Jet Zero: further technical consultation

Response from the Aviation Environment Federation

25th April 2022

The Aviation Environment Federation (AEF) campaigns on aviation, for people and the environment. Our focus is on aviation policy, relating primarily to climate change, noise and air pollution, and we participate in several Government engagement groups, including having a seat on the Jet Zero Council. Internationally, we are a lead member of the NGO grouping ICSA (the International Coalition for Sustainable Aviation) which has observer status to the UN's International Civil Aviation Organisation.

Our response is structured around the questions posed in the consultation. Alongside this document, we are submitting a report we have commissioned from Element Energy on the 'Role of Aviation Demand Reduction in UK Decarbonisation'. We refer to this a number of times in our response.

1. 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? (question 2 of the initial consultation)

AEF supports and encourages ambition to tackle the climate crisis. The Government's decarbonisation policies must, however, ensure credible pathways to net zero aviation that minimise any risk that targets will not be met. The Government's current approach creates significant uncertainty about the scale, timing and sustainability of proposed mitigation, while facilitating significant passenger growth. We believe this approach is fundamentally wrong. We disagree that the DfT's scenarios paint an adequate picture of the likely future emissions from aviation, and do not believe that the Government has considered a wide enough range of possible futures. There are a number of ways in which things may turn out differently, some of which are considered below.

In response to the second part of this question: we previously indicated several alternative evidence-based scenarios that we believe provide useful perspectives on how a more effective and balanced approach could be delivered. In addition, since our last consultation response, AEF commissioned Element Energy to (i) provide their views on DfT's assumptions and of any significant risks inherent in DfT's approach and (ii) set out their own recommendation of a lower-risk pathway towards aviation decarbonisation, drawing on their previous work and modelling for DfT, BEIS, CCC and others.

Availability of carbon removals

We note that all of the scenarios considered achieve net zero. While this is welcome, it sets the bar high in terms of the action we would expect to see from the Government by way of policy – a point we return to in question 3. At present, however, there is simply an assumption that whatever remains by 2050 in terms of actual aviation emissions will be cancelled out by way of carbon removals. We do not consider this to be a safe assumption.

Notwithstanding the work commissioned by DfT from Element Energy that indicates a theoretical availability of future carbon removals at relatively low cost, whether or not removals are successfully delivered should be an input variable to the scenarios. There are plenty of experts who remain deeply skeptical about whether the barriers that have existed so far to the rollout of CCS will be possible to address in time to offer large-scale removals. Proactive policy is likely to be needed to require airlines to invest in this technology, or to invest on their behalf and recover the cost through taxation. And plans will need to be in place to deliver net zero flying through other means if GGRs turn out not to be deliverable at the scale and in the timeframe required.

In its report for AEF, Element Energy identify a number of risks associated with relying on high levels of BECCS and DACCS, including technological and market barriers, potential impacts of bioenergy production and harvesting on land use, and fugitive emissions. The report cautions that confidence in a technological solution that can solve emission problems in the future could reduce the sense of urgency to mitigate emissions today. EE's conclusion is that "Overall, the evidence suggests that removal technologies represent a significant risk to any strategy, meaning they should only be deployed once both technological and behaviour change options to reduce emissions have been exhausted first."

AEF believes that the Government should consider a scenario with low availability of removals in 2050.

Carbon prices

Carbon price assumptions play an important role in the scenarios because, with the exception of 'Continuation of Current Trends', they account for 27% of the overall 2050 emission reductions, acting as a proxy for the costs of carbon abatement in the absence of any formal assessment of those costs by the Department. Differences in carbon price have a considerable effect on outcomes. EE's report highlights that "with 6 Mt CO2e under a low CORSIA scenario compared to 14Mt CO2e under mid CORSIA projections (assuming the same ETS pricing in each case)" the "difference of 8Mt CO2e between these cases (and increase of ca. 250% from low to mid pricing) represents a substantial risk factor."

