



Appeal by: Bristol Airport Limited

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**Supplementary proof of evidence of
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Carbon Emissions

Reference: NSC/W6/4



Ricardo
Energy & Environment

Supplementary Proof of Evidence from Dr Mark Hinnells on behalf of North Somerset Council

PINS Appeal ref APP/D0121/W/20/3259234

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North Somerset Council

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1 Introduction

1. On the 14 July 2021 the Government published its Transport Decarbonisation Plan (CD 9.134)¹ together with its *Jet Zero* Aviation consultation paper (CD 9.135)² (“the Consultation”). The latter was accompanied by a document entitled “*Evidence and Analysis*” (CD 9.136)³. On this same day the Government published “*Targeting net zero - next steps for the Renewable Transport Fuels Obligation*”(CD 9.137) which set out its conclusions following a consultation process regarding Renewable Transport Fuels⁴. A week later the Government commenced a consultation relating to a “*Mandate for Sustainable Aviation Fuel*” (INQ/040)⁵, then another consultation on 17 August on a “*UK Hydrogen strategy*” (INQ/043)⁶ which could be important for both Sustainable Aviation Fuel production and for combustion in zero emission aircraft.
2. Whereas the Transport Decarbonisation Plan is a policy document, Jet Zero, the SAF Mandate and Hydrogen strategy are consultation documents. There are few meaningful commitments in the Transport Decarbonisation Plan other than to consult or to support early stage innovation and so it is not considered further here (see pages 121-125). The other documents are discussed in detail.
3. In addition, since my proof, and rebuttal and update, was provided to the Inquiry, the National Infrastructure Commission has published a report relating to engineered greenhouse gas removals (No INQ Ref)⁷. The IPCC has also published the first of three reports which make up its sixth Assessment Report (AR6) the summary for policymakers of which is before the Inquiry at INQ/032. This updates AR5 which was published in 2014. This report from Working Group 1 on the science of climate change provides a significant update on the science, and is material in that 195 Governments, including the UK as chair of COP26, agreed the drafting before publication. Working Group 2 on impacts and adaptation, and Working Group 3 on mitigation will follow later this year and early next.
4. The Inquiry will already be aware that in a letter dated 23 July 2021 (INQ/9) to the Secretary of State for Transport the Council expressed concerns that the Jet Zero consultation process does not provide consultees with sufficient information to be able to provide an informed response. It sought further information from the Department for Transport on a wide range of detailed matters which I shall discuss further below.

¹ <https://www.gov.uk/government/publications/transport-decarbonisation-plan>

² www.gov.uk/government/consultations/achieving-net-zero-aviation-by-2050.

³ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1002163/jet-zero-consultation-evidence-and-analysis.pdf

⁴ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1001880/targeting-net-zero-next-steps-for-the-renewable-transport-fuels-obligation-government-response.pdf

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

⁶ www.gov.uk/government/publications/uk-hydrogen-strategy

⁷ <https://nic.org.uk/studies-reports/greenhouse-gas-removals/engineered-greenhouse-gas-removals/>

5. The Department for Transport provided a response to some of the questions asked on Friday 13th August 2021 (INQ/042), together with a new published dataset of assumptions and scenarios in Jet Zero (INQ/041).
6. The Council remains concerned that the amount of information provided to date is not sufficient to constitute a lawful consultation process in accordance with the principles identified in *R. (on the application of Moseley) v Haringey LBC* [2014] 1 W.L.R. 3947⁸. Fairness demanded that the consultation document should refer to and test alternative methods of achieving the desired outcome (in that case surrounding council tax). In this case, there has been no assessment of the likelihood of the various assumptions actually coming about, nor of the potential need to adopt different or additional policy measures, e.g. to constrain the expansion of airport capacity. Indeed, the potential implications of constraining capacity has not been considered at all. Further, the DfT has confirmed that the Jet Zero consultation has not examined whether the scenarios it presents are consistent with the attainment of the 6th Carbon Budget targets which have been adopted. No analysis of the relative risk to the attainment of the adopted carbon targets has been assessed i.e. the DfT has not examined or identified the package of policy measures which is most likely to deliver the targets nor the relative costs of doing so by different means.
7. In a context where the statutory framework in the CCA 2008 requires the adoption of policies to “ensure” that carbon targets are attained, the Council is very concerned that the consultation does not present the information necessary to enable an informed response to the question of whether the proposed strategy will “ensure” attainment of adopted carbon reductions targets. Whilst there are significant questions remaining as to the appropriateness of the approach set out in the Consultation, the position set out in my Proof of Evidence remains apposite, i.e. it is still premature to grant planning permission for the Appeal Scheme since it cannot be concluded that doing so will not prejudice the formulation of emerging policy.
8. It remains my view that it cannot be demonstrated that the Appeal Scheme will not have a material effect upon the ability of the Government to meet its adopted carbon emissions reduction targets.
9. In this Supplementary Proof of Evidence I provide additional evidence to that provided in my original proof.

2 Jet Zero

2.1 The Jet Zero Consultation Paper Approach

10. Paragraph 2.8 of the Consultation states...*“we need to make sure that, whichever mix of measures emerges, we remain on track to meet these goals. So, we propose to set a*

CO2 emissions reduction trajectory for aviation from 2025 to 2050 against which we will monitor progress. We propose to set this based on our 'high ambition' scenario (see page 14), whilst noting the uncertainty regarding the future technological mix. This would see in-sector CO2 emissions of 39Mt in 2030, 31Mt in 2040 and 21 Mt in 2050 (any residual emissions in 2050 should be offset by greenhouse gas removal methods)."

11. Paragraph 2.9 of the Consultation states *"Alternatively, a trajectory based on net CO2 emissions – where offsetting and removals are considered as part of the target – would see CO2 emissions of 23-32 Mt in 2030, 12-19 Mt in 2040 and 0 Mt in 2050."*
12. The consultation paper envisages growth on a basis which is significantly greater than that envisaged by the CCC (60% growth in terminal passengers on a base of 2018 for scenarios 1 and 2 and 58% for scenarios 3 & 4 compared to 25% by CCC).
13. It also envisages further airport expansion without the need to constrain demand, whilst the CCC did not. The consultation paper envisages that the required carbon emissions trajectory can be achieved solely by *"focussing on new fuels and technology"* without need for capacity constraint or demand management. However, in my view there is insufficient evidence and risk assessment contained within the consultation material to justify this approach.
14. Following the Council's request for further information, a dataset was released by DfT (INQ/041) which included the capacity assumptions in the consultation. For modelling purposes the dataset treated capacity at Heathrow as a variable which was not fully explained⁹. However, if Heathrow is added in as foreseen in DfT 2017 forecasts, then UK capacity is as below. Comparing capacity to demand in each of the scenarios shows that DfT have modelled capacity and demand separately. The utilisation rate is not dissimilar from 2016 which was 78%.

DfT Airport capacities ('000 passengers p.a.) assumed in Jet Zero

	2016	2030	2040	2050
Capacity with Heathrow at DfT 2017 levels*	341,300	502,132	540,845	557,714
Demand SC1	266,631	336,283	402,294	465,635
Demand SC2	266,631	336,283	402,294	465,635
Demand SC3	266,631	328,480	395,346	460,870
Demand SC4	266,631	328,480	395,346	460,870
Utilisation SC1 and SC2	78%	67%	74%	83%
Utilisation SC3 and SC4	78%	65%	73%	83%

Notes: *2016 data for capacity taken from DfT (2017) Table 22. Heathrow data from Table 65 HNWR case. Note some airports -notably Gatwick- have plans for higher capacity than is assumed by the DfT and thus presented in the table above

⁹ Terminal capacity was not limited as the DfT has assumed that the constraint at Heathrow will be runway capacity even if a third runway is constructed. The resulting passenger throughput assumed for Heathrow in the future is not explained or apparent from the material provided by the DfT.

