Gatwick Airport Northern Runway Project

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Table of contents

Figures

Glossary

Term	Definition
ABAGO	Airport buildings and ground operations. ABAGO activities refer to energy use for buildings, infrastructure and operations to provide heating, cooling, lighting and power needs; fuels for airside land vehicles; refrigerant losses; water consumption and treatment; and operational waste disposal and treatment.
Base year	Year used for inflation adjustment and discounting. In this report, this is 2010.
Baseline	The situation that would arise without the Project. Analogous to the 'do minimum' scenario.
Benefits arising from fare effects	Benefits to passengers arising from changes in air fares as a result of the Project.
Benefits arising from time effects	Benefits to passengers arising from changes in travel time as a result of the Project.
Factor values	Values net of indirect taxation.
Fare elasticity of demand	Average percentage change in passenger demand in response to a 1% change in air fares.
GVA	Gross value added, a standard measure of economic activity that statistical agencies (such as the Office for National Statistics—ONS, and Eurostat) routinely use to ascertain an industry's contribution to an economy's total output. It is defined as the total value of output from a service excluding the value of any intermediate inputs (ie outputs of other sectors used as inputs from the supply chain).
Indirect tax correction factor	The average rate of indirect taxation in the economy.
London aviation system	London City, Gatwick, Heathrow, Luton, Southend, and Stansted airports; airlines operating at these airports; and passengers travelling through these airports.
Market values	Values gross of indirect taxation.
Normal profit	The profit that airlines would make in competitive market conditions.
Optimism bias	An adjustment made to the costs of the Project due to the propensity to overstate scheme costs and delivery times.
Present value	A value of a stream of impacts (cash or non-cash) discounted to the base year.
Providers of aviation services	Airlines and airports.
Real value	An inflation-adjusted value deflated to the base year.
Shadow cost	The value of scarcity, reflected in air fares that are higher than those that would prevail if there were no capacity constraints.
User surplus	The value of obtaining a service beyond the price that is associated with it.
Provider surplus	The value of delivering a service beyond the cost that is associated with it.
The Project	Gatwick's Northern Runway Project—this proposes alterations to the existing 'standby' or 'northern' runway at Gatwick Airport, which, together with lifting the current restrictions on its use, would enable dual runway operations. The proposed alterations would enable the northern runway to be used for take-off-only operations (ie only departures) for smaller aircraft (up to and including Code C aircraft).

Users of aviation services	Existing and potential air passengers and freight shippers.
Wider economic impacts	Impacts of the Project on people and businesses beyond the users and providers of the aviation network.

Source: Oxera.

1 Executive summary

1.1.1 This report, prepared by Oxera on behalf of Gatwick Airport Limited, presents the findings of a national Economic Impact Assessment of Gatwick's Northern Runway Project ('the Project') - a proposal to bring the Existing Northern Runway, which is currently restricted to use as a standby/emergency runway, into routine operation alongside continued use of the main runway.[1] The proposed alterations would allow departing flights to be shared between the existing main runway and the northern runway, with the northern runway being used for smaller aircraft (up to and including Code C aircraft).

1.1.2 For the purpose of the assessment, and in line with the indicative construction programme, the Project is assumed to become operational in 2029 to meet demand for additional capacity that cannot currently be provided by the main runway. As a result of the Project, additional air traffic would be able to flow through Gatwick Airport and the London aviation system as a whole. Air traffic forecasts produced by Gatwick suggest that the Project would increase passenger volumes at Gatwick Airport by approximately 13.2 m in 2038 and 13.0 m by 2047, compared with the passenger throughput that would exist without the Project. This is equal to the number of passengers using Birmingham Airport in 2019.[2] The use of this capacity by passengers and airlines would have substantial economic impacts at the local, regional and national levels, and Gatwick has commissioned Oxera to undertake an assessment of these economic impacts. This report focuses on the national economic impacts of the Project using a welfare-based approach. The impact of the Project on local employment and Gross Value Added (GVA) are assessed in a separate report, in **ES Appendix 17.9.2: Local Economic Impact Assessment** (Doc Ref. 5.3).[3]