The available evidence suggests that the low- to mid- carbon prices may be insufficient to drive investment in technology and SAF at the pace required. Using the costs identified for removals in EE's report[1] for BEIS, and taking the midpoint of the costs for SAF pathways calculated by McKinsey in its Clean Skies for Tomorrow report[2], the CORSIA low price – which applies to the majority of UK

[1] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1026988/ggr-methods-potential-deployment.pdf

[2] https://www.mckinsey.com/~/media/mckinsey/industries/travel%20transport%20and%20logistics/our%20insights/scaling%20sustainable%20aviation%20fuel%20today%20for%20clean%20skies%20tomorrow/clean-skies-for-tomorrow.pdf

aviation emissions in the modelling (72% according to EE) – is considerably less than the abatement cost throughout the period 2020 to 2050 (see Figure 1).

	CORSIA low £/CO2	SAF PtL £/CO2	SAF HEFA £/CO2	Removals POWER BECCS £/CO2	Removals DACCS £/CO2
2020	3	852	340	No data	No data
2030	6	511	316	120	300
2040	15	341	304	110	215
2050	37	304	292	100	130

Figure 1: Comparison of CORSIA low prices and likely abatement costs 2020-2050 (red indicates that carbon prices are unlikely to be sufficient to encourage uptake and investment)

When considering the CORSIA mid-price assumption, the carbon price in most cases exceeds the abatement cost for SAF and removals only from the 2040s onwards (see Figure 2).

	CORSIA mid £/CO2	SAF PtL £/CO2	SAF HEFA £/CO2	Removals POWER BECCS £/CO2	Removals DACCS £/CO2
2020	3	852	340	No data	No data
2030	6	511	316	120	300
2040	132	341	304	110	215
2050	378	304	292	100	130

Figure 2: Comparison of CORSIA mid prices and likely abatement costs 2020-2050 (red indicates that carbon prices are unlikely to be sufficient to encourage uptake and investment, green indicates that prices are likely to be higher than abatement costs)

The assumed UK ETS mid-price performs better given its more rigorous framework, although prices are again unlikely to exceed SAF abatement costs until the 2040s (see Figure 3).

	UK ETS (mid price) £/CO2	SAF PtL £/CO2	SAF HEFA £/CO2	Removals POWER BECCS £/CO2	Removals DACCS £/CO2
2020	21	852	340	No data	No data
2030	150	511	316	120	300
2040	264	341	304	110	215
2050	378	304	292	100	130

Figure 3: Comparison of UK ETS mid prices and likely abatement costs 2020-2050 (red indicates that carbon prices are unlikely to be sufficient to encourage uptake and investment, green indicates that prices are likely to be higher than abatement costs)

At present most aviation emissions attract no carbon price at all (for example, EE estimates that only about 17% of total aviation emissions are currently priced within the ETS while CORSIA will not create any offset obligations until global international traffic exceeds 2019 levels). To go from the present situation to one in which high carbon prices generated by the full convergence of global carbon markets are applied to flights may seem far-fetched. Nevertheless both the UK Government and the aviation industry typically argue that (1) carbon pricing is the correct tool for delivering both accelerated technology change and a tempering of aviation demand in line with the speed of that change and (2) the best way to deliver this is through international agreement. That being the case at least one of the scenarios presented should be based on the high CORSIA price that would be generated by a fully functional global scheme.

Annex B of the Further Technical Consultation indicates that "Incorporating the DfT 'high' ETS and CORSIA price series leads to savings of 17 MtCO2e in 2050. This is because the higher carbon price series feed through into higher costs to operators and therefore higher fares which result in lower levels of demand." Exclusion of any scenario that allows for this effect appears to be cherry picking the data series that generate a 'sweet spot' in terms of Government preferences between faster technology uptake with minimal demand impact. The approach that the Government claims elsewhere to be the most effective is not modelled.

Demand not tracking GDP

We are aware that the Government is reluctant to consider demand management as an approach to cutting aviation emissions. We consider it a shortcoming of the scenarios however that no scenario has been included in which there is behaviour change in aviation as a result of growing climate awareness.