15. DfT in its response to the Council's request for further information (INQ/042 response 20) has indicated that high carbon prices (higher than £600/t) would have to be used to constrain demand. If additional capacity is made available through expansion, but then demand is then constrained by price, it is not surprising the carbon price has to be high in order to constrain the use of capacity once it has been provided. What the DfT has failed to examine is whether the costs of constraining additional capacity now would be less. This was examined by the CCC which took the view that the cost of constraining supply (rather than demand) through not building additional capacity is zero¹⁰. In my view, the failure to fully examine the implications of constraining demand represents a flaw in the consultative process. In order to reject constraining capacity as an option, it is highly material to consider the relative costs of an option which does not constrain expansion but which may require constraining demand later against an option which does constrain expansion but which would not require demand constraint later.
16. A further option the DfT could have explored through scenarios it has examined would have been to link the development of additional capacity to commercialisation of new low carbon technologies. This is something airports have themselves considered, including Luton and Heathrow, through Green Managed Growth or Environmentally Managed Growth proposals. Such an approach would at least have given both clear market incentives as well as certainty that legally binding targets would be delivered.
17. The nature of the scenarios and assumptions adopted simply reinforces the point I made in my Proof of Evidence that it is premature to grant planning permission for the expansion of Bristol Airport. That is because there are significant issues to be engaged with in the Consultation(s) and to date the material provided is simply insufficient to enable an informed response by consultees, and simply insufficient for this Inquiry to conclude that granting planning permission of the Proposed Development would not have a material impact upon the ability of the Government to meet its carbon reduction targets.
18. The Jet Zero consultation paper explains that:
- a. "3.39 This Government is committed to tackling the CO2 emissions from flights, whilst preserving the ability for people to fly."

¹⁰ CCC Estimates of the cost of carbon reduction measures in aviation

Subsector	Average cost of abatement (£/tonne CO ₂ e)	2050 Abatement (MtCO ₂ e)
Aviation: Efficiency, hybridisation	-276.8	7.7
Aviation: Demand management	0.0	11.7
Aviation: Low carbon fuels	109.7	7.8
Removals: DACCS	179.4	5.0

Source: CCC 6th Carbon Budget (CD 17.81 "The-Sixth-Carbon-Budget-Charts-and-data-in-the-report", see tab "Advice Report Ch5&6", line 81 onward).

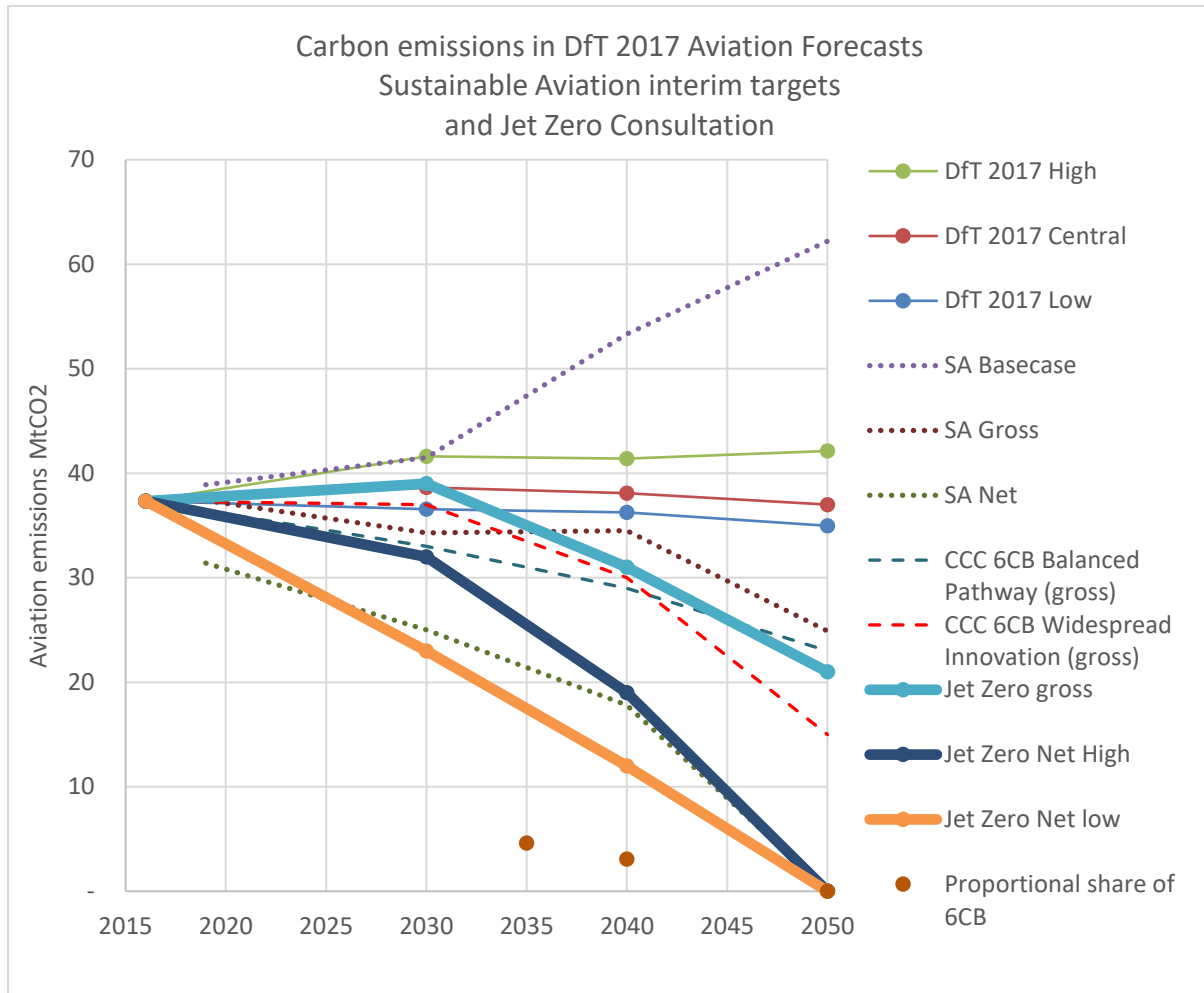
- b. *“3.40 COVID-19 has devastated passenger numbers over the short-term, and we do not yet know what the longer-term effects on demand might be. Only as the pandemic continues to come under control and consumer confidence returns, will we begin to understand how it will affect the sector over the longer-term.” (my underline)*
- c. *“3.41 Nonetheless, even if the sector returns to a pre-COVID-19 demand trajectory, as we have assumed in our analysis, we currently believe the sector can achieve Jet Zero without the Government needing to intervene directly to limit aviation growth. The industry's need to rebuild from a lower base is likely to mean that plans for airport expansion will be slower to come forward.³⁹ Our analysis shows that there are scenarios that can achieve similar or greater CO2 reductions to those in the CCC's Balanced Pathway⁴⁰ (which limits growth to 25% by 2050 compared to 2018 levels compared to a baseline of 65% growth) by focussing on new fuels and technology, with the knock-on economic and social benefit, rather than capping demand.” (my underline)*
- d. *“3.42 We recognise that net zero 2050 must be achieved and we must ensure that any growth in aviation is compatible with our emissions reduction commitments. The approach we intend to set out in our Strategy will prioritise in-sector reductions through technological and operational improvements, then seek to address residual carbon emissions through robust, verifiable offsets and additional greenhouse gas removals. It relies on the rapid scale-up and deployment of technologies that are currently at a relatively early stage of development and requires collaboration and commitment across all parts of the sector if it is to succeed.”*
19. As I explain in more detail below, the basis for the “*current belief*” that net zero can be attained without the Government needing to act to limit aviation growth is not explained in the Consultation or the supporting material.
20. In particular, as can be seen from the DfT Response, there has been no examination of the likelihood of the assumptions adopted actually coming about. Indeed, there has been no examination of the likely risk of action to limit growth being required. As such, there is no evidenced or rational basis for the “*current belief*”.
21. Indeed, I understand that there must questions whether the adoption of a policy founded upon an absence of a wider assessment of other options and an absence of an assessment of both risk and cost being lawful. Under section 1 of the CCA 2008 it is the duty of the Secretary of State “to ensure” that the net zero target for 2050 is attained. Further, by virtue of Section 4(1)(b) of the CCA 2008 it is the duty of the Secretary of State to ensure that the UK carbon account for a budgetary period does not exceed the carbon budget for that period and by section 13(1) of the CCA 2008 the Secretary of State is under a duty to prepare such “proposals and policies” as will enable the carbon budgets to be met.