1.1.3 Oxera's assessment, described in this report, finds that, by alleviating the capacity constraints at Gatwick Airport, the Project would increase the number of flights that the airport can accommodate, and therefore enable airlines to increase service frequencies. Congestion premiums that are related to capacity constraints and are reflected in air fares would decrease, leading to lower fares for passengers. As a result, there would be a transfer of benefits from airlines to passengers. The close proximity and substitutability of Gatwick Airport with other London airports mean that these impacts would extend to all passengers in the London aviation market. It is estimated that the net benefits to passengers and airlines would be £10.8 bn in 2010 prices and values.[4]

1.1.4 In addition, the increase in the number of passengers with the Project would increase the revenues of London airports, resulting in net benefits of £2.2 bn. Overall, the net benefits accruing to passengers, airlines and airports are estimated to be £13.1 bn.[5]

1.1.5 The Project is also expected to have impacts beyond passengers, airlines and airports. By providing increased connectivity, the Project would benefit businesses, leading to benefits of £13.5 bn. The increase in air traffic would also result in higher Air Passenger Duty (APD)

[1] Further details are provided in the **Planning Statement** (Doc Ref. 7.1).
[2] Civil Aviation Authority (2019), 'UK Airport Data', available at: https://www.caa.co.uk/data-and-analysis/uk-aviation-market/airports/uk-airport-data/uk-airport-data-2019/annual-2019/ (last accessed August 2022).
[3] For the assessment of the economic impacts of the Project at a local level, please see the **ES Appendix 17.9.2: Local Economic Impact Assessment** (Doc Ref. 5.3).
[4] Present value calculated over the appraisal period of 60 years from Project opening in 2029.
[5] Numbers presented may not sum due to rounding.

revenues for the Government of £2.5 bn.[6] However, increased road traffic due to the Project would result in estimated costs to UK society of £4.0 bn.

1.1.6 Increased activity at the airport would also have environmental impacts. For example, it would affect noise levels in the vicinity of the airport, along the flight paths, and through Gatwick's surface access network. Increased noise can have adverse health effects on individuals.[7] The net social costs of changes in noise levels are in relative terms small – estimated to be £9.2 m.

1.1.7 In addition, as a result of the Project there would be a change in air quality levels due to increased air and surface access travel. The monetised costs of this change in air quality are estimated to be £83.5 m.

1.1.8 Lastly, the Project is expected to have an impact on the level of greenhouse gas (GHG) emissions from four sources: aviation, surface access, construction, and the airport's operations. These GHG costs are estimated to be £1.3 bn.

1.1.9 In total, the social costs of the environmental impacts are estimated to be £1.4 bn. To reflect uncertainties in the carbon price trajectories and air quality costs, a sensitivity range was produced that shows that the environmental costs would be in the range of £0.6 bn to £2.2 bn.

1.1.10 Taking into account the scheme's OPEX and CAPEX costs of £2.1 bn, the net present value (NPV) of the Project is estimated to be £21.6 bn.[8]

1.1.11 The above estimates do not account for a number of additional benefits that the Project is expected to provide, but which are difficult to quantify, or which have not been included in the NPV due to concerns about double-counting.

1.1.12 For example, additional local employment generated directly and indirectly by the Project may result in workers switching jobs. This could bring positive employment impacts if the new positions are more productive, which could amount to £0.1 bn. Similarly, additional productivity benefits could arise as a result of increased concentration of economic activity in the local area, which would facilitate greater exchange of ideas and technological spillovers. These benefits are known as agglomeration effects, and are estimated at £0.7 bn. However, these two impacts do not factor in the potential displacement of workers from other areas, and hence are not included in the NPV of the Project.

