2.173 Those in agreement with the approach recognised that these methods are necessary for aviation to reach net zero and that GGRs have the potential to ensure any residual emissions from the sector are addressed. These respondents viewed GGRs and carbon markets as one part of a wider solution for decarbonising aviation but suggested that the focus should be on reducing in-sector emissions.
- 2.174 There was overall support for strengthening carbon pricing to ensure markets are fully effective and to reflect the actual cost of proven removal technologies. There was support for strengthening CORSIA specifically and respondents raised how the scheme would interact with a SAF mandate and the UK ETS, with some concerns raised regarding the potential double-counting of emissions.
- 2.175 For the UK ETS, the future alignment of the cap with a net zero trajectory was widely welcomed, and some respondents suggested that the free allowances currently given to airlines could be withdrawn in line with recent EU ETS proposals from the European Commission. Others suggested expanding the scope of the UK ETS to cover all UK departing flights.
- 2.176 A number of responses agreed with the principle of shifting from offsetting through avoided emissions (reducing emissions by preventing their release into the atmosphere) to permanent removals through GGR technology over time.
- 2.177 Some responses from industry expressed support for the 'Oxford Principles for Net Zero-Aligned Offsetting', which state that between now and 2050 an increasing proportion of offsets should be permanent removals (rather than avoided emissions), reaching 100% by 2050.

**Government response:**

- 2.178 The Government recognises that the aviation sector has a responsibility to minimise environmental impacts. Carbon markets underpin this responsibility by incentivising investment and practices which can lead the sector to net zero. Through the Jet Zero Strategy, we have confirmed our view that investment in GGR technologies is vital for the aviation sector to meet the UK's net zero target. We recognise that GGRs are nascent technologies; however whilst this presents risks it offers the UK an opportunity to be a leader in new technologies with corresponding opportunities for jobs, growth and exports. We will continue to invest in the development of GGR technology and have committed £1 billion in investment to develop four Carbon Capture, Usage and Storage clusters by 2030. Furthermore, as stated in the Jet Zero Strategy, we have considered the role that the UK ETS could play as a long-term market for GGRs that will incentivise future investment in these technologies. However, we remain open to the possibility that other steps, or a mixture of methods,



may be better suited to supporting GGRs in future. We also agree with stakeholders who caution that GGRs can only be part of wider solutions to carbon emissions.

- 2.179 The Government agrees with the majority of respondents on the importance of ensuring that carbon markets are fully effective and reflect the actual cost of proven removal technologies. We view these markets as essential levers for reaching net zero aviation, incentivising investment in practices and technologies that will reduce carbon emissions over the longer term.
- 2.180 We will continue working closely with other states, including at the 41st ICAO Assembly and beyond to maintain and strengthen CORSIA as a global offsetting scheme. We believe that it is paramount to maintain the momentum behind CORSIA and to use the CORSIA Periodic Reviews to improve the operation of the scheme and increase its environmental integrity.
- 2.181 The UK ETS replaced the UK's participation in the EU ETS in 2021. A consultation on future developments to the UK ETS closed in June 2022. The consultation included proposals on the level of ambition for the UK ETS, including aligning the cap with a net zero trajectory, the future of free allocation of allowances, as well as the role that the UK ETS can play in the incentivisation of SAF use. As part of this, we consulted on the phasing-out of free allocation for aviation.
- 2.182 The consultation also looks at the role the UK ETS could play as a long-term market for GGRs that would encourage investment in GGR solutions on the scale required to meet net zero. We will respond to the consultation in due course.

### **Question 12: What could be done further or differently to ensure carbon markets and greenhouse gas removal methods are used most effectively?**

#### **Summary of responses:**

- 2.183 Many respondents were supportive of strengthening carbon pricing for the aviation sector and continuing to enforce the 'polluter pays' principle. Industry respondents stressed the importance of an international approach to carbon pricing for aviation, and the need to continue working through ICAO to strengthen measures like CORSIA. Some respondents thought that there should be increased regulation of carbon markets.
- 2.184 A large number of respondents were critical of carbon markets and offsetting, especially due to concerns around accountability, prompting calls for increased transparency. Respondents highlighted the importance of ensuring that offsetting and removal projects represent verified and permanent emissions reductions. Some respondents thought that government should accept the CCC's advice that, without reform, CORSIA credits should not be used to meet the UK's future carbon budgets.
- 2.185 A number of organisations, largely environmental groups and NGOs, also suggested that the non-CO<sub>2</sub> impacts of aviation could be appropriately priced or included in market-based mechanisms.