22. The DfT Response confirms at 24.1 – 24.3 that the Jet Zero consultation does not seek views on sectoral targets relating to the 6th Carbon Budget i.e. that it is seeking views on a carbon reduction strategy for aviation that does not address the 6th carbon budget and is not prepared with regard to the delivery of the 6th carbon budget target in mind. I struggle to see how the adoption of policy on this basis can be seen to be consistent with the statutory duties I have identified above.
23. The Consultation presents no assessment of the extent to which it is consistent with the delivery of the 6th Carbon Budget. As such, it does not demonstrate that the expansion of airport capacity it has assumed is consistent with the achievement of the duties set out in sections 4 and 13 of the CCA 2008.
24. As I explain below, this means that there is no analysis produced by central Government which demonstrates that the airport expansion envisaged by MBU or in the jet zero consultation is consistent with ensuring that the 6th carbon budget targets are met. As a consequence, I remain of the view that MBU, whilst current Government policy, is out of date and of little weight. Further, in the absence of an assessment from Central Government which demonstrates that further expansion of airport capacity including the Appeal Scheme can be permitted consistent with the attainment of the 6th Carbon Budget target, it cannot be demonstrated that granting planning permission for the Appeal Scheme would not have a material effect on the ability of the Government to attain that target. The exercise which is required has not been undertaken by Central Government. BAL is not in a position to be able to undertake that exercise. The Inquiry cannot undertake that exercise. As a result, the position is akin to that which the Inspectors in the A38 decision found themselves in; they were unable to satisfy themselves that to grant consent for the scheme would not materially affect the ability to meet carbon reduction targets. That same conclusion has to be reached in the present case.

2.2 Jet Zero compared to other policy projections

25. The graph below shows the Government's preferred Scenario from Jet Zero (Scenario 2: High Ambition) compared to DfT (2017) Forecasts, Sustainable Aviation scenarios, CCC 6th Carbon Budget recommendations, and also against aviation taking a proportionate share of the 6th Carbon Budget (ie a 78% cut compared to 1990 baseline in line with the rest of the economy). In essence,
- The preferred scenario would allow aviation to emit the same carbon emissions in 2030 as the DfT 2017 central case before offsets assumed. Consequently, it does not represent any material change from the approach applied to the aviation sector prior to the adoption of the 6th Carbon Budget and Net Zero as carbon emissions targets.
 - Both the Sustainable Aviation (SA) zero carbon routemap and CCC were more aggressive in seeking early cuts in emissions than is proposed Government policy in the period to 2035. This is important in aiming at a 1.5 degree rather than a 2 degree temperature trajectory under the Paris Agreement, and means

that to meet the 6th Carbon Budget other sectors would need to make earlier deeper savings. The extent to which this is feasible or achievable is not explored in the Consultation.



26. The High Ambition Scenario (which forms the basis for scenarios 2,3, & 4 in the Consultation) is based on:

- 8.8% carbon reduction from demand impact of pricing (ie demand reduction by price, but no capacity constraint).
- 36% carbon reduction from efficiency improvements.
- 4.1% carbon reduction from **zero emission aircraft**, which could be seen as all domestic aviation being electric and or hydrogen by 2040.
- 14.4% carbon reduction from **Sustainable Aviation Fuel (SAF)**. The consultation paper acknowledges at para 3.16 "*the costs of SAF are high and uncertain, ranging from 2-3 times compared to the price of the fossil*

counterfactual, and potentially up to 8 times more for certain technology pathways.” (my underline)

- e. 36.7% carbon reduction from **offsets or removals**. My Rebuttal and update discussed the early stage of the offset and removals markets, and the Jet Zero consultation echoes this.

2.3 Absence of an impact assessment

27. The Jet Zero consultation purports to have been undertaken in accordance with the Governments adopted “Consultation Principles”. This states that consultation documentation should *“Include validated impact assessments of the costs and benefits of the options being considered when possible; this might be required where proposals have an impact on business or the voluntary sector.”*
28. However, no validated impact assessment has been conducted.
29. At 1.2 of the DfT Response letter it is stated that: *“An impact assessment was not deemed appropriate or possible at this stage given the consultation is on a broad strategy for achieving net zero aviation rather than setting out detailed policy proposals. Should they be required, the department will carry out impact assessments to accompany subsequent consultations on policy proposals to achieve the goals of this strategy.”*
30. If this is correct then the Government is proposing to adopt a strategy for the achievement of net zero for the aviation sector without assessing the costs and benefits and risks of the various policy approaches that could be adopted e.g. constraining demand vs not constraining demand or allowing no airport expansion, limited airport expansion, expansion linked to the actual delivery of assumed technical developments, or allowing expansion as envisaged by MBU.
31. I do not consider that this approach is consistent with the Consultation Principles or indeed rational. This may have implications for the lawfulness of the consultation process.

2.4 Making Best Use of Existing Runways

32. In my original proof of evidence I examined in detail the nature of the exercise undertaken in Making Best Use of Existing Runway Capacity (CD/6.04 paragraphs 55-64). I concluded that MBU is out of date because it is not based upon any assessment which demonstrates that the level of airport capacity expansion it envisages is compatible with the attainment of the 6th Carbon Budget or Net Zero 2050 (see my proof paragraphs 110 – 111).
33. The Jet Zero consultation paper states at footnote 39: *“Beyond the horizon The future of UK aviation: Making best use of existing runways (2018) and Airports National Policy Statement: new runway capacity and infrastructure at airports in the South East of*

England (2018) are the most up-to-date policy on planning for airport development. They continue to have full effect, for example, as a material consideration in decision-taking on applications for planning permission. The government is clear that expansion of any airport must meet its climate change obligations to be able to proceed. (emphasis added).

34. As I have explained above, the basis for the “*current belief*” is not explained in the consultation paper, and can be contrasted with the more cautious wording of the “*Evidence and Analysis*” supporting paper which explains at paragraph 2.22: “*This analysis suggests that capping demand may not be necessary to reduce emissions to levels which can be offset by GGRs to achieve net zero (such as the level suggested by the CCC’s Balanced Net Zero Pathway, 23 Mt in 2050). There is much uncertainty however, and clearly there could be many combinations of technology improvements, GGR costs and demand growth which would achieve net zero.*” (my underline).
35. This latter quotation does not rule out a need to cap demand as necessary in the future in order to attain carbon reduction targets. In my view, given the absence of any assessment of the risks/likelihood of delivery of the trajectories examined in the consultation process and the significant uncertainties/lack of clarity in the information underlying the consultation process (which I shall explain further below), the basis for the Government’s “belief” is both far from clear, and fraught with uncertainty, such that it would be unreasonable to conclude that the need for the introduction of capacity constraint in the future can be ruled out now.
36. The assessment necessary to reach a conclusion that capacity constraint is not required now and is not likely to be required in the future simply has not been conducted.

2.5 Capacity and demand

37. At paragraph 2.21 the Evidence and Analysis paper states: “*In order to achieve the CCC’s proposed demand limit of a 25% increase in passenger numbers on today’s levels by 2050, our modelling suggests a carbon price substantially higher than £600/t could be necessary.*” It goes on: “*we think before carbon prices reached this level, they would be sufficient to incentivise technologies to reach net zero GHG emissions by 2050.*” This seems to assume that only price can constrain demand, whereas many have been calling for a moratorium on new capacity.
38. With this in mind, and as above, it is striking that the Consultation paper (nor any assessment it relies upon) does not examine the relative cost of constraining *capacity* now, compared to building more airport capacity and then constraining *demand* for it, if measures do not deliver the carbon reductions required. It is particularly striking since in its assessment the CCC regarded the cost of constraining airport capacity as zero, and that constraining demand would not only be zero cost, but in addition, would also be the

measure which could provide the largest potential for abatement of emissions¹¹. I regard this lack of analysis as a significant flaw in the policy development process. I struggle to see how it can be rational to allow airport expansion without assessing the likelihood of the need to constrain that additional capacity in the future. This work needs to be undertaken and compared with relative costs and benefits of the other policy options e.g. constraining demand now, only allowing expansion upon delivery of technological improvements etc.