1.1.13 Another benefit could arise from improvements in national productivity through increased trade facilitated by the Project. These improvements in productivity are estimated to range between £4.0 bn and £6.7 bn over the course of the appraisal period. However, these trade-related benefits have been excluded from the NPV of the Project due to concerns about double-counting with the user and provider impacts. Similarly, the improved access to international markets associated with the Project could facilitate foreign direct investment (FDI). For example, multinational firms could experience a reduction in costs as the increased connectivity would facilitate face-to-face interactions. Although this improvement in costs could affect international

[6] For consistency, all figures in this report are in 2010 prices and values, as 2010 is the price base year used by the Department for Transport. Unless otherwise stated, all estimates are reported in 2010 prices. Department for Transport (2022), 'TAG Unit A1.1 Cost-Benefit Analysis', November, p. 5.
[7] Civil Aviation Authority (2016), 'Aircraft noise and health effects: Recent findings', March. These health impacts include heart attacks, strokes and dementia.
[8] This represents the central case of the main assessment scenario.

investment decisions, the productivity impacts related to FDI changes are difficult to disentangle from trade-related impacts and hence have not been quantified.

1.1.14 Additional welfare effects arising from the Project could be associated with increased spending by the additional leisure passengers accommodated by the Project. This spending could result in productivity changes in the economy as, for example, higher activity in the supply chain of the tourism sector might direct labour to more productive jobs.

1.1.15 Capacity constraints also influence the level of competition between airports. The additional capacity would alleviate the capacity constraints at Gatwick Airport, enabling Gatwick Airport to provide a stronger competitive constraint on other airports in the London market in terms of competition for new and existing airlines and passengers.

1.1.16 Finally, Gatwick Airport provides an important source of air freight capacity to the UK—in 2019 the airport handled 150,000 tonnes of air freight. The Project would help to facilitate an increase in air freight at Gatwick Airport by increasing the number of ATMs and thereby increasing both the frequency and range of destinations served. Air freight traffic is expected to increase by 10% in the Project's opening year, and by 27% and 20% in 2038/39 and 2047/48 respectively as a result of the Project.

1.1.17 Overall, the Project would have significant benefits at a national level through its impact on aviation markets and the wider economy. These benefits would be materially larger than the negative impacts that have been quantified, meaning that the Project would have a net positive social impact of £21.6 bn.[9]

[9] This estimate reflects the central case of the main assessment scenario and excludes some impacts that have not been quantified due to robustness issues. For a summary of these impacts see **Annex A2.**

2 Updates in response to consultation feedback

2.1.1 The table below summarises the updates to the national Economic Impact Assessment (EIA) that have been made in response to stakeholder feedback on the PEIR EIA report produced by Oxera in August 2021, and which was subject to consultation in Autumn 2021.

Table 2.1: overview of Oxera's updates in response to 2021 consultation feedback

Topic	Summary of feedback	Update
Sensitivity analysis on slower growth impacts	The sensitivity analysis produced by Oxera may not accurately reflect a worst case scenario for national impacts.	Air traffic forecasts for the slow growth sensitivity have been updated by the air traffic consultants. The national impact assessment uses these forecasts as inputs to the sensitivity analysis.
Price elasticities of air demand	The analysis used literature elasticities different from the estimates produced by DfT.	The main analysis uses the updated price elasticities of demand which were published by the Department for Transport alongside the Jet Zero modelling framework.
Base air fares	Not enough information was provided about the source of these prices.	These base fares were provided as inputs. A table of the raw data has now been added in the report.
Tourism	No information is provided on how the Project would affect tourism on a national scale.	The mechanisms through which the Project would affect welfare due to changes in inbound and outbound tourist flows are discussed. This analysis focuses on welfare impacts rather than the direct financial impacts that a change in tourism might bring. Due to a lack of robust data and uncertainties in modelling the impact of increased tourism on UK productivity, these impacts have not been quantified in this report. Monetary impacts of tourism (ie in terms of GDP impact) are assessed in **Needs Case Appendix 2 - The Economic Impact of Gatwick Airport: A report by Oxford Economics** (Doc Ref. 7.2).
GHG costs	The monetisation of GHG impacts should be updated with the latest appraisal carbon cost values.	The appraisal values used in the analysis have been updated to the values in Department for Transport (2022), 'Greenhouse gases workbook', May.
Non-CO2 effects from aviation	The EIA did not assess the impact of the non-CO_2 effects of aviation's emissions.	A qualitative assessment of these impacts has been added in line with guidance from the Department for Transport.