- 2.186 Many respondents shared the view that government needs to increase investment in removal methods to ensure that we meet the goal of net zero by 2050.
- 2.187 Some responses from the aviation industry called for government to commit to investing the revenue raised through the UK ETS into aviation decarbonisation activities and called for increased transparency regarding the amount of revenue generated by the UK ETS and how it is used. It was suggested as an example that UK ETS revenues could directly fund the development of GGR technologies.
- 2.188 Aviation industry respondents also highlighted areas where they felt government could act to support the scale up of GGRs, including providing a policy framework, funding for development and establishing a marketplace.
- 2.189 Some respondents also thought that there was a key role for government to play in clearly communicating the benefits and necessity of GGRs in order for aviation and other hard-to-abate sectors to reach net zero, that would help to build public understanding and support.

**Government response:**

- 2.190 As noted above, we will continue to negotiate and work with like-minded states to maintain and strengthen CORSIA, ensuring it is an effective and transparent measure to meet ICAO's medium-term goal of carbon neutral growth for international aviation from 2020, as well as supplementing in-sector measures in contributing towards a long-term decarbonisation goal once this is agreed.
- 2.191 We are also exploring whether and how non-CO<sub>2</sub> impacts could be included in the scope of the UK ETS. As part of a recent consultation on developing the UK ETS, we sought to gather evidence on the feasibility and appropriateness of expanding the scope of the UK ETS to incorporate the non-CO<sub>2</sub> impacts of aviation, where these impacts could be monitored and priced in a similar way to CO<sub>2</sub>. Responses are being carefully considered and will help to inform future long-term policy development in this area. We also sought views on any potential near term measures, such as charges within the UK ETS, that could account for non-CO<sub>2</sub> impacts in the interim.
- 2.192 To support the scale up of GGRs, we are exploring preferred business models to incentivise investment in engineered GGRs to enable deployment from mid-to-late 2020s. The technical consultation (published in June) seeks evidence on the applicability of GGR business models to key technologies and highlight interactions with other business models and policy initiatives such as SAF. This will enable government to set out recommendations on the creation of a market for GGRs that incorporates innovative and evidence based GGR technology.
- 2.193 We acknowledge the role that government can play in communicating the benefits of GGRs. In 2021, the National Infrastructure Commission highlighted that engineered GGRs could become "a major new infrastructure sector for the UK" worth billions of pounds per year by 2050. Through outreach and engagement government will continue to stress the opportunity and economic benefits of this emerging sector and its potential to provide new export opportunities and high-quality green jobs across the UK. The Jet Zero Strategy highlights the role that GGRs can play in the

decarbonisation of aviation and commits to exploring business models to incentivise investment.