39. In addition, in my view the statement in footnote 39 that MBU is the “*most up-to-date*” policy on planning for airport development cannot be read as meaning that this policy is, in fact “up to date”. The “most” up to date” cannot be read as “up to date”. It is a qualified statement. That statement is repeated using identical language in the DfT Response (24.3) Indeed, as I demonstrated in my original proof MBU is not up to date since its conclusions are founded upon an analysis of the climate change implications of the 80% by 2050 target. It did not assess the ability to expand capacity against the 6th Carbon Budget nor the Net Zero 2050 target since these had not been adopted at the date when MBU was published.
40. As explained above, there is no assessment which demonstrates that the trajectories set out in the Consultation are consistent with the attainment of the 6th Carbon Budget target. Consequently, until the Government adopts a new policy founded upon a robust assessment exercise which demonstrates that the policy contained in MBU is consistent with the attainment of the 6th Carbon Budget and Net Zero 2050 targets, I remain of the view that MBU is out of date and to be given little weight. I do not read footnote 39 as saying that MBU is up to date and to be given full weight. Indeed, if it were to be regarded as saying this, I would consider such a statement as irrational in the light of the analysis set out in my original proof of evidence.
41. Given the significant questions that remain to be answered relating to the scenarios assessed in the consultation paper little, if any, weight can be placed upon the assessment set out in the Consultation. This reinforces the point I made in my original proof that it is premature to grant planning permission for the expansion of Bristol Airport at this stage. There are significant issues that remain to be resolved by Government as part of the Consultation process. Until those are resolved it is not possible to determine

¹¹ CCC Estimates of the cost of carbon reduction measures in aviation

Subsector	Average cost of abatement (£/tonne CO ₂ e)	2050 Abatement (MtCO ₂ e)
Aviation: Efficiency, hybridisation	-276.8	7.7
Aviation: Demand management	0.0	11.7
Aviation: Low carbon fuels	109.7	7.8
Removals: DACCS	179.4	5.0

Source: CCC 6th Carbon Budget (CD 17.81 “The-Sixth-Carbon-Budget-Charts-and-data-in-the-report”, see tab “Advice Report Ch5&6”, line 81 onward).

whether the expansion of Bristol Airport would have a material impact upon the Government's ability to meet its carbon reduction targets.

2.6 The Scenarios Examined

42. In the Evidence and Analysis document, an analysis of four scenarios is presented. However, the basis for and nature of the assumptions adopted in each scenario remain unclear. The Council asked a number of questions to obtain further information in this regard in its letter to the Department for Transport (INQ/9).
43. The four scenarios examined are
 - a. Scenario 1: continuation of current trends
 - b. Scenario 2: high ambition
 - c. Scenario 3: high ambition with breakthrough on SAF
 - d. Scenario 4: high ambition with breakthrough on Zero emission aircraft
44. It is important to note that at paragraph 4.1 of the Evidence and Analysis paper the Government states: "...the four scenarios we have modelled result in residual in sector emissions of between 9 Mt and 36 Mt in 2050. The scenarios show that significant in-sector abatement could be possible if we make substantial progress with new technologies. However, making the required technological progress will be very challenging and there are many barriers that will need to be overcome, especially for the final two scenarios. Our trajectories also indicate that aviation net zero can be met by 2050 with future capacity assumptions consistent with Making Best Use policy and the Airports National Policy Statement." (my underline).
45. At paragraph 4.3 the "Evidence and Analysis" paper, the Government states:

"There is significant uncertainty surrounding the abatement potential, uptake and costs of the measures described in this document and therefore these scenarios should be seen as illustrative pathways rather than forecasts."
46. This must mean that the statement that net Zero 2050 can be met with future capacity assumption consistent with MBU and the ANPS is founded upon illustrative pathways and not forecasts. The DfT Response confirms *"We have not produced official forecasts. Our illustrative scenarios suggest net zero could be achieved (if the challenges we have outlined for each scenario are overcome) with future capacity assumptions consistent with Making Best Use policy and the Airports National Policy Statement."*
47. I take this to mean that the Government has not produced any projections or forecasts which show that the targets for the 6th carbon budget for 2033-27, and net zero aviation by 2050, can be met, with the capacity assumptions from Making Best Use policy and the Airports National Policy Statement; rather it has produced some illustrative material based on assumptions which shows how this might be achieved but that these are subject to significant uncertainty, and without conducting any analysis of risks and risk mitigation associated with those assumptions. The DfT Response does not identify any assessment of risk has been undertaken.

48. Further, my understanding is that when considering the adoption of policy the Government is required to have regard to the precautionary principle. The DfT Response confirms that there has been no assessment of the application of the precautionary principle in developing the trajectories which are the subject of the Consultation (see DfT Response 25). I regard the failure to consider the application of the precautionary principle as significant in circumstances where a strategy is being formulated with a view to ensuring the attainment of particular legally binding environmental targets in circumstances where there is considerable uncertainty. In my view that application of that principle requires the decision maker to adopt the approach which on an objective scientific basis is most likely to deliver the targets. The failure to analyse this issue is a significant one in my view.
49. The Council has also asked whether other scenarios were examined. The DfT response explains (DfT Response 2) that a sensitivity analysis has been conducted building on scenario 1 but with different assumptions regarding SAF uptake.

2.6.1 Baselines

50. There was a considerable lack of clarity in the growth assumptions adopted. At paragraph 3.8 of the “evidence and analysis” document, the demand assumption of 60% growth on 2018 levels is adopted resulting in growth of 273 million terminal passengers in 2018 to 466 million in 2050. Scenario 2 is also based upon the same level of growth over the same timescale. However, the charts produced in the Evidence and Analysis are the graphs unambiguously use a baseline of 2016. A 60% growth from 268 mppa in 2016 would imply 430 mppa based on 2016.
51. This has been clarified in the DfT Response (DfT Response 9). “*The passenger growth rates stated in the evidence and analysis document of 60% for Scenarios 1 and 2 and 58% in Scenarios 3 and 4 represent the passenger growth between actual 2018 passenger numbers and modelled 2050 passenger numbers. At paragraph 3.8, the passenger numbers referenced reflect modelled 2018 and 2050 passenger numbers. The aviation model uses a base year of 2016, and therefore there is some discrepancy between modelled passenger numbers and actual passenger numbers between 2016 and 2020. Passenger demand increases have been quoted against 2018 levels (rather than the model baseline of 2016) for comparison against demand figures suggested by the CCC, which were presented as increases on 2018 figures.*”

2.7 Analysis of the scenarios

52. Further to the Council's letter the DfT has now published a dataset (INQ/041) as part of the consultation exercise which sets out more detail on the assumptions adopted.
53. As can be seen all three “do something” scenarios (2,3 and 4) rely upon a “high ambition” approach. This involves making assumptions relating to:

- a. Carbon Price;
- b. Airport Capacity;
- c. The Future Fleet Mix;
- d. Fuel Efficiency;
- e. Sustainable Aviation Fuel (SAF) Uptake

2.7.1 Carbon Price Assumptions

54. Paragraph 2.18 of the “Evidence and Analysis” recognises that:
- a. There is uncertainty surrounding the values to use when modelling future carbon prices.
 - b. The value the government places on changes in carbon emissions is currently under review now that the UK has increased its domestic and international ambitions by committing to net zero.
 - c. BEIS central carbon values are likely to undervalue GHG emissions in the long term since they were developed by reference to the previous decarbonisation target of 80% reduction in emissions by 2050.
 - d. The potential impact of placing a higher value on GHG emissions has been explored by using the existing BEIS high carbon values series in scenarios, in addition to the prescribed central values.
55. The DfT Response confirms that no analysis was undertaken which examines the likely scale and/or nature of the uncertainty surrounding the values to use when modelling future carbon prices (DfT Response 4.1). No modelling of future carbon process has been conducted (DfT Response 4.2). It is BEIS which is the responsible department for examining these issues and the DfT is unable to provide a timescale for when the government review to identify appropriate carbon prices consistent with the attainment of the 6th Carbon budget.net zero 2050 will be concluded.
56. Thus, the High Ambition Scenario 2 is not a scenario which is in fact based upon carbon prices which reflect the 6th carbon budget targets or net Zero 2050. Indeed, it appears that the Government has not yet calculated or identified the carbon price implicit in its carbon targets.
57. At paragraph 2.12 of the “Evidence and Analysis” document, it is recognised that increased costs are likely to be passed on to air passenger and that this in turn may reduce demand for air travel. This is important since higher prices will reduce demand. The DfT Response explains (DfT Response 6) that no analysis of the impact of market-based measures on fares was been undertaken for the Consultation.
58. If demand is reduced, then the need or scope for further airport expansion will reduce. This has the potential to mean that not all airport expansion will be required. However, this does not appear to have been taken into account in Scenario 2. Again, the revised carbon pricing which will be output of the BEIS’s ongoing review (see above) will also affect this issue. Thus, the demand forecasting will need to be revised once the BEIS ongoing review is concluded. As a result, I would question the appropriateness of making

any determination on the Jet Zero consultation in advance of the outcome of the BEIS review of carbon pricing. It is not reasonable or rational to reach a concluded view on a Jet Zero consultation in advance of the outcome of that review and further Jet Zero consultative process which takes that review into account.

