Communities Against Gatwick Noise Emissions (CAGNE)
Gatwick Airport Northern Runway project DCO application
PINS Reference Number: TR020005

SUBMISSIONS ON BEHALF OF CAGNE
DEADLINE 9 (21 August 2024)

INTRODUCTION

1. These submissions are made by CAGNE at Deadline 9, providing a summary of CAGNE's position on key issues at the close of the Examination. CAGNE's full case has been presented in detail throughout the Examination, both at hearings and in written submissions. CAGNE continues to rely on those previous submissions and invites the ExA to have regard to them in their totality in making its determination.

2. Within this document, CAGNE sets out brief final remarks in respect of:
   a. Policy;
   b. Noise (see also the final remarks from CAGNE's expert consultants, SUONO, at Appendix 1);
   c. Air quality (see also the final remarks from CAGNE's expert consultants, Air Pollution Services, at Appendix 2);
   d. Surface Transport (see also the final remarks from CAGNE's expert consultants, Sterling Transport Consultancy Ltd, at Appendix 3);
   e. Climate change (including as Appendix 4 the "Jet Zero: Modelling Framework" (March 2022), which CAGNE meant to provide at Deadline 1);
   f. Wastewater;
   g. Housing and socioeconomics; and
   h. Waste.

3. CAGNE notes the Examining Authority has asked the Applicant to provide further information on the impact of the DfT TAG assessment at Deadline 9. CAGNE will respond, as appropriate, at Deadline 10. CAGNE also notes the invitation from the Examining Authority to respond to the recent decision on London City Airport, and will do so at Deadline 10.

POLICY

4. CAGNE has reviewed the Applicant's various submissions on points of policy, up to and including Deadline 8. While the Applicant has addressed policy in a number of documents, it has largely repeated what was set out in the original Planning Statement and at Deadlines 1 and 2. As such, CAGNE continues to rely on the detailed submissions made in REP1-137 and REP3-113 and does not repeat these in full here.

5. In short, it remains clear that the Northern Runway Project ("**NRP**") is not supported by national aviation policy, the key elements of which comprise (i) the "Airports National Policy Statement: new runway capacity and infrastructure at airports in the South East of England" ("**ANPS**") and (ii) the "Beyond the horizon – The future of UK aviation – Making best use of existing runways" ("**MBU**"). The reason the NRP is not supported is that it would result in the creation of a new runway in the South East (and not at Heathrow). This core difficulty remains unanswered in substance.

Policy only supports one new runway in the South East[1]

6. It has not been disputed by the Applicant during the course of the Examination that the ANPS is "*important and relevant*" policy with respect to this Application.[2]

7. As is made expressly clear within the ANPS at §1.41, part of what is important and relevant to the ExA's determination is the ANPS' conclusions on need and preferred means of meeting it:

[1] See the full detail of CAGNE's case in this regard at REP1-137, §§11-17.
[2] See ANPS §1.12, §1.14, §1.41.

"*….Among the considerations that will be important and relevant are the findings in the Airports NPS as to the need for new airport capacity and that the preferred scheme is the most appropriate means of meeting that need.*"

8. Those "findings" on the need for new airport capacity are also not in dispute. The ANPS, following the work of the Airports Commission, makes very clear that policy only supports the need for one new runway in the South East of England.[3]

Heathrow has been chosen to meet that need[4]

9. There is also no dispute that the Government, through the ANPS, expressly chose the third runway proposed at Heathrow (and only a third runway at Heathrow) to meet that identified need.[5] That selection reflected a careful and substantial balancing exercise, as explained in detail within the ANPS. A key factor was the risk to the UK's "hub status" were the additional runway to be located at Gatwick instead.[6]

10. The ANPS considers a number of further comparative advantages to a third runway at Heathrow vs a second runway at Gatwick, which are not repeated in detail here.[7] The ANPS concludes that Heathrow would deliver the greatest boost in long haul flights and the greatest benefit to air freight; it further concludes that a new runway at Heathrow would also result in larger benefits to the wider economy and a much greater number of additional jobs.

11. The ANPS concludes at §3.73 that "only" the Heathrow scheme "*is likely to deliver to meet the overall needs case for increased capacity in the South East of England and to maintain the UK's hub status*".

12. It is thus the Heathrow Third Runway Scheme, and that scheme alone, which will benefit from the policy support in the ANPS and the effective presumption in favour of a grant of a DCO for a policy-compliant scheme under section 104 of the Planning Act 2008. The Application does not benefit from any policy support from the ANPS.

---

3 See e.g. §1.4, §1.8, §1.42, §2.26, §2.32, §3.3.
4 See the full detail of CAGNE's case in this regard at REP1-137, §§18-35.
5 ANPS §2.33, §3.12.
6 ANPS §§2.9-2.14, §2.19, §§3.14-3.19.
7 ANPS §§3.24-3.55.

13. While the NRP proposes a different design and configuration to the Gatwick Second Runway Scheme ("**LGW-2R**") than was considered by the Airports Commission, the NRP must be treated the same way in terms of policy,[8] meaning that the NRP cannot claim any policy support from the ANPS. This is (1) because the same policy issues arise; (2) because many of the same impacts arise from what would be the same overarching outcome (i.e. a second simultaneous operational runway at Gatwick airport) and (3) in order to prevent Gatwick from subverting the choice of the Airports Commission and the policy force of the ANPS.

14. The Applicant's response to CAGNE's submissions on this point did not engage with substance, but rather emphasised a number of differences in the design between the NRP and LGW-2R, including the lengths of the proposed runways.[9] Those differences do not answer the thrust of the submission, reiterated above.

<u>At other airports, policy only supports making best use of existing runways[10]</u>

15. At airports beyond Heathrow, the ANPS only supports "*making best use of their existing runways*".[11] The Applicant emphasised in its response to CAGNE's Written Representation that the ANPS supports such further development proposals.[12] This support is, however, limited to making best use of <u>existing</u> runways (which is not the proposal). The ANPS is also clear that any such "*making best use*" airport expansion projects in the South East should be able to demonstrate an additional need over and above the identified need for Heathrow. As per the ANPS at §1.42:

> "*…. it may well be possible for existing airports to demonstrate sufficient need for their proposals, additional to (or different from) the need which is met by the provision of a Northwest Runway at Heathrow…*"

16. The "making best use of existing runways" policy is reflected in the MBU policy document. As the Applicant agreed in ISH6, the key policy statement in MBU is at §1.29 (bold in the original):

---

8 REP3-074, §1.3.3.
9 REP4-024.
10 See the full detail of CAGNE's case in this regard at REP1-137, §§36-64.
11 ANPS §1.39.
12 ANPS §§3.24-3.55.

> "***1.29 Therefore the government is supportive of airports beyond Heathrow making best use of their existing runways. However, we recognise that the development of airports can have negative as well as positive local impacts, including on noise levels. We therefore consider that any proposals should be judged by the relevant planning authority, taking careful account of all relevant considerations, particularly economic and environmental impacts and proposed mitigations. This policy statement does not prejudge the decision of those authorities who will be required to give proper consideration to such applications. It instead leaves it up to local, rather than national government, to consider each case on its merits***."

17. It is obvious from this key paragraph (and the title of the policy document itself) that it is providing policy support to proposals beyond Heathrow which make best use of "existing runways" only. The Applicant's proposal for a new operational runway beyond Heathrow is not compliant with this policy.[13]

18. Furthermore, it is clear from MBU's terms that it envisages most development that would make "*best use of their existing runways*" would be of a relatively small and local scale.[14] For example, §1.28 notes:

> "*Given the likely increase in ATMs that could be achieved through making best use of existing runways is relatively small (2% increase in ATMs "without Heathrow expansion" scenario; 1% "with Heathrow"), we do not expect that the policy will have significant implications for our overall airspace capacity….*"

19. The Applicant's proposal would result in a larger increase than the 11.8mppa assumed to be possible nationally under MBU.[15]

20. The Applicant sought during the Examination process to try to undermine this clear policy by stating that the terms "existing runways" and "existing infrastructure" are used interchangeably. The Applicant is clearly concerned that its proposal does not make use of an "existing runway"; as such it has attempted to broaden the scope of the policy. However, that argument cannot be sustained and, in any event, does not assist the Applicant's case.

---

[13] See also §1.5 and §1.25 of MBU - only express government support for other airports making "best use of their existing runways".

[14] See MBU §1.9, §1.23, §1.29.

[15] MBU Table 1; REP3-113 §8.

a. First, the terms are not used "interchangeably". The term "infrastructure" is used in §§1.2-1.4 of the MBU where the policy sets out what the Airports Commission's Final Report stated.[16] This is also reflected in the ANPS, which only uses the phrase "*existing infrastructure*" twice, both in paragraphs describing the Airports Commission's conclusions (§§1.42 and 2.22). In taking this recommendation forward into policy, the Government chose to focus not in "existing infrastructure", but "existing runways" – that is the term used throughout the remainder of MBU and in the ANPS at §§1.39 and 1.42.
b. Secondly, in setting out the Government's policy, the ANPS and MBU choose a specific word with a specific meaning – "runways" – when giving policy support to airports other than Heathrow. This is plain from the title of the key policy document: "Making Best Use of Existing Runways".
c. Thirdly, in any event, and as set out below, the NRP does not even propose to make best use of "existing infrastructure" as it requires significant new infrastructure. It is therefore not clear how the "existing infrastructure" argument assists the Applicant.

21. In this context, the Applicant has also referred to the Aviation Policy Framework ("**APF**"). The APF sets out the Government's "*high-level objectives and policy on aviation*" (APF paragraph 5.26) as things stood in March 2013, prior to the Airport Commission's recommendations. As such, the APF cannot be relied on to in some way weaken the policy in MBU. Even within the APF, the focus of the key §1.60 is the policy to "*make better use of existing runways*", and the reference to "*making best use of existing capacity*" is set within those overarching confines.

22. In summary, an airport (such as Gatwick) cannot argue that an application which results in the introduction of a new runway is nonetheless compliant with policy on the basis that it involves making best use of "existing capacity".

23. Since the ANPS and MBU, the Department for Transport has published the "Flightpath to the Future" (May 2022) ("**F2F**"), the "Jet Zero Strategy – Delivering net zero aviation by 2050" (July 2022) ("**JZS**") and the Jet Zero Strategy One Year On (July 2023) ("**Jet**

[16] This is a distinction that the Applicant recognises and has itself relied on: REP3-074 §1.4.1.

Zero OYO") documents. However, these documents do not affect the status of the ANPS and MBU as the two key expressions of national planning policy on airport development. As the Applicant agreed in ISH6, the JZS and Jet Zero OYO are not policy.[17] The proposal cannot gain any policy support from either strategy.

24. As to the JZS, the Applicant has emphasised that the NRP was included in the capacity assumptions used in the underlying modelling.[18] That, of course, provides no support for the Applicant's contention that the NRP is policy-compliant. It is clear from the terms of the "Jet Zero: Modelling Framework" (March 2022) that the "*capacity assumptions required by the model do not pre-judge the outcome of any future planning application, including decisions taken by Ministers*".[19] In any event, as the information that Aviation Environment Federation ("**AEF**") obtained from the DfT demonstrates, Jet Zero OYO updated the DfT modelling in the JZS and the revised modelling for Jet Zero OYO shows a significantly lower level of capacity utilisation at Gatwick Airport when compared to its available capacity.[20]

25. In all, whilst national policy only supports Heathrow as the location for a new runway in the South East, it still affords support via MBU to other airports making best use of their existing runways and infrastructure, where an additional need can be demonstrated. Crucially, however, that policy support does not extend to those other airports introducing new operational runways, as this project seeks to do.

The NRP does not "make best use of an existing runway"[21]

26. What is proposed by the NRP is not making best use of an existing runway but the introduction a new operational runway, which is not supported by policy.

27. The result of the Development would be to transform Gatwick from a single runway airport into a dual runway airport.

---

17 REP4-093 §7.

18 See Planning Statement APP-245 at §8.2.19, and the emphasis placed on this point in the Applicant's response to CAGNE's Deadline 4 submissions in REP5-080.

19 Modelling Framework at §3.18. CAGNE meant to provide this framework as an Appendix to its deadline 1 submissions on policy REP1-137, but it was mistakenly omitted. It is now provided as Appendix 4.

20 REP6-119.

21 See the full detail of CAGNE's case in this regard at REP1-137, §§66-74 and REP3-113.

a. Gatwick is currently only able to use one runway at any given time and is therefore recognised as a single runway airport (see e.g. ANPS §2.11 "*…Gatwick Airport is the busiest single runway airport in the world…*).
b. The purpose of the NRP, in the Applicant's words, is to "*enable dual runway operations*".[22]
c. The simple fact that the NRP will transform Gatwick from a single runway to a dual runway airport means it will have introduced a new operational runway into the South East of England, not at Heathrow.

28. In order to achieve this goal of moving from a single to dual runway airport, the Application seeks powers for significant works. The NRP proposes replacing the existing emergency/standby runway and creating a new main runway to the north. The emergency/standby runway will need to be completely repositioned, such that its centreline is moved to the north by 12 metres, and resurfaced; the resulting runway will be a new runway.[23]

29. The Applicant claims that whilst "*it is not a central question for the purposes of planning policy*", the works proposed would fall within the definition of operational development benefitting from permitted development rights.[24] That cannot be correct. The Town and Country Planning (General Permitted Development) (England) Order 2015, Class F provides that the carrying out of works in connection with the provision of services and facilities at a relevant airport is permitted development unless it relates to "*the construction or extension of a runway*". The NRP does propose the construction or extension of a new runway: it requires physically creating a new runway on land where one was not there previously, some 12m to the north.

30. That conclusion is reinforced by the further substantial development required for the creation and operation of the second main runway, which include, *inter alia*:[25]

22 See for example the non-technical description of development in the Application Form (APP-002).
23 See e.g. ES Chapter 1 at paragraph 1.3.3 (APP-026).
24 At §§3.2.11-3.2.12 of REP1-062.
25 Details provided by the Applicant at REP1-062 §§4.1.3-4.1.12. The ES also summarises the scope of this work at paragraph 5.2.3 (APP-030).

a. construction of a new 12m strip of hardstanding to the north (requiring diversion of buried utilities, excavation to 1.5m, and laying up and installation of granular base materials);
b. reconstruction of the existing northern shoulder to bring this to runway standard (requiring saw cut and removal of the existing shoulder, excavation to 1.5m, laying up and installation of granular base materials);
c. removal of a 12m strip of hardstanding, on the southern side of the existing northern runway (requiring saw cut and removal of the southern side of the runway and placement and compaction of engineered fill in the excavated area), and return to grass by way of grading and landscaping;
d. resurfacing of the repositioned northern runway involving the removal of circa 100mm of asphalt and new asphalt to be layered to c. 150-250mm; and
e. replacement and reinstallation of drainage and lighting.

31. These works – including excavation, reprofiling of the land, moving buried utilities, new drainage, new lighting, and upfilling the ground – cannot be described as anything other than a creation of a new runway in a different position and with different physical attributes to the existing standby runway.

32. In addition to the need completely to re-position the runway, there are other substantial works required to facilitate dual runway operations at Gatwick, including reconfiguring taxiways, pier, drainage, and stand amendments (including a proposed new pier), reconfiguration of other existing airfield facilities, and extensions to both Terminals.[26]

33. Finally, it is notable that while the ANPS and MBU anticipate that proposals seeking to "make best use of existing runways" would be of a relatively small and local scale, the NRP would lead to both:
   a. A stark increase in movements, with the NRP alone proposing in excess of the 2% increase in ATMs anticipated by MBU for all "making best use" proposals combined.[27]

[26] Planning Statement (APP-245) at §1.3.5, §1.3.7. The extent of reconfiguration of taxiways needed (including the exit and entrance taxiways) is extensive, as detailed in the Applicant's ES at §§5.2.23-5.2.41 (APP-030).
[27] Planning Statement (APP-245) at §3.5.17.

b. As already mentioned, a stark increase in passengers, with the NRP again resulting in a larger increase than the 11.8mppa assumed to be possible nationally under MBU.[28] The strength of this point is not diminished by the fact that MBU anticipated a project could come forward as an NSIP (i.e. adding at least 10mppa),[29] given that MBU nevertheless assumed that best use would, in 2050, result overall in an 11.8mppa increase nationally.

34. In short, it cannot be argued that a development which results in a change from single-runway to dual-runway operations has merely made best use of its "existing runways". That the existing northern runway would need to be moved and resurfaced with significant associated works including to the taxiways also means that the NRP scheme is not even "making best use of existing infrastructure": there is no "existing infrastructure" that simply needs to be brought into use or improved.

35. By introducing a new runway into the South East outside of Heathrow, the Development runs entirely counter to the aims and policy of the ANPS. The NRP would undermine the careful balancing exercise of planning merits which justified the selection of Heathrow over Gatwick. The end result would be the delivery of airport expansion that is not justified in planning terms.

36. The NRP does not comply with policy. This is a matter that the ExA will need to weigh carefully in its assessment of the planning balance.

NOISE[30]

37. Submissions from Suono are attached at Appendix 1. Suono highlight that at the close of the Examination:

a. In general, the Applicant's responses to concerns raised repeatedly by Suono about the noise modelling have been selective and piecemeal, with conflicts in the evidence presented.[31] Key concerns remain unanswered.

---

28 Planning Statement (APP-245) at §3.2.7.
29 Relied on by the Applicant in REP4-024 at §2.1.8.
30 See REP8-143, REP8-144, REP7-128, REP7-129, REP6-122, REP5-121, REP4-099, REP3-112, REP2-070, REP1-137.
31 See Suono's Appendix A which summarises the missing information.

b. Noise envelope: While the Applicant has made some corrections in the noise envelope following Suono's identification of problems, other errors remain uncorrected. Moreover, the noise envelope contours do not align with the Applicant's analysis of the central and updated central cases; the Applicant's comparative analysis of the noise envelope for the different cases is misleading; and the Applicant appears to have misinterpreted changes in forecasts as leading to noise changes.

c. Noise insulation scheme ("**NIS**"): Despite previous assurances, the Applicant has still not addressed key issues raised by Suono in relation to the NIS. Further, some of the recent amendments make the document even more confusing and potentially misleading. In light of ongoing deficiencies in the Applicant's approach, Suono supports the ExA's suggestions for the NIS within R18 of PD-028.

d. Ground noise: The Applicant's decision not to remodel ground noise despite updating its core case has resulted in inconsistencies across the documentation. Suono has raised multiple concerns about the reliability of the assessment, which have not been allayed by the Applicant's partial responses.

e. The Environmental Statement noise chapter (APP-039) is also now out-of-date.

Airspace Modernisation

38. CAGNE's detailed submissions on airspace modernisation are set out at REP8-146. In summary, the NRP would result in significant growth in flights. The evidence suggests this is not feasible without the modernisation of airspace, known as Future Airspace Strategy Implementation South ("**FASIS**"). That evidence includes the airlines, who have explained through their representations (REP1-198 and RR-1256) that the increase in flights proposed by the NRP would require airspace modernisation. If Gatwick is reliant upon modernisation of airspace to achieve the growth proposed, then the environmental effects of the changed routes should have been assessed as part of the NRP. Without such assessment, there will be unassessed impacts on communities, particularly in the area of noise.

AIR QUALITY[32]

39. Brief summary submissions from Air Pollution Services ("**APS**") are attached at Appendix 2. At Deadline 8, APS provided a detailed update as to the position on key issues (REP8-145). The ExA is asked to have particular regard to that document.

40. APS make the following overarching key points:
    a. The draft DCO fails to include an air quality monitoring strategy and an air quality action plan to protect human health. There is no mechanism for controlling the health effects associated with the NRP, if they are greater than predicted. If adverse occur, a cap on flights should be imposed.
    b. Ultrafine Particles ("**UFP**"): The Applicant is incorrect that the health effects of UFP are unimportant. The most recent research shows the hazards of UFP and $PM_{2.5}$ are the same order of magnitude.
    c. Road modelling: Fundamental errors and failure to follow good practice mean that the Applicant's modelling of the air quality impacts of the emissions from road transport is not fit for purpose. The Applicant has not responded to APS' detailed comments in this regard.
    d. Future standards: The Applicant relies in many places on policy and strategy trajectories for delivering future improvements to air quality. However, the uncertainty in the future air quality assessment level ("**AQAL**") has not been factored into any of the Applicant's sensitivity tests.

SURFACE TRANSPORT[33]

41. Submissions from Sterling are attached at Appendix 3. Sterling has repeatedly set out the inadequacy of the Applicant's surface access proposals in previous submissions. Yet, throughout the course of the Examination, the Applicant has failed to engage or to respond in detail to key points raised. The Applicant's final surface access proposals are reactionary, lacking in ambition, and have limited certainty of delivery. Specific problems with the Applicant's final approach include:

[32] See REP8-143, REP8-145, REP4-095, REP4-098, REP1-137.
[33] See REP7-127, REP6-121, REP5-120, REP4-097, REP3-114, REP1-137.

a. Failure to expose the underlying detail of the traffic analysis;
b. Unresolved problems with the transport modelling, including in relation to the uncertainty log and future scenarios;
c. Deficiencies and lack of commitment by the Applicant to the rail interventions required; and
d. Disjointed and incomplete commitments to bus service provision.

CLIMATE CHANGE

42. Over the course of the examination, the following has emerged/occurred:

a. Confirmation by the DfT, in information provided to AEF,[34] that neither the JZS nor Jet Zero OYO assume the extent of GHG emissions which would be caused by the proposal and that the modelling for Jet Zero OYO in fact shows a significantly lower level of capacity utilisation at Gatwick Airport, and hence lower GHG emissions, than the Applicant predicted would result from the proposal;
b. The finding in *R(Friends of the Earth) v SSESNZ* [2024] EWHC 995 (Admin) ("**the *CBDP* judgment**")[35] that the Carbon Budget Delivery Plan ("**CBDP**") is unlawful as a result of the Secretary of State taking an erroneous or unreasonable approach to risk assessment; and
c. The clarification of the law on indirect effects in *R (Finch) v Surrey County Council* [2024] UKSC 20 ("***Finch***").

43. As a result of these matters, although the Applicant has refused to provide an updated version of Chapter 16 of the ES, which would have been the most helpful approach, the ExA has sufficient information before it to decide that the Proposed Development – which would result in a larger increase in passengers and emissions than any airport expansion since the passing of the Net Zero legislation – would bring about so significant an increase in greenhouse gas emissions as to have a material effect on achieving the obligations both in the national carbon budgets and in other relevant trajectories and in-sector targets.

34 REP6-119.
35 REP4-093 Appendix 1.

44. In addition to the summary comments made below, CAGNE supports the detailed submissions made by AEF to the Examination to date on climate change matters,[36] together with those which AEF will submit at Deadline 9 (of which CAGNE has had an advance summary).

The Jet Zero Strategy

45. Reliance on the JZS has been a mainstay of the Applicant's responses on the climate impact of the proposal. The Applicant relies on the JZS as evidencing that airport expansion can take place, without demand management, and that net zero will be achieved even if its expansion and resulting GHG emissions are permitted to take place.[37] The Applicant relies on the expansion of Gatwick Airport being built into the JZS modelling[38] and the Applicant's ES assessment of GHG emissions adopts various assumptions from the JZS High Ambition scenario.[39] The Applicant invites the ExA to place substantial weight on the JZS and the commitments within it.[40]

46. This is no longer tenable in light of the *CBDP* decision and the information provided by the DfT to AEF. CAGNE drew attention to the *CBDP* judgment and the finding by the High Court that the Secretary of State, in making the CBDP (which relies on the JZS to address aviation emissions), had not lawfully taken into account the risk that policies would not achieve the requirements to meet the Carbon Budgets; indeed, he was not provided with the requisite evidence on those risks.[41] Accordingly, despite the JZS and Jet Zero OYO referring explicitly to risks, the *CBDP* judgment evidences that the Secretary of State was not provided with the requisite evidence on those risks to understand the extent to which the proposals and policies might not be delivered in full.

47. The Applicant is simply incorrect that the *CBDP* judgment is distinguishable because it was "fact specific to that case" or because it focused on the duty under section 13 of the

36 REP1-114, REP3-158, REP6-119
37 See eg REP3-086 pdf pg 6; REP4-032 Applicant's post ISH6 submissions §3.1.25-3.1.35.
38 See eg REP4-032 Applicant's post ISH6 submissions §6.1.30.
39 APP-041 pg 16-36.
40 REP5-080 §1.1.3.
41 REP4-093 §§18-25.

Climate Change Act 2008.[42] The section 13 obligation is what obliges the Secretary of State to prepare the proposals forming the CBDP and to achieve net zero, and those proposals rely on the JZS to address aviation emissions. The *CBDP* judgment is thus plainly relevant to the weight to be given to the JZS.

48. In any event, the information provided by the DfT to AEF shows that the Applicant cannot rely on the JZS or Jet Zero OYO as addressing or managing the climate impact from the forecast higher level of emissions associated with the proposal. The Applicant's response to this is unconvincing. Having previously emphasised the importance of Jet Zero OYO as strengthening the JZS and showing the Government fulfilling its promised monitoring of the position,[43] in the face of the DfT's actual modelling for Jet Zero OYO, the Applicant tries to fall back on the JZS's modelling, while nevertheless emphasising the DfT's own caveats about not relying on the modelling results.

49. CAGNE supports the submissions made by AEF and drew the ExA's attention to the case of *Stephenson v Secretary of State for Housing and Communities and Local Government* [2019] PTSR 2209, [2019] EWHC 519 (Admin) ("***Stephenson***"), where the High Court accepted a submission from the Secretary of State that updated scientific evidence can justify departure from planning policy <u>in the context of individual decisions on applications</u> – i.e. when making decisions on individual projects (§§71-72).[44] That being the case, it is even clearer that updated scientific evidence can justify giving reduced weight to, or not relying on, the trajectories in the JZS and Jet Zero OYO. This is not impermissible disagreement with government policy but permissible reliance on the most up to date scientific information. The Applicant relies on the fact that the judgment in *Stephenson* referred to policies pulling in the opposite direction or resolving tension between policies.[45] That does not distinguish the principle that *Stephenson* establishes, particularly as the same type of tension arises in this examination between support given to airport expansion in the JZS and the desirability of protecting the environment and addressing climate change impacts.

---

[42] REP5-080 §§1.1.6-1.1.8.
[43] eg REP4-032 §3.1.16 and §3.1.39.
[44] REP4-093 §§11-17.
[45] REP5-080 §1.1.4.