### **Question 13: Do you agree or disagree with the overall focus on influencing consumers?**

#### **Summary of responses:**

- 2.194 The majority of respondents supported the overall approach to influence consumers to make more sustainable travel choices, however, a large proportion emphasised that more urgency was required, and the measures described would only be part of the solution, questioning the level of impact they would have on reducing emissions overall.
- 2.195 Most respondents who agreed with the focus on influencing consumers felt that raising awareness of the impacts of flying was important as it could help incentivise and reward industry to act, with respondents referencing the impact of public campaigns around cigarettes and food labelling.
- 2.196 Respondents highlighted that the majority of flights are taken by a small minority, and measures to influence these consumers specifically could be beneficial. Demand management measures were frequently raised and many respondents felt that the most effective way to influence consumers could be to make the cost of flying more reflective of the environmental cost, and more sustainable travel choices more affordable.
- 2.197 With regard to the proposal to provide consumers with environmental information at the point of booking a flight, respondents suggested that any information provided should include comparisons of emissions across different modes of transport, as many felt that behavioural change to reduce our reliance on aviation would be key to reaching net zero.
- 2.198 Some responses raised the importance of providing standardised, verified data, noting that a number of platforms that already provide emissions data for flights often rely on averaged data, which does not allow for accurate comparisons. The aviation industry emphasised the need to provide comprehensive information so that fair and accurate comparisons can be made.
- 2.199 Some organisations highlighted the complexities involved in assessing the impacts of individual flights, suggesting a range of factors that could be included, such as the passenger's end-to-end journey, non-CO<sub>2</sub> impacts, load factors, the use of SAF and offsetting and comparisons between direct and indirect flights. Organisations also highlighted that that information provision should apply to all commercial airlines using UK airspace, and international cooperation would be required to avoid duplication of costs and requirements for airlines.

#### **Government response:**

- 2.200 Through our Jet Zero Strategy, we have confirmed our approach to supporting consumers to make sustainable travel choices. We want to empower consumers and

businesses to make the greenest choices when flying, and by doing so, reward those parts of the sector that move quickly to decarbonise.

- 2.201 The aviation sector is important for the whole of the UK economy in terms of connectivity, direct economic activity, trade, investment, and jobs. Before COVID-19, it facilitated £95.2 billion of the UK's non-EU trade exports; contributed at least £22 billion directly to GDP; directly provided at least 230,000 jobs across all regions of the country; and underpins the competitiveness and global reach of our national and our regional economies.
- 2.202 We remain committed to enabling a green recovery of the sector, as well as sustainable growth in the coming years. Our approach to sustainable growth is supported by our analysis, which shows that we can achieve Jet Zero without government needing to intervene directly to limit aviation growth. As a responsible government, we recognise that we will need to keep our strategy under review. We intend to assess progress on the sector's emission reduction pathway and update our strategy where necessary through five-year reviews. Our full stance on demand management is set out on pages 48-49.
- 2.203 Through the Strategy we have also confirmed that we will work with the CAA to consult on the proposal to provide consumers with environmental information at the time of booking a flight. The CAA will publish a Call for Evidence in autumn 2022, and a formal consultation on the policy design for sharing environmental information with consumers in 2023. The CAA are aiming to have the policy in place by the end of 2023. The CAA committed to this through their Environmental Sustainability Strategy, published in May 2022, which set out their overall strategic intent to improve total environmental performance in the aviation and aerospace system.

#### **Question 14: What more can the Government do to support consumers to make informed, sustainable aviation travel choices?**

##### **Summary of responses:**

- 2.204 A key theme of responses for this question was the promotion of, and investment in, greener modes of transport, especially for domestic travel, favouring a whole-of-transport approach to decarbonisation.
- 2.205 A dominant view was that government could do more, with some respondents wishing to see wider campaigns to educate consumers on the impact of aviation on climate change, while others suggested promoting the positive developments in aviation decarbonisation or making more data from airlines publicly available so consumers can make more informed choices.
- 2.206 Demand management measures were raised frequently, including policies for frequent flyers, such as individual carbon allowances, increased taxes (with additional funds used to support the sector to decarbonise) and the scrapping of air miles schemes.
- Other common themes included:
  - policies to support local tourism

- reducing air freight
- discouraging business travel and instead encouraging the use of technology for business meetings

**Government response:**

2.207 The Transport Decarbonisation Plan (TDP), published in July 2021 alongside the Jet Zero Consultation, set out the Government's commitments and the actions needed to decarbonise the entire transport system in the UK. The Jet Zero Strategy is aligned with the TDP, as well as the economy-wide Net Zero Strategy.

2.208 Domestic air travel in the UK is vital for supporting jobs, trade and investment and ensures regional connectivity, and through the Jet Zero Strategy, we have set an earlier target for domestic flights to be net zero by 2040, 10 years ahead of the economy-wide target.

2.209 We have also established a Jet Zero Communications and Engagement Network, to engage wider industry and communicate the work happening across government and industry to achieve Jet Zero.