59. As a result, I do not regard the material provided as sufficient to demonstrate that carbon pricing assumptions have been adopted on a basis which is consistent with 6th Carbon Budget (2033-37) and the attainment of Net Zero 2050. The reality here is that the consultation process has been commenced ahead of the Government determining the appropriate value to ascribe to carbon in the future. The adoption of a strategy/policy relation to the attainment of net zero by the aviation sector in advance of the conclusion of its ongoing review would not be reasonable or rational.

2.7.2 Fuel Efficiency

60. The risks associated with the assumptions on to fuel efficiency made in the Consultation are high in my view. However, there is no exploration of the level of risk associated with these assumptions in the Consultation whatsoever. The Council sought further information in this regard, and DfT provided some commentary in their response, but their response does not demonstrate that risk has been considered in any material way.
61. The DfT 2017 Aviation Forecasts include assumptions on aircraft efficiency in their forecast¹². The DfT 2017 forecasts suggests 46-48% cumulative improvement, whereas calculating out the annual increments over the whole period only adds up to a 29-30% improvement.
62. The CCC in its Balanced pathway to 2050 adopted the assumption that *“the fuel efficiency per passenger of aviation is assumed to improve at 1.4% per annum, compared to 0.7% per annum in the baseline. This includes 9% of total aircraft distance in 2050 being flown by hybrid electric aircraft.”* The 1.4%/year efficiency improvement is a figure in-line with the historical average trend and was adopted based on the November 2018 paper by ATA and Ellondee *“Understanding the potential and costs for reducing UK aviation emissions”*¹³ which the CCC and DfT jointly commissioned. CCC considered the 1.4% annual rate of efficiency improvement was more realistic than the 2.1% explored in the widespread innovation and Tailwinds pathways¹⁴. Yet DfT have adopted the higher number without outlining how it is delivered. DfT also appear to count electric aviation as additional reduction, and thus appear to double count electric aircraft.

¹² See Table 8 (p.55) of www.gov.uk/government/publications/uk-aviation-forecasts-2017

¹³ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/785685/ata-potential-and-costs-reducing-emissions.pdf

¹⁴ Table M8.1 Aviation scenario composition The Sixth Carbon Budget Aviation <https://www.theccc.org.uk/wp-content/uploads/2020/12/Sector-summary-Aviation.pdf>

63. All four scenarios in the “Evidence and Analysis” paper appear to assume a 2.0% per annum fuel efficiency (2017-2050), but the further data released by DfT show in the spreadsheet of scenarios, that no fuel savings are made before 2030.
64. The ATA Ellondee paper glossary explains that the: *“Assessment range covers three possible outcomes for the attributes of each technology. Worst is the lowest level of attribute change: Nominal is expected level of attribute change: Best is the highest level of attribute change. Three scenario options have been created. Pessimistic uses only the most obvious high value low challenge technologies: Likely adopts the most likely technologies based on the current well developed technology plans: Optimistic introduces some high-risk technologies in addition to the technologies adopted in the “likely” case.”* (my underline)
65. The additional technology content of the optimistic scenario within the ATA Ellondee research can be found on page 24 Table ES-5 Technology. The Council asked the Department for Transport for its assessment of the likelihood of these “high-risk” technologies coming forward and for all other assessments which explain why it is appropriate to adopt a 2% fuel efficiency assumption rather than the 1.4% seen as a more central scenario by the CCC. This is particularly important since both the CCC and the DfT commissioned the ATA research, yet each has drawn different conclusions from it.
66. The DfT Response (INQ/042 11.1) confirms that no assessments or information relating to the assessment of likelihood of the “high-risk” technologies coming forward or the timescale for them was undertaken.
67. Not recognising both the categorisation of each technology explored as either pessimistic, likely or optimistic, and not having regard to the degree of uncertainty surrounding the delivery of the assumptions seems to me to represent a failure to have regard to a material consideration, particularly in a context where there is a statutory duty to adopt a policy approach which “ensures” that carbon reduction targets are met. The reality is that there is significant uncertainty here which the ATA paper recognises but which the Consultation has not recognised or examined. I agree with CCC’s conclusion that achieving the carbon target by not building airports in the first place is likely to be a less expensive and more certain approach to ensuring attainment of carbon reduction targets (see DfT Response 11.2). However, this has not been explored by the DfT in the work underlying the Consultation. This is a failure to have regard to a material consideration and results in a flawed consultative process in my view.
68. In relation to the ICAO aspirational goal, the ICAO Environmental report 2019 computed 1.37% per annum long-term fuel efficiency, which includes the combined improvements associated with both technology and operations. The individual contributions from technology and operations is 0.98% and .039% respectively¹⁵. The DfT Response (DfT

¹⁵ see www.icao.int/environmental-protection/Documents/EnvironmentalReports/2019/ENVReport2019_pg17-23.pdf

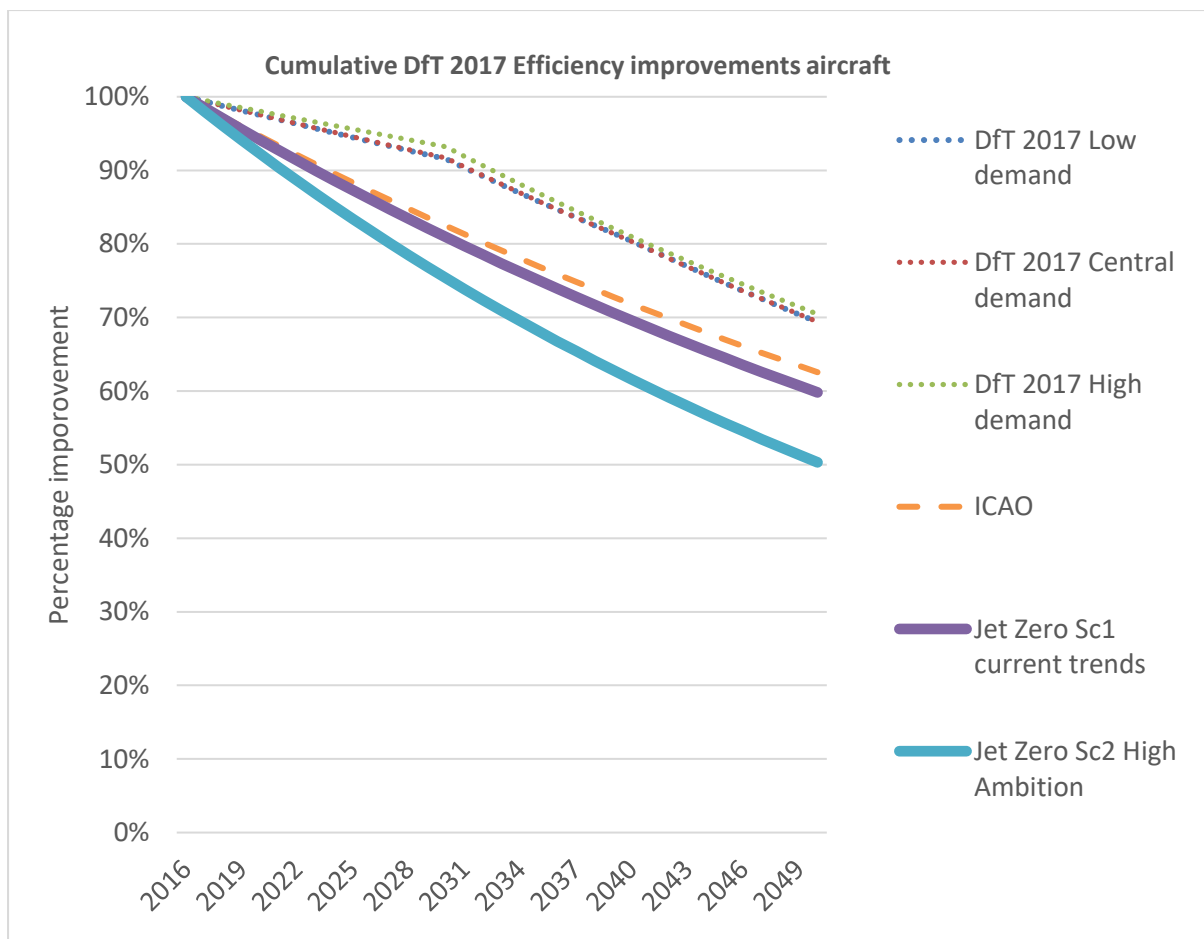
Response 11.3) confirms that the DfT has not identified an evidenced basis for the ICAO aspirational goal. It appears to me that the Government is placing reliance on an aspiration, rather than any evidence that the fuel efficiency improvements of 2% per annum are likely to be achievable or deliverable in practice.