We note, for example, that a number of businesses including Ernst and Young, PWC and AstraZeneca have all set targets for reducing the emissions from their business travel and are looking at how to incentivise staff making lower carbon choices when it comes to meetings. This could have a wider impact on the market too, since many airlines derive significant profits from business travellers (who are typically less price sensitive than leisure travellers) even if the proportion of tickets sold for business travel is small, and may have to restructure fares accordingly. The Government has meanwhile stated its intent to provide consumers with greater opportunities to make sustainable, informed choices on their travel plans, for example, by providing better information on the climate impacts of travelling on different routes, or on different airlines.

A scenario modelling the application of more explicit demand constraint measures should also have been included. The CCC has advised the Government not to expand net airport capacity, and to keep further demand reduction policies in play as a backstop in case the hoped-for technology improvements do not materialise. EE's report states that the reliance on rapid technology development in the DfT High Ambition scenario results in a high risk of missing the emission budgets. The report considers the level of additional demand reduction that may be required to bridge the gap with both the DfT's assumed ambition for the sector, and EE's vision for a lower risk approach that cuts emissions earlier. In 2050, the emission savings required through demand reductions are approximately 23-24 MtCO2e in EE's recommended aviation pathway, significantly greater than the 14MtCO2e assumed to come from carbon pricing alone. There are also significant short-term differences in the level of demand reduction required by 2035.

We note the point made in the consultation about the impact of COVID: "Our scenarios are based on updated passenger demand scenarios but do not fully take account of the impact of COVID-19 on aviation demand. …There is also uncertainty about the impact of COVID-19 on passenger behaviour in the longer term. Adopting this approach to the impact of COVID-19 means our scenarios may be based on an overestimate of demand, and therefore lead to an overestimate of future emissions." While this is true, the significant risk in this approach is of unduly strengthening the case for airport expansion in the short term while relying largely on future technologies such as GGR delivering carbon cuts in the long term.

Future policy to tackle non-CO2 impacts

Aviation has very significant impacts on the climate that go beyond CO2 alone and are unique to aviation as emissions are released directly into the upper atmosphere. This is well-acknowledged by the scientists working on radical aircraft and fuel options for aviation as part of the ATI, for example, since some potential energy sources such as e-fuels and to some extent hydrogen would still have warming effects as a result of impacts such as increased contrail formation, even if their CO2 impact could be made net zero. The latest scientific research estimates that aviation has historically caused three times as much as global warming as would be expected from its CO2 emissions alone.

CCC has advised that policies will need to be developed to ensure no further warming from aviation's non-CO2 impacts after 2050. Given the historic lack of progress in this area it should be a priority area of focus. Yet no scenarios have been included that assume any impact arising from policy action on non-CO2. One possible approach would be to treble the level of emissions estimates to have been caused by aviation in 2020, and then to present a trajectory towards zero that brings both CO2 and non-CO2 impacts to zero. While policymakers have shied away from introducing non-CO2 multipliers to carbon and trade systems such as the EU ETS, failure to represent non-CO2 impacts in the modelling of scenarios significantly underestimates both the scale and the nature of the challenge of achieving net zero aviation.

We were encouraged that the BEIS consultation on the future of the UK ETS recognised that the level of uncertainty associated with non-CO2 impacts is not uniform, and that it invited comment on whether NOx emissions could be included in policy sooner than some of the other impacts. While it makes no specific commitments, the question does suggest that non-CO2 impacts are likely to be recognised in policy before 2050. Given that one of the aims of the scenarios is to create long-term certainty about the scale of the reductions required, not including non-CO2 in any of the scenarios risks a significant future revision to the aviation trajectory with little time for Government and industry to respond. This view is reinforced in the EE report which states that "Given the source of this additional warming will have to be tackled in the future and DfT will likely have to capture these emissions in modelling before 2035, ignoring this problem now just means additional emission reductions will have to be found at short notice in the future, with the risk that this is not achievable."

EE recommends that: "As a precautionary approach, a non-CO2 multiplier on aviation emissions should be applied when comparing aviation emissions to other UK sectors to give a more realistic comparison of warming impact. While a non-CO2 multiplier may not be the best method to incentivise reductions in non-CO2 impacts at an individual policy level and future forecasts may not continue to reflect historic relationships between CO2 and non-CO2 emissions, it is essential at a top level to give policymakers a clear perspective of the level of change needed in the sector."