2.210 Lastly, our stance on demand management is set out on pages 48-49.

**Question 15: What could be done further or differently to ensure we tackle non-CO<sub>2</sub> impacts from aviation?**

**Summary of responses:**

2.211 Many respondents felt more could be done to tackle non-CO<sub>2</sub> impacts, with some suggesting they should be considered in the illustrative scenarios and our net zero targets.

2.212 Some respondents felt that more measures could be implemented at little cost to industry, such as avoiding contrail formation by banning night flights, use of SAF, and altering flight paths to avoid ice supersaturated regions. Some respondents highlighted that focusing on the development of technological solutions, such as SAF and ZEF, could also reduce non-CO<sub>2</sub> impacts.

2.213 There was support for more research, monitoring and modelling of non-CO<sub>2</sub> impacts to better understand the issues and guide future policy development. Respondents suggested that government should work through ICAO to gain further international support and collaboration on understanding aviation's non-CO<sub>2</sub> impacts and, when appropriate, pursue international standards on non-CO<sub>2</sub> impacts in aviation.

2.214 Respondents also suggested more could be done to reduce aviation noise for local communities and to promote alternative transport modes and sustainable public transport systems to, from and between airports. However, the most commonly raised theme in response to this question was the need for demand management measures, including restricting airport expansion.

**Government response:**

- 2.215 Through the Jet Zero Strategy, we have confirmed our objective to address non-CO<sub>2</sub> by better developing our understanding of their impacts and potential mitigations.
- 2.216 This will include working closely with atmospheric scientists, other researchers, and industry, including through the Jet Zero Council SAF DG, to better understand the science of the non-CO<sub>2</sub> impacts from aviation. This includes exploring the potential positive effects that using SAF in aircraft could have on reducing non-CO<sub>2</sub> impacts. We will also seek to further understand how hydrogen and electric aircraft could realise similar benefits in reducing the negative impacts of non-CO<sub>2</sub> emissions.
- 2.217 There are a number of ongoing trials exploring contrail avoidance including through EUROCONTROL and the German Aerospace Center (DLR) who have conducted the first worldwide live operational trial on contrail prevention aimed at mitigating non-CO<sub>2</sub> impacts.
- 2.218 We will review the outcomes of these ongoing trials and consider the scientific and practical underpinning work needed to determine at what point contrail avoidance trials in the UK may be beneficial.
- 2.219 The CCC recommends that non-CO<sub>2</sub> effects are tackled alongside UK climate targets without increasing CO<sub>2</sub> emissions. We have committed to working with the CCC to explore their recommendation for no additional non-CO<sub>2</sub> warming from aviation after 2050, and we will work with industry and academia to explore a means of estimating and tracking the non-CO<sub>2</sub> impacts from the UK aviation industry on a regular basis.
- 2.220 We are committed to working through ICAO to lead research into the non-CO<sub>2</sub> impacts of international aviation and their mitigation. As the evidence base develops we will support the consideration of appropriate international measures to address non-CO<sub>2</sub> impacts alongside reducing CO<sub>2</sub> emissions.
- 2.221 The Government is clear that its aim is to limit and, where possible, reduce the number of people in the UK significantly affected by aircraft noise. The Flightpath to the Future strategic framework, published in May 2022, sets out that we will explore key issues facing the aviation sector, including noise, climate change and decarbonisation.

**Question 16: Do you have any other comments you would like to add?**

**Summary of responses:**

- 2.222 Some respondents highlighted the opportunities for the UK in transitioning to new technologies and fuels and thought that greater government ambition on SAF would be beneficial.