2.7.3 Future Fleet Mix

69. The Evidence and Analysis paper explains at paragraph A.7: *“DfT recently updated the fleet mix component of the aviation model to better reflect the age profile of aircraft operating in the UK. This is the module that forecasts the type of aircraft that service the flights predicted by the model.”*
70. Paragraph A.11 refers to the “Fleet Mix Model”. The fleet mix model is not however provided nor are the assumptions adopted regarding the profile of aircraft assumed to be operating in the UK over time. The assumptions relating to the CO2 emissions of aircraft are obviously crucial to understand in examining the risks associated with the attainment of carbon reduction targets in each scenario. The Council sought further information in this regard in its letter.
71. The DfT Response refused to provide the fleet mix model (DfT Response 10). The Council was invited to ask for further information. The Council will be seeking further information in order to explore the extent to which assumptions have changed since 2017 including:
- a. updated aircraft supply pool data since 2017 for each seat class/operator type, including the aircraft types, the years they enter and leave the supply pool and the assumed retirement ages, together with the assumed percentage of newly built aircraft by each type.
 - b. any changes to the fuel burn modelling in the model since 2017.
72. At paragraph 3.11 the Evidence and Analysis paper which supports Jet Zero explains: *“Achieving such a high rate of fuel efficiency improvement will also be challenging, and may not be met if airlines cannot afford to invest in modernising their fleets at sufficient speed, or if the aerospace sector cannot afford to invest in creating the necessary aircraft advancements (made even more likely by the huge financial impact of Covid-19 on the aviation industry)”*
73. The scenarios in Jet Zero present no assessment of the likelihood of airlines being able to afford to invest in modernising their fleets at the speed assumed in the scenarios given the ongoing disruption cause by the Covid-19 pandemic. The DfT Response to our letter (INQ/04212.1-12.2) confirms that the Government has not undertaken any analysis of the ability of the aviation sector to afford to modernise the fleet on a basis which is consistent with the assumptions adopted in the trajectories presented. There has been no analysis of the risks or likelihood of assumptions being delivered in practice.
74. In my view the fuel efficiency assumption is very sensitive to the assumed ‘Entry Into Service’ date of new more fuel efficient aircraft and to assumed retirement ages. Yet a

discussed The Jet Zero Consultation included no explanation of how the fleet turnover modelling was undertaken (and none is forthcoming from further inquiry), and no analysis of the sensitivity of results to changes in assumptions is provided, and no analysis of the effect the COVID is having on retirements or new orders for aircraft is set out. In my view there is a significant likelihood that the pandemic has affected the cashflow of airlines to such an extent that it is likely that the ability for airlines to invest in new aircraft will be affected and that in turn this may delay the introduction of more fuel efficient aircraft into service.

75. Taking the fuel efficiency and fleet mix uncertainties together, the DfT has produced a different projection of emissions than that which it identified only four years ago in 2017 and which has been identified by others since. This is shown in the graph below. The latest DfT position has not been justified.

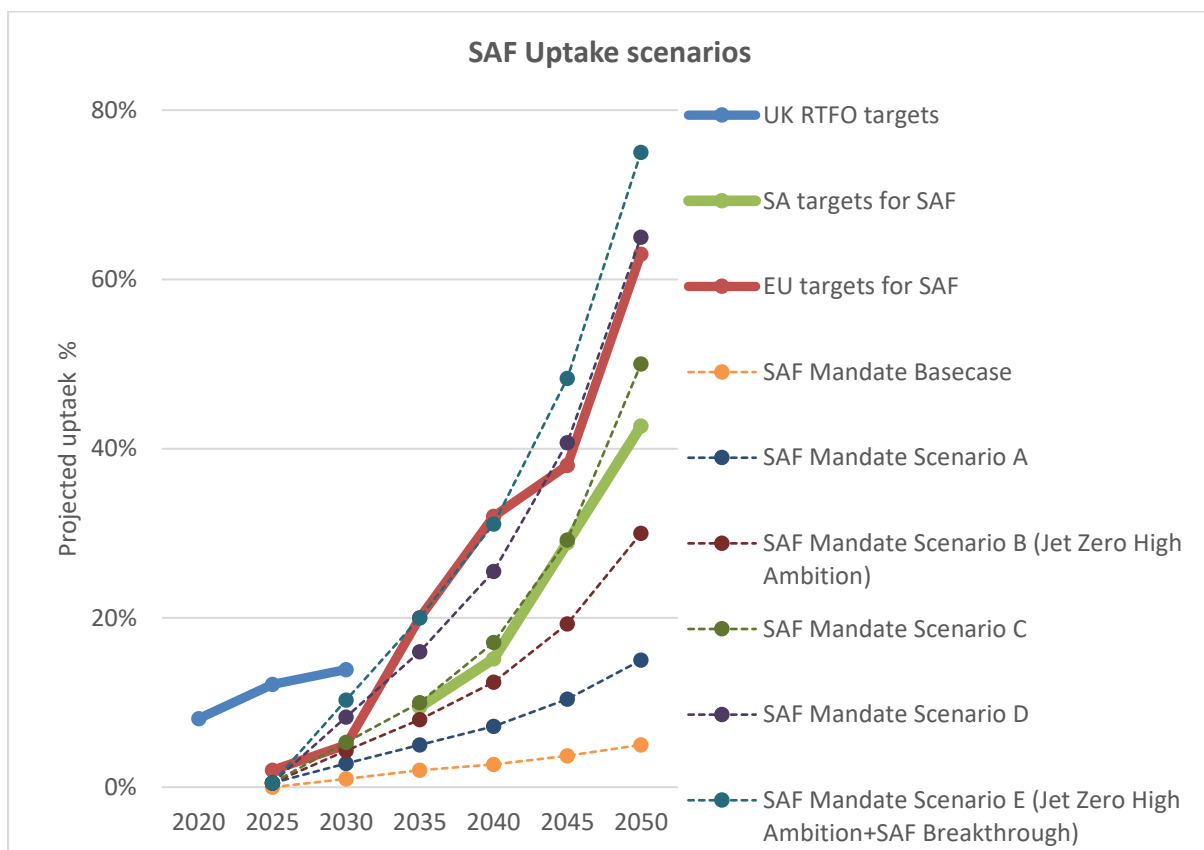


2.7.4 Sustainable Aviation Fuel (Including the consultation on a Sustainable Aviation Fuel Mandate)

76. A week after the launch of the Jet Zero Consultation and the consultation response on Renewable Transport Fuels, and shortly after the EU published its own proposals, the Government launched a consultation on developing a mandate for Sustainable Aviation Fuel.

77. The chart below quantifies some of the proposals for possible SAF Mandates, with:

- a. **UK RTFO** – in blue, historical and covering all transport fuels, revised just a few weeks ago to achieve 14.6%, of transport fuels in 2032.
- b. **Sustainable Aviation Group proposals** in green.
- c. **The proposed EU SAF Mandate¹⁶** (which relied on work from Ricardo to develop) proposals in red, being closest to Scenarios D of the UK SAF Mandate Scenario D.
- d. **UK SAF Mandate** consultation included a Basecase plus scenarios A-E, with Scenario B being the rate of uptake needed to deliver Jet Zero High Ambition scenario achieving 30% by 2050, and also similar to SA projected uptake, and Scenario E being the rate of uptake needed to deliver Jet Zero High Ambition +SAF Breakthrough.