Extent of GHG emissions and *Finch*

50. The clarification of the correct position on indirect impacts in *Finch* has resulted in the Applicant having to assess the extent of emissions from inbound flights. These additional GHG emissions mean the project's emissions are well beyond the indicative threshold of one that can materially affect the achievement of the carbon budgets.[46]

51. The key point of the EIA process that the Appellant misses in its emphasis on the way in which aviation emissions are reported by the UK is that there is a crucial difference between national reporting of emissions and project-specific assessment of emissions. The latter, as clarified in *Finch*, focuses properly on informing the decision-maker and the public of the actual predicted impact on the climate from the extent of GHG emissions that the project will cause, rather than avoiding double-counting. From a decision-taking perspective, there is no difficulty: as CAGNE emphasised in REP7-129, Lord Leggatt expressly finds at §125 that "*there is no rule that the same effect on the environment cannot result from more than one activity or that, if particular effects have been or will be assessed in the context of one project, this dispenses with the need to assess them as part of an EIA required for another project*." The Applicant failed to address this at all in its response at Deadline 8, which instead just mentioned CAGNE once[47] and which failed to engage substantively with CAGNE's points.

52. The first question is thus what the actual increase in emissions will be which the project will cause. The Applicant's explanation in its latest response on *Finch* relies on various national accounting practices and is simply not relevant to that question.[48] Similarly, the Applicant's focus on domestic aviation emissions (rather than international aviation emissions) is a distraction.[49]

53. Notably, although the Applicant mentions CAGNE's Deadline 8 submissions on *Finch*, it fails to provide a revised updated Chapter 16 of the ES and instead makes general submissions about the difficulty of contextualising the *Finch*-compliant extent of emissions. None of these points answer CAGNE's Deadline 8 submissions that the

46 REP8-143 §§5-7.
47 REP8-119 at §1.1.3
48 REP8-119 at §1.1.6-1.1.7
49 REP8-119 at §§1.1.9-1.1.12

emissions can still be contextualised against the UK Carbon Budgets given that the Applicant itself has not required absolute methodological parity with the UK Carbon Budgets in order to use them in its ES as the relevant context for emissions from the project.[50] The JLA also called for an updated Chapter 16 and also pointed out that the Applicant can contextualise the updated figures, including emissions from inbound flights, using the IEMA methodology, which includes contextualisation against the UK Carbon Budgets and the indicative threshold of significance of 5% of the UK Carbon Budget in the applicable period.[51]

54. This is relevant to the second question, which is whether the GHG emissions from the project and their inevitably harmful effect on the climate, will likely be significant. CAGNE's submission is that they will be, no matter which contextualisation is used: sectoral; national or even global, given that for a single project to amount to 0.11% or 0.16% of the global ICAO international aviation emissions trajectory is significant. The latter point is also made by the JLA (which also note that the 'global' contextualisation used by the Applicant is not part of any recognised methodology of which the JLA are aware).[52]

<u>Non-CO2 Emissions</u>

55. As with many other areas of impact which it is acknowledged will occur, the Applicant has refused to provide the ExA with information on non-CO2 emissions. The only reason given by the Applicant is that the same approach should be taken in this examination as was taken in relation to Bristol Airport.[53] The Applicant takes aim at a number of straw men – the BEIS multiplier; the non-defective EIA – which were central to the Bristol Airport decision in the High Court but are irrelevant to this examination. CAGNE's points about the High Court decision[54] remain both unanswered and well-founded:

    a. The Bristol Airport judgment did not conclude that, as a matter of principle, non-CO2 emissions should be ignored by decision-makers considering airport expansion proposals. Rather, the Court held that, in light of the fact that only

---

50 REP8-143 at §§6-7 pg 21.
51 REP8-161 at §2 pgs 5-6.
52 REP8-161 at §3 pg 6.
53 REP5-080 at §§1.1.15-1.1.16.
54 REP4-093 at §§30-31. The full High Court judgment is provided in at Appendix ISH6-1.

the BEIS 1.9 multiplier had been relied on in the inquiry and given the other technical evidence on non-CO2 emissions before the inquiry, it was rational in those circumstances for the Panel to conclude as a matter of its judgment that it was not appropriate to apply the multiplier (see §§199-206).

b. The circumstances in the instant examination are different. The multiplier of 0.7 proposed by AEF – different from, and more conservative than the BEIS multiplier, and sufficiently robust to be applied by the Government in the context of company reporting[55] – can lawfully and rationally be used to provide at least an indication of the scale of non-CO2 emissions that would be caused by the Proposed Development and it would be lawful and rational for the Examining Authority to take that into account in its determination of the application. The lack of a settled methodology (which would result in assessment becoming a legal requirement in light of *Finch*) does not prevent the use of a valid methodology to provide helpful information, particularly in circumstances where the Applicant cannot deny that non-CO2 impacts will occur and will have some radiative forcing effect.

56. The Examining Authority is therefore able to take into account both the extent of non-CO2 impacts on climate, as calculated by AEF, and the extent of the economic harm which those impacts would cause.

The Carbon Action Plan requirement

57. Without prejudice to the above, CAGNE's proposed wording for the modification of the Carbon Action Plan ("**CAP**") to include a carbon cap scheme was provided in REP8-143 at pgs 13-15. The Examining Authority has asked for comments on this wording at Deadline 9, so CAGNE will respond further at Deadline 10.

[55] REP1-114 at §9.2.

WASTEWATER

58. At the close of the Examination, the Applicant has remarkably still not settled on a solution to the fundamental problem that there is no evidence that Thames Water's ("**TW**") existing infrastructure can cope with the proposed growth.

59. Critically, TW has still not carried out the detailed assessment required for it to assess what additional upgrades to infrastructure would be necessary, and by when, to enable the increased demand proposed by the NRP to go ahead without overloading the system.[56] In that context, TW has requested that the DCO include a phasing requirement, such that TW can put a plan in place to fund and carry out the necessary upgrades before additional growth occurs.[57]

60. The Applicant does not consider the imposition of such a requirement to be necessary or appropriate in view of TW's underlying statutory responsibility/duty to accommodate the additional flows. For the detailed legal reasons set out at REP4-094, §§4-26, CAGNE considers that the Applicant errs in law. In summary, while under section 106 of the Water Industry Act 1991 ("**WIA**") owners and occupiers are afforded a right to connect, the more nuanced duty under s.94 WIA recognises that undertakers are unable always to invest immediately to cope with new demand and are legally entitled to operate a fair prioritisation system. In *Barratt Homes Ltd v Dwr Cymru Cyfyngedig* [2009] UKSC 13, [2010] PTSR 651 ("***Barratt Homes***"), the Supreme Court recognised that section 106 WIA cannot require sewerage undertakers to address all overcapacity issues immediately (at §§41-43).

61. The Court of Appeal in *Barratt Homes* held that the solution to the problem that the right to connect generates overcapacity issues is in the planning process (see §§41-43, §57 of the Supreme Court judgment). The Supreme Court appeared to concur that the planning process was one of the few ways to address the problem, even though this could give rise to difficult issues (at §57): it noted that a planning authority can make planning

[56] See CAGNE's detailed submissions in this regard at REP4-094, §§4-26. The total daily volumes discharged from Gatwick Airport to Crawley STW are predicted to increase by 67.5% on a dry day and by 16.7% on a wet day with the NRP (not including an allowance for climate change) – see REP1-048 10.2 Relevant Representations Report [GAL's response].

[57] TW Deadline 3 submission (REP3-149), Deadline 1 submission REP1-103 at §2.3, REP1-038 SOCG with TW §2.22.4.1, TW at ISH 7.

permission conditional upon the sewerage authority first taking any steps necessary to ensure that the public sewer will be able to cope with the increased load by way of a Grampian condition (§43, §§57-58).

62. That approach aligns with other case law that CAGNE has set out in detail at REP4-094 §§17-21 and with the Planning Practice Guidance ("**PPG**") on Water Supply, Wastewater and Water Quality, which provides at §020 (emphasis added) that:

> "*If there are concerns arising from a planning application about the capacity of wastewater infrastructure, applicants will be asked to provide information about how the proposed development will be drained and wastewater dealt with…The timescales for works to be carried out by the sewerage company do not always fit with development needs. In such cases, local planning authorities will want to consider how new development can be phased, for example so it is not occupied until any necessary improvements to public sewage system have been carried out*."

63. In the present circumstances, it would be entirely appropriate and necessary for the ExA to impose a phasing requirement in the DCO for no additional growth until the upgrades are carried out.

64. In tacit acceptance that it cannot secure consent for the NRP without such a phasing requirement, which the Applicant is concerned would prejudice deliverability, towards the end of the Examination process the Applicant shifted course and proposed an entirely new solution: provision of an onsite wastewater treatment works ("**WWTW**").

65. CAGNE considers this approach is an improvement on the Applicant's alternative proposal, which is effectively that the NRP be allowed to proceed and to discharge to TW's assets without the necessary upgrades being required in advance.

66. However, as set out at REP6-120 and in CAGNE's consultation response to the Project Change at REP6-123, CAGNE is very concerned about the fundamental lack of detail provided as regards the onsite WWTW. The Applicant's failure to provide the necessary detail has prevented a proper assessment of the adequacy of the proposed facility during the Examination.

67. The Applicant has yet to provide any clear information on how much sewage the facility would be required to treat (i.e. would it take any sewage from the wider airport and would

it take all of the new flows); whether the proposed design would be able to cope with such a quantum; and the flows that would eventually be discharged to the River Mole, with their associated water quality impacts (including in the case of overflows).[58]

68. In addition, a key part of the onsite WWTW proposal involves the transporting of sewage "cake" produced to TW's treatment plans offsite. Yet, TW have not yet agreed to this; it is therefore unclear whether the WWTW is even deliverable.[59]

69. The Environment Agency has expressed a number of additional concerns.[60]

70. If the ExA concludes that the Applicant's proposal for onsite WWTW is unsatisfactory, including because inadequate information has been provided by the Applicant, then CAGNE maintains as per its legal submissions at Deadline 4 that it would be appropriate and necessary to include a phasing requirement in the DCO.

71. To secure the onsite WWTW within the DCO, CAGNE has proposed an amendment to requirement 31. CAGNE has set out its concerns with the unlawful tailpiece contained within this requirement in some detail at REP7-129 and REP8-143. In short, Requirement 31 is unacceptable, as it allows the Applicant to resile from building the onsite WWTW in the event some alternative agreement is reached in future with TW.

72. The ExA has not been given the necessary information to scrutinise the only alternative option, which is discharge to TW's assets. It is not appropriate for the Applicant and TW to have the scope to reach an agreement behind closed doors on what is such a fundamental issue for the DCO. The wording creates a risk that the Applicant will seek to make significant changes to the development post-examination in a way that deprives third parties of the opportunity to comment. That is something both case law and the Government warn against.

---

58 While section 14 of REP6-076 provides some additional information, these fundamental points – in particular discharge to the River Mole – remain entirely unclear.

59 See AS-146 at §2.1.11.

60 See REP5-058 10.1.12 Statement of Common Ground between Gatwick Airport Limited and Environment Agency Version 2 (Tracked) at §2.22.3.13 and REP5-090 Environment Agency comment on Change 4.

73. The Applicant has now at the last Deadline acknowledged the legal risk posed by tailpieces of the kind proposed.[61] In response, the Applicant notes that paragraph 1(4) of Schedule 2 to the draft DCO provides as follows:

> "*Where submitted details or actions can be "otherwise agreed" by a discharging authority pursuant to requirements 4, 5, 7, 8(4), 10(3), 11(3), 12(3), 13(3), 14(1), 14(2), 20, 21, 22(3), 23(2), 24, 25(3), 27(3), 28(3), 29(3), 30(3), [31(3)] and 32(2) such agreement is not to be given by the discharging authority save where it has been demonstrated to the satisfaction of the discharging authority that the departure from the previously certified or approved document, details or obligation does not give rise to any materially new or materially different environmental effects to those assessed in the environmental statement*."

74. That simply does not provide any satisfactory answer. While paragraph 1(4) may provide some protection where a tailpiece allows alternative agreement to be reached with the local authority (which can assess planning matters in the round), the same is not true when the "discharging authority" is the sewage undertaker (which has a far narrower remit and expertise).

75. TW in its role as statutory sewage undertaker cannot be expected to carry out detailed assessment of the comparative environmental effects of an onsite WTWW versus offsite discharge; to date, TW has not even managed to assess the capacity of its own infrastructure. It is not TW's role to conclude on whether there are significant and different environmental implications arising from these alternative approaches in EIA terms (including non-sewage related implications such as odour, traffic and carparking).

76. Furthermore, paragraph 1(4) does not allay the concern that TW and the Applicant would be able to reach agreement following the close of the Examination without any scrutiny or input from third parties. It is critical to keep in mind that EIA is process and not simply an outcome. In *Finch*, the UKSC emphasised that public participation is integral to lawful assessment of environmental impacts, and the mitigation of effects is something with which the public must have the opportunity to engage: see §§18-21; 63, 105 and 109. The current requirement continues to allow an option that completely subverts public participation.

---

[61] See the submissions at REP8-116 at §§1.3.3-1.3.8.

77. The decision as to whether the NRP would provide an onsite WWTW – or whether it would discharge to TW's offsite infrastructure – is a fundamental part of the Application that the ExA as planning decision-maker should resolve, having regard to representations of all parties that have been part of the process.

78. Finally, CAGNE notes that at Deadline 8 the Applicant has proposed a new requirement in the DCO, called "Thames Water phasing plan".[62]

> "*36.—(1) Prior to the commencement of the authorised development, the undertaker must prepare and provide to Thames Water Utilities Limited a passenger throughput phasing plan which will include forecast passenger growth numbers for the period up to the commencement of dual runway operations and five years after the commencement of dual runway operations. (2) The details in the plan provided pursuant to sub-paragraph (1) must not materially exceed the forecast annual passenger numbers shown for the equivalent time periods for the airport with the authorised development in Table 9.2-1 of the forecast data book*."

79. It is self-evident that this requirement goes nowhere to providing the requisite certainty that untenable growth does not occur prior to the upgrading of TW's assets. It is not a phasing requirement that prevents growth of the airport until TW's assets are able to cope with increased demand. It is simply a requirement to provide information to TW on growth and to then adhere to the information provided. It provides no reassurance whatsoever that the sewage implications of the NRP would be acceptable and would not overwhelm existing infrastructure.

80. In all, at the close of the Examination the Applicant has failed to demonstrate an adequate solution in terms of the sewage output of the development. This presents a fundamental barrier to the NRP being granted consent. Any DCO granted despite the concerns set out above should include either a clear requirement for an onsite WTWW, that cannot be resiled from by way of private agreement with TW, or a phasing requirement that prevents growth occurring until TW's upgrades have been carried out.

[62] Updated track changed DCO is at REP8-004.

HOUSING AND SOCIO-ECONOMICS

81. The Appellant prays in aid of their planning balance a series of alleged socio-economic benefits, including in relation to employment opportunities.

82. However, CAGNE has from the outset of the Examination demonstrated that a significant difficulty arises regarding where new workers will come from and where they will live.[63] CAGNE has submitted a report showing there is a lack of workforce locally and difficulty for those further afield accessing jobs.[64] Key factors include poor rail links and limited affordable public transport options, nearby local authority areas having comparatively low levels of unemployment, and high housing prices. The areas around Gatwick (not just limited to Crawley) are already experiencing a crisis of housing affordability, homelessness and social housing waiting lists.[65] For the reasons set out in REP8-143, provision of a housing fund does not resolve the problem – not least because of limited land availability.

83. As regards socio-economics more generally, CAGNE supports and adopts in full NEF's detailed submissions on the wider benefit-cost impacts of the development.[66]

WASTE

84. CAGNE remains concerned that as part of the DCO process the Applicant has not provided analysis of the quantity of waste it would produce and where that would go. This is a particular worry for local residents, who will experience impacts such as increased HGV trips to and from offsite incinerators. CAGNE's details submissions in this regard are set out, *inter alia*, at REP6-120 (§§2-5) and REP8-143.

85. The UKSC in *Finch* made it clear that there is a legal obligation to provide sufficient evidence on which to base an assessment (§§74-75). There Applicant must (or should have) estimates of the quantity of waste and a basic idea of where the waste would go. As such, a key environmental impact has not been properly assessed or scrutinised.

---

63 See REP1-137 and REP8-143.
64 REP1-149.
65 See data provided by CAGNE at REP8-143 and REP8-147.
66 REP8-173, RR-3251.

86. The issue of unlawfulness in light of the UKSC's decision in *Finch* arises again, because the Applicant's approach thwarts the requisite public participation. It also deprives the ExA of important information, both from the Applicant and from those who would engage with and comment on the Applicant's information, meaning that, contra §152 of *Finch*, the essential legal obligation to ensure that a project which is likely to have significant adverse effects on the environment is authorised with full knowledge of these consequences has not been fulfilled.

CONCLUSION

87. For all these reasons and for the reasons cited within CAGNE's submissions made throughout the Examination process, both written and orally, the NRP represents an unacceptable and harmful proposal. Accordingly, the ExA is invited to recommend refusal of the Application.

21 August 2024

Appendix 1

SUONO

Note

Title	Deadline 8 Noise Responses		
Project	Gatwick Airport DCO		
Reference	28AD.NT.9.1	**Author(s)**	BHo
Date	20 August 2024	**Reviewer**	VC

Overview

1. This note sets out Suono's response to the noise-related aspects within the Applicant's Deadline 8 documentation, as well as a concluding statement.

2. The Applicant has responded to a selective number of concerns raised by Suono at Deadline 6, although we note that of the new information provided, there is once again the need to raise questions as to why this information was not made available at an earlier stage.

3. There are also several instances where the Applicant does not respond to concerns, nor are we aware of these concerns being responded to elsewhere in the Applicant's response to other parties. The piecemeal approach taken by the Applicant is not giving Interested Parties the opportunity to properly scrutinise the application. In many instances, it is difficult to follow what the Applicant's position is due to the lack of information provided or because their position continues to change. Where there is evidence of a position, this often conflicts with their position as stated elsewhere in their noise documentation.

4. Due to the fragmented nature of the Applicant's Deadline 8 documentation, this response is broken down into issues, with references to specific documentation within these, rather than responding to the particular documents in turn.

5. We once again summarise the information missing in **Appendix A**. Many of these concerns have received no response from the Applicant, either directly or indirectly, at any stage of the examination, highlighting their lack of engagement.

The Noise Envelope

REP8-115: The Applicant's Response to Deadline 7 Submissions

<u>Minor Errors</u>

6. The Applicant has updated "*the minor error in the Noise Envelope identified at paragraph 8.3.3*" [bullet 1 paragraph 2.1.1] but we note that their correction does not itself appear to be correct, as detailed later in this note at **paragraphs 10-13.** The correction also includes reference to a now updated document, so the paragraph requires further correction.

7. We also remind the Applicant that we have identified many other errors which they have not yet updated. For example, the mechanical services plant noise limits are not correctly identified, as described in section 3 of REP2-070. **Appendix A** of this document is designed to assist the Applicant in identifying errors we have found that should be corrected.

<u>2047 Information</u>

8. As per bullet 2 of paragraph 2.1.1, the Applicant has now provided some information relating to the primary noise metrics for the Updated Central Case in 2047. We respond to this more fully in **paragraphs 10-13** below.

9. It is not clear when the Applicant received these new noise contours from ERCD, but it seems highly unlikely that these were produced between Deadline 6 and Deadline 8. We also note that the Applicant has admitted to having other Updated Central Case (UCC) contours in their possession since before the examination began. Given that the Updated Central Case forms the Applicant's new core case, such information is clearly extremely pertinent and all parties should have sight of it at the earliest opportunity.

REP8-085: The Noise Envelope version 4 (ES Appendix 14.9.7)

10. Section 8.3.3 has been updated at Deadline 8 to read:

> *"The noise envelope contour areas will be set based on the Updated Central Case fleet forecast as reported in the ES Addendum - Updated Central Case Aircraft Fleet Report [REP4-004]. This involves predicted movements being kept the same as in the Central Case forecast, but updating the rate of fleet transition from that expected pre-Covid, allowing for the latest information on aircraft manufacturing and airline fleet procurement in 2023/2024"*

11. If the only difference between the Central Case (CC) and the Updated Central Case (UCC) were the rate of fleet transition, then one would expect the difference between corresponding noise contours for the two scenarios to converge, with the UCC trending towards the CC. This does not occur.

12. Even though the project forecasts as far ahead as 2047, by which time the fleet mix is expected to be almost entirely new generation aircraft, the UCC is still calculated as having a larger impact than the CC. This could not occur if the only difference between the two scenarios is the rate of transition. These differing impacts can be seen in REP8-012 Table 3.1.

13. Further, the shapes of the CC and UCC are different, with the UCC covering a different geographical extent to the CC in two different sets of contours. This clearly implies further differences with the fleet mix than just rate of transition and constitutes the fourth time that the Applicant appears to have misinterpreted changes in forecasts as leading to noise changes. The previous occurrences are documented in REP6-122.

14. One of these previous misinterpretation occurrences is repeated in REP8-012 at 3.2.15. We note there is also newly added text around this point which we find concerning. Paragraph 3.2.14 states:

> *"3.2.14 The noise contour areas and populations for the Updated Central Case fleet lie between the Central Case and the SFT case. This is as expected given the overall noise levels from the Updated Central Case fleet lie in between those for the Central Case and SFT case."*

15. The Applicant has not provided the noise levels that would allow for comparison of how the UCC lies in relation to the CC or the SFT, so it is not possible to review their above statement in any detail. Instead, it is only possible to review the noise contour areas and populations.

16. The Applicant compares the noise contour areas and populations in the final sentence of paragraph 3.2.15 of REP8-012, which states:

> *"In both these cases (the 2038 baseline and 2038 with Project cases) the areas of all the Updated Central Case contours are smaller than those for the SFT case (see Table 3.1) and*

the populations within all the Updated Central Case contours are smaller than those for the SFT case (see Table 3.2) indicating the noise impacts are lesser for the Updated Central Case than for the SFT case."

17. This comparison is potentially misleading and could be pointing to an incorrect outcome. The noise impact of any scenario is determined by the difference between the Without Project and the With Project case in any particular year, not by comparing the With Project case of one scenario to the With Project case of another scenario, all of which have their own Without Project cases.[1]

18. For example, the Applicant states that both the Without Project and the With Project contour areas are smaller for the UCC compared to the SFT, but this does not necessarily equate to a smaller noise impact. Indeed, if the 'With Project UCC' contour areas vs. 'UCC Without Project' differences are relatively smaller than the 'SFT With Project' contours vs. the 'SFT Without Project' differences, there could be a larger noise impact.

19. Paragraph 3.2.16 of REP8-012 then repeats this potential misunderstanding by stating:

"In 2029, 2032, 2038 and 2047 the Updated Central Case fleet would result in noise impacts above those reported in the ES for the Central Case fleet and below those reported in the ES for the SFT case, as discussed in the following sections."

20. This statement is simply not correct, in all possible circumstances for the reasons stated above. All three With Project scenarios here (CC, UCC and SFT) have their own 'Without Project' scenarios, and therefore, could have noise impacts that differ from each other. It is simply not correct to correlate noise impact to the differences between the three With Project scenarios.

REP8-106: The Applicant's Written Summary of Oral Submissions ISH9 - mitigation

21. The Applicant states in section 3.1.42:

"In response to comments from Interested Parties supportive of the ExA's drafting, the Applicant noted that these parties support the proposal without any evidential basis at all to understand its effect or why it is required to meet the requirements of policy or avoid significant adverse effects. The Applicant observed that these parties have not produced any evidence which substantiates why the noise levels specified in the ExA's requirements, the reductions provided for by reference to the 2019 baseline or the timings of those reductions are justified as necessary rather than the Applicant's proposal. The Applicant observed that nothing has been advanced to justify a requirement in this form or to show that it would adhere to, and be compliant with, policy."

22. Firstly, we note that the Applicant's approach is one of confrontation, rather than collaboration. Irrespective of what the proposal is, any party can be supportive of the aims sought to be achieved by the ExA and it is illogical to need '*any evidential basis*' to do this. Should the Applicant disagree with the ExA's aims, it is their responsibility to set this out clearly and comprehensibly, not to shout down other parties. Given that paragraph 5.60 of the Airports National Policy Statement 2018 (ANPS) states, "*the design of the* [noise] *envelope should be defined in consultation with local communities and relevant stakeholders*", the Applicant's apparent desire to not consider these views could itself be viewed as not compliant with policy.

[1] We note the Applicant refers to the term '2038 baseline' in the quote above, in reference to the 2038 Without Project case. Without criticising the Applicant's terminology here, it is important to understand that the 'baseline' typically refers to the historically assessed year, in this case 2019, and the term '2038 baseline' refers to the '2038 Without Project', so as to aid the understanding of paragraph 18 above.

23. Secondly, as set out in REP8-168 and REP8-144, the Legal Partnership Authorities (LPAs) and Suono have both independently set out their own evidence, rather than simply disagreeing with the Applicant. This has been a feature of the criticisms against the Applicant's positions throughout this examination, where disagreements are provided alongside relevant justifications. The similarities between the criticisms of the various parties point towards the weakness of the Applicant's position is in many instances. Again, the lack of engagement from the Applicant is highlighted.

24. We note that the Applicant has not provided any evidence as to why the ExA's aims are incorrect, instead they appear to target the ExA's justifications. We have seen no evidence as to how the Applicant expects the ExA's proposed reductions will actually impact on their operations, only statements that it will.

25. The Applicant also made great effort to highlight that ICAO global trends go up, such as in paragraph 3.1.57, but we note global trends appear to be of little relevance given the Applicant's own forecasts, which clearly show an overall reduction in noise. There also appears to be reasonable correlation between the Applicant's proposals and the ExA's proposed reductions, at least in part. Global trends should not take precedence over UK government policy, which is to limit and where possible reduce total adverse noise impacts.

26. Moving on in the document, in paragraph 3.1.44, the Applicant states:

> *"[Post-Hearing Note: the Applicant notes the endorsement given by the ANPS at paragraph 5.66 to the CAA as an appropriate body to secure and enforce noise management measures.]"*

27. However, paragraph 5.66 of the ANPS concludes:

> *"These bodies might include the Secretary of State, local authorities (including those over a wider area), and / or the Civil Aviation Authority."*

28. The ANPS therefore does not give any particular weight to the Applicant's position, as it also clearly supports CAGNE's position that the Local Authority is best placed to enforce noise limits.