Modal competition	The EIA did not consider the impacts on competition with other modes of transport.	A discussion of how the Project is likely to affect competition with other modes of transport, such as high speed rail, has been added.
Trade and FDI	Lack of quantification or illustrative assessment of the benefits to trade and foreign direct investment resulting from the Project.	The welfare impacts of the Project associated with trade have now been quantified. However, due to potential double-counting with other quantified benefits, these are not included in the NPV of the Project. Given that FDI benefits are realised through the same channels as trade, FDI benefits are not quantified as this would result in double-counting.

Note: The table summarises the key changes to the national impacts assessment methodology. Other feedback points made with respect to the presentation of the impacts and additional information required on the methodology are also incorporated in the update but not mentioned here.

Source: Oxera.

3 Introduction

3.1. Background

3.1.1 Aviation plays an important role in the UK economy. By enabling the movement of people and goods internationally, air travel facilitates trade, investment and business activity, as well as tourism and leisure activity. The role of aviation in connecting the UK to the global economy is reflected in the growth of the sector before the COVID-19 pandemic: between 2000 and 2019, the number of passengers at UK airports increased by 66%.[10]

3.1.2 Gatwick Airport was the UK airport with the second highest number of passengers in 2019, and has continued to hold this position even during the COVID-19 pandemic.[11] It is currently served by a single runway. It has a second runway, located to the north of the main runway, but planning restrictions restrict the use of this northern runway as a standby or emergency runway (ie for use when the main runway is closed). Gatwick is proposing to make alterations to the northern runway, which, along with lifting the current restrictions on its use, would bring it into routine operation alongside continued use of the main runway ('the Project'). The proposed alterations would allow departing flights to be shared between the main runway and the northern runway, with the northern runway being used for smaller aircraft only (up to and including Code C aircraft). All arriving flights would use the existing main runway and there would be controlled dependency between the two runways to enable safe crossing of the northern runway by arrival flights.

3.1.3 As a result, the Project would significantly expand capacity at Gatwick Airport and in turn lead to additional air traffic at Gatwick and in the London aviation system as a whole.[12] Gatwick has commissioned Oxera to undertake an economic assessment of the Project.

3.2. Overview of the national impact assessment

3.2.1 The HM Treasury Green Book guidance on scheme appraisals sets out guidance on how to assess the costs and benefits of a scheme, such as new infrastructure investment, to UK society.[13] A cost–benefit analysis involves quantifying the relevant costs and benefits of a scheme in order to assess its overall value.

3.2.2 By applying the principles set out in the HM Treasury Green Book, the Department for Transport (DfT) has developed a framework for cost–benefit welfare analysis in the transport sector, known as Transport Analysis Guidance (TAG). According to the DfT, transport interventions for which funding and/or policy are subject to Government approval, should be appraised using welfare-based measures in TAG. However, private-sector funded schemes seeking planning consent such as is the case with the Project, are not required to be appraised using TAG.

3.2.3 Nevertheless, a TAG welfare analysis is considered as a useful framework to assess and present the economic impacts (costs and benefits) of the Project that are additional at the national level. The DfT recognises that any appraisals should be proportionate to the scale of the likely impacts

[10] Department for Transport (2020), 'Air traffic, United Kingdom airports', AVI0101.
[11] In 2019, close to 47 m passengers travelled through Gatwick. During the pandemic, however, only 10 m and 6 m passengers travelled through Gatwick in 2020 and 2021, respectively. Gatwick is second to Heathrow, which welcomed 81 m passengers in 2019, 22 m in 2020, and 19 m in 2021. Civil Aviation Authority, 'Annual airport data 2019', available at: https://www.caa.co.uk/data-and-analysis/uk-aviation-market/airports/uk-airport-data/uk-airport-data-2019/annual-2019/ (last accessed March 2023).
[12] Consisting of Gatwick, Heathrow, London City, Stansted, Luton and Southend airports.
[13] HM Treasury (2022), 'The Green Book Central Government Guidance on Appraisal and Evaluation', p. 8. The approach in this report is also comparable with previous appraisals by the DfT and the Airports Commission.

and the degree to which data is available and/or can reasonably be collated.[14] Therefore, where possible, the relevant TAG units have been used to conduct a welfare analysis and estimate the NPV of the net benefits of the Project.[15] As discussed in section 6 and section 8, this does not capture the full range of benefits that the Project would deliver and therefore additional benefits are set out in this report.