- 2.223 Other respondents reiterated comments covered in previous questions including the lack of demand management measures in the consultation, the need for modal shift, over-reliance on unproven technologies and the lack of ambition on targets.
- 2.224 Greater duties for the CAA were also highlighted by some respondents to ensure environmental issues can be placed at the forefront of their work.
- 2.225 There was widespread support for delivery of our Jet Zero Strategy in partnership, by working across government, with different political parties and other transport modes, as well as effectively utilising the Jet Zero Council. Some public sector respondents also requested working with all types of stakeholders, including NGOs, and regional/ local authorities and communities.
- 2.226 Respondents noted that future skills requirements for the sector (for example, skills to work with emerging ZEF technologies), freight, energy infrastructure, the supply chain and surface access were not covered extensively in the consultation but that they should be considered holistically as part of our wider approach.
- 2.227 There were also numerous comments on the possible impact on families with low incomes, with some suggesting that any rises in fuel costs resulting from policies or new technologies, or increased costs due to carbon markets, could make it too costly for them to fly. Furthermore, it was suggested that it will be those who are poorer who will suffer most from the damage that flying causes to the environment. .
- 2.228 A number of comments were also made about how the ability to fly was linked to ability to pay, and the effect of taxation, the polluter pays principle and carbon markets.

**Government response:**

- 2.229 The Jet Zero Strategy sets out our strategic framework for achieving net zero aviation by 2050 and includes ambitious policies to increase SAF uptake in the UK.
- 2.230 Our strategy does not include any direct demand management measures. In our updated 'high ambition' scenario, ETS and CORSIA deliver 27% of abatement in 2050, demonstrating how these schemes deliver significant carbon savings. Our position on demand management can be found on pages 48-49.
- 2.231 The Government will continue to work closely with the independent UK aviation regulator, the CAA, in the delivery of the Jet Zero Strategy.
- 2.232 As set out in the Delivered in Partnership chapter of the Jet Zero Strategy, we are clear that achieving Jet Zero will require collaboration across industry, academia, with different sectors and international partners to work together to develop, test, and implement the solutions we need.
- 2.233 We have noted views that surface access issues should be considered and will be working with airports, other government departments, local authorities, and other interested bodies to help airports improve their surface access, through developing Master Plans and Surface Access Strategies with the aim of encouraging passengers and employees to travel on sustainable modes of transport to and from the airport

where possible. We recognise the importance of ensuring that the appropriate skills are in place to handle emerging technologies and therefore will look to invest in apprenticeships and training programmes to up- and cross-skill talent in the UK to work on ZEF technologies.

2.234 The Government is clear that all parts of the sector will need to play their part to help meet the UK's climate change ambitions and therefore our emission reduction trajectory includes emissions from the freight sector and our 2040 domestic net zero target includes domestic freight as well. We have also recently expanded the Jet Zero Council to include representation from the freight sector, ensuring this part of the sector is appropriately considered.

2.235 Our approach focusses on new fuels and technologies that could result in airlines passing on the additional cost to consumers and as a result this could impact those on low incomes. To mitigate against this, we will continue to consider the impact of ticket prices on consumers during the formulation and implementation of all of our policies.

## 3. Demand Management

- 3.1 Whilst we did not consult on any direct demand management measures through either the Jet Zero consultation or further technical consultation, this theme was raised regularly by respondents to every question posed.
- 3.2 The aviation sector is important for the whole of the UK economy in terms of connectivity, direct economic activity, trade, investment and jobs. Before COVID-19, it facilitated £95.2 billion of UK's non-EU trade exports; contributed at least £22 billion directly to GDP; and directly provided at least 230,000 jobs across all regions of the country.
- 3.3 The Government remains committed to growth in the aviation sector where it is justified and to working with industry to ensure a sustainable recovery from the pandemic. Our analysis set out in the Jet Zero Strategy shows that the aviation sector can achieve Jet Zero without government needing to intervene directly to limit aviation growth, with scenarios that can achieve our net zero targets by focusing on new fuels and technology, with knock-on economic and social benefits, without limiting demand. Our 'high ambition' scenario, has residual emissions of 19.3 MtCO<sub>2</sub>e in 2050<sup>4</sup>, compared to 23 MtCO<sub>2</sub>e residual emissions in the CCC's Balanced Pathway. We recognise that to achieve this trajectory we will need to see significant investment in, and uptake of, new technologies and operational processes and government is committed to working with the sector to ensure we achieve our aims.
- 3.4 Furthermore, airport growth has a key role to play in boosting our global connectivity and levelling up in the UK. The Government is, and remains, supportive of airport expansion where it can be delivered within our environmental obligations. Our existing policy frameworks for airport planning - the ANPS and MBU - provide a robust and balanced framework for airports to grow sustainably within our strict environmental criteria. We do not, therefore, consider restrictions on airport growth to be a necessary measure.