PD-028: ExA's draft DCO

29. We support the addition of the passenger cap and the removal of the sub-paragraph (b) in R19 (Airport Operations) for the same reasons as those provided by the ExA.

Noise Insulation Scheme

REP8-087: Noise Insulation Scheme version 3 (ES Appendix 14.9.10)

30. At ISH8, the Applicant gave assurances that it would take account of Suono's comments, as set out in REP5-121, on their Noise Insulation Scheme (NIS). The Applicant has now updated their NIS document, and disappointingly these comments have not been addressed; some are basic acoustic comments and are not taken to be controversial issues. This again appears to highlight the lack of engagement by the Applicant.

31. Further, some of the amendments make the document more confusing and contain potentially misleading statements.

32. It remains unclear as to how the Applicant 'addresses overheating'. It is acknowledged that certain mitigation measures would improve airflow rates, but they have not provided any

commentary on what rates are required to actually address overheating, or whether they achieve them.

33. Figure 1 has now been added, to show where the ground noise-qualifying properties are located. The mapping provided within this figure is simply not sufficient to locate properties, nor see where any other properties might be located which also deserve to be part of the scheme but do not qualify within the Applicant's thresholds.

34. Ground noise specific issues are discussed later in this note.

35. It remains unclear why the different Zones have different mitigation options and differing costs. It would be entirely logical to maintain maximum flexibility so that each residence can be treated as specifically to its own needs as possible. All mitigation options should be available for selection, only being limited by the available budget.

REP8-111: The Applicant's Response to Actions ISH9 - mitigation

36. Section 9 of REP8-111 sets out the text provided to CAGNE ahead of Deadline 8. As we have set out in REP8-145, this information was inadequate.

37. One of the reasons this information was found to be inadequate is that it did not include the number of properties to be treated in each year of the rollout. This information has now been made available in sections 16.1.3 - 16.1.6 of REP8-111, although some confusion remains.

38. These paragraphs state that there are 400 residences within the Inner Zone of the NIS and a total of 3,500 residences within the combined three Outer Zones, meaning a total number of 3,900 residences.

39. The Applicant provided reassurance at ISH9 that it could achieve the full installation of insulation of the Inner Zone before the new runway came into effect, as 400 properties had been insulated in one year under the previous (current) scheme.

40. Based on our understanding from the information provided by the Applicant, the following timeframes are proposed:

- Inner Zone and Outer Zone 1 (60 dB $L_{Aeq,16hour}$ and above) – 2 years duration, complete before new runway operational.
- Outer Zone 2 (57 dB $L_{Aeq,16hour}$ and above) – 2 years duration, complete within 2 years of new runway becoming operational.
- Outer Zone 3 (54 dB $L_{Aeq,16hour}$ and above) – 1 year duration, complete within 3 years of new runway becoming operational.

41. If the Applicant is managing to provide mitigation to approximately 400 residences per year, then it would take longer than the provided timeframes to insulate all properties (3,900 total residences / 400 per year = circa 10 years).

42. If the Applicant can provide mitigation at a faster rate as alluded to in its proposals, then it is not clear why it would be a full three years from operations beginning on the new runway to complete the rollout (3,900 total residences / 7 years (4 years to begin operations and 3 years post) = circa 557 residences per year.

43. Rather than request that the ExA ask the Applicant to confirm their rollout rates, we simply note that the ExA's proposals within R18 (Noise Insulation Scheme) of PD-028 would remove the need for this information.

44. We also note that the ExA's same proposals would remove our concern with the NIS not being delivered before residents were exposed to significant increases in noise, as we set out previously in REP8-144. The proposals also alleviate our concerns on schools insulation not being rolled out sufficiently quickly to only constitute compensation, rather than mitigation.

Ground Noise

REP8-115: The Applicant's Response to Deadline 7 Submissions

45. In bullet three of 2.1.1 the Applicant states:

> *"The Applicant does not propose to remodel ground noise with the updated central case fleet but rather will use the slower transition fleet assessment as the worst case because ground noise effects are similar, and that assessment forms the basis of noise mitigation, including noise insulation."*

46. This is the reverse of their air noise position, whereby not only have they remodelled the UCC in order to set noise limits, they have also limited their NIS offering to the smaller UCC noise contours. We also highlight the Applicant's position between not needing to update the ES to the UCC for air noise, because it is 'similar' to the Slower Fleet Transition (SFT) and CC.

47. This leads to a complete lack of consistency within the noise chapter of the ES (APP-039) and its various appendices, updates and errata documents.

48. We noted in REP4-099 that we have no confidence in the ground noise assessment. This position has not changed. Despite their constantly adjusting narrative, at no point has the Applicant put forward any logical position with regards to how ground noise is modelled, assessed or mitigated.

49. For instance, in REP5-072 paragraph 3.3.4, the Applicant states that high levels of road traffic noise can mask ground noise, which itself is entirely unproven. Putting this point aside, the criterion that the Applicant uses to assess this masking is when road noise is at least equal to ground noise, a point when both noise sources would clearly be expected to be audible, thus there being no masking.

50. In NV.1.1 of REP5-072, the Applicant changed their argument on the required height of the bund, confirming that a height of 10m "*gave only 0.5dB less attenuation than 12m at the nearest receptor, so 10m was adopted for the preferred design.*" As we highlighted in REP6-122, this is entirely contrary to aviation noise policy.

51. We note that the aim of R32 within PD-028 may be to ensure the above is corrected, given the reasoning provided of "*To ensure that there will be sufficient protection in the transition phase and that the replacement bund and wall provides at least the same level of mitigation as the existing bund.*" but note that the ExA's recommended amendment does not include a requirement for the replacement bund and wall to be at least the same level of mitigation. We support the general principle of the amendment in any regard.

52. Another example as to why we have no confidence in the Applicant's ground noise assessment can be found in NV1.5 (8) of REP5-072, whereby the Applicant states that they cannot provide noise contours down to the LOAEL, as this could be misleading. As we highlighted in REP6-122, they have provided these levels in tabulated form in, for example, Tables 14.9.13 and 14.9.14 of APP-039. By the Applicant's own logic, either their own tables are misleading, or they have simply chosen not to provide ground noise contours.

53. We also raised in REP2-070 multiple aspects of the model that are of concern, all of which have the potential to underestimate ground noise impacts within the assessment.

54. If there was any doubt as to why it is important to not have an underestimated ground noise impact, this can be seen in the new Figure 1 of REP8-087, whereby properties eligible for full insulation due to ground noise (covered by the Inner Zone specification) are close to or outside of the third Outer Zone area.

55. There is clear potential for residences to be likely to be exposed to significant ground noise levels, yet no mitigation available to them. The ground noise assessment would therefore not meet the requirements of the NPPF in paragraph 191, nor the first aim of the Noise Policy Statement for England.

56. We note that the ExA's proposals within R18 (Noise Insulation Scheme) of PD-028 alleviate this major concern to some degree but raise that without suitable ground noise contours from the Applicant, it is impossible to ensure that all relevant properties are mitigated.

57. The Applicant's plan to measure noise levels at properties that may be affected by ground noise remains entirely unsuitable and, in any event, would clearly only provide compensation, not mitigation.

Consolidated Environmental Statement

REP8-115: The Applicant's Response to Deadline 7 Submissions

58. Paragraph 2.1.1, as has been discussed in detail in this note, responds to select points from our note REP7-128. It does not respond to every matter raised here though, missing out the following bullets from the '*newly missing information*' list in paragraph 6 under air noise assessment:

- 2029 – 2047 assessment of secondary metrics, including Number Above contours and awakening assessment for new core case.
- 2029 – 2047 detailed information and results of noise assessment at community-representative locations for new core case.

59. Without this information, only the Central Case can be used. This is also the core case within the ES. The fourth bullet of paragraph 2.1.1 states:

> *"The updated central case is not expected to change passenger numbers or road traffic vehicle forecasts, so the road traffic noise assessment does not require revision."*

60. This is therefore another clear indication of why noise limits should be based off the Central Case. If both the CC and the UCC handle the same number of passengers, then it is clearly possible to reduce noise from the UCC to the CC, as we state in REP8-145. This would be policy compliant.

61. Alternatively, if the CC is out of date, as the Applicant suggests, then the ES is out of date.

REP8-107: Appendix A to the Applicant's Written Summary of Oral Submissions – ISH9: Mitigation

62. The Applicant states in paragraph 2.1.7:

> *"Each application must be considered on the basis of its own impacts, rather than applying an approach from another project with different impacts where such mitigation is necessary.*

However the Applicant notes that the Luton expansion project offers noise insulation to community buildings at Leq 16 hr 63dB and no community buildings at Gatwick are predicted to be at levels above this."

63. We first note that the two sentences here appear to contradict each other.

64. Putting this apparent contradiction aside, we note that most of the Applicant's thresholds and approach within the application is based on projects undertaken by others, with justifications relying heavily on other instances where the same values have been applied, rather than any project-specific justifications derived for Gatwick.

65. The extent to which this has happened even extends as far as the Applicant's work containing the same typos as were found in the Luton Airport DCO, as we noted in REP4-099.

66. Finally, it is not clear which project(s) the Applicant is contesting so far as comparisons being made is concerned.

REP8-120: Consolidated Environmental Statement

67. The Applicant's position that REP8-120 can be used by readers to navigate the ES, with its many changes, updates and errata, is unacceptable.

68. Were anyone looking to investigate the noise documentation of this application at any point from now, such as say the Secretary of State, and were they to somehow first come across REP8-120, they would find this single row of a table relating to noise:

Document name	Original Application document reference	Latest version of document	Other documents which are relevant to the content of the document and comprise the ES
ES Chapter 14: Noise and Vibration	APP-039	APP-039 (Version 1)	Change Request 1, specifically the Change Application Report [AS-139] and Appendix D [AS-141]
			Change Request 2, specifically the Change Application Report [REP6-072] and Appendix C [REP6-075]
			Change Request 3, specifically the Third Notification of a Proposed Project Change [AS-153] and the Change Application Report (Doc Ref. 10.60 v2)
			ES Addendum: Updated Central Case Aircraft Fleet Report (Doc Ref. 5.1 v2)
			Supporting Noise and Vibration Technical Notes to Statements of Common Ground [REP6-065]

69. This table would guide them to look into the original ES noise chapter (APP-039), which presents neither the current core case (that being the UCC) nor the current baseline. Neither does it contain the correct results of some outdated assessments, such as the ground noise assessment errors which were subsequently corrected.

70. This newcoming individual would then have to read all of the wrong information to be able to understand any of the amendments and updates in the various secondary documents listed in the right-hand column.

71. It is clear to Suono that the ES cannot be considered up to date in its current form and we entirely reject the Applicant's position.

Examination Conclusions

72. All of the nine documents written by Suono over the course of the examination focus on two main themes of the Applicant's noise documentation; the first identifying missing information and stating why this information is needed, and the second identifying errors in the noise assessments. Unlike most aviation expansion schemes on which Suono have worked, relatively less time has been spent on reviewing the finer details of the application than dealing with these themes.

73. Our first note [REP1-137] began in paragraph 1.3:

> *"We have focussed the note on issues found, many of which are fundamental to the noise assessments. Given the number of issues identified, it is expected that other issues will be identified as Gatwick Airport Limited (GAL; the Applicant) respond."*

74. Unfortunately, the Applicant has not responded in any substantive manner to the majority of these raised issues, and we therefore expect that there may be more issues which remain unidentified.

75. The Applicant's position on various noise matters has changed throughout the examination [such as ground noise arguments in REP6-122]. Also, they are inconsistent in their assessments of different noise sources [such as that raised in REP5-121]. We have raised concerns of results being misinterpreted [for example in REP4-099, REP5-121 and REP6-122], as well as obfuscation when responses have been received [REP6-122].

76. Residents subject to unacceptable noise levels have not been identified as the Applicant has not set an Unacceptable Adverse Effect Level (UAEL) threshold, nor believes that one in necessary despite this being a feature of every other recent airport expansion application [REP8-145].

77. Significant noise effects are likely to be underestimated and, even where identified, may not be eligible for mitigation [this document]. Both of these matters, as well as others raised by Suono, are contrary to national policy, as set out in National Planning Policy Framework, Noise Policy Statement for England and Planning Practice Guidance: Noise.

78. The noise chapter of the Environmental Statement [APP-039] has not been updated despite knowingly containing errors [such as corrections in Applicant's document REP3-071 and those identified by Suono in REP2-070]. Furthermore, it was submitted for examination while the Applicant was in possession of forecasts and noise contours for an updated core case, with new associated baseline [REP4-004]. This would normally warrant a full update of all noise assessments, given its importance.

79. The Applicant's view is that this is not necessary, nor is it necessary to supply supporting noise information for the updated core case as they have done for their original core case. They base this lack of update on an incorrect comparison between the various With Project scenarios. They fail to consider that the true test of noise impact is the difference between the With Project and Without Project scenarios, which they have ignored when comparing the updated core case to the original [as set out in this document]. We consider this lack of an updated Environmental Statement chapter to be unacceptable.

80. Should the ExA be minded to recommend approval, we politely remind the ExA that we support the principles of their recommended alterations to the draft DCO in PD-028 [such as set out in REP8-145 and this document]. We again note that some of these amendments allay our concerns to some degree, such as the Applicant's proposed Noise Insulation Scheme being insufficient [for instance, REP5-121]. The Applicant's response to some of these proposed amendments has been to delve in detail into global trends of aviation noise, ignoring that their own noise assessment trends in the opposite way [this document].

81. Our position, as set out in REP8-145, is that that a revised and updated ES chapter is required from the Applicant, such is the confusion and inaccuracy surrounding their methodology and results. Given the lack of time to examine any updated noise chapter, we also state again that in our experience of aviation expansion applications, the extant noise information provided is inadequate and that the resulting description of the consequent noise effects is not sufficient to allow for any permission to be granted.

SUONO

Appendix A: Noise Issues

Noise issues identified by Suono to date.

Topic and Issue	Summary of our understanding of Applicant's position	Summary of Suono's position
Identification of core and sensitivity cases	Updated Central Case replaces Central Case.	UCC is not sufficiently assessed.
Air noise: results for all assessment years	The information provided in the Noise Chapter and Addendum is sufficient.	Results are missing for primary and secondary metrics for the new core case.
Noise envelope limits are too flexible	Noise contour limits set for 14 years into the future only.	Noise policy states that residents must be given certainty, which is not the case.
Providing forecasts used in modelling	Set out in REP3-071 Appendix F	Forecasts provided.
Air Noise UAELs	UAELs not set.	UAELs should be set as per previous permitted applications.
Lack of School Assessment	A school assessment is not necessary.	It is not acceptable to ignore a potentially significant noise effect.
Awakening assessment shortcomings	Awakening assessment only needs to consider air noise.	Awakening assessment should consider air and ground noise together.
Future generation aircraft noise levels not justified	Applicant has not provided any justification, so position is unclear.	Justification should be provided.
Air noise: model assumptions and clarifications	The assumptions used are sufficiently accurate.	Justifications should be provided.
Total aviation noise for air and ground assessments	There is no need to consider both sources cumulatively.	Comparable contours for both assessments should be provided.
Flightpaths	The existing flightpaths can be used.	It has not been demonstrated that the flightpaths are the reasonable worst-case.
Additional noise controls	No additional noise controls are necessary.	There is not enough information to inform what noise controls are necessary.

Topic and Issue	Summary of our understanding of Applicant’s position	Summary of Suono’s position
Noise contour figures (air and ground)	The figures provided are sufficient.	Noise contour figures should be provided using a high-quality Ordnance Survey underlay to allow the identification of residences.
Noise Insulation Scheme: worsening	The Applicant has updated their NIS as a result of Suono’s comments.	There remain outstanding improvements to be made.
Noise Insulation Scheme: policy	The NIS is sufficient.	The Inner Zone should be expanded to cover the 60 dB $L_{Aeq,16hour}$ daytime contour area.
Noise Insulation Scheme: funding	The NIS is sufficient, having been revised as a result of Suono’s comments.	The level of funding should be revised upwards to at least match industry best practice.
Noise Insulation Scheme: overheating	The NIS is sufficient.	Mitigation, such as blinds or cooling mechanisms, should be made available to the whole scheme.
Noise Insulation Scheme: ground noise	The NIS is sufficient, having been revised as a result of Suono’s comments.	It is not possible to inspect the proposals, as the noise contours provided are insufficient.
Noise Insulation Scheme: clarifications	The NIS is sufficient, having been revised as a result of Suono’s comments.	Multiple requests for clarification have been set out in this note.
Noise Insulation Scheme: schools	The NIS is sufficient, having been revised as a result of Suono’s comments.	The ‘mitigation’ offered is actually compensation and does not reduce the likelihood of significant effects occurring.
Fixed mechanical plant noise errors	The Applicant has not updated their original assessment.	The assessment should be updated to account for fundamental errors.
Ground noise: model and assessment descriptions	The information provided in the Noise Chapter is sufficient.	We request a full description and details of the noise model and assessment.
Ground noise: LOAELs and SOAELs	These thresholds should match the air noise assessment.	The Applicant’s approach does not align with these thresholds.
Ground noise: EGR splits	The Applicant has provided 60% of split locations.	100% of how locations are split in model should be provided.
Ground noise: providing contours	The Applicant has provided contours at one value only.	Full sets of noise contours should be provided.
Ground noise: results for all assessment years	The Applicant has provided results for only a selection of assessment years.	Results are missing for primary and secondary metrics for the new core and sensitivity cases.

Topic and Issue	Summary of our understanding of Applicant's position	Summary of Suono's position
Ground noise: figures showing modelled locations	The information provided in the Noise Chapter is sufficient.	A figure showing where noise sources are located in the ground noise model should be provided.
Ground noise: baseline measurements	The baseline measurements provided are representative.	The baseline measurements are potentially not representative due to a changing noise climate since 2016.
Ground noise: wind corrections	The wind corrections within the noise model are sufficient.	The wind corrections are not the reasonable worst-case, nor standard industry practice.
Ground noise: taxi speeds	The Applicant states two inconsistent positions in their documentation.	Taxi speeds in APP-075 and APP-173 differ, and the ground noise model could be underpredicting noise effects.
Ground noise: bund heights	The bund and barrier height can be reduced from 12m to 10m.	Reducing the barrier height is contrary to aviation noise policy.
Road traffic noise: assessment traffic flows	There is no need to update the road traffic flows within the noise model with the new core case.	Justification should be provided as to why the road traffic noise model does not need to be updated.

Appendix 2

Chapel House, Barton Manor, Bristol, BS2 0RL
Tel: 01179 112434. Email: contact@airpollutionservices.co.uk

Closing Statement: Gatwick Northen Runway Key Air Quality Issues

Client: CAGNE

Reference: APS_S1043A_A4-2 **Date Published:** 20 August 2024

Rev.	Date	Description	Prepared	Reviewed	Authorised
01	19/08/2024	Draft	CH	KL	KL
02	20/08/24	Issued	CH	KL	KL

AIR POLLUTION SERVICES	THE CLIMATE CONSULTANTS
ENVIRO DATA SERVICES	IAQ CONSULTANTS
ODOUR CONSULTANTS	BIOAEROSOL CONSULTANTS

B1. Introduction

B1.1. Air Pollution Services (APS), part of KALACO Group, has been commissioned to CAGNE to provide a summary of the outstanding concerns raised regarding the air quality impacts of the Gatwick Airport Northern Runway project (NRP).

B1.2. This note is based largely on the APS's written submission for Deadline 8 (REP8-145). It has been produced to support Counsel's closing statement.

B2. Draft DCO

B2.1. The draft DCO fails to include an air quality monitoring strategy and an air quality action plan to protect human health. Yet it includes an Odour Monitoring and Management Plan (REP8-100) to protect amenity. Excluding air quality monitoring and an action plan from the DCO means that there is no mechanism for controlling the health effects associated with the NRP, if they are greater than predicted. Including monitoring in the s106 agreement does not provide any such mechanism for reducing the effects when the Norther Runway is operational.

B2.2. The Applicant has acknowledged that ultrafine particles (UFP) are elevated around airports (e.g. paragraph 17.2.2 REP4-037), and that health effects of nitrogen dioxide (NO_2) and particulate matter (PM_{10} and $PM_{2.5}$) occur at levels below the current air quality standards/thresholds (e.g. paragraph 18.8.1, APP-043). The Applicant supports the monitoring of UFP (REF para 18.8.85, APP-043).

B2.3. There are no commitments to undertake post-operation studies for evaluating the real effect of NRP on air quality. Where adverse effects are identified, a cap on flights should be imposed to minimise these effects, utility such a time as they are demonstrated to be acceptable. If the Applicant is confident in their assessment this will not be a restrictive covenant but should be regarded as an aid to ensure the EIA is fit-for-purpose.

B3. Ultrafine Particles (UPF)

B3.1. The Applicant suggests that the health effects of UFP are unimportant because the hazard ratio of smoking is 20 times higher (e.g. paragraph 2.31 REP4-037). They argue that the medical evidence shows that UFP are less toxic than $PM_{2.5}$ (paragraph 17.2.7 REP4-037) when the most recent research by the highly respected Health Effects Institute shows that this is not the case and that the hazards of UFP and $PM_{2.5}$ are the same order of magnitude (paragraph 2.35, REP6-145).

B3.2. They have based the Health and Wellbeing assessment on spurious associations between UFP and $PM_{2.5}$ levels (e.g. paragraphs 2.41, and 2.42 REP8-145) and not carried out an assessment of the likely change in UFPs within the air quality chapter.

B4. Impact of Road Transport Emissions and Modelling

B4.1. The assessment of the air quality impacts of the emissions from road transport associated with the NRP fails to follow good practice despite the Applicant's assertion that it does. The roads modelling is not fit-for-purpose (see Paragraphs 2.9-2.12 REP8-145; Section 2 REP4-095). The simple fact is the model excluded the impact of buildings (street canyon type influences) on the predicted concentrations, a fundamental error that is likely to explain the poor verification of the model at many locations. Air pollution impacts occur where buildings restrict the dilution of emissions. There is no valid excuse for ignoring the existence of building when modelling road traffic emissions, and for not following good practice guidance.

B4.2. CAGNE provided detailed comments on the modelling explaining why it was not proportionate and not necessarily a 'reasonable worst case situation' (paragraphs 1.13-1.22 REP4-095) and the Applicant has failed to respond to these comments.

B4.3. The modelling approach for road traffic is not conservative because it is not fit-for-purpose nor takes into account uncertainty in the modelling.

B5. Health

B5.1. The Applicant has made it clear that the concentrations inferred from the air quality modelled grid ('the contours') are not appropriate to determine concentrations at specific locations (paragraph 15.1.5 REP-037), however, the Health and Wellbeing Assessment (Paragraph 6.1.4 APP-158) uses the concentrations from the modelled grid at specific locations to assess exposure.

B6. Future Air Quality standards

B6.1. The applicant relies in many places on policy and strategy trajectories for delivering improvements and for determining the effects in future years, however, the uncertainty in the future air quality assessment level (AQAL) due to the trajectory of such standards, has not been considered, despite noting explicitly that there are acknowledged health effects due to the project, below the current legislated thresholds (Last row Table 13.3.1: Air Quality Guidance APP-038).

B6.2. The Applicant has considered sensitivity assessments for many factors but the key factor which has not been considered in any sensitivity test is the effect of the AQAL used, noting that the methodology used determines the effect relative to the AQAL rather than the change in the concentrations due to the Project relative to the baseline (paragraphs 2.21-2.26 REP8-145).

B7. Overall

B7.1. It remains a concern that the assessment has not fully defined the likely effects (mainly due to poor quality roads modelling, limitations in the approach regarding future standards and the lack of an appropriate UPF assessment). On this basis the Applicant has minimised their mitigation obligations and has not committed to any post-operation analysis of the real effects; although it is noted the Applicant intends to implement some measures to improve air quality.

Appendix 3

CAGNE Deadline 9: Surface Access

Sterling Transport Consultancy Limited

21 August 2024

Introduction

1. Sterling Transport Consultancy Limited (Sterling) on behalf of Communities Against Gatwick Noise Emissions (CAGNE) has made substantive submissions in respect of surface access matters at each preceding examination deadline.

2. Within these earlier submissions on behalf of CAGNE Sterling has clearly set out the inadequacy of the applicant's surface access proposals for the enlarged airport.

3. The applicant's approach to surface access matters throughout the examination can be characterised by a lack of willingness to engage or to respond in detail or at all to Sterling's submissions. CAGNE and Sterling have also noted little or no evolution of the applicant's position on surface access issues during the examination phase of the DCO determination process.

4. Sterling has also throughout the examination reviewed the submissions of other parties, concentrating this effort on IPs who have a statutory or formal role to play in the matter of surface access to the airport.

General Matters

5. Sterling recorded that there has been and continues to be a failure by the applicant to apply relevant guidance documents in its assessment of transport matters.

6. The matter of car parking capacity with - and without - the DCO scheme has remained an issue of debate throughout the examination. Sterling has repeatedly sought clarity over the numbers of additional parking spaces generated by the DCO scheme. The applicant has, late in the examination process,[1] provided further clarity on employee parking numbers, airport parking provided by the airport itself and on-site hotel parking numbers. Whilst this clarity is to be welcomed, Sterling remains concerned that staff parking will not be reduced in quantum to reflect the applicant's self-imposed staff travel mode share targets. The failure to reduce staff parking levels provides no encouragement for sustainable staff travel.

7. The scope of the traffic modelling is strategic in nature and therefore inadequate to test local community impacts. The applicant recognised that local impacts do occur and therefore conducted local modelling of the major roads in Gatwick terminal area. From Sterling's perspective it is notable that none of the highway and transport authorities[2] required to form a view on the traffic modelling and the highway mitigation proposed have reached agreement on the traffic modelling conducted by the applicant. In Sterling's view this lack of endorsement

[1] REP6-068 and REP6-085

[2] e.g. at REP1-071, REP5-088 and REP5-115

demonstrates the weakness in the applicant's approach to transport analysis. To claim[3] that the only adverse traffic impacts occur at junctions 25+ kms away from the airport on the fringes of urban London is scarcely tenable. In turn, the flawed analysis limits the reliance that the ExA can place on consequential assessments of surface access related environmental matters e.g. noise, air quality and visual amenity.