¹⁶ https://ec.europa.eu/info/sites/default/files/refuelev_aviation_-_sustainable_aviation_fuels.pdf

78. Paragraph 3 of the SAF mandate consultation noted “*SAF production and use is very limited, both in the UK and globally. First-of-a-kind production plants present high capital costs, which result in a very expensive fuel, and the cost constrains demand [for the fuel]. In addition, technology risks can affect production, as can the availability of feedstock and local supply chains. These barriers result in a significant economic risk which can disincentivise private investment.*” (my emphasis).
79. Paragraph 1.11 notes “*high capital costs of first-of-a-kind commercial plants, which could go even beyond £1 billion. This results in high fuel prices (three to eight times the cost of kerosene) and consequently limited demand for SAF, at present, and limited revenues.*”¹⁷
80. Paragraph 11 noted “*We acknowledge high targets will be contingent on multiple technology and policy developments that could unlock a very rapid roll-out of several SAF plants in the short term, the quick commercialisation of SAF technology not yet proven at scale and the certification of new production pathways.*”
81. Paragraph 12 proposes review points in 2030, for post-2035 uptake, in 2035 for post-2040 uptake and in 2040, for post-2045 uptake, including beyond 2050. This implies very significant uncertainty in future trajectories.
82. In the Jet Zero “*Evidence and Analysis*” paper (para 2.7) in scenarios 2 and 4 the assumption is that 30% of fuel demand will be met by Sustainable Aviation Fuel (SAF). The evidential foundation for the adoption of this assumption is the Analysis by E4Tech for Sustainable Aviation in 2018¹⁸.
83. The E4Tech paper 2018 concluded that with the right policy and investment framework UK aviation can reduce its CO2 emissions by between 15-24% by 2050. E4Tech explained: “*This is based on the assumption that sustainable fuels contribute between 25% and 40% of the aviation fuel market*”. Further it stated: “*Achieving this result will require a step change in the current policy and investment framework for sustainable aviation fuels.*” “*To achieve the high 24% GHG emissions saving target, based on the high scenario for production to 2030, would require a sustained annual growth rate of around 14% per year between 2030 and 2050.*”
84. The Consultation paper does not provide any evidence that sustained growth of 14% per annum between 2030 and 2050 is likely or realistic. The Council asked to be provided with a copy of any assessment which appraises the likelihood and/or risks associated with the adoption of an assumption that 30% of fuel demand will be met by Sustainable

¹⁷ https://theicct.org/sites/default/files/publications/Alternative_jet_fuels_cost_EU_2020_06_v3.pdf

¹⁸ Sustainable Aviation (2018) Sustainable Aviation Fuels Roadmap. <https://www.sustainableaviation.co.uk/wp-content/uploads/2018/06/SA-SAF-Roadmap-FINAL-24-Nov-2.pdf> Note this is the 2018 version referred to in the Jet Zero Evidence and Analysis document, though there was a later version in 2020. It is curious the later document was not referenced given the speed of technical change.

Aviation Fuel. The DfT Response confirms that no such analysis has been undertaken (DfT Response 13).

85. Paragraph 2.8 of the Evidence and Analysis document states: *"The costs of SAF are high and uncertain. A recent ICCT report suggested that, in general, SAF is around two to three times the cost of kerosene, and potentially up to eight times the cost of kerosene for certain pathways (for example Alcohol-to-Jet) . Based on a range of evidence, we estimate the abatement costs of SAF to currently be broadly in the range of £200-600/tCO₂ , though it is expected that these should fall over time as production scales up."* (my underline).
86. The Council asked to be provided with the documents that constitute the "range of evidence" referred to in paragraph 2.8. The DfT Responded (INQ042 Response 15.1) referred to a number of sources. But these sources are estimates of generalised costs at a point in time years ahead – they present a wide range of routes to SAF, and level of uncertainty in cost, and expected entry into service of SAF production, and uptake. As a result, it is not appropriate to base a strategy on the assumption that any particular level of SAF usage will materialise by any particular point in time, particularly in the absence of any appraisal of the likelihood of those assumptions actually coming about.
87. The Council also asked for any assessment undertaken relating to the estimate of abatement costs of SAF or which examines the implications for abatement costs of SAF as a result of a scaling up of production. The DfT Response (DfT Response 15.2) confirmed that the DfT did not undertake an internal assessment of the abatement costs of SAF for the Jet Zero Consultation.
88. Paragraph 2.8 of the Evidence and Analysis document states: *"The WEF Clean Skies for Tomorrow report suggests that production costs could fall by 20-70% by 2050, depending on the fuel pathway, mainly driven by economies of scale and reductions in the cost of input feedstocks."* The Council asked the Department for Transport for its assessment of the likely fall in costs of SAF production in the UK by 2050. The DfT Response confirms that the DfT did not undertake any assessment itself of costs in the UK (DfT Response 15.5 and 16).
89. In relation to scenario 3, paragraph 3.14 of the Evidence and Analysis paper states: *"Achieving such a high proportion of SAF would require a high share of more advanced SAF pathways in particular (such as power-to-liquids), which are currently much more expensive than others. Secondly, there will need to be a substantial ramp up of SAF production. There are currently a number of barriers to these two conditions, including the high capital costs of building first-of-a-kind plants, the high risk for investors due to low technological maturity, the stringent certification requirements for new fuel pathways and blend limits (there are currently only eight certified SAF pathways), the lack of secure and sustainable supply chains for feedstocks, competition for feedstocks with other sectors (such as biomass used in road fuels), potential changes needed to aircraft engines and re-fuelling infrastructure to be compatible with SAF at blends higher than*

50%, and the lack of a domestic market. Only if these challenges are overcome, in addition to those discussed in the previous scenarios, will such a scenario be plausible.”

90. The Council asked to be provided with the Department for Transport’s assessment which examines the likelihood of the challenges identified in paragraph 3.14 being overcome and thus the likelihood of this scenario being plausible. The DfT Response confirms that no such assessment has been undertaken (DfT Response 17).
91. In other words, there is an almost total absence of any examination of the likelihood of the assumptions adopted in the Consultation trajectories actually coming about. The reality is that there is considerable uncertainty regarding the extent to which SAF will be utilised in the future. Indeed, the policy associated with an SAF Mandate has not yet been adopted. The degree of that uncertainty is highly material to consider when adopting a Jet Zero policy and yet that is not a factor that has been assessed by the DfT in any material way. This again reinforces the point that I made in my previous proof of evidence, namely that it is premature to grant planning permission for the proposed development at present.

2.7.5 Zero emissions aircraft

92. In relation to scenario 4, paragraph 3.17 of the Evidence and Analysis paper states: *“In order for such a scenario to be feasible, a number of challenges will need to be overcome. For example, a step change in battery density improvements and other technological advancements will be required (enabled by a greater investment in R&D), certification and safety regulations will need to keep up with new technologies as they emerge, airport infrastructure (e.g. re-fuelling infrastructure for hydrogen and electricity supply for charging electric aircraft) will need a coordinated change to facilitate the use of new aircraft types, and airlines will need to be able to quickly incorporate new aircraft types into their fleets. For hydrogen specifically, the development of a hydrogen strategy and supply-chain across the economy is crucial. Furthermore, for both electric and hydrogen aircraft, the costs of these technologies will ultimately need to fall so that zero emission aircraft offer a cost-effective approach to decarbonisation, relative to using SAF or GGRs”*
93. Again, the Council asked for the Department for Transport’s assessment undertaken which examines the likelihood of the challenges identified in paragraph 3.17 being overcome and thus the likelihood of this scenario being feasible. Once again, the DfT Response (DfT response 18) confirms that no such assessment was conducted.