SAF uptake levels and their impact on ticket pricing

The new scenarios significantly increase the assumed level of SAF uptake "based on expert judgement, a review of the latest evidence and industry views". We would question whether this provides a sound enough basis for the large numbers now included in the modelling given both historic low levels (in contrast to previous industry forecasts) and important issues to be resolved around the likely availability of sustainable feedstock and energy inputs. We note that "'uptake of SAF is not calculated within the aviation model, instead an uptake trajectory is assumed and fed into the department's aviation CO2 model as an input." This approach, it seems to us, comes with significant risk that the real world costs and barriers of delivering SAF have been underestimated.

The EE report notes E4Tech analysis which suggests that UK-produced sustainable aviation fuel could provide between 1.0% and 7.8% of the UK aviation fuel demand by 2035 which is 10-16% below the supply required for the DfT High Ambition scenarios. Given that there is currently negligible UK production and that this would require growth significantly above the most optimistic UK production forecasts, the UK would be highly reliant on SAF imports, competing with demand from the EU and diverting SAF supply away from non-European countries hindering their own decarbonisation efforts.

Assumed rate of aviation technology improvement

All scenarios with the exception of 'continuation of current trends' assume that annual fuel efficiency jumps from its historic rate of 1.5% per annum to 2% per annum. We're doubtful about whether this can be achieved, particularly with the low levels of carbon pricing assumed in the short term. EE's report concludes that "unless a range of currently unannounced policies are published, the well-established historic rate of 1.5% annual efficiency improvement is significantly more likely out to 2035 than the 2% assumption used within DfT's High Ambition scenarios".

Taking the technology and SAF assumptions together, EE identifies a significant level of risk.

2. Do you agree or disagree with the possible trajectories we set out, which have in-sector CO2e emissions of 36Mt in 2030, 28Mt in 2040 and 15Mt in 2050, or net CO2e emissions of 24-29Mt in 2030, 12-17Mt in 2040 and 0Mt in 2050? (question 3b of the initial consultation - values updated in line with the new analysis)

We don't agree that these trajectories offer an adequate picture of the range of possible CO2 futures for aviation. Many of the comments we have made about the scenarios would have implications for the emissions trajectories. Broadly:

- If different assumptions were made about the likely availability of GGRs, it may be necessary to achieve bigger in-sector emissions reductions in order to achieve net zero.
- If high carbon prices were assumed then in-sector emissions would be lower
- If demand was lower then emissions would be lower.
- If non-CO2 impacts were included then emissions would be higher
- If assumed SAF levels were lower then emissions would be higher (we comment on SAF emissions savings separately below).
- If aviation technology were to improve more slowly then emissions would be higher.

The need for early action

The assumption that carbon prices (particularly under CORSIA) remain low until the 2030s and that carbon pricing acts as a proxy for other changes in the aviation market (such as the adoption of SAFs) means that the majority of emissions reductions and removals are assumed to take place after 2040. This is problematic for several reasons:

- It will make it harder to achieve the economy-wide commitment to a 78% emissions reduction by 2035 (by which time international aviation emissions will be included in carbon budgets).

- It allows demand to grow and airports to expand in the short term, making it harder to deliver the future demand reduction that may be necessary if the hoped-for technology improvements do not materialise. CCC has described this need for demand limits to be kept in play as a backstop measures.
- It means that cumulative emissions (the total amount of CO_2 emitted during the period between now and 2050 indicated by the 'area under the curve') will be higher than in a scenario where greater emissions cuts are made earlier, increasing the risk of dangerous temperature rises
- It increases the overall level of risk inherent in the approach.

A scenario in which emissions do not begin to fall, compared to the level in 2020, until the mid 2030s should not, in our view, be described as 'high ambition'. The EE report sets out an alternative trajectory based on a more equitable and lower risk approach to delivering UK climate targets that requires aviation to make deeper emissions reductions than those currently proposed by DfT in the near- to mid-term.