8. The modelling uncertainty log[4] from Sterling's perspective should represent a realistic analysis by the applicant of future transport growth and committed transport schemes in order to allow the DCO scheme impacts to be fully assessed. The Sterling position remains that the uncertainty log and the future scenarios for low and high traffic growth which evolve from it are not truly reflective of how uncertainty should be dealt with as set out in DfT TAG Unit M4. Sterling notes that further work has now been completed by GAL[5] that deals with the matter of covid-19 effects but not the matter of long-term (to 2047) growth scenarios that need to be the subject of a number of alternative views of growth. The most recent analysis has correctly removed certain schemes from the 'committed' list of schemes included in the transport model. A sensitive test[6] made with the revised covid-19 uncertainties shows less rail use and therefore highlights concern over mode share when it is based on the same airport growth as other non-covid scenarios.

9. The applicant to date has failed to expose the traffic model's local modal validation report (LVMR) to public scrutiny. As the LMVR provides the only authoritative view of the traffic model's fitness for purpose, this lack of transparency by the applicant is deeply unfortunate. Sterling is led to understand that this report may have been viewed by the appropriate highway authorities but as described above the lack of clear endorsement of the analysis derived from the model suggests that full acceptance is unlikely to have been achieved.

10. Sterling notes the recent disagreement[7] on the supply of traffic modelling information between the applicant and Surrey CC (as a landowner) in respect of Surrey CC land required for the project. Whilst Sterling has no observation on the detail of the traffic modelling information not supplied it reinforces the view that the lack of engagement between the applicant and IPs (including Sterling) over traffic analysis is an ongoing and fundamental failure on behalf of the applicant to seek meaningful agreement.

11. Sterling previously recorded that the proposed revision of the application to provide a non-incinerating waste disposal plant had not been reflected in the applicant's transport analysis. The applicant produced a further assessment of freight movements in relation to waste[8] that is strategic in nature and does not seek to disaggregate the specific changes caused by the change in the development proposal.

12. The matter of baseline mode share has been raised at ISH7 by multiple IPs.[9] Sterling concurs with the legal partnership authorities' view that the ES is based upon a suitable baseline surface access

[3] See in APP-258 and REP3-059
[4] See APP-260 and REP3-059
[5] AS-121
[6] As noted at REP3-104 and reported at AS-121
[7] Late submission by Surrey CC 16th August 2024, AS-165
[8] REP6-017
[9] See for example REP5-093 which sets out the Joint Legal Authorities views

mode share being present at the proposed opening of the DCO scheme in 2029. The Environmental Statement requires a baseline to be established; the applicant's approach is to disown its own assessment of baseline conditions. Sterling has consistently stated that the proposed 'with scheme' mode share targets lack ambition and are below the minimum for sustainable modes of travel that the applicant should seek in order to negate the adverse effects of its application. The applicant's view (set out verbally at ISH7) that the starting point for surface access mode share is irrelevant to consideration of the DCO is misplaced, indeed the applicant has now added commitment 1A to the Surface Access Commitment document which does provide for some definition of mode share near to the commencement of scheme operations. What this new commitment fails to address is how a mode share deficiency at that point in time would be dealt with; it would be inappropriate for the applicant to seek to rely on DCO commitments and funding to rectify such a failure to deliver.

Transport Mode Specific matters

Rail

13. Throughout the examination Sterling highlighted the deficiencies and lack of commitment by the applicant to the rail interventions required.

14. The rail industry IPs, Network Rail and Southern Railways, have not signalled any approval of the applicant's plans for rail surface access, nor do they consider the plans to be sufficient to allow the rail mode share proposed by the applicant to be delivered. Network Rail retain concerns[10] about the applicant's rail demand forecasting assessment. Sterling has repeatedly confirmed that as the applicant has no or limited influence on the rail timetable, only an appropriate level of contractual commitment with central government who determine the basis for rail passenger service provision can meet the tests of certainty the DCO requires. Ultimately the professional rail IPs have concluded[11] that the applicant's rail proposals are not tenable, a view with which Sterling concurs. Given the significant role rail would play in surface access to the enlarged airport under the DCO this must be seen a fatal flaw in the applicant's strategy to manage surface access under the DCO.

15. In addition to the lack of commitment by the applicant to delivery of rail enhancements to service the expanded airport, Sterling has detailed[12] the basic weakness of the applicant's rail proposals for locations away from the Brighton mainline. In those cases, access to the airport by rail is severely restricted by route opening hours at times of airport peak demand (overnight and early mornings in particular) and by limited on train capacity. The applicant has not considered east-west rail connectivity to the airport due to its concentration on the Brighton mainline axis.

16. The latest iteration of Surface Access Commitments register (V5 submitted at D8) retains Commitment 14A in relation to rail matters. Sterling previously commented[13] on this commitment

[10] As set out at REP5-108
[11] REP5-108
[12] REP1-139
[13] REP7-129

which lacks detail and does not address the fundamental issues of capacity and timetabling raised by the rail industry IPs. Commitment 14A also provides for a 'Rail Enhancement Fund' to be established to a maximum value of £10m. This value is substantially lower than would be necessary for meaningful rail enhancements to be made 'after the fact' and should, in Sterling's view, be dismissed as mere 'window dressing' on the applicants' part. What is required by the applicant is a substantive, funded and contractual commitment to infrastructure and rail service enhancements that enables the delivery of the mode share proposition the applicant itself has advanced.

Bus

17. Sterling has highlighted throughout the examination the disjointed and incomplete commitments to bus service provision by the applicant. Sterling remains of the view that the bus and coach service offer is not sufficiently developed in scope or commitment to ensure that the proposed mode share targets are achieved. The placing of reliance on market forces to develop and retain bus services which notionally are recorded as 'committed' by the applicant leads to a clear concern that delivery of these services will not be sustained.

18. The local transport authority IPs have notable concerns[14] that the bus and coach offer is at best reactive to events and subject to market forces at the point of delivery. Each local transport authority at various times in the examination process has requested that bus improvements are put in place prior to the development becoming operational through a clear DCO requirement.

19. Sterling notes the Surface Access commitment 5 provides for a small number of new bus services. However, the detail of these exposes a notable weakness in the commitment, namely that the days and hours of operation are uncommitted. The risk is that 'token' services emerge solely to discharge the commitment as opposed to a meaningful and useable service.

20. Beyond the services designated in commitment 5, the applicant has now offered the following additional paragraph:

    "Beyond the specific Commitment 5 to fund the services in Table 1 for a minimum of five years, GAL will if necessary to meet Commitments 1, 2, 3 and 4 of the SACs, fund additional regional bus and express coach services or other such measures as required in order to meet the SACs."

    Sterling is of the view that this is untested and too vague to be enforceable as a commitment. It is not clear who determines what is 'necessary' and what criteria would be applied to define 'necessary'. Sterling concludes that the weakness of the bus service offer is demonstrated fully by the applicant now proposing at D8[15] an undefined and unquantified proposal in the final stages of the examination process to placate IPs who have raised ongoing and fundamental concern about the bus offer proposed. The ExA is invited by Sterling to reject the applicant's vague approach as set out in the commitment 5 additional wording and require a fully committed plan of proposed bus services to be produced by the applicant.

[14] See for example, REP6-100, REP6-102, REP6-105

[15] REP8-053

Sustainable travel

21. Sterling has highlighted that the sustainable transport mitigations are limited in scope and local in nature, lacking in aspiration to provide a meaningful local alternative to private car transport. We note that there is at least one 'missing link' in the proposed cycle and pedestrian routes in close proximity to the airport which appears to be listed as an 'optional extra' by the applicant - A23 London Road / North Terminal Link signal-controlled junction crossing and the proposed signalised crossing on Longbridge Way.

Working of the Transport Forum Steering Group (**and Transport Mitigation Fund**)

22. Sterling has commented previously on the operation of the Transport Forum Steering Group (TFSG). The real impacts of a failure of the applicant to deliver on either current or future surface access commitments is felt by the local communities that surround the airport. It is therefore incongruous that the airport has no community involvement in the TFSG which is making decisions in respect of managing travel demands created by the airport either now or in its potentially expanded guise under the DCO.

23. The details of the proposed Transport Mitigation Fund (TMF) and its decision-making machinery are set out in the draft section 106 agreement[16]. Again, Sterling remains highly concerned that no community involvement in decision making is proposed. Noting the observations made by Sterling on the matter of surface access it is clear that the £10m capped fund is highly likely to be inadequate to provide meaningful additional mitigation. By way of example, the deployment of a single bus typically costs, based on industry information, £175k to £225k per year. The provision of zero emission buses in the UK is totally reliant on public subsidy to 'top up' the additional capital expenditure needed to procure fleets of zero-emission buses and depot equipment. In the zero emission case bus capital expenditure rises from a quoted £280k for a diesel double deck bus to circa £500k for the zero-emission equivalent. These figures show the inadequacy of the TMF value proposed.

Conclusions

24. The applicant has approached surface access issues in a manner that suggests it is an afterthought to the application. The lack of meaningful engagement with stakeholders has manifested itself in a proposed approach that is reactionary to circumstances post opening, lacks in ambition and has limited certainty of delivery. The surface access commitments proposed reflect this weakness of thought and approach.

25. The lack of detail forthcoming makes informed comment difficult on a range of matters. The failure to expose the detail of the traffic analysis in particular is a material weakness that strains the credibility of the applicant's commentary in other surface access issues. It is notable that IPs with formal transport responsibilities are still not in agreement with the applicant's analysis of surface access effects.

[16] Version 2, REP6-063

26. The failure of the applicant to respond to commentary by Sterling on behalf of CAGNE and other IPs, including those with formal responsibility for surface access matters is lamentable and provides no certainty the applicant is capable of delivering its commitments or responding if (or when) those commitments are exposed as inadequate.

27. Any failure of the applicant's DCO surface access plans will impact directly on the communities proximate to the airport. A lack of formal direct community representation on the bodies that monitor the surface access outcomes is a material weakness that the applicant should rectify.

28. The applicant's flawed transport analysis has material implications for other parts of the Environmental Statement, including air quality and noise.

Appendix 4

Department for Transport

Jet Zero: modelling framework

March 2022

Department for Transport
Great Minster House
33 Horseferry Road
London SW1P 4DR

This publication is also available on our website at www.gov.uk/government/organisations/department-for-transport

Any enquiries regarding this publication should be sent to us at www.gov.uk/government/organisations/department-for-transport

Contents

1. Modelling development

Passenger and aircraft forecasting

Introduction

1.1 The analysis for the Jet Zero Consultation and the further technical consultation uses the Department's aviation model. The model framework was described in detail when a full set of forecasts was last published in 2017. The model, also used by the Climate Change Committee (CCC), has been updated in recent years in line with the department's policy of continuous improvement to its analytical models. Recent improvements have focused on bringing the model up to date to accurately represent UK aviation passenger demand, aircraft movements and emissions for 2019, the last normal year of aviation activity before the COVID-19 pandemic. The precision in forecasting aviation emissions throughout the period 2020-2050 has been further refined.

1.2 The structure of the modelling suite used for the current Jet Zero consultation is illustrated in Figure 1.[1]

1.3 The updated version has been rigorously tested and calibrated against data on passenger and aircraft movements and outturn emissions up to the point at which the COVID-19 pandemic disrupted UK aviation activity and therefore the updated model version has been deemed fit for use and now more suitable than its predecessor for use in assessing carbon emissions by UK aviation.

Uncertainty

1.4 Aviation demand forecasting over the rest of this decade is exceptionally difficult because of the impact of the COVID-19 pandemic on demand for UK passenger aviation. The department’s forecasts are made by examining evidence and then mathematically modelling the long-term relationships between passenger aviation demand and its established economic drivers. The analysis of the long-term

---

[1] Note that for clarity Figure 1 only shows those elements of the modelling that have been active in the Jet Zero carbon abatements: downstream elements such as infrastructure economic appraisal and airport mode share modelling have been omitted.

relationship between aviation demand and its key drivers use continuous data series from the past 30 years. For the next few years, the relationship between aviation demand and these established drivers of demand may be different, and the strength and timing of full recovery remain uncertain. The confidence in any forecast out to 2030 will inevitably be lower than in previous forecasting.

1.5 The approach taken here is to forecast using the established relationships between demand and its drivers throughout the period 2016-2050. The most up to date forecasts on the economic drivers (GDP, trade, oil prices, taxes and fares) have been used, but these cannot fully explain the short-term disruption caused to aviation demand by the COVID-19 pandemic. This is reasonable in terms of looking at long-term strategies for abating carbon (CO2e) emissions,[2] given that the critical period when abatement measures begin to have real impact is likely to be 2030-2050. This approach presents a risk that the forecasting of underlying base emissions is an overestimate. But this is deemed an acceptable risk because when assessing potential strategies to reduce aviation CO2e emissions, it is preferable to take the precaution of starting from the most realistic high passenger demand growth baseline setting the greatest carbon abatement challenge.

[2] 'CO_2e emissions' are defined 'CO_2 equivalent emissions and allow for other greenhouse gases emitted when jet-fuel is burnt including methane (CH_4) and nitrous oxide (N_2O) – these additional gases add only around 1% to the warming impact of CO_2. See also paragraphs 5.14-5.15.

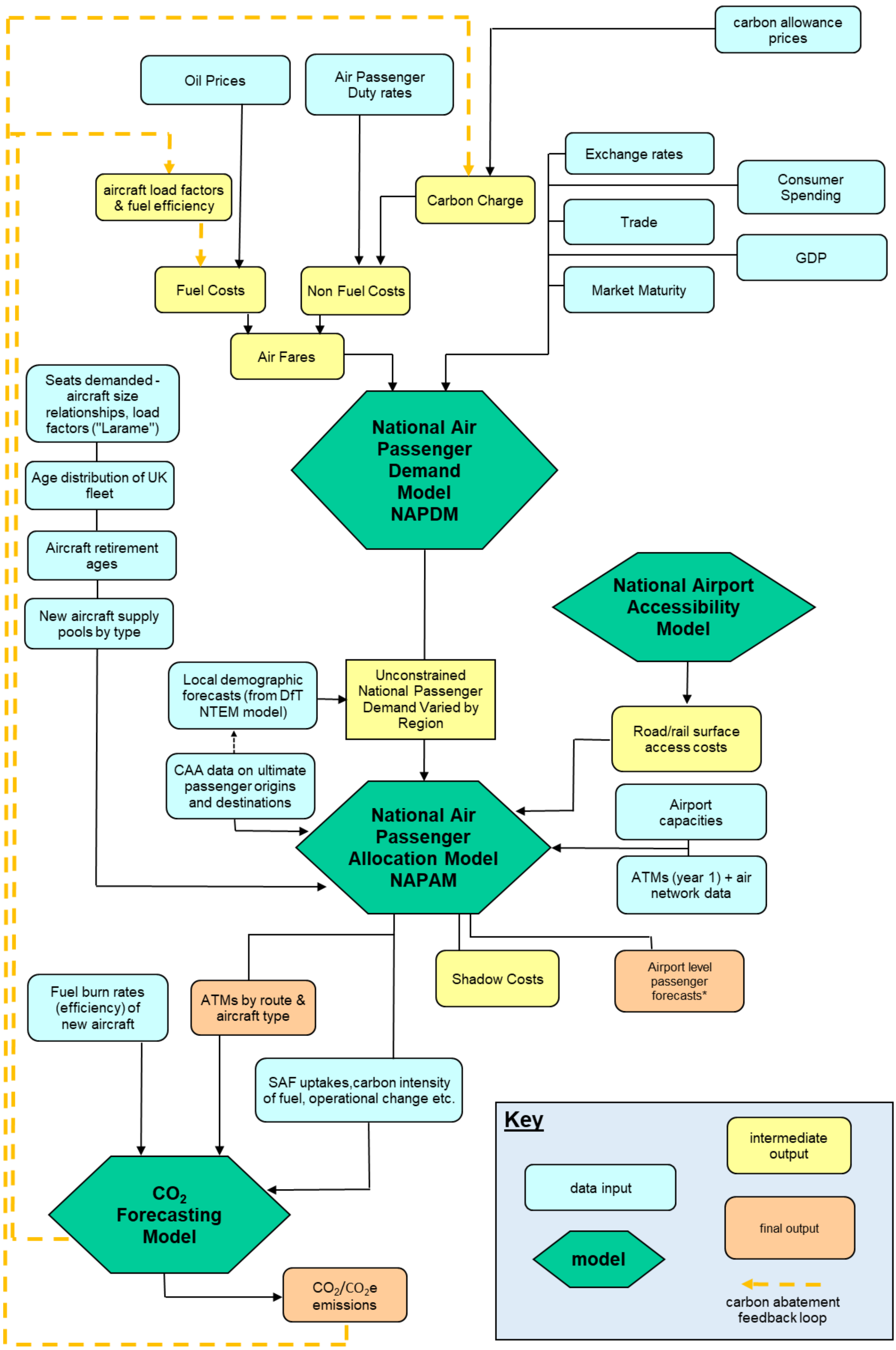


Figure 1 Aviation modelling suite used for Jet Zero

This report

1.6 This report accompanies and sets the scene for the companion document Jet Zero: further technical consultation and explains how the department have updated their aviation modelling suite since the last main forecasts were published in 2017. A significant range of updates have been made since then. This report summarises them and explains why the latest version of the model provides a robust base for forecasting aviation CO2e emissions. The report emphasises the change to a more modern and detailed world geography, new elasticities of demand, more precision in the aircraft forecasting and a robust pre-pandemic 2019 base year performance.

1.7 No passenger demand forecasts are presented in this document – but a wide range of possible UK aviation CO2e emissions pathways forecasts are presented in Jet Zero: further technical consultation. Although the airport allocation model is a necessary part of the carbon modelling process because of its aircraft forecasting, no detailed analysis of airport forecasts is presented as local competition between airports for international and domestic routes have little material effect on the emissions forecasts at a national level.

- **Chapter 2** describes the changes made to the National Air Passenger Demand Model (NAPDM). It explains how these impact on the national forecasts with reference to the new elasticities, updating of economic driver forecasts and the treatment of carbon pricing.
- **Chapter 3** introduces recent changes in the National Air Passenger Allocation Model (NAPAM). These include a more precise geography, a new validated base year of 2019, updated 'making best use' capacities and
- In **Chapter 4** there is a description of how the Fleet Mix Model (FMM), previously exogenous, now operates more precisely at the route level inside NAPAM at the point at which ATMs (air transport movements) are calculated.
- **Chapter 5** updates the CO2 model[3] downstream of NAPAM, essentially unchanged from the last model version, but updated to and validated against 2019 CO2e emissions returns.

[3] Note that the department's 'CO_2 Model' can output results in units of CO_2 or CO_2e. Throughout this analysis CO_2e is the unit of emissions, 'CO_2' is only used when referring to the modelling tool itself.

2. National air passenger demand forecasts (NAPDM)

Introduction

2.1 The National Air Passenger Demand Model (NAPDM) is the starting point of the path that leads to the aircraft (ATM) and CO_2e emissions forecasts in the department's aviation modelling suite. It produces national level estimates of the demand for passenger trips unconstrained by airport capacity. These forecasts are passed downstream to other models in the modelling suite which allocate these trips into passengers at airports, aircraft movements and CO_2e emissions.

2.2 NAPDM consists of econometric models to estimate demand elasticities for passenger markets for different journey purposes and regions of the world. The markets are defined by:

- whether a passenger has an international or domestic destination
- the global region an international passenger is travelling to or from
- whether the passenger is a UK or foreign resident
- the journey purpose (leisure or business)
- whether the passenger is coming to the UK or just passing through a UK airport to connect between international flights

2.3 The key drivers in the econometric models are incomes and associated economic activity, and air fares with the models modified over time to take account of market maturity assumptions.

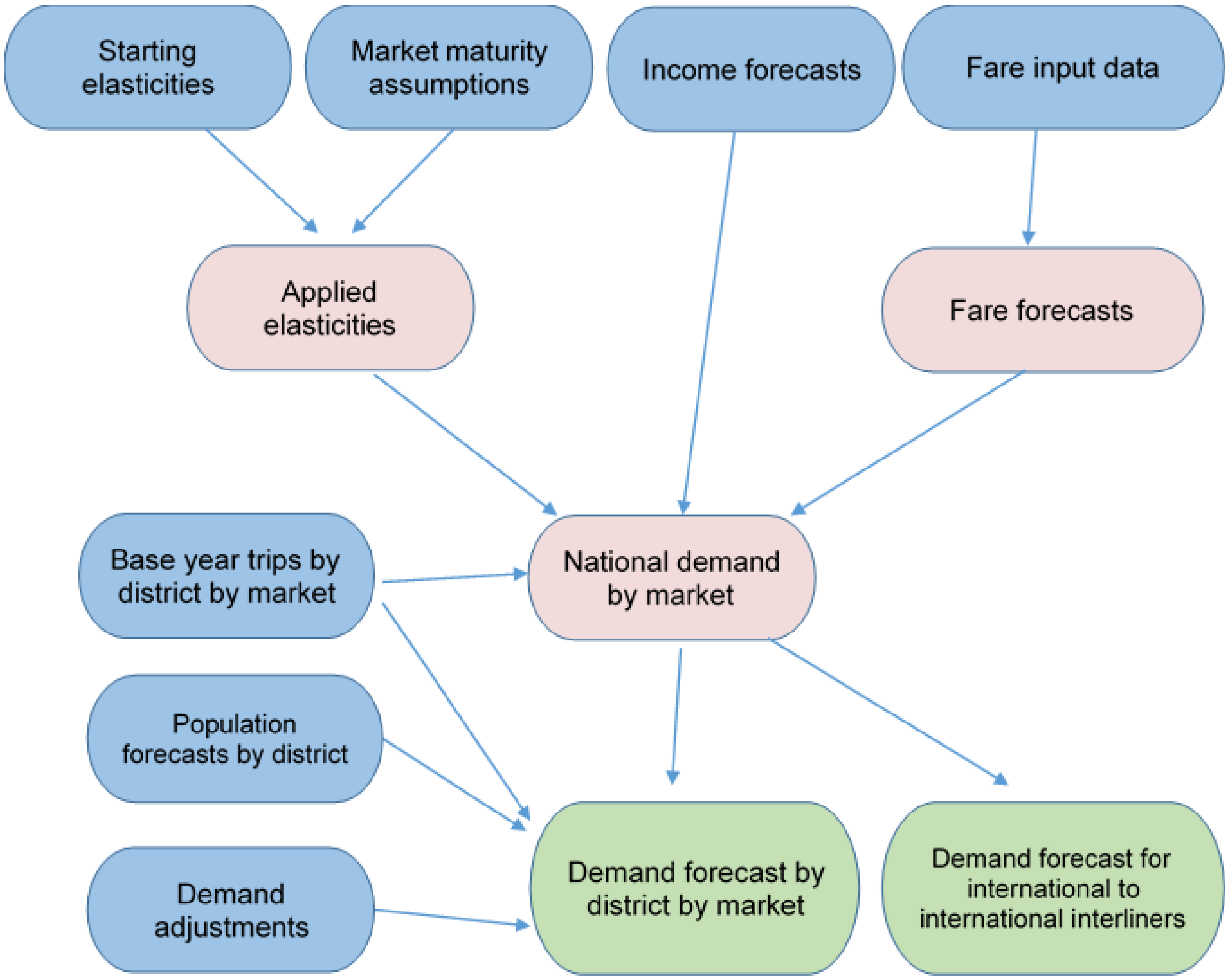


Figure 2 NAPDM model structure

2.4 The NAPDM fare forecasts module plays an essential part of the emissions forecasting and assessment of carbon abatement scenarios.

2.5 The fares module breaks future fares down by modelling market into key variable elements including:

- fuels costs per passenger allowing for the impact of changes in the expected passenger load factors of the regional aircraft fleets; and forecast changes in the fuel efficiency of the future aircraft fleet
- carbon prices
- UK aviation taxes (Air Passenger Duty (APD))
- all other non-fuel and non-tax related airline costs

2.6 In most model applications the model process cascades from NAPDM and its macro-economic inputs through the airport and aircraft forecasting down to the CO2 emissions output model. However, it is recognised that future changes to input carbon prices could significantly affect the fuel efficiency of the aircraft fleet, uptake of alternative fuels and aircraft passenger loadings. As such changes can have an impact on fares, and therefore demand, there is an option to use an iterative feedback loop between the CO2 emissions model and NAPDM demand forecasts.[4] This model feedback relationship, illustrated in Figure 1, has been used in Jet Zero.

2.7 A full account of the NAPDM forecasting principles is in the department's 2017 aviation forecasts document and much of this remains valid. However since 2017 there have been significant updates and improvements to NAPDM.

- The domestic and international econometric models have been re-estimated and new long-run income / economic activity and price elasticities of demand have been derived using time series data covering the period 1986-2017.

- Although there are still 16 international markets (2 passenger residency * 2 journey purposes * 4 world regions), the international regions (agglomerations of countries) have been redefined to provide both better fitted econometric models and more evenly sized passenger markets. As explained below, it better represents the changing pace and character of regional world economic development in recent years.

- NAPDM now outputs unconstrained demand of national passenger trips rather than estimates of national terminal passengers (avoiding the need to make assumptions about patterns of transfer – beyond the scope of NAPDM).

- Instead of applying just one carbon price series across all regions, as in the previous version, the NAPDM fare model can now apply a different carbon price series to different markets. This can better reflect the impacts of different carbon pricing mechanisms on demand and emissions in relevant world regions. Specifically, assumptions about UK ETS carbon prices are applied to the new Southern Europe (SE) and Rest of Europe (RoE) forecasting regions, while assumptions about ICAO CORSIA eligible emission unit prices are applicable to OECD and Rest of World (RoW) regions.

- All the main economic inputs driving growth have been updated to the most recent available OBR, OECD, IMF forecasts, and all other external model input reviewed.

2.8 As before, NAPDM continues to model the domestic and international to international transfer market separately to the 16 international markets. Domestic passengers flying within the UK are split into business and leisure (2 markets), while international to international transfers, with no ground origin or destination in the UK, are not split by journey purpose. In addition, all the UK based demand forecasts are allocated to a regional level based on ONS population forecasts, as described at the end of this Chapter.