3.2.4 TAG suggests that expansion at a capacity-constrained airport, as in the current case, will have direct economic impacts on air passengers, airlines and the airport itself, as it will enable more passengers to travel at reduced fares and at higher frequencies.[16] These benefits are additional to the national economy.

3.2.5 The additional capacity from the Project would relieve peak-time capacity constraints at Gatwick Airport, providing more options for airlines to offer aviation services and for passengers to benefit from these services. The impact of this capacity expansion, however, would extend beyond aviation services at Gatwick Airport during peak times, as the additional capacity would be available at all times. It may also affect air traffic at other London airports as passengers may prefer to use new services at Gatwick Airport with the Project instead of using other London airports. The current assessment focuses on the increased ability of the London market to satisfy demand due to the additional capacity provided by the Project.[17]

3.2.6 In addition, the increased activity that the Project would generate at the airport is expected to have wider impacts, such as benefits to businesses, increased revenues to the Government, costs from increased road traffic, and increased environmental costs associated with air travel.[18] These costs and benefits can be calculated to determine the overall value of the Project to UK society.

3.2.7 First, two scenarios are modelled as part of the analysis:

- a Baseline scenario, which is the scenario that is expected absent the Project; and
- a Project scenario, which refers to the situation where the Project proceeds.

3.2.8 Then, in order to determine the impact, differences between these two scenarios are evaluated as follows:

- only impacts that are additive at the national level are analysed;[19]
- only impacts that are incremental because of the Project are considered—ie impacts that are different between the Baseline and Project scenarios;
- an appraisal period of 60 years from scheme opening is used and includes the period of the Project's construction;[20]

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[14] Department for Transport (2022), 'TAG Unit A5.2 Aviation Appraisal', November, p. 3.
[15] The TAG units used in this assessment are: Units A1.1–3; Units A2.1–4; Unit A3; and Units A5.2 and A5.4. Although this report refers to the latest version of the TAG Units dated November 2022, the underlying analysis has used the previous version of the TAG Databook released in November 2021, for consistency with other analysis commissioned by Gatwick as part of the Environmental Statement.
[16] Department for Transport (2022), 'TAG Unit A5.2 Aviation Appraisal', November.
[17] The impact of capacity constraints with and without the Project is discussed and assessed in further detail in section 5.
[18] More information on additional employment opportunities is provided in **ES Appendix 17.9.2: Local Economic Impact Assessment** (Doc Ref. 5.3).
[19] For example, there might be benefits at a local level that are associated with disbenefits in other parts of the economy. The analysis accounts for both of these, and estimates the net change in welfare. HM Treasury (2022), 'The Green Book Central Government Guidance on Appraisal and Evaluation', p. 8.
[20] Department for Transport (2022), 'TAG Unit A1.1 Cost-Benefit Analysis', November, p. 5.

- all figures are reported in market prices;[21]
- prices are inflation-adjusted (real) (2010 prices);[22] and
- impacts are presented in present value terms (2010 values).[23]

3.2.9 Following DfT guidance,[24] the value of the Project is assessed by first determining the total benefits of the Project to passengers, providers and the wider economy.[25] Then the environmental impacts of the Project are evaluated to calculate the net social benefits. Finally, the scheme costs are subtracted from the net social benefits to calculate the Net Present Value (NPV) of the Project.[26] The NPV represents the sum of future discounted benefits minus the sum of future discounted costs.[27]

3.2.10 The national impact assessment also considers additional benefits to the UK economy, such as benefits from additional employment opportunities, productivity benefits, trade benefits, and increasing resilience to unexpected disruptions. However, these benefits are not included in the overall NPV as they are difficult to robustly quantify and/or there are concerns about double-counting with other benefits that are included in the NPV.