<u>Assumed level of emissions reduction from SAFs</u>

As with the previous modelling, the trajectories assume that all SAF use generates a 100% emissions reduction. Combined with the very high levels of SAF assumed this means that in the highest ambition scenario SAF use generates 54% of the total emissions abatement. We acknowledge that this is a carbon accounting method that is also now adopted by the CCC. We think nevertheless that much closer scrutiny is required of the supposed emissions reduction or avoidance taking place elsewhere in the economy that is supposedly captured under this approach. Of all the experts we have spoken to so far none has been able to set out how this works.

While the convention is to treat SAF use as an 'in sector' or 'actual' emissions reduction, SAF usage is in all cases in fact a form of carbon offset, since the CO_2 emissions generated by aircraft using SAF are as high as from those using fossil kerosene. Just as protocols have needed to be developed around the use of carbon offsets and are now being discussed in relation to greenhouse gas removals, so these assessments need to take place around SAF usage. We note, for instance, that the BEIS consultation on the UK ETS considers it an open question whether the rights of a GGR credit should accrue to the buyer or to the seller, and highlights the importance of avoiding double counting.

This becomes particularly relevant where SAF is imported. Even if it were possible to design a closed system of carbon accounting within the UK and even if it were decided that 100% of the carbon benefit of using SAF should accrue to the airline rather than to the fuel supplier, it would be difficult to ensure a global system of seamless carbon accounting under which SAF production elsewhere in the world appears on that country's carbon accounts as a CO_2 increase in order to allow a UK airline to claim a 100% emissions reduction.

3. Do you have any other comments in relation to the updated illustrative scenarios?

As we have indicated previously, the presentation for consultation of aviation 'scenarios' in the absence of policy proposals makes this exercise slightly meaningless. The difference between a desirable policy outcome and a likely one is not addressed.

The scenarios place a heavy reliance on new technologies (including GGR) and fuels being developed as a result of carbon prices driven primarily through global agreement. This presents two major problems. First, the impact of factors other than cost is not really considered. It has been the case for many years, for example, that flying the most direct routes will cut fuel use and therefore emissions, and yet political and other considerations (including noise) have prevented the reorganisation of airspace into in a perfectly efficient network. As noted above, potential behaviour change (as a result of COVID and/or climate change) is not accounted for. Clearly both the Government and industry meanwhile see the need for technology R&D support, and enthusiastic political and other public communications about the potential for these technologies, alongside carbon markets in order to stimulate low carbon technology.

Secondly, there is no discussion of what 'plan B' the Government will implement if global carbon markets fail to deliver the improvements anticipated. While we support the principle of 'high ambition' we consider some of the assumptions made to represent very optimistic outcomes. Our experience of the ICAO talks, for example, gives us reason to doubt that agreement will be achieved on an increased stringency for that scheme that generates the mid-level values assumed in the High Ambition scenario. If in fact the lower prices used in the 'continuation of current trends scenario;' are realised, this will make the achievement of net zero aviation in the UK very much harder. At what point would the Government begin to intervene to remedy the situation if this was the case? If the market stimulus for greater aircraft efficiency, lower net carbon fuels and greenhouse gas removal technologies were to disappoint, how would aviation decarbonisation then be delivered?

At present, the Government's plans for net zero aviation are largely dependent on action taking place elsewhere and at some time in the future. What we need is action to tackle emissions now, and a plan for holding back aviation demand and airport growth until progress has been demonstrated – not just promised – on technology and on effective carbon pricing.

Concluding comments

The views set out in our submission to the earlier consultation remain our views. Overall, we said, "the Jet Zero strategy assesses potential for aviation emissions mitigation rather than likelihood. While some of the issues considered help to frame a policy discussion, the proposed measures to decarbonise the sector fall a long way short of the scale of the challenge ahead. The focus appears to be on what targets are most deliverable rather than on how to overcome the challenges identified, and the proposals fail to give a clear steer on the overall direction that the industry needs to take."

The new analysis, while addressing some of the specific criticisms that we had levelled for example in relation to carbon pricing, strays even further into the realms of fantastical assumptions about future technologies and fuels while conveniently allowing passenger growth and even emissions to increase in the short term.