---

[4] This outer iterative forecasting technique was first used and rigorously tested in by the Airports Commission to produce demand forecasts fitted to carbon targets – see Strategic fit: updated forecasts (publishing.service.gov.uk) especially chapter 4. Note CO_2e targeted forecasts are not used in the Jet Zero assessments, but the feedback mechanisms are. Jet zero feedbacks are used to impact the fuel efficiency and load factor inputs to the NAPDM fares per passenger model rather than the input carbon price which is calculated off-model.

Geographical definition

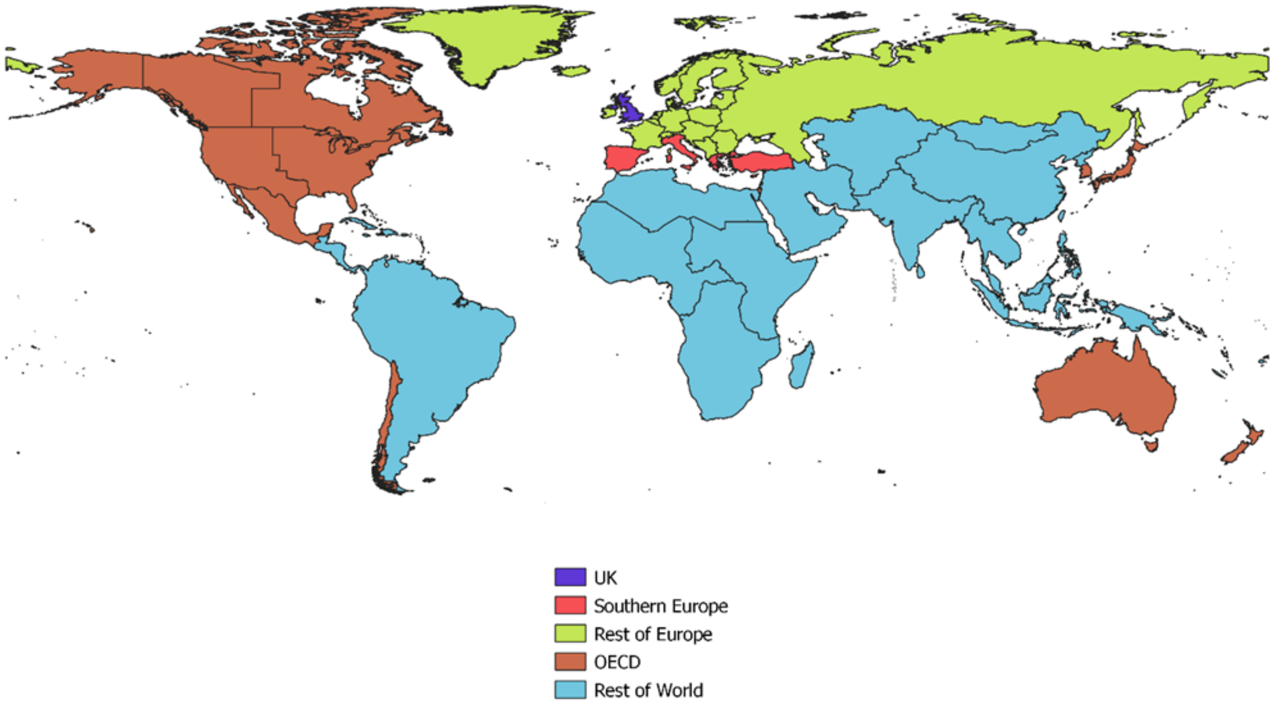


Figure 3 Updated NAPDM forecasting regions

2.9 The 2017 forecasts version of NAPDM used in the consultation had four global regions: Western Europe (which in practice encompassed all short-haul, being all of Europe including Russia), OECD (long-haul members), Newly Industrialised Countries and Less Developed Countries. There were two problems with this old grouping which became more prominent over time.

1. The region sizes were not well balanced, with the “Western Europe” region being responsible for about 80% of all international traffic.

2. The old distinction between the ‘Newly Industrialised Countries’ and the ‘Less Developed Countries’ regions had become problematic with some countries arguably moving between categories during the relevant period.

2.10 Resolving these issues also meant that more robust econometric models could be calibrated out of the newly extended 1986-2017 time series data. The current international NAPDM model is now disaggregated into four revised global regions:

- Southern Europe (SE)
- Rest of Europe (RoE)
- Other OECD countries (OECD)
- Rest of the World (RoW).

2.11 The change in the short-haul/Western European market is significant. It is now split into two with the largest market, Southern Europe, representing slightly under 50% of total European trips. The long-haul Less Developed and Newly Industrialised categories have effectively been merged as long-haul Rest of the World while the other long-haul region, OECD, is essentially unchanged from the previous version of NAPDM.

2.12 The European market has been split according to market type. When travelling for leisure, people often travel to Southern Europe for 'sun and sand' holidays, and the Rest of Europe for a variety of business, tourist and cultural attractions. It is recognised that this distinction is often not clear-cut. For example, France, a major destination, could be included in either category but was placed in the Rest of Europe market.

Demand elasticities

2.13 Since 2017, the econometric models have been re-estimated to provide updated demand elasticities. These reflect both the extension of the time series of aviation, and a review of current best practice in academic econometric and mathematic modelling. The modelling has gone through both internal peer review and external academic review processes.[5] The updates include:

- The unit of measure of demand for elasticities in NAPDM has changed from terminal passengers to trips. The difference between the two relates to the way passengers are counted in national aviation forecasting: a passenger who transfers at a UK airport will be counted as two to three terminal passengers for each airport arrival and departure on a one-way trip.[6] The need to transfer at an airport can only be properly represented over time by a passenger to airport allocation model (i.e. NAPAM), so at this point in the modelling it is preferable to work with passenger trips.

- As described above, the grouping of countries into international regional markets has changed. The transition of the former Western Europe, OECD, Newly Industrialised Countries and Less Developed Countries regions into the four new global trip forecasting regions of Southern Europe (SE), Rest of Europe (RoE), Rest of OECD (OECD) and Rest of the World (RoW), necessitates new econometric models and elasticities.

- Input data on aviation demand and its economic drivers are updated and extended from a final year of 2008 to 2017. The data include principally annual aviation passenger numbers by journey purpose, income measures (e.g. GDP, import and export), and air fares.

- The current models introduce structural breaks, where applicable, into the series and derive demand elasticities separately before and after the structural breaks. Although

[5] The external academic review stated that the current state-of-the-art practice has been followed, and it concluded that no better elasticity estimates could have been obtained within the current form of modelling and data resource availability.

[6] For example, on an outbound one-way trip a UK originating passenger transferring at a UK hub will count one passenger movement (a departure) at the local departure airport and two passenger movements (an arrival and departure) at the hub airport when they transfer. A non-UK originating transfer will count as two passenger movements: an arrival and departure at the UK hub airport.

tests for structural breaks were undertaken when the previous NAPDM models were estimated, no robust evidence was then found, probably because of the shorter time series.

- The explanatory variables (economic drivers) have been found to be the same as in the previous version of NAPDM. But while the previous models included the sterling exchange rate to US dollar as a driver in only the foreign leisure to OECD market, exchange rates have now been found to be significant drivers in in more markets.[7]

2.14 These developments mean that the demand elasticities with respect to income (yed) and price (ped) are changed. The headline previous and current demand elasticities in broad passenger groupings are summarised below. The full set of market elasticities by purpose (‘U’=UK resident, ‘F’=foreign resident, ‘B’ =business passenger, ‘L’ = Leisure passenger by region (D=Domestic, SE, RoE, OECD, RoW) are tabulated in Annex A.

[7]More information is in supporting document Econometric Models to Estimate Demand Elasticities for the National Air Passenger Demand Model, Department for Transport, March 2022. Also note that in old and new versions of NAPDM, although exchange rates are a significant explanatory variable of historic air demand, exchange rates are not varied for the purposes of forecasting future demand.

	Previous NAPDM elasticities		Current NAPDM elasticities	
	income	price	income	price
Passenger type	yed	ped	yed	ped
All business passengers	1.0	-0.2	0.9	-0.2
All leisure passengers	1.2	-0.6	1.3	-1.1
Southern Europe	1.2	-0.7	1.2	-1.0
Rest of Europe	1.1	-0.6	1.2	-0.9
OECD	0.9	-0.3	1.1	-0.9
Rest of World	1.1	-0.4	1.8	-0.9
All domestic passengers	1.2	-0.5	1.1	-0.6
All UK residents	1.2	-0.6	1.1	-0.9
All foreign residents	0.9	-0.5	1.6	-0.9

yed: income elasticity of demand
ped: price elasticity of demand

Where elasticities do not relate to a specific market, they have been weighted

Previous NAPDM regional elasticities have been re-weighted by country to provide equivalence with the current geographic definitions

2.15 A full technical account of the updating of NAPDM's econometric models is in the associated document: Econometric Models to Estimate Demand Elasticities for the National Air Passenger Demand Model, Department for Transport, March 2022.

Input assumptions and sources

2.16 Since the 2017 forecasts were published, key model inputs have either changed sources or been replaced by more recent publications from the same source. The external data sources were brought up to date at the start of this current phase of model development in autumn 2021. Figure 4 below summarises the sources used to project the key drivers of demand in the current model.

2.17 Input GDP and other income related forecasts include the projected wider impacts of the COVID-19 pandemic and recovery of the UK and world economies. In the main forecasts this is the only direct inclusion of the pandemic effects.[8] It is therefore assumed that the long-term relationship between demand and key drivers estimated from historic data is unaffected by the pandemic.

Model Input	Period	Source
UK GDP, Growth Rates	2015-2020	ONS, August 2021
	2021-2080	OBR, October 2021
Consumption Expenditure, Growth Rates	2015-2080	OBR, various years
Foreign GDP Growth Rates	2015-2026	IMF, April 2021
	2027-2060	OECD, July 2018
	2061-2080	Held constant by assumption
GDP Deflator Growth Rate	2015-2020	ONS, August 2021
	2015-2026	OBR, October 2021
	2027-2080	Held at 0% by assumption
ETS Carbon Prices	2015-2080	DfT carbon price series for aviation modelling[9]
CORSIA Carbon Prices	2021-2080	DfT carbon price series for aviation modelling
Oil Prices	2015-2080	BEIS, February 2020
Exchange Rate	2015	ONS, May 2017
	2016	BEIS, 2016
	2017-2026	OBR, various years
	2027-2080	Held constant by assumption
APD	2015-2023	HMRC, April 2021; Autumn Budget 2021
	2024-2080	Held constant by assumption
Load Factors	2015-2050	NAPAM, November 2021
	2051-2080	Held constant by assumption
Fuel Efficiency	2015-2050	NAPAM, November 2021
	2051-2080	Held constant by assumption
Trips by District	2020-2080	DfT
Population by District, Growth Rates	2015-2080	DfT NTEM v7.2

Figure 4 NAPDM current input demand driver data sources

Carbon price and fare modelling

2.18 When NAPDM applies the various price elasticities to changes in fare by forecasting market (see Annex A), it uses a model of future fares for each market. The components and sources of the NAPDM fares model are detailed in the footnote to Annex A.

2.19 In the context of Jet Zero abatement scenarios, carbon prices are a particularly important component in the NAPDM fare model. Carbon prices are a cost element to airlines that they are expected to pass on to consumers through air fares. The higher

[8] Except, as discussed in Chapter 4, the accelerated removal of some older less fuel efficiency aircraft types from the UK fleet in the ATM modelling, to reflect what had been an observed response to lower demand by some airlines.
[9] See Annex B of Jet Zero: Further Technical Consultation for details.

carbon prices, the higher the air fares, and this in turn drives down the total national aviation demand.

2.20 The previous version of the NAPDM model had applied one carbon price series across all routes. However, since the departure of the UK from the EU ETS carbon trading scheme, flights within the UK and from the UK to the EEA are treated as part of the new UK ETS scheme, while the remaining, mainly long-haul, international flights are covered by ICAO's Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) scheme.

2.21 The NAPDM fares model has therefore been extended to apply different carbon price series to different markets. UK ETS Carbon prices are applied to the Southern Europe (SE) and Rest of Europe (RoE) regions while CORSIA prices are applied to OECD and Rest of World (RoW). Further detail on the carbon price assumptions used in the modelling is given in Jet Zero: further technical consultation.

Air Passenger Duty

2.22 In October 2021 the Government announced a halving of Air Passenger Duty (APD) on domestic flights to £6.50 (nominal) and a new 'extra-long-haul' band C for flights over 5,500 miles. In nominal values Band C is Band B (2,000-5,500 miles) +£4 for an economy ticket. These changes are due to be introduced in 2023 and have been included in the NAPDM forecasting from then.

2.23 APD rates used in NAPDM are based on HMRC figures set out in April 2021 and rates and regime later amended in the Budget of 2021. The rate in each geographic region in the forecast model is aligned with APD geographic bands using CAA passenger survey data and is a weighted average across APD rates for reduced and standard classes. In addition, an adjustment has been made to reflect that those aged under 16 are now exempt. The rates are assumed to be held constant in real terms for the rest of the modelling period and are only applied when departing from a UK airport. The table below sets out the average rates used in the forecasts converted from the APD band areas to the NAPDM forecasting regions in 2015 prices.

NAPDM region	2015 APD rate, £	2023 APD rate, £
Domestic end-end	26	11
Southern Europe	13	11
Rest of Europe	13	11
OECD	75	91
Rest of World	63	86

APD is paid when departing a UK airport, and aviation trips entirely within the UK involve doing so twice. Prior to 2023, the domestic end-end rate is about double the Southern Europe and Rest of Europe rate because of this.

Fuel efficiency and load factor inputs

2.24 As illustrated in the aviation modelling suite structure in Figure 1, there are optional outer iterative loops between the connecting outputs from the CO2 Model and fare inputs of NAPDM.

2.25 Load factors and the fuel efficiency of the aircraft fleet both can have some impact on the series of fares, given the same carbon prices. The fuel efficiency feedback loop has been used in the context of the Jet Zero illustrative scenarios reported in the Jet Zero: further technical consultation.[10] Higher load factors result in lower fares overall as the fuel, carbon charge and non-fuel cost air fare components are spread across more passengers. Greater output indices of fleet fuel efficiency by forecasting region are used to adjust the fuel cost per flight, so increased fuel efficiency results in some reduction of average air fares in the model feedback loop. The indexed fuel efficiencies by NAPDM region are shown in Figure 5 below.

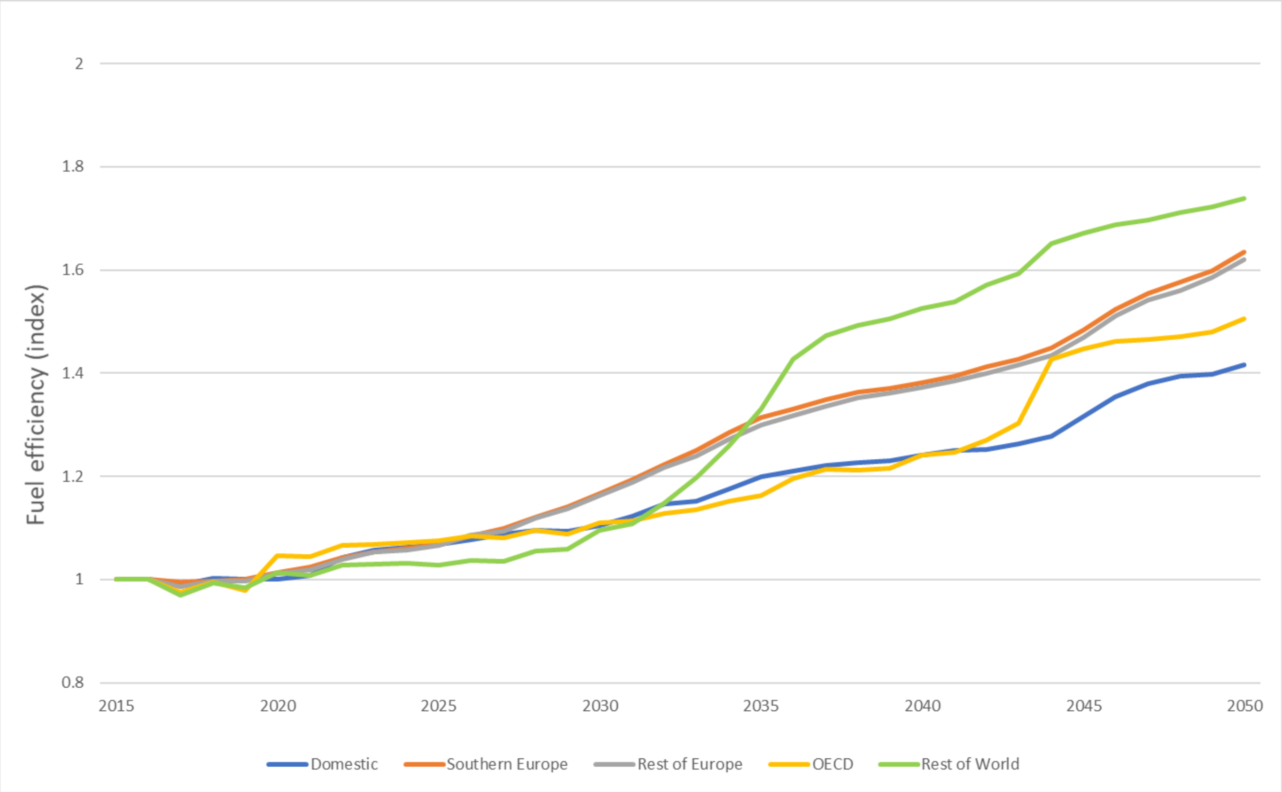


Figure 5 Baseline indices of fuel efficiency by NAPDM forecasting region

Overall change in modelled fares

2.26 Figure 6 below provides an overview of the modelling of average total fares split by component and shows how the carbon component of air fares progressively increases through the modelled period. The graph in Figure 6 shows an

[10] Fuel efficiency is measured as seat-kms/tonne of fuel, to eliminate the impact of the passenger load factor from the rate of fuel efficiency.

amalgamated fare for all international passenger forecasting markets weighted by total trips.[11]

2.27 In all years, the single largest fare element shown in Figure 6 is ‘other costs’. These costs are not separately modelled but include staff salaries, equipment maintenance, depreciation or lease, insurance, navigational and airport passenger handling fees, landing and departure fees and parking charges, and marketing, promotion and other general administration costs.

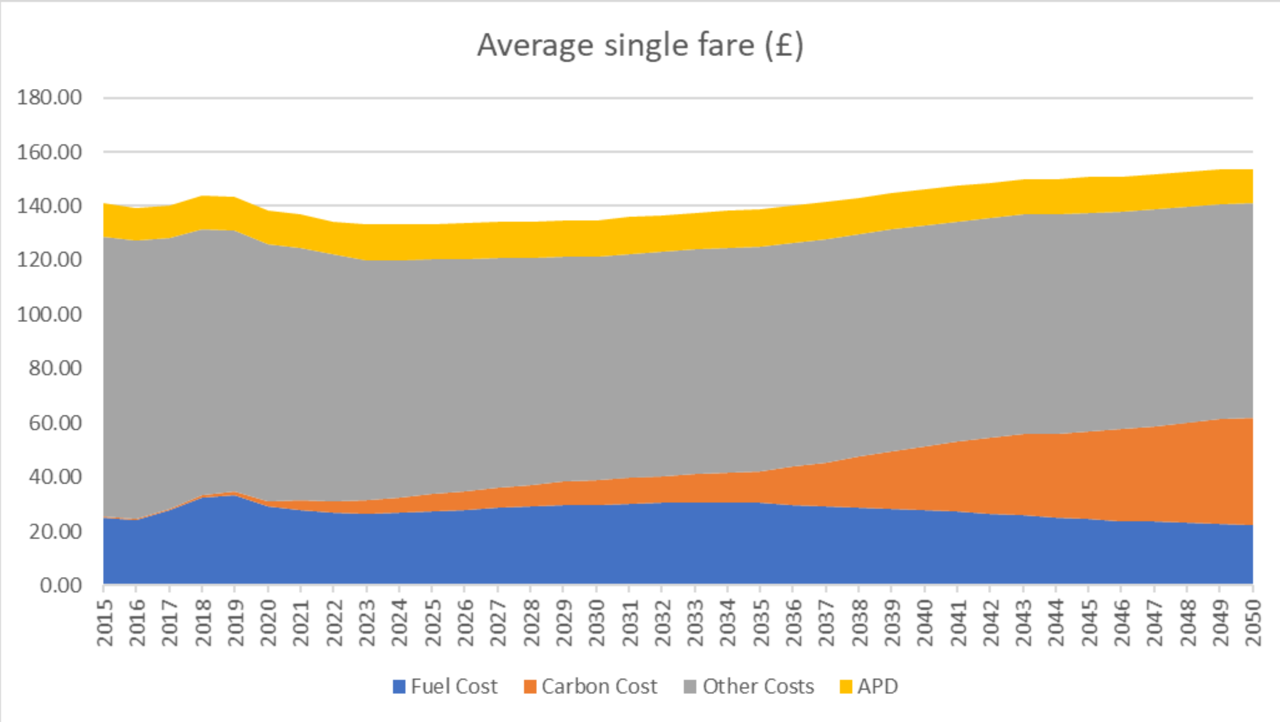


Figure 6 Projected composition of future air fares weighted by trips, central demand

Distribution of national demand around the UK regions

2.28 NAPDM has a function to manage the disaggregation of the growth in demand to the more local district level needed to allocate forecast national demand to airports in the passenger to airport allocation model NAPAM while controlling to the forecast national trip totals. NAPDM determines how the local distribution within the national trip forecast may change over time. The 2017 forecasts document reported how, after a series of statistical tests, changes in the local district composition of demand were driven solely by projected local population changes.[12] Districts with faster forecast population growth received a higher share of each market’s forecast demand growth.

2.29 This approach has been reviewed since the 2017 forecasts. Some stakeholders, such as airport operators in the north of England, had raised concerns that this

[11] In practice in NAPDM the fares are separately calculated for each regional market and journey purpose.

[12] The population projections for the period 2016-2051 for mainland UK were taken from the department’s Tempro 7.2 trip end model, which uses ONS data to forecast population growth by district for Great Britain. with ONS principal population projections for Northern and the Republic of Ireland’s Central Statistical Office for the rest of the island of Ireland.

approach disproportionately allocated demand to London and the south east, at the expense of northern regions.[13]

2.30 Further statistical regressions have been used to re-test population growth against other potential economic variables which could be possible drivers of regional variations in propensity to fly. Again, population growth was consistently found to be a significant driver as a single explanatory variable. Similar regressions on other economic indicators – Gross Value Added local income (GVA) and Gross Domestic Household Income (GDHI), GVA per head, and GDHI per head – also demonstrated their significance as sole explanatory variables. But GVA and GDHI were also found to be significantly correlated with population, and this justified retaining the use of independent (ONS) forecasts of population growth as the sole driver of regional variation in propensity to fly.

2.31 A second stage in the review was to test the forecast accuracy of the 2017 forecasts methodology over various sample periods which were then compared to historical demand data. The forecasting accuracy of the methodology was tested by estimating the correlation between actual and forecast demand over given sample periods. A high correlation was found at the local level between historical demand and the demand forecast using the population growth based method.[14]

2.32 Doubtless local factors do play a role, often short term, in changing the propensity to fly from regions and local airports. But such factors are hazardous to predict over the longer term. Overall, the review clearly found that the alternative methodologies considered did not consistently outperform the methodology used in the department's 2017 forecasts. The 2017 methodology demonstrated a good forecast performance while being both simple and based on transparent and widely available ONS projections. Therefore, the population based growth methodology is retained for the current NAPDM baseline distribution of future demand around the regions.[15]

[13] However, it should be noted that after a brief period, 2016-2017, when regional throughputs outgrew the London and SE airports, since 2017 there has been a return to the long-term pattern of London & SE airports displaying stronger growth rates, even in the COVID-19 affected year of 2020.

[14] A further variation on the population growth-based methodology was also tested. This method applied a population elasticity based on estimation or calibration to demand growth. The results showed that the local demand forecast based on alternative elasticities estimated or calibrated were over-sensitive to sample selection. The reliability of this alternative was also undermined by poor out-of-sample forecast performance of the sample alternatives.

[15] Regional variations are controlled to the overall national trip growth forecast produced by the econometric models, so, although NAPDM incorporates a regional growth scenario override function which can redistribute the overall growth around the regions, there is little reason in applying local overrides in the context of Jet Zero forecasting as any impact on national CO_2e emissions totals would be minimal.

3. National Air Passenger Allocation Model (NAPAM)

3.1 As set out in the 2017 forecasts document, the National Air Passenger Allocation Model (NAPAM) takes national forecasts of the demand for air passenger trips to and from and within the UK from the national NAPDM forecast. Passengers are allocated around the main airports throughout the UK and four competing overseas hubs. It forecasts how passengers might choose airports in reaction to their relative estimated attractiveness now and in the future. This choice takes account of current and future limits to and pressures on airport capacity, accessibility and levels of air services.

3.2 As part of this process, it also translates passenger demand for different routes into ATMs (air transport movements), i.e. the demand for aircraft flights. Specific current and forecast aircraft types on each route are forecast for use downstream in the CO2e emissions modelling.

3.3 A comprehensive range of software improvements and updating of inputs in the current version of NAPAM have allowed

- greater geographic detail and compatibility with NAPDM forecasting regions
- good quality model validation of performance against 2019 actuals on passengers, aircraft and emissions at UK airports
- updating of the airport capacity assumptions to be used specifically for aviation emissions modelling in line with recent airport planning applications or specific proposals published by UK airports since 2018
- improved model convergence through tighter fitting of demand to the annual runway capacity of individual airports
- better representation of recent trends in aircraft passenger load factors
- greater precision of present and future route-level aircraft type forecasting by incorporation of the Fleet Mix Model directly into the NAPAM.

3.4 Significant modernisation of the NAPAM program software, faster run times and a greater range and granularity of its outputs have further facilitated rigorous model checking, a general upgrade in model performance and an improved range of outputs.

3.5 Some other pipeline model improvements less directly connected to the emissions modelling, or which have been less thoroughly tested or supported by robust input assumptions, have been withheld to avoid unnecessary inconsistency with the previous CO2 forecasts.[16]

Geographical definition

3.6 The UK mainland geography of 455 district-based ground origins described in the 2017 forecasts document remains unchanged.[17]

3.7 The modelling treatment of Northern Ireland has been upgraded to incorporate 37 new zones on the island of Ireland. This means that the two Belfast airports will no longer be modelling "add-ins" but are now modelled in the same way as the mainland UK airports. Locally this provides more responsive and consistent passenger allocation and ATM modelling.