2.7.6 GGR Assumptions

94. As I explained in my original proof of evidence, the aviation sector cannot attain net zero 2050 without reliance on GGR measures. This position is confirmed by the analysis set out in the Jet Zero consultation papers.
95. All of the four scenarios examined produced in the Jet Zero consultation result in the aviation sector producing residual carbon emissions in 2050 which are required to be off-set. At paragraph 2.19 of the Evidence and Analysis paper it is stated that: *“our analysis suggests that there would be sufficient GGR capacity to offset the residual aviation emissions that are estimated in all the scenarios we present below. We define residual emissions as those which remain after efforts to decarbonise the aviation sector have been made.”*
96. Of course, whether this is an appropriate judgment to reach depends upon the likely amount of GGR capacity as at 2050 and the competing demands for that capacity from other sectors.
97. The Council sought further information of any assessment which examines these issues. The DfT Response (DfT Response 19) confirmed no such assessment was undertaken. It explained *“in paragraph 2.19 as referenced, we have referred to research by the Royal Society and Royal Academy of Engineering that suggests there could be up to 125 Mt removals in 2050. Similarly, the CCC1 suggest that an upper bound of around 110 Mt of removals may be available annually by 2050. The highest level of residual emissions in our scenarios are 36 Mt in Scenario 1, which leads us to infer that based on current research, and the expected demand for removals across other sectors as set out by the CCC in their 6th carbon budget report, there would be sufficient removals to offset the residual emissions from aviation.”* Again these are estimates of potential GGR capacity at a point in time a long way in the future, made without knowing the market framework for supporting removals (eg carbon price, whether there is double counting with CORSIA), without knowing what date of entry into service different technologies may have, and without knowing the different levels of regulation placed on offsets versus removals.
98. Once again the degree of uncertainty associated with the range of potentially available GGR capacity is a matter which is relevant to decision maker who is under a duty to adopt a policy to “ensure” the attainment of carbon reduction targets. The Secretary of State has to ensure there is sufficient GGR capacity not just for the aviation sector but for all sectors which are unlikely to be able to meet net zero 2050. This means that the Jet Zero policy has to be adopted alongside a consideration of the cumulative carbon emissions from all sectors. There is no evidence that the DfT has analysed the position on this basis and no such cumulative assessment is presented in the consultation material either for the 6th carbon budget period or as at 2050.

99. I regard the failure to consider the degree of uncertainty associated with the potential GGR capacity or a cumulative assessment of the likely demand for GGR capacity as a failure to have regard to a material consideration. This has implications for the lawfulness of the Jet Zero consultation.

2.7.7 Non carbon warming

100. Section 4 (p.42) of the main consultation discusses non carbon warming. The only action is “*improving our understanding of non-CO2 impacts and will ensure that the latest scientific understanding of aviation non-CO2 impacts is used to inform our policy*”. Mitigation measures for Non carbon warming impacts include a raft of options including capacity or demand constraint. The extent to which the Consultation addresses the obligation to limit total warming is wholly unclear. Only this week the IPCCs latest report recognises the need to tackle any and all warming.

3 The Hydrogen strategy

101. The UK set out a hydrogen strategy for consultation on 17 August 2021, which at pages 67-69 gave examples of innovation projects that Government has supported in aviation, both in hydrogen or fuel cell aircraft, and in production of Sustainable Aviation Fuel which can use hydrogen (so there may be an overlap with the SAF Mandate). There are no targets or certainties relating to the use of hydrogen within the aviation sector at this stage. Hydrogen technology development is leading edge and a long way from commercialisation or being a reliable route to mitigating impacts of airport expansion.
102. There is more than one way to produce hydrogen, including “green hydrogen” made via electrolysis with energy from renewable resources, and “blue hydrogen”, which is derived from natural gas through the process of steam methane reforming. The carbon dioxide emissions produced are then captured and stored underground using Carbon Capture, and Storage, leaving nearly pure hydrogen. However, this route to hydrogen production can cause more carbon emissions than using natural gas in direct combustion and the Chair of the UK hydrogen and fuel cell association resigned just hours before the launch of the strategy over support for fossil-fuel dependent ‘blue hydrogen’, saying ‘*Blue hydrogen is at best an expensive distraction, and at worst a lock-in for continued fossil fuel use*’¹⁹.
103. It is difficult to place any weight on the hydrogen strategy producing any material carbon reduction within the aviation sector since there are so many uncertainties. This

¹⁹ <https://www.independent.co.uk/climate-change/news/blue-hydrogen-association-chair-quits-b1905437.html>

is particularly so, given that there is such disagreement on methods of producing hydrogen, and the impacts associated with its production.

4 The NIC report on Engineered Greenhouse Gas Removal

104. Engineered greenhouse gas removals capture carbon dioxide directly from the atmosphere and permanently store it. The National Infrastructure Commission (NIC) sees the need for a major new infrastructure sector for the UK over the coming decades, helping the UK meet its climate targets by offsetting residual emissions. The Commission's analysis²⁰ suggests:

- a. *"engineered removals technologies need to have capacity to remove 5 to 10 megatonnes of carbon dioxide no later than 2030, and between 40 and 100 megatonnes by 2050. With costs ranging between £100 and £400 million per megatonne of carbon dioxide removed, this market could see revenues reach £2bn a year by 2030."*
- b. *"The biggest barrier to deploying engineered removals is a lack of demand for negative emissions. There are currently no obligations on some of the UK's most carbon intensive industries to reduce their emissions. Government has set ambitious targets to reduce the UK's emissions to net zero. Given some sectors are hard to abate fully, this will not be possible without engineered removals."*
- c. *"Engineered removals are expensive, although the costs will be phased in over time. By 2030, revenues of around £2 billion per year could be required to support a sector capable of delivering the necessary engineered removals. Polluting industries, not taxpayers, should bear these costs. But government should support the initial deployment of a portfolio of engineered removals, and, in time, the transition to a competitive market, which will be the most efficient solution."*
- d. *"This new sector will need to be independently monitored to provide confidence to the public and investors. Government, regulators and infrastructure operators will need to plan for the enabling infrastructure, including carbon transport and storage networks. All this needs to happen alongside, not instead of, action to reduce and prevent emissions."*

²⁰ <https://nic.org.uk/studies-reports/greenhouse-gas-removals/engineered-greenhouse-gas-removals/>

105. Thus, the difficulties in creating a new market for this technology are acknowledged by the Commission. However, the Consultation document simply assumes that sufficient GGR capacity will be available. I do not regard this as a safe assumption and have seen no assessment which establishes that it is realistic to adopt the assumptions of both quantum and timing contained in the supporting information to the Consultation.

5 IPCC AR6

106. Earlier this week the IPCC published its 6th Assessment Report“ (AR6). Key conclusions from the IPCC AR6 report relevant to this inquiry are that:

- a. The Summary for Policymakers was signed off not just by scientists but by 190 Governments including the UK Government as chair of COP26.
- b. It is unequivocal that human influence has warmed the atmosphere, ocean and land.
- c. Human-induced climate change is already affecting many weather and climate extremes in every region across the globe. Evidence of observed changes in extremes such as heatwaves, heavy precipitation, droughts, and tropical cyclones, and, in particular, their attribution to human influence, has strengthened since the Fifth Assessment Report (AR5).
- d. The earth is now projected to hit 1.5 degrees in the near term (2020-2040) in almost all scenarios. The issue now is can we keep temperatures at that level or will we continue to temperatures of 1.8-4.4 or even above 5 degrees over the next century (Table SPM.1).

107. This report serves to emphasise the need for significant action on climate change. It is self evidently unlikely that continuing the same approach that was adopted in the DfT 2017 central forecast, produced prior to the 6th Carbon Budget and the adoption of net zero, and of course produced before the latest IPCC AR6 report, will achieve the appropriate degree of action.

6 Conclusions

108. The Consultation does not provide sufficient information to enable an informed reader to respond on key aspects. There are significant uncertainties in the supporting material which remain to be evidenced and explained. In particular, given the requirement in law to ensure that targets are met, it seems bizarre that a proposed strategy/policy is to be adopted without any assessment of the likelihood of it actually ensuring delivery of those targets. I regard this as a fundamental failure in the Consultation Process, since it means

that the public cannot make any meaningful response to the Government's view of the likelihood of the scenarios actually being deliverable nor of the likelihood of them actually delivering the statutory targets.

109. Further, the Consultation has been launched in advance of the Government adopting a position in relation key inputs into the policy making framework e.g. carbon pricing and the SAF Mandate. There are significant issues that remain to be addressed. It seems likely to me that further consultation is likely to be required, founded upon these key inputs, before the Government can adopt a policy for net zero for the aviation sector on a robust basis. As a result, the timescale for the adoption of a net zero strategy/policy for the aviation sector is likely to be somewhat prolonged.
110. In the absence of the adoption of a new policy/strategy founded upon an assessment which demonstrates that it will deliver the 6th carbon budget targets and net zero 2050, MBU remains out of date and it is not possible to demonstrate that the grant of planning permission for the expansion of Bristol Airport will not prejudice the policy decisions which remain to be made. The Consultation serves to reinforce my view that it is premature to grant permission for the proposed development at this stage.
111. At present, it has not and cannot be demonstrated that the grant of planning permission for the expansion of Bristol Airport would not have a material impact on the ability of the Government to meet its carbon emissions reduction targets.



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