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<sup>4</sup> Under formal GHG accounting rules, as used by the CCC and in the analysis for the government's Net Zero Strategy, where SAF is presented as delivering 100% emission savings relative to kerosene in the aviation sector, this scenario results in 15.4 MtCO<sub>2</sub>e of residual emissions in 2050. For more details see the supporting analytical document - *Jet Zero illustrative scenarios and sensitivities*.



- 3.5 Our strategy does not include any direct demand management measures. In our updated 'high ambition' scenario, ETS and CORSIA deliver 27% of abatement in 2050, demonstrating how these schemes deliver significant carbon savings.
- 3.6 Many respondents expressed their support for a frequent flyer levy (FFL) as the primary tax on the aviation sector. As part of the [Treasury's consultation on aviation tax reform](#), the Government sought views on whether an FFL could replace APD as the principal tax on the aviation sector. In the responses received to the consultation, government received a wide range of views on this, which it considered carefully. Following the consultation, government published [a response](#) which outlined that it was minded to retain APD as the principal tax on the aviation sector, noting particular continuing concerns around the possible administrative complexity and data processing, handling and privacy of an FFL.
- 3.7 The Chancellor also announced a package of APD reforms to be introduced from April 2023 that aim to bolster air connectivity within the Union and further align the tax with the Government's environmental objectives.
- 3.8 Firstly, the Government will reduce the rate of APD on domestic flights in order to support UK-wide connectivity. While government will be reducing the domestic rate of APD, and recognises that aviation is currently responsible for 8% of the UK's greenhouse gas emissions, it is important to note that domestic aviation accounted for less than 1% of the UK's total emissions in 2019. Emissions from domestic flights, flights from the UK to the European Economic Area and flights between the UK and Gibraltar, are also capped as part of our UK ETS. This means that emissions from sectors covered by the UK ETS, including domestic aviation as well as flights to the EEA, power generation, and heavy industry, are limited by the overall cap under the scheme. As mentioned on page 40, the Government recently consulted on putting the UK ETS on a net zero trajectory, which will help to ensure that these flights achieve Jet Zero by 2050.
- 3.9 The Government will also introduce a new ultra long-haul band covering flights that are greater than 5,500 miles from London. This will ensure that those who fly furthest, as well as the most frequently, and have the greatest impact on emissions, incur the greatest duty.
- 3.10 Our Jet Zero Strategy confirms our approach to supporting consumers to choose the most environmentally friendly flight, restates our commitment to global leadership in decarbonising the aviation sector, and emphasises the work we will do with industry and academia to achieve our Jet Zero goals. It also shows our commitment to scaling up the UK SAF industry, and confirms that we will continue to support industrial R&D through the ATI Programme through funding. These policies demonstrate our commitment to tackling climate change and delivering Jet Zero.
- 3.11 As a responsible government, and given the nascent nature of the technologies required to decarbonise aviation, we have committed to reviewing our strategy every five years and adapting our approach based on progress made. We will measure progress against our emissions reduction trajectory and key performance indicators which have been set out across each of our policy measures in the Jet Zero Strategy.

## 4. Public sector equality duty

4.1 We invited comments from respondents on how the Jet Zero Strategy could further achieve the objectives as set out under s149 of the [Equality Act 2010](#) to:

- eliminate discrimination, harassment, victimisation and any other conduct that is prohibited by or under the Equality Act 2010
- advance equality of opportunity between persons who share a relevant protected characteristic and persons who do not share it
- foster good relations between persons who share a relevant protected characteristic and persons who do not share it.

### **Summary of responses:**

4.2 Overall, we received very few comments on the topic. However, some responses expressed concern for younger, future generations having to carry responsibility for actions (or lack of action) taken in the present.