3.8 The international geographical definition used in the 2017 and earlier forecasts has been substantially revised and modernised. The previous 48 modelled international destination zones of (27 route groups and 21 individual European airports) had not been changed since the model was first developed. They have now been replaced with the 67 zones illustrated below in Figure 7 and listed Annex B. The reasons for making changes were:

Modernisation: the previous system was becoming outdated.

- The previous separately modelled 21 European airports represented the busiest destinations in the 1990s. That selection proved durable, but some relatively minor updates (Budapest, Malaga, Alicante, Berlin in, Nice out) reflect significant changes in demand in the past 20 years.
- Dubai as a major international transfer point for UK passengers had previously been represented as part of a Middle East zone group, its recent development requires modelling as an individual airport.

[16] Such ongoing developments, and reasons for exclusion, include: extending the model run horizon from 2050 to 2080 because of an absence of post 2050 aircraft fleet assumptions; new passenger to airport choice model coefficients because of shortage of time to test and check airport allocation against actuals; removal of the scheduled, charter, low cost airline types from the airport choice modelling because of delay in adopting new model choice coefficients; and, modelling updated airport surface accessibility costs as these have been affected by significant recent announcements of changes on future rail schemes but also have relatively little impact on total aviation emissions, which are driven primarily by international travel.

[17] Using 1991 census boundaries for greater granularity.

- Major political, economic and demographic changes in world geography since original model development are reflected e.g. the growth of China and the accession of eastern European countries to the EU.

Boundary consistency.

- The new zones can be aggregated precisely to align with boundaries such as membership of the EU, the EU ETS, the OECD etc.

- greater internal consistency within the department's aviation modelling suite: the new NAPAM zoning is now compatible with new NAPDM and short-haul and long-haul definitions (see Annex B).

Improved precision in the passenger allocation ATM and CO2e modelling

- Because of their diversity, several of the larger previous generation of zone groups had become more difficult to model in terms of validating model forecasts against current patterns of observed demand

- defining the mix of aircraft types going to specific destinations becomes more precise

- distances flown become more precise

- precision of CO2e emissions modelling benefits from all the above.

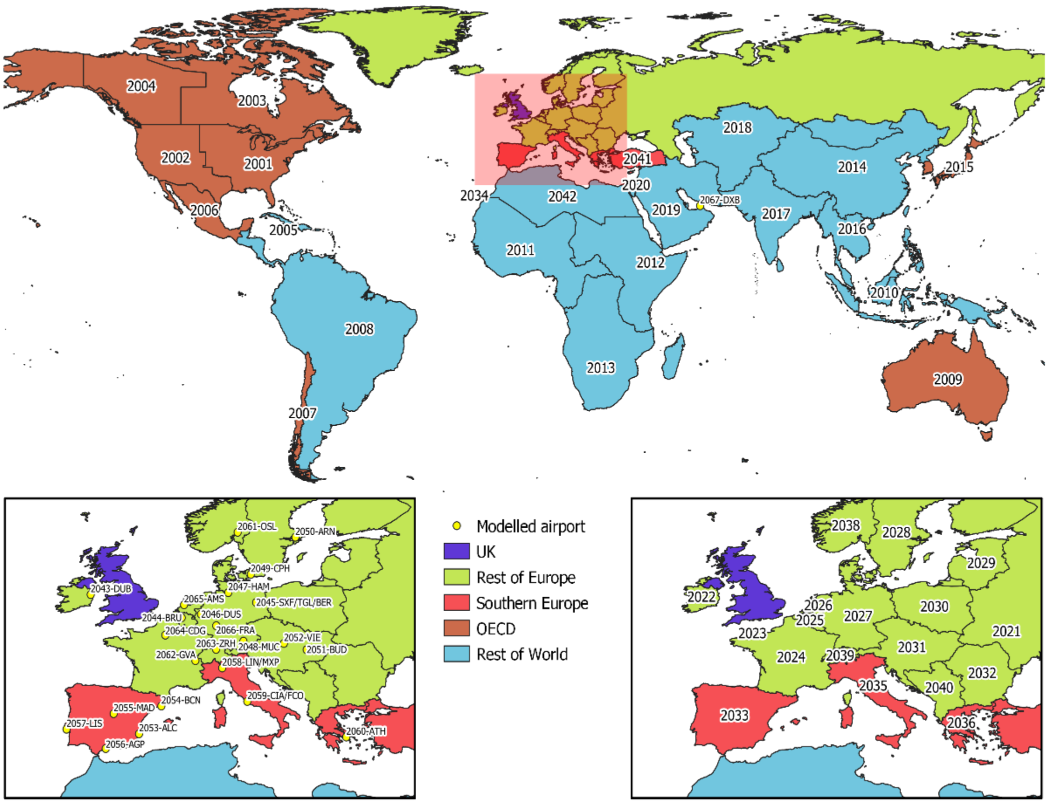


Figure 7 New NAPAM 67 international zone system

Airports modelled in NAPAM

3.9 NAPAM continues to model all the busier UK airports which had some regular international commercial passenger air services operating in 2019. As described in the next section, the airports are modelled as constrained by their assumed annual runway capacities or, in some cases, by terminal capacities. Forecasts are still made at the “route” level where a route here is defined as one of the modelled UK airports to one of the 67 international modelled zones and domestically from one of the UK modelled airports to either another UK modelled airport or a smaller unmodelled UK airport. International routes can also include flying via one of the major overseas modelled hubs: Amsterdam Schiphol, Paris Charles de Gaulle, Frankfurt or Dubai.

3.10 The only changes to NAPAM’s set of UK modelled airports made since the 2017 forecasts is the removal of Blackpool and Coventry airports where commercial international services have been absent for several years. The representation of Belfast International and Belfast City airports has been upgraded by modelling the surface ground origins of their passengers and their airport access in the same manner as the mainland UK airports. The current list of UK airports modelled in NAPAM is given in Annex C.

3.11 The modelling for the Jet Zero Consultation and the further technical consultation focuses on forecasting emissions to illustrate the different pathways reducing international and domestic UK aviation emissions at the national level. There is therefore less focus on levels of activity at individual airports. But airport constraints are still expected in the future and capacity constrained airport modelling continues to underlie the emissions modelling.

Model performance: passengers and ATMs 2019

3.12 NAPAM modelling starts in the year 2016 with a base origin and destination pattern of demand for that year and applies the NAPDM growth factors for each market and forecasts each year out to 2050. The year when modelled performance is validated against independent statistics has been advanced to 2019, four years into the modelling period. Model validation checks:

- allocation of passengers to airports
- conversion of passenger demand to aircraft (ATM) demand at each airport
- representation of passenger loadings on aircraft at each airport.[18]

3.13 The model has therefore been thoroughly quality checked on its performance against observed aviation activity immediately before the disruption to the industry caused by the COVID-19 pandemic, and it performs well.

3.14 Annex E summarises performance of the model’s passenger to airport allocations (including competing major overseas hubs) against statistical outturns (‘actuals’)

[18] Passenger loads, calculated at the NAPAM route level, are a combination of model performance in terms of representing reasonably accurately both aircraft size and load factors.

provided by the CAA for 2019.[19] There is a good match between predicted passenger numbers and the actuals at all the major passenger airports.

3.15 Annex F provides the model performance in converting passenger demand to ATMs against statistical outturns ('actuals') provided by the CAA for 2019 and in making a good representation of average passenger aircraft loadings at each modelled airport. Both are important outputs for accurately assessing CO2e emissions abatement strategies. Both provide a good match between the actuals and modelled.

UK airport capacities

3.16 These basic principles apply to airport capacity modelling used in the department's updated aviation modelling suite:

- all airports must be given an assumed annual runway capacity (an upper bound on the number of aircraft movements that can be accommodated on a runway); in some cases, runway capacity inputs may have been set by local planning consents or planning proposals.
- terminal (passenger) capacity constraints are now only used where there is a current planning restriction in place, or a decision on a current planning application is expected to result in a restriction on passenger numbers.[20]
- in most cases where no terminal capacity is available, effective passenger capacity assumptions in any year is calculated in the model as passenger aircraft movements multiplied by the average modelled aircraft load for that airport in that year.

3.17 The capacity assumptions required by the model do not pre-judge the outcome of any future planning applications, including decisions taken by Ministers. The capacity assumptions do not represent any proposal for limits on future capacity growth at specific airports, nor do they indicate maximum appropriate levels of capacity growth at specific airports for the purpose of planning decision-making. However, specific assumptions must be made on several inputs, including about the future runway capacity of the main airports in the UK, for NAPAM to operate. In line with a precautionary approach to the level of future carbon emissions, and to reflect the uncertainty around future developments in this area, we have assumed capacities that are consistent with current planning applications, including proposals on which airports have consulted the public (e.g., statutory pre-application consultation). Increasing capacity limits in this way allows the analysis to focus on testing the potential of abatement technologies to meet the challenge of net zero, without capacity constraints imposing an extra demand restriction or simply causing emissions to be exported to competing overseas airports.

---

[19] CAA only provide statistics for UK airports – see DfT Transport Statistics UK for overseas hubs - Aviation (TSGB02) - GOV.UK (www.gov.uk).

[20] The airports with a consent, application or a planning consultation that have been given a specific planning passenger capacity are London City (11mppa), Luton (32mppa), Stansted (43mppa), Bristol (12mppa), Southampton (3mppa) and Leeds-Bradford (7mppa). All these airports will also be given an assumed annual runway capacity and the airport activity will be limited to whichever of the two capacities ceilings is reached first.

3.18 In June 2018, the government set out its policy support for airports to make best use of their existing runways in Beyond the Horizon: The future of UK aviation: making best use of existing runways ("MBU") and a new runway at Heathrow Airport in the Airports National Policy Statement: new runway capacity and infrastructure at airports in the South East of England (ANPS), subject to related economic and environmental considerations. In common with the Jet Zero Consultation the capacity assumptions in our modelling reflect and are aligned with these policies. The assumptions for a small number of airports have been updated only where better evidence has become available.[21] These include factoring in changes to the assumed delivery timeframe of a third runway at Heathrow, as a result of expansion activity pausing during COVID-19. Heathrow Airport Limited have based its latest Net Zero Plan on a runway opening in 2030, and we have assumed no temporary capacity relaxation on the existing runways before then. As previously assumed, the additional new runway capacity is expected to be phased in over 10 years from the date the new runway is operational. The capacity of the full scheme is limited to the additional 260,000 ATMs assessed by the Airports Commission in their 2015 recommendations.

3.19 This modelling scenario is not therefore a prediction of what the Department of Transport thinks will happen with future capacity expansion but acts as a reasonable upper bound of possible future airport capacity levels and therefore associated UK aviation emissions. Its purpose is limited to providing a consistent basis to better test the potential effectiveness of measures to meet net zero.

3.20 The capacity assumptions for runways and for passengers (only where a planning constraint exists) are shown in Annex D and in footnote 21. These capacities should not be confused with forecast throughput. Outside of the South East of England, where airports tend to be more crowded, most regional capacities are notional and far exceed current and predicted usage.

Aligning airport throughputs to capacity

3.21 There have been significant model improvements in the capacity constrained modelling to align forecast throughputs to input capacities at those airports which have become full. There are two main reasons behind this improvement.

1. The new practice of specifying terminal (passenger) capacities only where there is a clear planning-imposed constraint. In many cases this eases the computational requirement of finding a converged solution which satisfies a dual passenger and terminal constraint. Where no terminal capacity is entered, detailed modelling of average aircraft loads over time (allowing for dynamic response to demand changes in aircraft seat capacity and passenger load factor) results in effective passenger throughputs being controlled by the runway capacity. Overall, this does not greatly

[21] See Annex D for current assumed annual airport capacities. Airport capacities have only been updated from the previous consultation where there have been planning decisions, new airport planning applications or airports publishing development plans for public consultation since the previous review in 2018. The change in modelling capacity (see paragraph 3.16) now also means there is no need to state passenger capacities where no planning limitation is in place.

change the balance between runway and terminal usage at constrained airports relative to our previous forecasts.

2. Software platform upgrades have permitted the introduction of machine learning techniques into the ‘goalsearch’ algorithm used to find system-wide converged market clearing shadow cost prices at over-capacity airports.[22] The search for shadow costs is also improved by greater stability in the required re-calculation of aircraft loads (through the aircraft sizing graphs in the ATM model) undertaken when a trial converged solution is undertaken.

3.22 As a result of these changes the tolerances around the input capacities are now much tighter than in previous model versions. For example, at Heathrow, converged throughput is now generally within +/- 1,000 ATMs for both the 480,000 current ATM cap and the 740,000 ATMs enabled by a third runway.

[22] See UK aviation forecasts 2017 (publishing.service.gov.uk) paragraphs 2.57-2.61 for more description of the role of shadow costs in solving to input airport capacities.

4. Modelling the UK aircraft fleet

4.1 The Fleet Mix Model (FMM) forecasts the type of aircraft that will be used in any particular year to service future demand. The FMM has been further developed from that described in the 2017 forecasts. This model continues to take base year (2018) age distributions of ATMs by specific aircraft type at all the main UK airports and forecast the future changes to that composition, having applied national level assumptions about:

- the typical retirement age of each aircraft type
- the split of new aircraft entering the fleet each year

4.2 Since the last forecast publication, the FMM has been integrated inside the NAPAM calculation of ATM demand. Whereas previously the FMM was applied to scheduled, charter and low cost carrier (LCC) airline type split into six seat band groups, the FMM is now applied at a more disaggregate and targeted manner within NAPAM's ATM model at the route level. This is done at the same time as the number of ATMs are calculated from the number of seats required to meet demand on a specific route.[23]

[23] The NAPAM ATM model is described in the 2017 Aviation Forecasts report. The six seats bands were 0-70, 71-150, 151-250, 251-350, 351-500 and 500+ seats. In practice the final large seat band became virtually unused as airline operational practices changed.

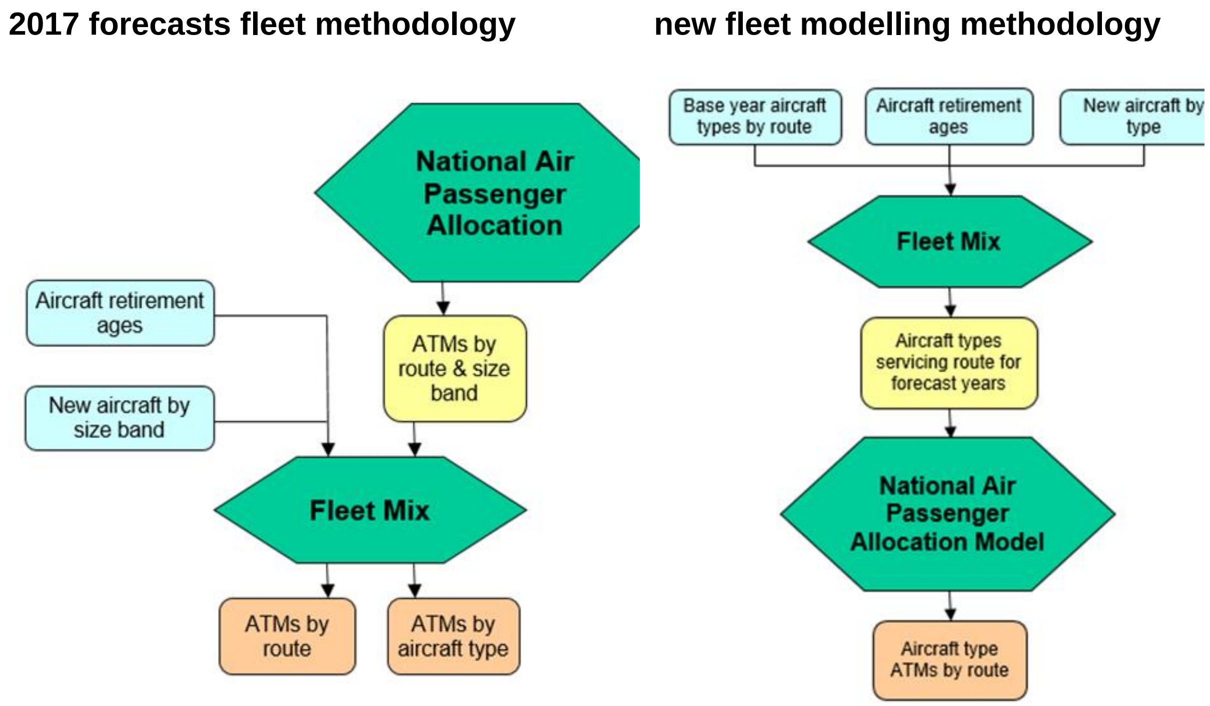


Figure 8 Incorporation of the Fleet Mix Model into NAPAM

4.3 Previously the same expected fleet composition for each model year had been applied to each of the three airline types and six seat band range combination. Now each of the current 135 airline and route specific aircraft sizing graphs in NAPAM's ATM model holds and applies the present and future fleet composition. This integration has delivered several advantages:

- increased granularity – fleets are now annually airport and route specific
- observed aircraft types by route are now a base year model input directly linking aircraft type to seats demanded by route
- extra functionality allowing entire aircraft types to be retired on a set date e.g. the recent retirement of all 747s
- greater precision on the future types of aircraft carried forward into the carbon modelling

4.4 Different scenarios for carbon abatement will produce some changes in the types of aircraft modelled, and some scenarios will explicitly model the introduction of different types of new generation aircraft into the fleet.

Model performance aircraft types

4.5 Prior to the Jet Zero Consultation, the department updated the fleet mix component of the aviation model to better reflect the age profile of aircraft operating in the UK in the years immediately before the pandemic. This update combined registration details of all 2.23m commercial aircraft movements recorded by the CAA at UK airports in 2017 with a current fleet inventory database to produce an updated age distribution of the active UK fleet. All retirements by aircraft type in the period 2014-2017 were analysed to produce a current UK specific retirement age profile by aircraft type. The future supply pool was also updated by analysis of manufacturer's aircraft order books.[24] Having used the 2017 data on fleet age distribution, expected aircraft retirement ages and expected replacements from the future supply pool, the new FMM was validated against CAA records of the fleet operating at UK airports in 2019.

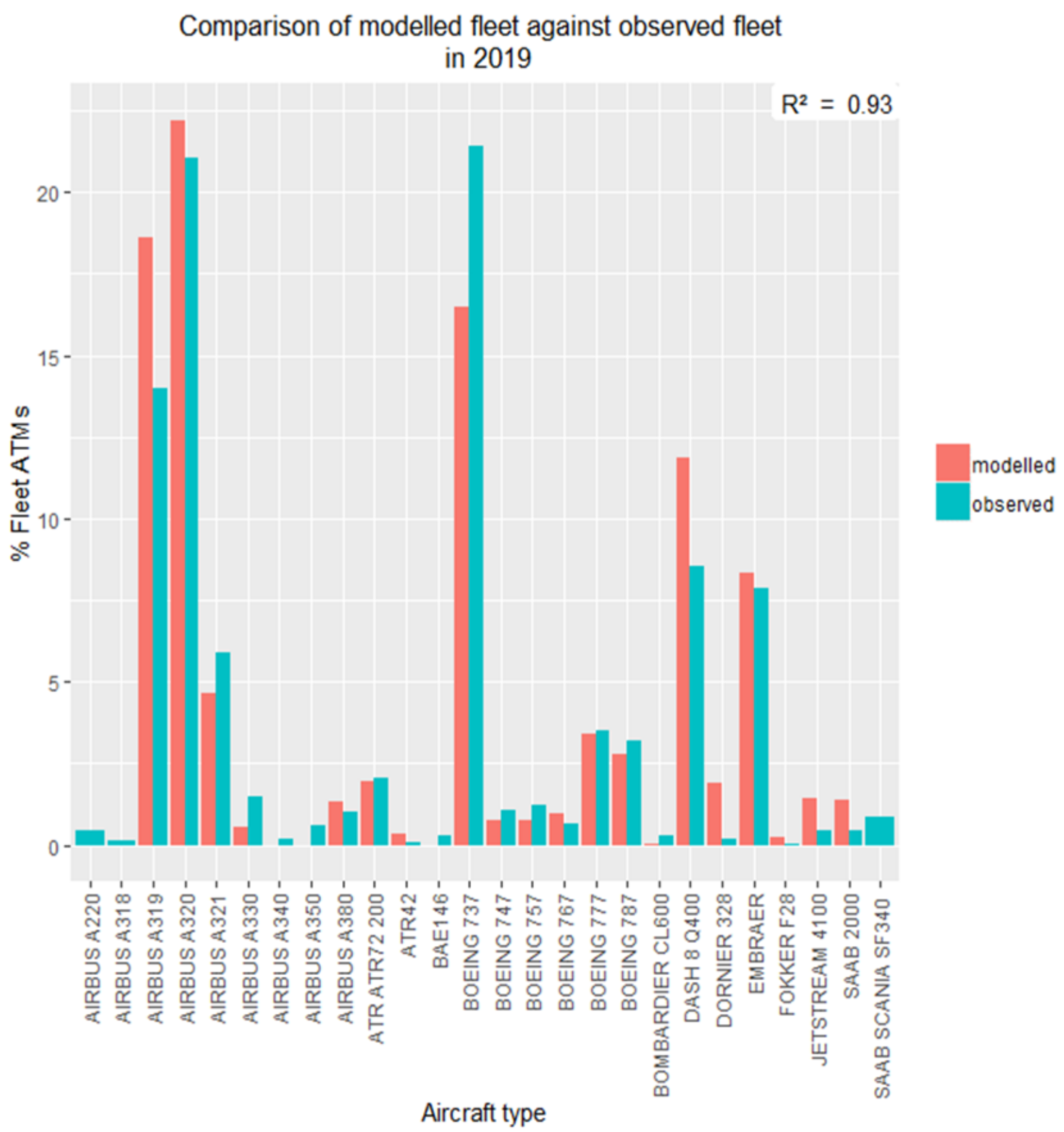


Figure 9 Comparison of predicted (modelled) and observed aircraft types, 2019

[24] All UK aircraft movements with registration mark data were provided by the CAA. The IBA iQ subscription database provided data on inventory of aircraft registrations with associated information such as model type, manufacturer, operator/owner details, manufacture year, seating configuration and activity status. IBA iQ order backlog databases provided the detail on ordered aircraft model, operators, engines, scheduled delivery dates and status of orders.

4.6 Figure 9 shows the fleet validation for 2019 at the UK national level. Across the entire fleet operating in 2019 the model provides a reasonable match with aircraft observed in CAA aircraft movement statistics.[25] There is an evident 5% shortfall of modelled Boeing 737s. This is offset by a surplus of Airbus A319 and A320s. In practice up to 9 aircraft types and type variants can operate some of the busiest routes or groups of modelled routes.[26] These tend to be highly competitive short-haul routes and groups of routes operated by the major low cost carriers. In terms of CO2e emissions modelling, these aircraft types have very similar fuel burn rates and so there is little if any distortion in the emissions modelling. Likewise, the excess of the modelled Dash-8, operated until 2020 principally by Flybe, which is offset by several other types of turboprops.[27] Short-haul turboprop aircraft are small (nearly always under 100 seats) and relatively low CO2e emitters, and so again there is little impact on the CO2e emissions modelling. This is illustrated by the table below which applies the department's CO2 and fuel burn models to the 2019 CAA route and aircraft-type ATM statistics.

	%ATM-Kms	CO2
Wide-bodied jet 4 engines	9%	21%
Wide-bodied jet 2 engines	36%	46%
Narrow-bodied jet	51%	32%
Turbo-prop	3%	1%
Others	1%	0%

4.7 ATM-kms travelled are an important indicator of potential CO2e impacts, but, as the table of fuel burn modelling applied to aircraft type outturn for 2019 illustrates, the relationship is far from linear. The department's CO2e modelling is discussed in the next chapter.

Aircraft fleet replacement modelling

4.8 As described above, the incorporation of route specific fleet modelling into NAPAM allows a more granular application of the forecast fleet turnover.

[25] In addition to this national comparison the 2019 model validation process includes more detailed checks on model performance with respect to numbers of ATMs, aircraft sizes in seats and passenger loads on a (NAPAM airport – zone) route level basis.

[26] Route group zones in NAPAM representing collections of individual smaller routes to destinations in a region.

[27] A turboprop is a hybrid engine that provides jet thrust and drives a propeller. It is used in the UK on domestic and short-haul passenger routes.

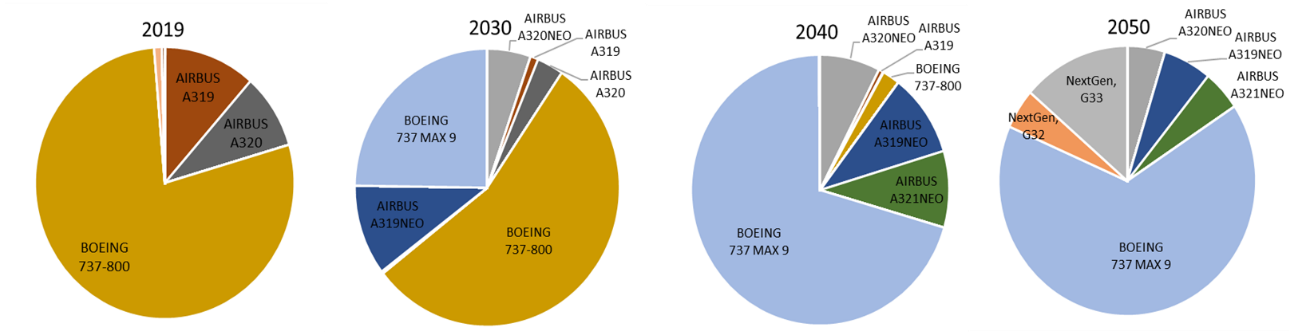
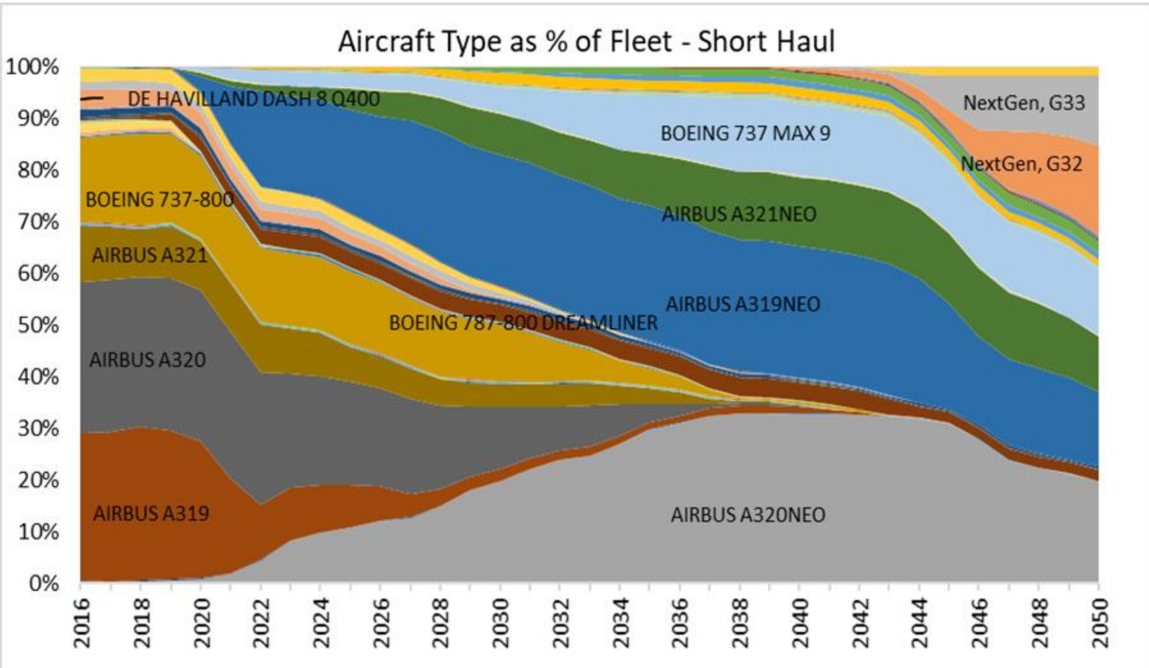


Figure 10 Fleet evolution on the NAPAM Stansted – Iberian Peninsula route forecasts

4.9 The future supply pool assumptions about replacement aircraft types and their potential fuel efficiency are essentially those used in the 2017 forecasts report. As described below modifications have only been made to these assumptions when there has been a clear and permanent change to the pattern of retirement patterns following the disruption to the airline industry caused by the COVID-19 pandemic.

4.10 While Figure 10 above illustrated the fleet replacement on a specific route, Figure 11 below illustrates the principle of how in the full model total short-haul and long-haul fleets evolve over time. This is the baseline model version. The companion document Jet Zero: further technical consultation details where and how these initial fleet mixes could develop differently in the forecast period.



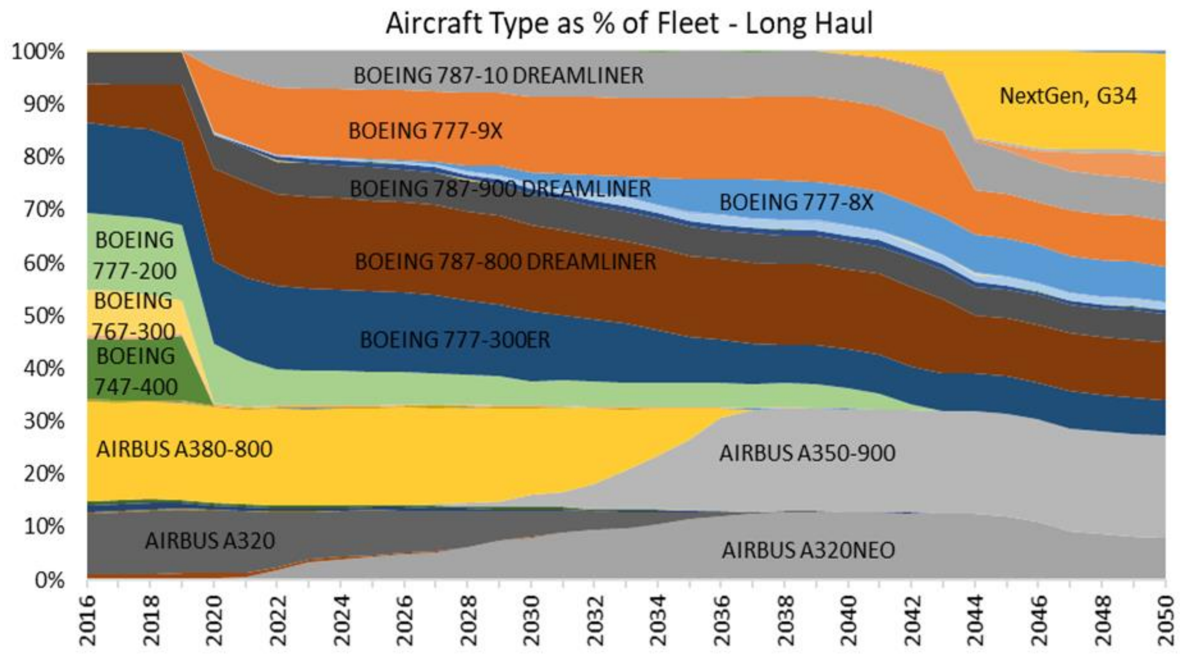


Figure 11 Baseline short and long haul fleet composition by year (illustrative)

4.11 The COVID-19 pandemic is likely to have had some impact on the fleets utilised by the airlines at UK airports. In previous downturns in aviation demand, airlines have reacted by retiring their least fuel-efficient aircraft. However, it is too early to establish with reliable data exactly how the current profile of the fleet has changed in response to recent circumstances. It is therefore premature to comprehensively review and update the assumed fleet age and replacement profiles. However, where there has already been clear evidence of the operational response by airlines, we have made limited updates to the base fleet. These include:

- bringing forward the retirement of old widebody aircraft – notably the Boeing 747
- retiring the Boeing 767 as a significant carrier in 2020
- bringing forward the introduction of more of the fuel-efficient types, e.g. the Boeing 787 Dreamliner, Airbus A350 and the next generation Boeing 777
- recognising that A380 production ended in 2021 and these aircraft leave the fleet in 2030s as they reach retirement age and causing a step change in fleet composition in the 2040s as the original widebody replacements start to retire.

4.12 Annex G shows graphically the evolution of the baseline aircraft type supply pool for the major passenger aircraft manufacturers.

Passenger load factors

4.13 The future size and passenger load factors of aircraft will be a key determinant of the number of aircraft needed to meet future demand. In recent years increased load factors have played a significant role in increasing practical capacity – in effect allowing airports to make better use of existing runway capacity in terms of numbers of passengers uplifted. Potentially higher load factors mean using less ATMs to meet demand and consequently less CO2e emissions. This latest version of the model accurately represents the recent rise in passenger load factors. There is a good model performance in reproducing 2019 aircraft loadings, as shown in Annex F. This updating is a key change affecting forecast CO2e emissions in comparison with those presented in the original Jet Zero Consultation analysis.

4.14 At the UK national level in the 10 years before 2020, the average size of aircraft used on commercial passenger flights has increased by 5% from 152 to 159 seats. At the same time the average passenger load per aircraft has increased by 11% from 118 to 131 passengers per aircraft.[28] So although the size in terms of seats has been increasing, the increase in load factors achieved by the airlines has arguably been even more significant in driving up average aircraft loadings in recent years.

4.15 The methodology behind the input of load factor growth assumptions has not been reviewed since the department published its forecasts in 2013. In light of recent developments, the method has been updated to better account for the observed trends while retaining the same rules on the limits to load factor growth.

- Observed CAA data for each modelled route is used for 2016-2019.[29] The ‘old’ 2017 forecasts model used observed data for 2016 only and by 2019 observed average load factors were 5% higher than those previously forecast. This uplift has a significant impact on the future numbers of ATMs forecast.[30]

- Annual growth increments in load factor updated are now calculated using observed growth rates from 2010-2019 for each route allowing historic trends for specific routes to be extended, but subject to a 95% cap.

- In previous forecasts load factors were forecast to grow in the period 2016-2030. Now they are forecast in line with route level historical statistical trends for the same 2016-2030 period. They remain subject to the same ultimate cap of 95% for both international and domestic flights.

- A setting which had allowed the modelled load factor to be grown by a further 2% spread over 10 years at any airport which reached runway capacity (i.e. experienced the onset of shadow costs) has been dropped. This was primarily because it was difficult to gather robust statistical evidence that such an impact occurred at over-capacity UK airports or of the duration of any such effect.

- The growth in load factors in the last decade has clearly been interrupted by the COVID-19 pandemic. But for the purposes of this work, given clear evidence of the

---

[28] The impact of rising load factors in the five years before 2020 is even more marked at Heathrow where the average load per aircraft has increased by 6% from 159 to 169 while the size of aircraft used to deliver this has decreased from 218 to 211 seats (-3%).

[29] Route here means a UK airport to either other UK airports or the 67 international zones in the NAPAM zone system.

[30] Outturn load factor data reviewed against forecast outputs for 2015-2019 showed that input assumptions tended to underestimate the load factor growth while the model was generally performing well in predicting changes in aircraft size.

importance of higher load factors to modern airline business models, it is assumed that load factors will revert to the previous trend.

5. Modelling aircraft CO2e emissions

Introduction

5.1 Aviation CO2e emissions are directly related to the amount and type of aviation fuel consumed. There are therefore four key drivers of aviation CO2e emissions:

- total aviation demand driven principally by levels of national and international economic activity and passenger sensitivity to the level of air fares including the cost of fuel burnt and carbon prices in the fares – this is the output of NAPDM described in Chapter 2;
- total distance flown: this comprises the volume and average distance of flights from the UK, in turn driven by passenger demand after accounting for airport capacity constraints – this is the output of NAPAM described in Chapter 3;
- fuel efficiency of aircraft: the fuel required to fly a given total distance will fall as aircraft efficiency driven by technological and operational improvements improves – efficiency gains derive from the turnover of the regular fleet as output in the NAPAM Fleet Mix Model and described in Chapter 4; and,

5.2 type of fuel or power utilised by aircraft: the CO2 emissions associated with a given amount of fuel burn will fall as the penetration of alternative fuels and power sources increases – these are a principal focus of the abatement strategy scenarios and are discussed in detail in Jet Zero: further technical consultation.

5.3 The CO2e modelling component in the department's aviation modelling suite is essentially unchanged from that used in the Jet Zero Consultation (July 2021). The key inputs to the fuel burn and CO2e forecasts are NAPAM forecasts of annual ATMs for each airport, by route and by forecast aircraft type. As described in the previous chapter, the aircraft type prediction is now made inside NAPAM at the route level rather than the previous exogenous Fleet Mix Model.

5.4 NAPAM now forecasts ATMs by specific aircraft types. On each route these aircraft types flying in and out of the UK are output as seat-kilometres. Distances applied are the 'great circle' distances, a common metric for aviation purposes, representing the shortest air travel distance between two airports taking account of the curvature of the earth. Separately in the department's CO2 model, the actual distance flown is increased above the great circle distance because of sub-optimal airspace routeing and other en-route air traffic control inefficiencies such as stacking for landing at airports during periods of congestion. An adjustment factor is therefore applied to uplift the distance flown by 5% for short-haul, and 6% for long-haul destinations as recommended in a model review by Ricardo Energy & Environment.[31]

5.5 In 2018 the department, jointly with the CCC, commissioned research from a consortium of academics and industry experts to examine the scope for fuel efficiency improvements of the fleet used in UK aviation. This work included assessed improvements to engine and airframe design and technologies, operational measures that were within the control of airlines and air traffic management. The research was based around representative aircraft types and methodologies in the department's Fleet Mix Model. We have used this analysis as an input to our modelling of fuel burn and carbon emissions. This research informed the baseline fuel burn technologies and timeframes of new aircraft types in the aircraft replacement supply pools (see Annex G) used in the Jet Zero Consultation and retained in this updated modelling. The generic assumed future aircraft types ('NextGen') shown in Figure 11 in the previous chapter are modelled with fuel efficiencies reflecting this latest research.

Modelling aircraft fuel burn

5.6 The European Environment Agency's (EEA) air pollutant emissions inventory guidebook 2016 has been an established starting point for fuel burn modelling. Fuel burn is measured in kilograms of fuel per aircraft and is broken down to bands of flight distances and the different stages of the flight (e.g. the landing and take-off cycles and cruise stage).[32]

5.7 The EEA inventory is an established and authoritative source of data on aircraft fuel burn rates, and has been significantly enhanced in recent years with many more aircraft types and anonymised actual operational data provided by airlines.[33] It is used for general reference, and for use by parties such as the Convention on Long Range Transboundary Air Pollution (LRTAP) and for reporting to the UNECE Secretariat in Geneva. It is also widely used by ICAO-CAEP in setting environmental policies and standards.

5.8 In the CO2 model, aircraft types and future types are mapped to types for which data is provided in the EEA guidebook or to future generation types. Where data for the specific plane type is not available, it is mapped to a similar 'proxy' type and, where needed, an adjustment made to account for higher/lower fuel efficiency. As part of a review of the CO2e modelling process, Ricardo Energy & Environment provided advice on mapping aircraft types to those in the EEA guidebook. The review also

---

[31] This input can be used as a potential decarbonisation lever, but these settings are held constant for the Jet Zero analysis.

[32] Aircraft burn fuel at a greater rate at the start of flights, not just because of take-off and climb out, but because there is more fuel weight to carry.

[33] It is assumed that fuel burn on a 100% loaded jet aircraft will be 5% higher than on a 70% loaded aircraft, due to the increased weight. See *An evaluation of aircraft emissions inventory methodology by comparisons with reported airline data*. Daggett, D. L., D. J. Sutkus Jr., D. P. DuPois, and S. L. Baughcum, 1999: NASA/CR-1999-209480.

advised on adapting guidebook fuel burn models for generic future aircraft types, mapping them to existing types but with an adjustment to account for anticipated performance improvements. Manufacturers' data and the PIANO aircraft design and performance model are used to project the fuel burn rates of new aircraft types expected to enter service soon.

5.9 Apart from taking account of the research jointly commissioned with the CCC on updating likely future aircraft fuel efficiency improvements and the incorporation of the FMM into NAPAM, the fuel burn to CO2e methodology is largely unchanged from the department's 2017 forecasts.

5.10 In common with previous forecasts, a similar approach is taken by forecasting at the national level using the forecast of freighter ATMs which are held constant at 2019 levels. Emissions are projected to grow by combining the number of freighter ATMs, average trip length, and fuel efficiency projections. Fuel efficiency is assumed to follow a similar path to that of equivalent passenger aircraft.

Fuel burn for future aircraft types

Data in the EMEP/EEA air pollutant emission inventory guidebook 2016 has been used to derive rates for fuel burn/distance (in kg/Nm) as a function of flight distance for most currently available aircraft types.

Fuel burn rates for future aircraft types, not contained in the guidebook, have been related to rates of existing aircraft types on the advice of Ricardo Energy & Environment as shown in the examples below for the major model types used in the Jet Zero assessment.

Future aircraft type[34]	Fuel burn
BOEING 737 MAX 9*	B739 -15.0%
AIRBUS A319NEO*	A319 -15.0%
AIRBUS A320NEO*	A320 -15.0%
AIRBUS A321NEO*	A321 – 15.0%
BOEING 777-9X*	B77W – 13.0%
NextGen G31, Post 2030 c1 1-70 seats*	ATR42 -31.5%
NextGen G32, Post 2030 c2 71-150 seats*	B734 -31.5%
NextGen G33, Post 2030 c3 151-250 seats*	B734 -31.5%
NextGen G34, Post 2030 c4 251-350 seats*	B772 -29.5%

* New future type developed from type in the guidebook with advice from Ricardo Energy & Environment

Which emissions are being counted?

5.11 The scope of aviation CO2e could cover many possible sources of emissions. For example, it may be argued that emissions from journeys to and from an airport are 'generated' by the existence of the airport and its services. However, this potentially

[34] Note that the specific Max and Neo variants now replace the 'NextGen G2' types in previous reports on the future composition of the FMM, this is a change in labelling more than a change in the modelling of the fuel burn.

causes double-counting of emissions in different parts of the UK national inventory where surface transport emissions are accounted separately.

5.12 It is also important to recognise that some actions or events that reduce UK inventory aviation CO2e emissions do not necessarily reduce global aviation CO2e emissions (and vice versa). For example, constraining activity at UK hub airports could result in some passengers making transfers via neighbouring continental hub airports instead of the UK, thereby offsetting the reduction in the UK emissions inventory with increases in emissions elsewhere. This is in effect exporting UK aviation emissions and not reducing the global climate impact of the emissions. The scope of the CO2e emissions modelling here is aircraft departing UK airports. The value of using the NAPAM model (see Chapter 3 and the 2017 forecasts report) is that it models the interaction between UK airports and competing continental hub airports. The value of adopting the airport capacity assumptions set out in Chapter 3 is that by representing a plausible maximum practical airport capacity case, it also realistically limits the export of passenger generated aviation emission and provides a suitable precautionary level of UK demand for considering UK aviation abatement strategies.

5.13 The sources of emissions covered in the forecasts in this chapter are set out in the table below. The approach used is consistent with the BEIS outturn estimates and the UNFCCC recommended approach for reporting on CO2e emissions from international aviation. The sources of CO2e included in the forecasts are those using A1-Jet fuel/Kerosene and exclude the light aircraft using aviation spirit/Avgas to reconcile with BEIS bunker fuel returns of A1-Jet fuel. Thus, business jets using jet-fuel are included as part of the residual (see below),[35] but light aircraft including most general aviation are excluded because the fuel is not included in the bunker jet/turboprop fuel returns.

Emissions source	**Included in forecasts?**
All domestic passenger flights within the UK	Yes
All international passenger flights departing UK airports	Yes
All passenger aircraft while on the ground in the UK e.g. taxiing	Yes
All domestic freighter aircraft departing UK airports	Yes
All international freighter aircraft departing UK airports[36]	Yes
All freighter aircraft while on the ground in the UK e.g. taxiing	Yes
Non- scheduled ‘business jets’.	Yes
Avgas using general aviation (non-commercial flights) in UK airspace	No
Military flights	No
Surface access, i.e. passenger and freight journeys to and from a UK airport	No
Non-aircraft airport sources, e.g. terminal power sources and airfield vehicles	No
UK registered aircraft flying from airports not in the UK	No
International flights arriving in the UK	No
Overflights passing through UK airspace	No

[35] Business jet cannot be modelled on a route by route basis and not reported in CAA statistics so have to be treated as part of the bunker fuel ‘residual’ – see below. They are thought to be the largest component of the residual.

[36] Emissions from freight carried in the belly hold of aircraft are captured in the passenger aircraft emissions.

CO2e.

5.14 It should be noted that since the 2017 forecasts were published the metric used by the department for reporting emissions is now by default CO2e (‘CO2 equivalent’) rather than CO2. The department’s model which produces these forecasts is still referred to as the ‘CO2 Model’, but it has been run in its CO2e output mode throughout this analysis.

5.15 In practice when kerosene is burned, small amounts of other greenhouse gases (included in the Kyoto Protocol) are also emitted including methane (CH4) and nitrous oxide (N2O). The emissions forecasts are uplifted accordingly. However, the amounts are small – they equate to around 1% of the global warming potential of the CO2 itself.[37]

Validation of emission forecasts with BEIS bunker fuel data

5.16 The new baseline forecasts using the updated FMM and CO2 models have been validated against base year CO2e actuals for 2019. In common with established national reporting practice, CO2e is counted for departing aircraft only.

5.17 Aviation emission forecasts are adjusted to match the Department for Business, Energy and Industrial Strategy (BEIS) estimate of 2019 outturn (i.e. published) aviation CO2e emissions (using the UNFCCC reporting method),[38] as reported in the National Atmospheric Emissions Inventory (NAEI). The BEIS estimates of outturn CO2e emissions from aviation are based on the amount of aviation fuel uplifted from bunkers at all UK airports.

5.18 In the modelling, the adjustment also reflects any difference in definition, including the absence from the modelling of the minor types of traffic such as business jets which are difficult to model, or flights from very small airports that are not included in the model.[39] The department adjusts to BEIS bunker-fuel based returns with a supplementary residual which is added to the modelled CO2e and held constant throughout the forecast period.

5.19 The reconciliation of 2019 modelled estimates against 2019 actuals, and the resulting residual adjustment, is shown below.

Million tonnes of CO2e	International	Domestic
Bunker CO2e actual 2019	36.7	1.4
Model CO2e 2019	35.1	1.3
Difference or ‘residual’	1.6	0.1

[37] The exact CO_2 to CO_2e factor applied to all CO_2 emissions is 1.01035.
[38] The 'forecast' for 2015 is about 1.0MtCO_2e (3%) below the latest revised BEIS estimate for that year. This residual amount is added back into the forecasts. A similar procedure is required by BEIS when converting DUKES air fuel sales data to CO_2e bunker emissions data for domestic and international civil aviation. The adjustment is held constant throughout the model period.
[39] In addition to allowing for aircraft and fuel burn modelling error, the residual must also accommodate any asymmetries in inbound and outbound flight refuelling caused by the practice of ‘tankering’. It excludes light aircraft using Avgas – see above.

5.20 A positive CO2e residual value is to be expected. The scale of the residual is well within the expected range and gives confidence in the more precise and disaggregate aircraft fleet modelling within NAPAM and the fuel burn models.

Annex A: Changes to NAPDM demand elasticities

	Previous model (using data to 2008)		Current model (using data to 2017)	
	Income elasticity	Price elasticity	Income elasticity	Price elasticity
UBD (UK business domestic)	0.9	-0.3	1.1	-0.2
ULD (UK leisure domestic)	1.4	-0.7	1.0	-1.0
UBSE (UK business Southern Europe)	1.1	-0.3	0.6	-0.2
UBRoE (UK business Rest of Europe)	1.1	-0.3	1.1	0.0
UBOECD (UK business other OECD)	0.9	0.0	0.1	0.0
UBRoW (UK business Rest of the World)	0.9	0.0	0.4	-0.6
ULSE (UK leisure Southern Europe)	1.2	-0.7	1.0	-1.1
ULRoE (UK leisure Rest of Europe)	1.2	-0.7	1.0	-1.1
ULOECD (UK leisure other OECD)	1.2	-0.3	1.3	-1.1
ULRoW (UK leisure Rest of the World)	1.4	-0.6	2.0	-0.9
FBSE (Foreign business Southern Europe)	1.0	-0.2	1.1	-0.1
FBRoE (Foreign business Rest of Europe)	1.0	-0.2	0.7	-0.3
FBOECD (Foreign business other OECD)	0.5	-0.2	0.9	0.0
FBRoW (Foreign business Rest of the World)	0.7	0.0	1.2	-0.3
FLSE (Foreign leisure Southern Europe)	1.1	-0.8	2.6	-1.1
FLRoE (Foreign leisure Rest of Europe)	1.1	-0.8	1.9	-1.1
FLOECD (Foreign leisure other OECD)	0.5	-0.3	1.1	-1.1
FLRoW (Foreign leisure Rest of the World)	0.5	-0.2	2.1	-0.9

Cells in yellow reflect overrides. Overrides are applied where a market's data are limited. When an override takes place, we refer to the elasticities of other similar markets with more robust data and validate with economic theory and existing literature.
In the markets where a structural break exists, it is the elasticities post the structural break that are shown.
Where elasticities do not relate to a specific market, they have been weighted.

	Previous model (using data to 2008)		Current model (using data to 2017)	
	Income elasticity	Price elasticity	Income elasticity	Price elasticity
Overall	1.1	-0.6	1.2	-0.9
All business	1.0	-0.2	0.9	-0.2
All leisure	1.2	-0.6	1.3	-1.1
Domestic	1.2	-0.5	1.1	-0.6
Southern Europe	1.2	-0.7	1.2	-1.0
Rest of Europe	1.1	-0.6	1.2	-0.9
OECD	0.9	-0.3	1.1	-0.9
Rest of World	1.1	-0.4	1.8	-0.9
All UK residents	1.2	-0.6	1.1	-0.9
All foreign residents	0.9	-0.5	1.6	-0.9
Where elasticities do not relate to a specific market, they have been weighted				

Annex A footnote: NAPDM time series fare inputs

Data	Source	Aggregation level	Unit
Exchange rates (short-term)	OBR	Year	$/£ (2015 prices)
Exchange rates (long-term)	Assumed no change	Year	$/£ (2015 prices)
Oil prices	BEIS	Year	$ / barrel (2015 prices)
Carbon prices UK ETS	DfT series	Year, UK / EEA	£/CO2 (2015 prices)
Carbon prices CORSIA	DfT series[40]	Year, long-haul	£/CO2 (2015 prices)
Air Passenger Duty (APD)	HMRC	Year, domestic / global region	£ (2015 prices)
Non-fuel costs changes	DfT calculation based on trends in CAA historic data	Year, short-haul / long-haul	Annual percentage change
Load factors	NAPAM	Year, domestic / global region	Percentage
Fuel efficiency	NAPAM	Year, domestic / global region	Seat km per tonne of fuel
Jet fuel price parameters: Relationship between oil price and fuel cost (fuel cost = α + βxOilPrice)	DfT regression	N/A	Constant (α): $ (2015 prices) Coefficient (β): Applied to oil price in $ / barrel (2015 prices) Result is fuel price $ / tonne of fuel (2015 prices)
Hedging assumptions	DfT assumption following review of airline statutory accounts	Year (3 years only)	Proportion of oil price applied by year (must sum to 100%)
Starting level of non-fuel costs	IPS fares data / DfT calculation	Year	£ per seat km in model base year (2015 prices)
Average trip length	NAPAM	Domestic / global region, journey purpose	Km
CO2e content of fuel (carbon intensity)	DfT CO2 model		

[40] More information on how these were derived is in *Jet Zero: further technical consultation*, Chapter 2 and Annex B.