4.3 In relation to the proposed target for domestic aviation to reach net zero by 2040, and the proposal to explore the feasibility of using SAF and ZEF on PSO routes, a small number of respondents noted that some remote communities rely on air travel and PSO routes, with 18 out of 24 routes in the UK connecting to the Highlands and Islands, and flagged the importance of ensuring that they remain viable. This concern could be seen to relate to the protected characteristic of age, where the population of the Highlands and Islands has a higher age profile than the rest of Scotland. However, the benefits of ZEF for inter-island flights were noted which could result in cheaper fuel, increased efficiency, and levelling-up opportunities.

4.4 Some respondents also noted the local air quality benefits to those living in the vicinity of airports that could result from proposals to reduce emissions.

4.5 On the contrary, the impacts of noise on these communities was also commented on. These impacts could disproportionately affect groups with a protected characteristic depending on the population profile of areas around airports.

### **Government response:**

4.6 The Government has undertaken an Equality Analysis and considers that there may be some indirect impacts to people or groups in relation to the protected

characteristics of age and disability; however, these impacts will be further explored as individual policies are further developed. We have noted concerns for younger, future generations having to carry responsibility for actions (or lack of action) taken in the present. Whilst the Government does not accept that, on a proper analysis, future generations are a protected group defined by age, we have nonetheless considered the impact on future generations and believe that our overall approach of decarbonising the sector should have a positive impact. Any action taken to reduce emissions should positively contribute to our efforts to reduce the impacts of climate change and on the global population and future generations.

- 4.7 The Department has not found any impacts in relation to sex, gender reassignment, marriage or civil partnership, pregnancy and maternity, race, religion or belief and sexual orientation at this stage. However, local population demographics, such as those around airports as well as those of the wider population, will be considered further as relevant policies are developed.
- 4.8 Having considered the overall impact of the policies set out in the Jet Zero Strategy on people with protected characteristics, the Government has decided to proceed with the strategic approach to decarbonising aviation set out in the Jet Zero Strategy. The UK is obligated under the Climate Change Act 2008 to achieve net zero carbon emissions by 2050, and the Jet Zero Strategy will ensure that aviation plays its part in achieving this target.

## 5. Glossary

**Airspace modernisation:** improving the UK's airspace structure by updating systems and using new technology to improve how air traffic is managed, which will help to deliver quicker, quieter and cleaner journeys.

**Carbon budgets:** under the Climate Change Act 2008, the Government must set 5-yearly carbon budgets, 12 years in advance, from 2008 to 2050, which restrict the total amount of greenhouse gases that the UK can emit over that period. The UK is the first country to set legally binding carbon budgets.

**Carbon leakage:** if a CO<sub>2</sub> emissions mitigation policy is applied only in one region of the world, emissions outside that region might increase. This is because companies and individuals affected by the policy may try and reduce its impacts on them by, for example, moving their operations to unaffected locations. This phenomenon is known as carbon leakage.

**Carbon markets:** a carbon market, such as the UK ETS or CORSIA, puts a price on each tonne of emissions included in the market, generating an incentive for participants to reduce their emissions.

**Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA):** CORSIA is a carbon market developed by ICAO to address CO<sub>2</sub> emissions for international flights, adopted in October 2016.

**Carbon values:** a mechanism by which the external costs of greenhouse gas emissions are quantified providing an economic signal to emitters.

**Climate Change Committee (CCC):** an independent, statutory body established under the Climate Change Act 2008 to advise the UK government and devolved administrations on tackling climate change.

**Contrail:** a type of ice cloud, formed by aircraft, as water vapour condenses around small soot particles produced during the combustion process. They can also form when water vapour from the airplane's engines collides with water vapour in the air.

**Free allowances:** carbon market credits allocated to aircraft operators to reduce the risk of carbon leakage.

**Frequent flyer levy (FFL):** policy proposal that aims to reduce the environmental impacts of flying in an equitable way by increasing tax the more you fly each year.

**Green hydrogen:** carbon neutral hydrogen produced by splitting water into hydrogen and oxygen using renewable electricity.