Annex B: NAPAM International zone definitions

Zone code	Zone Name	Haul	Former zone	Changed?	NAPDM	EU/ETS
2001	US East	L	513	N	OECD	
2002	US West	L	512	N	OECD	
2003	Canada East	L	503	N	OECD	
2004	Canada West	L	502	N	OECD	
2005	Caribbean	L	522	Y	RoW	
2006	Mexico	L	522	new	OECD	
2007	Chile	L	522	new	OECD	
2008	South America (other)	L	522	Y	RoW	
2009	Australia & New Zealand	L	526	Y	OECD	
2010	South Pacific (other)	L	526	Y	RoW	
2011	Africa West	L	519	N	RoW	
2012	Africa East	L	520	Y	RoW	
2013	Africa South	L	521	N	RoW	
2014	China (Incl.Hong Kong)	L	525	Y	RoW	
2015	Japan & South Korea	L	525	new	OECD	
2016	Far East (other)	L	525	Y	RoW	
2017	Indian Sub-continent	L	524	Y	RoW	
2018	Asia (other)	L	518	Y	RoW	
2019	Middle East	L	523	Y	RoW	
2020	Israel	S	523	new	OECD	
2021	Russia & non-EU former Soviet	S	518	Y	RoE	
2022	Ireland	S	511	N	RoE	EU
2023	Channel Islands	S	527	N	RoE	EU
2024	France	S	505	Y	RoE	EU
2025	Belgium & Luxembourg	S	501	N	RoE	EU
2026	Netherlands	S	510	N	RoE	EU
2027	Germany	S	506	Y	RoE	EU
2028	Scandinavia (EU)	S	516	Y	RoE	EU
2029	Baltic States	S	518	new	RoE	EU
2030	Poland	S	518	new	RoE	EU
2031	Central Europe (EU)	S	517	Y	RoE	EU
2032	Bulgaria & Romania	S	518	new	RoE	EU
2033	Iberian Peninsula	S	514	Y	SE	EU
2034	Canary Islands	S	504	N	SE	EU

Zone code	Zone Name	Haul	Former zone	Changed?	NAPDM	EU/ETS
2035	Italy	S	509	Y	SE	EU
2036	Greece-other, EU eastern Med	S	507	Y	SE	EU
2037	Iceland (& Greenland)	S	508	N	RoE	(ETS)
2038	Norway	S	516	new	RoE	(ETS)
2039	Switzerland (& Liechtenstein)	S	517	new	RoE	
2040	Non-EU Balkan	S	515	new	RoE	
2041	Turkey	S	515	new	SE	
2042	African Mediterranean	S	519/520	new	RoW	
2043	Dublin	S	529	N	RoE	EU
2044	Brussels	S	532	N	RoE	EU
2045	Berlin	S	506	new	RoE	EU
2046	Dusseldorf	S	534	N	RoE	EU
2047	Hamburg	S	545	N	RoE	EU
2048	Munich	S	537	N	RoE	EU
2049	Copenhagen	S	535	N	RoE	EU
2050	Stockholm	S	540	N	RoE	EU
2051	Budapest	S	517	new	RoE	EU
2052	Vienna	S	541	N	RoE	EU
2053	Alicante	S	514	new	SE	EU
2054	Barcelona	S	543	N	SE	EU
2055	Madrid	S	536	N	SE	EU
2056	Malaga	S	514	new	SE	EU
2057	Lisbon	S	546	N	SE	EU
2058	Milan	S	539	new	SE	EU
2059	Rome	S	538	new	SE	EU
2060	Athens	S	544	N	SE	EU
2061	Oslo	S	542	N	RoE	(ETS)
2062	Geneva	S	547	N	RoE	(ETS)
2063	Zurich	S	533	N	RoE	(ETS)
2064	Paris CDG	S	528	N	RoE	EU
2065	Amsterdam	S	530	N	RoE	EU
2066	Frankfurt	S	531	N	RoE	EU
2067	Dubai	L	523	Y	RoW	
2068	UK offshore	S	599	N	UK	

Annex C: UK modelled airports in NAPAM

IATA	New_code	Name	Region	Old_code
LGW	3001	Gatwick	London & SE	471
LHR	3002	Heathrow	London & SE	473
LCY	3003	London City	London & SE	478
LTN	3004	Luton	London & SE	479
STN	3005	Stansted	London & SE	486
SOU	3006	Southampton	Other SE	485
SEN	3007	Southend	Other SE	484
BOH	3008	Bournemouth	South-West	465
BRS	3009	Bristol	South-West	466
EXT	3010	Exeter	South-West	470
NQY	3011	Newquay	South-West	482
CWL	3012	Cardiff	Wales	467
NWI	3013	Norwich	East	483
BHX	3014	Birmingham	Midlands	464
EMA	3015	East Midlands	Midlands	468
DSA	3016	Doncaster Sheffield	North	491
HUY	3017	Humberside	North	474
LBA	3018	Leeds/Bradford	North	476
LPL	3019	Liverpool	North	477
MAN	3020	Manchester	North	480
NCL	3021	Newcastle	North	481
MME	3022	Teesside	North	487
ABZ	3023	Aberdeen	Scotland	461
EDI	3024	Edinburgh	Scotland	469
GLA	3025	Glasgow	Scotland	472
INV	3026	Inverness	Scotland	475
PIK	3027	Prestwick	Scotland	492
BHD	3028	Belfast City	Northern Ireland	463
BFS	3029	Belfast International	Northern Ireland	462
XX1	3030	Spare1	n/a	488
XX2	3031	Spare2	n/a	489
XX3	3032	Spare3	n/a	490
CDG	3033	Paris CDG	Overseas Hub	493
AMS	3034	Amsterdam	Overseas Hub	494
FRA	3035	Frankfurt	Overseas Hub	495
DXB	3036	Dubai	Overseas Hub	496

Note: NAPAM only models the busier UK airports which had some regular international commercial passenger air services operating in 2019.

Annex D: Airport runway capacity assumptions for carbon modelling

Annual Capacities		Annual ATMs (000s)				mppa Annual passengers (if in use)			
		2019	2030	2040	2050	2019	2030	2040	2050
Gatwick	LGW	291	346	383	386				
Heathrow*	LHR	480	505	740	740				
London City*	LCY	111	151	151	151	6.5	11.0	11.0	11.0
Luton	LTN	160	210	210	210	18.0	32.0	32.0	32.0
Stansted*	STN	259	259	259	259	35.0	43.0	43.0	43.0
Southampton	SOU	150	150	150	150	2.5	3.0	3.0	3.0
Southend*	SEN	53	53	53	53				
Bournemouth	BOH	150	150	150	150				
Bristol	BRS	150	150	150	150	10.0	12.0	12.0	12.0
Exeter	EXT	150	150	150	150				
Newquay	NQY	75	75	75	75				
Cardiff	CWL	105	150	150	150				
Norwich	NWI	175	175	175	175				
Birmingham	BHX	206	206	206	206				
East Midlands	EMA	264	264	264	264				
Doncaster Sheffield*	DSA	57	57	57	57				
Humberside	HUY	150	150	150	150				
Leeds/Bradford	LBA	150	150	150	150	5.0	7.0	7.0	7.0
Liverpool	LPL	213	213	213	213				
Manchester	MAN	324	400	500	500				
Newcastle	NCL	213	226	226	226				
Teesside	MME	150	150	150	150				
Aberdeen	ABZ	175	225	225	225				
Edinburgh	EDI	150	225	230	261				
Glasgow	GLA	226	226	226	226				
Inverness	INV	150	150	150	150				
Prestwick	PIK	150	150	150	150				
Belfast City*	BHD	48	48	48	48				
Belfast International	BFS	260	260	260	260				
Paris	CDG	690	690	690	690				
Amsterdam	AMS	510	630	750	750				
Frankfurt	FRA	700	700	700	700				
Dubai	DXB	560	1360	1760	1760				

* assumed planning condition on ATMs

>0 = assumed condition on passenger numbers

Note: NAPAM only forecasts to capacity at the busier UK airports which had some regular international commercial passenger air services operating in 2019. See also paragraphs 3.18 to 3.22 for commentary on the updating of these capacity assumptions.

Annex E: Model performance – passengers at airports 2019

2019		Actual mppa	Modelled mppa
Gatwick	LGW	46.6	47.5
Heathrow	LHR	80.9	81.9
London City	LCY	5.1	4.8
Luton	LTN	18.2	17.3
Stansted	STN	28.1	29.9
Southampton	SOU	1.8	1.6
Southend	SEN	2.0	1.4
Bournemouth	BOH	0.8	0.7
Bristol	BRS	9.0	8.4
Exeter	EXT	1.0	1.0
Newquay	NQY	0.5	0.5
Cardiff	CWL	1.7	1.4
Norwich	NWI	0.5	0.5
Birmingham	BHX	12.6	11.1
East Midlands	EMA	4.7	5.4
Doncaster Sheffield	DSA	1.4	1.3
Humberside	HUY	0.2	0.2
Leeds/Bradford	LBA	4.0	4.5
Liverpool	LPL	5.0	4.2
Manchester	MAN	29.4	29.2
Newcastle	NCL	5.2	5.4
Teesside	MME	0.1	0.2
Aberdeen	ABZ	2.9	2.6
Edinburgh	EDI	14.7	14.0
Glasgow	GLA	8.8	8.4
Inverness	INV	0.9	0.7
Prestwick	PIK	0.6	0.3
Belfast City	BHD	2.5	2.6
Belfast International	BFS	6.3	5.2
UK Airport Totals		295.7	292.0

r^2 = 0.99885

Paris	CDG	76.2	76.6
Amsterdam	AMS	71.7	71.9
Frankfurt	FRA	70.6	70.2
Dubai	DXB	86.4	86.7
Foreign Hub Totals		304.8	305.5

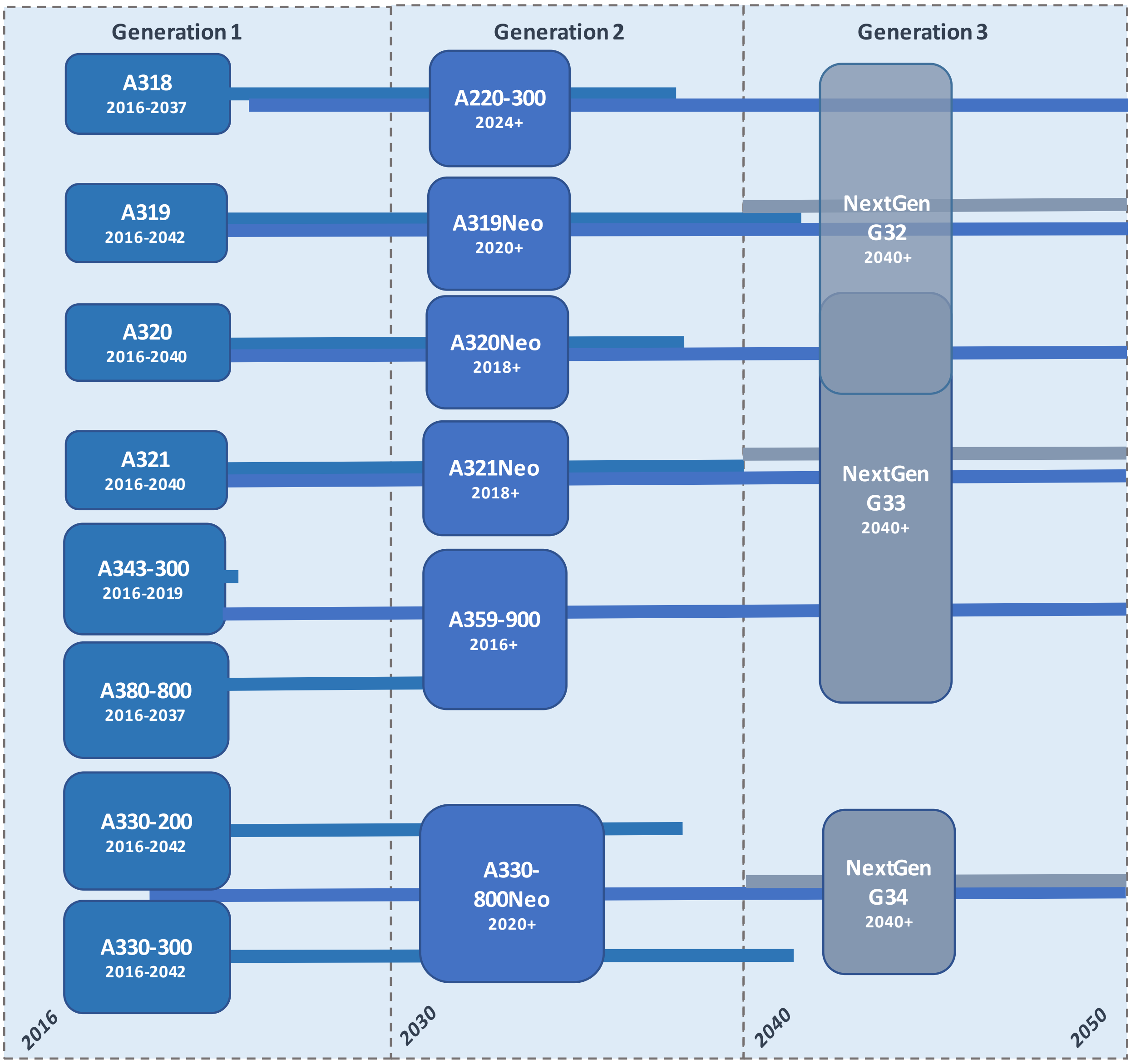
r^2 = 0.99850

Annex F: Model performance – aircraft movements (ATMs) and aircraft passenger loads at UK airports 2019

2019		ATMs '000s Actual	ATMs '000s Modelled	Passenger loads Actual	Passenger loads Modelled
Gatwick	LGW	283	288	165	165
Heathrow	LHR	480	477	170	173
London City	LCY	81	81	64	59
Luton	LTN	113	120	165	146
Stansted	STN	184	196	164	162
Southampton	SOU	33	33	55	47
Southend	SEN	19	11	108	139
Bournemouth	BOH	5	4	162	166
Bristol	BRS	63	60	144	141
Exeter	EXT	15	13	78	81
Newquay	NQY	8	9	68	66
Cardiff	CWL	17	19	105	76
Norwich	NWI	20	21	53	41
Birmingham	BHX	103	93	127	122
East Midlands	EMA	56	64	142	134
Doncaster Sheffield	DSA	10	9	148	140
Humberside	HUY	7	8	47	48
Leeds/Bradford	LBA	30	33	134	137
Liverpool	LPL	35	31	153	143
Manchester	MAN	196	202	152	147
Newcastle	NCL	40	44	131	124
Teesside	MME	4	4	41	40
Aberdeen	ABZ	78	83	66	49
Edinburgh	EDI	127	127	125	119
Glasgow	GLA	79	80	127	120
Inverness	INV	13	13	90	69
Prestwick	PIK	5	2	149	137
Belfast City	BHD	35	42	71	62
Belfast International	BFS	47	42	146	137
UK Airport Totals		2182	2211	145	141
		r^2 = 0.99791		r^2 = 0.94521	

Annex G: Fleet model aircraft supply pools

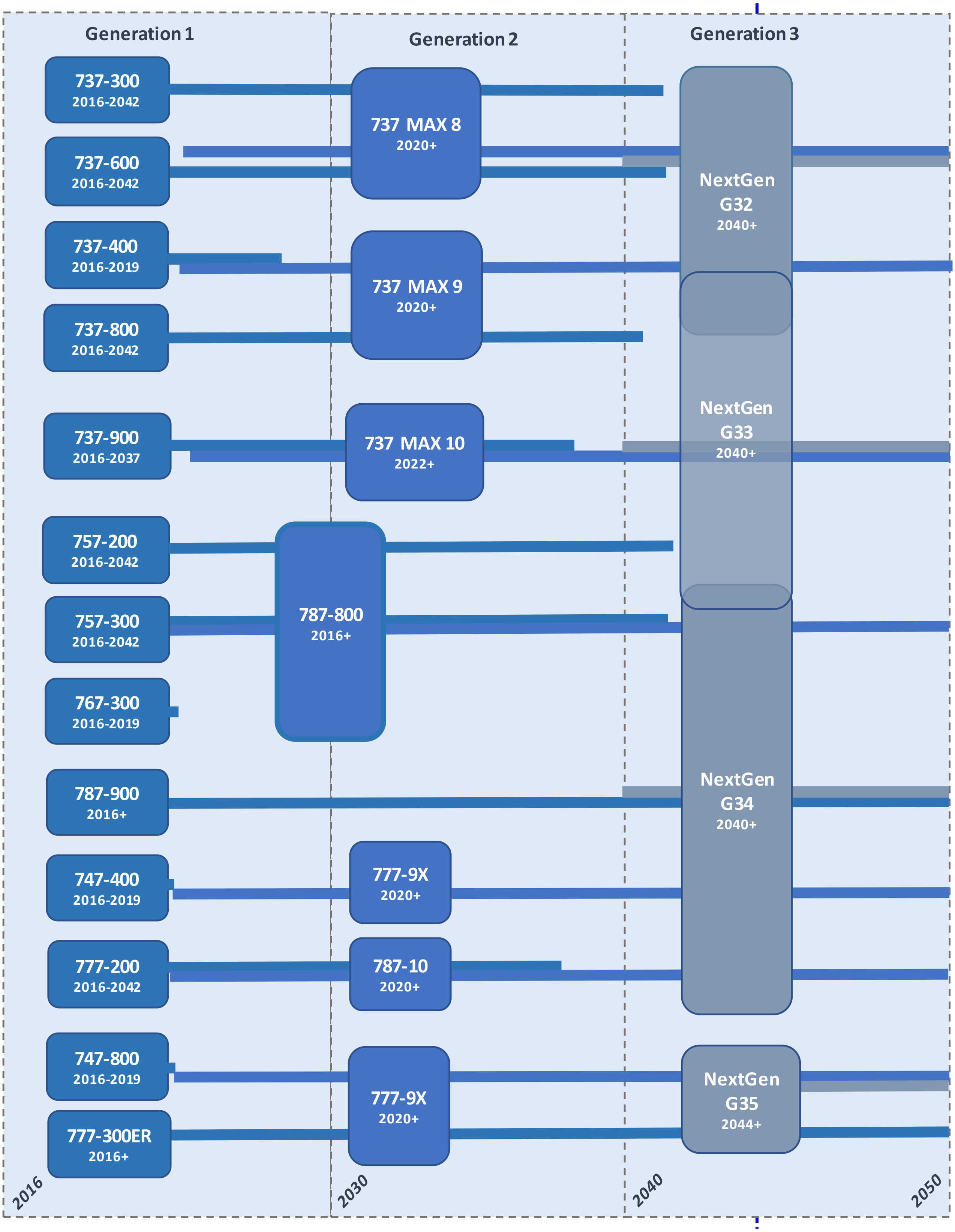
Airbus



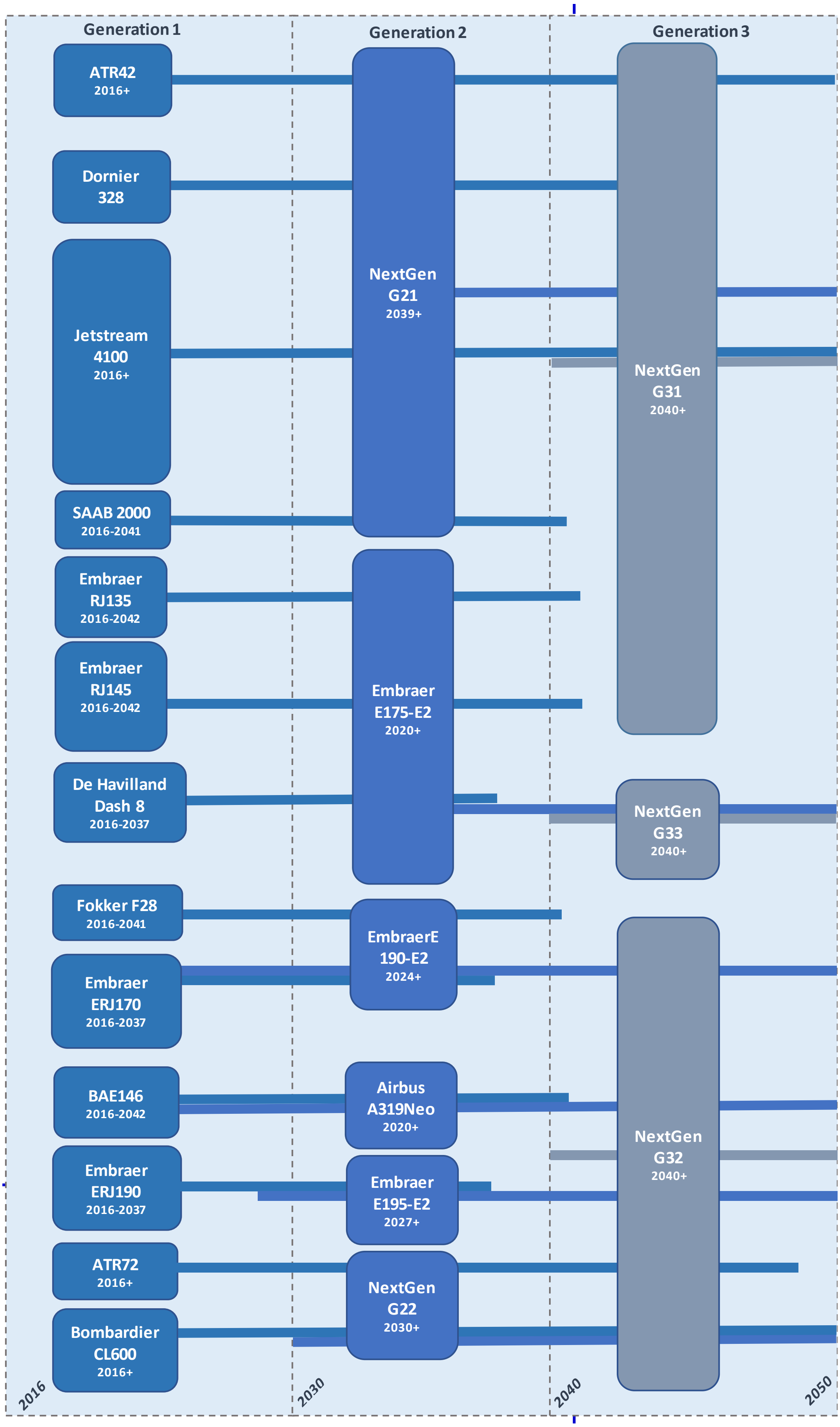
NextGen Code (*GYC*)		Introduction Date		Seat Class	
Y	introduction date	2	post 2030	1	0 - 70
C	Seat Class	3	post 2040	2	71 -150
				3	151 - 250
				4	250 - 350
				5	350 - 500

*Note that each supply pool has been developed with reference to the peer review undertaken by Ricardo Energy & Environment
(see DfT aviation fleet mix model: a review - GOV.UK (www.gov.uk)). The only change to this review is to remove existing aircraft types that have ceased significant operation at UK airports since the disruption caused by the COVID-19 pandemic.

Boeing


Generation 1
Generation 2
Generation 3
737-300
2016-2042
737-600
2016-2042
737-400
2016-2019
737-800
2016-2042
737-900
2016-2037
757-200
2016-2042
757-300
2016-2042
767-300
2016-2019
787-900
2016+
747-400
2016-2019
777-200
2016-2042
747-800
2016-2019
777-300ER
2016+
737 MAX 8
2020+
737 MAX 9
2020+
737 MAX 10
2022+
787-800
2016+
777-9X
2020+
787-10
2020+
777-9X
2020+
NextGen
G32
2040+
NextGen
G33
2040+
NextGen
G34
2040+
NextGen
G35
2044+
2016
2030
2040
2050

Others


Generation 1
Generation 2
Generation 3
ATR42
2016+
Dornier
328
Jetstream
4100
2016+
SAAB 2000
2016-2041
Embraer
RJ135
2016-2042
Embraer
RJ145
2016-2042
De Havilland
Dash 8
2016-2037
Fokker F28
2016-2041
Embraer
ERJ170
2016-2037
BAE146
2016-2042
Embraer
ERJ190
2016-2037
ATR72
2016+
Bombardier
CL600
2016+
NextGen
G21
2039+
Embraer
E175-E2
2020+
EmbraerE
190-E2
2024+
Airbus
A319Neo
2020+
Embraer
E195-E2
2027+
NextGen
G22
2030+
NextGen
G31
2040+
NextGen
G33
2040+
NextGen
G32
2040+
2016
2030
2040
2050

* Research suggests that the A319Neo will prove the most common replacement for movements previously made by the BAe146, hence it appears in both Airbus and ‘Other’ supply pool illustrations.

Annex H: Glossary

APD	**Air Passenger Duty**
ANPS	Airports National Policy Statement
ATM	air transport movement (i.e. a commercial aircraft flight)
BEIS	Department for Business, Energy, Industrial Strategy (UK government)
CCC	Committee on Climate Change (independent government advisory body)
CO2	carbon dioxide
CO2e	carbon dioxide equivalent – includes and uplift to forecast carbon dioxide to allow for other greenhouse gases methane (CH4) and nitrous oxide (N2O) emitted when jet fuel is burnt
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation (ICAO)
EEA	European Environment Agency
ETS	Emissions Trading Scheme
FMM	Fleet Mix Model – conversion of ATM forecasts into specific aircraft types by forecast year allowing for retirement and replacement of the fleet
fuel efficiency	Seat-kms delivered per tonne of aviation fuel
GDHI	Gross Domestic Household Income
GVA	Gross Value Added – a measure of production of goods and services in an area
ICAO	International Civil Aviation Organisation
IMF	International Monetary Fund (economic forecaster)
MBU	'Making Best Use' – current government policy on making best use of the capacity of existing runways with the airport expansion stated in the ANPS
mppa	million passengers per annum (terminal passengers)
NAEI	National Atmospheric Emissions Inventory (of the UK)
NAPAM	National Air Passenger Allocation Model – distributes unconstrained UK passengers around UK airports and competing foreign hubs
NAPDM	National Air Passenger Demand Model – econometric model of unconstrained trip demand by passenger markets
OBR	Office of Budget Responsibility (the independent UK economic forecaster)
OECD	Organisation for Economic Co-operation & Development – but also a long-haul region in NAPDM
ONS	Office of National Statistics (UK)
ped	price elasticity of demand
RoE	Rest of Europe – a short-haul region in NAPDM
RoW	Rest of the World – a long-haul region in NAPDM
SE	Southern Europe – a short-haul region in NAPDM
tankering	practice of taking on board more fuel where lower prices offset the cost of transporting surplus fuel
yed	income demand elasticity