**Greenhouse gas removals (GGRs):** a range of approaches that directly remove greenhouse gases from the atmosphere and fall broadly into 2 categories:

- nature-based approaches, such as afforestation, forest management and soil carbon sequestration
- engineering-based approaches, such as direct air carbon capture and storage (DACCS), bioenergy with carbon capture and storage (BECCS), wood in construction, biochar and enhanced weathering.

**Ice supersaturated regions:** a frequent phenomenon in regions of the atmosphere below 0°C where cirrus clouds can form and contrails are long lasting.

**Illustrative scenarios:** the 4 potential pathways set out in the Jet Zero consultation, the further technical consultation, and now the Jet Zero Strategy to model different scenarios with a different mix of technologies to illustrate potential pathways for reaching net zero aviation by 2050.

**In-sector emissions:** emissions produced by the aviation sector before consideration of offsets, avoided emissions in other sectors, or greenhouse gas removal methods.

**International Civil Aviation Organization (ICAO):** a specialised agency of the United Nations that supports the planning and development of international air transport across 193 nations, providing an internationally accepted set of standards.

**Jet Zero:** collective term used across government and industry for our ambition to achieve net zero CO<sub>2</sub> aviation by 2050.

**Jet Zero Council:** a partnership between industry and government to bring together ministers and chief executive officer-level stakeholders, with the aim of delivering zero emission transatlantic flight within a generation.

**Jet Zero Strategy:** the Jet Zero Strategy will be published in response to the Jet Zero consultation and further technical consultation.

**Load factor:** percentage of available seats an airline can sell on its flights. Each airline's break-even load factor depends on its costs and expenditure, but is usually around 70% on average.

**Net zero:** the Government target that the UK's total greenhouse gas emissions should be equal to or less than the emissions the UK removes from the environment. This can be achieved by a combination of emission reduction and emission removal.

**Non-CO<sub>2</sub> impacts:** impacts other than CO<sub>2</sub> that also affect the climate and local air quality, in particular contrails and NO<sub>x</sub> emissions.

**NOx:** nitrogen oxides, a source of air pollution.

**Offsets/offsetting:** the process of compensating for carbon emissions arising from human activity by participating in schemes designed to make equivalent reductions of carbon dioxide in the atmosphere.

**Public Service Obligation (PSO) routes:** a route-support measure that allows government to provide funding for the operation of air services on routes (to London or within a devolved administration) that are vital for the economic and social development of a region but are not viable on a wholly commercial basis.

**Renewable Transport Fuel Obligation (RTFO):** one of the Government's policies for reducing greenhouse gas emissions from road transport in the UK by encouraging the supply of renewable fuels.

**SAF mandate:** proposed tradeable credit, greenhouse gas emissions scheme to encourage the supply of, and generate demand for, SAF with the lowest possible emissions, and support the development of the SAF industry.

**Scope 3 emissions:** emissions owned and controlled by airport tenants and other stakeholders.

**Slots:** permission to use the airport infrastructure to operate an air service on a specific date and time for the purpose of landing or take-off. The allocation of slots between air carriers is a planning tool to ensure, where airport capacity is scarce, that available landing and take-off slots are used efficiently.

**Surface access:** surface access refers to all the ways in which passengers, visitors, employees and commercial traffic travel to and from an airport when they are not in an aircraft.

**Sustainable aviation fuel (SAF):** renewable or waste-derived aviation fuels that meet specific sustainability criteria and can be used in existing aircraft without significant engine modifications.

**Systems efficiencies:** encompasses both improvements in existing engine and airframe design (such as more efficient engines and lighter materials), and also operational improvements (such as air traffic control improvements and efficiencies at airports).

**Tankering:** the practice of carrying excess fuel to reduce or eliminate refuelling at the aircraft's destination.

**UK Emissions Trading Scheme (UK ETS):** cap and trade scheme involving the allocation and trading of greenhouse gas emission allowances overseen by the UK government and devolved administrations.

**Zero emission flight (ZEF):** The ecosystem supporting zero emission aircraft.