3.2.11 Non-welfare impacts, such as the number of jobs created or supported by the Project or its GVA impact, are assessed for the local study area around Gatwick Airport as part of the **ES Appendix 17.9.2: Local Economic Impact Assessment** (Doc Ref. 5.3). These non-welfare measures are not assessed in this report as they are only part of the full economic impact this assessment is seeking to capture using a welfare approach. Nevertheless, these are meaningful indicators of the impact of the Project.

3.2.12 Following the DfT's TAG, the analysis covers a 60-year period between 2029 and 2088, and also includes all pre-2029 Project-related development costs.[28]

3.3. Policy context

3.3.1 Undertaking an Economic Impact Assessment of the Project addresses some of the planning policy considerations against which the application for development consent will be determined.

3.3.2 For instance, the Airports National Policy Statement[29] details some of the considerations for weighing adverse impacts against benefits for any airport development, including potential benefits such as job creation, which the economic impact assessment examines. The Aviation Policy Framework[30] recognises that the aviation sector contributes significantly to the UK

[21] Department for Transport (2022), 'TAG Unit A1.1 Cost-Benefit Analysis', November, p. 5. The results in the current report are reported in market prices. The choice of unit of account affects the scale of impacts, but it does not affect the sign of the cost–benefit metrics.
[22] Department for Transport (2022), 'TAG Unit A1.1 Cost-Benefit Analysis', November, p. 5. The DfT's price base year is 2010. Unless otherwise stated, all estimates are reported in 2010 prices.
[23] Department for Transport (2022), 'TAG Unit A1.1 Cost-Benefit Analysis', November, p. 5. This corresponds to the time value of money for which the DfT's base year is 2010. Unless otherwise stated, all estimates are reported in 2010 values.
[24] Department for Transport (2017), 'Updated Appraisal Report Airport Capacity in the South East', October, p. 43.
[25] Users and providers of aviation services are passengers, airlines and airports. The 'wider economy' refers to non-aviation markets. The definition in this report follows Department for Transport (2018), 'Addendum to the Updated Appraisal Report Airport Capacity in the South East', June.
[26] Net social benefits do not include scheme costs, given that the scheme is not publicly funded. As such, the present value of net social benefits should be interpreted as the impact of the Project on society as a whole.
[27] According to TAG, the NPV is a useful metric for schemes that do not affect the broad transport budget. Therefore, this assessment focuses on the NPV of the Project. Department for Transport (2022), 'TAG Unit A1.1 Cost-Benefit Analysis', November, para. 2.8.11.
[28] 2030 is expected to be the first full year of operation at Gatwick Airport with the Project in place.
[29] Department for Transport (2018), 'Airports National Policy Statement: new runway capacity and infrastructure at airports in the South East of England', June.
[30] Department for Transport (2013), 'Aviation Policy Framework', March.

economy. More recently, Flightpath to the Future[31] recognises aviation's vital importance to the UK, in terms of economic contribution, jobs and the personal value it provides to individuals despite current challenges due to recovery from the impact of the COVID-19 pandemic and climate change. The current assessment addresses the contribution that the Project could make to the UK national economy while taking some of these challenges into account.

3.3.3 From a broader perspective, various policy documents have consistently confirmed the Government's support for making best use of existing runway capacity and infrastructure at airports beyond Heathrow.[32]

3.3.4 In addition, 'A Better, Greener Britain', published in July 2021, sets out the Government's commitments and actions to decarbonise the transport system in the UK.[33] The plan follows from previous policy documents identifying the scale of additional reductions needed to deliver the transport sector's contribution to legally binding carbon budgets and delivering net zero by 2050.[34] In a similar manner, the Jet Zero Strategy details the Government's proposed approach and principles to reach net zero aviation by 2050.[35]

3.3.5 For a summary of the key planning policy documents that informed the national Economic Impact Assessment approach, and its relevance as part of the application for development consent, please refer to **Annex A1.5**.

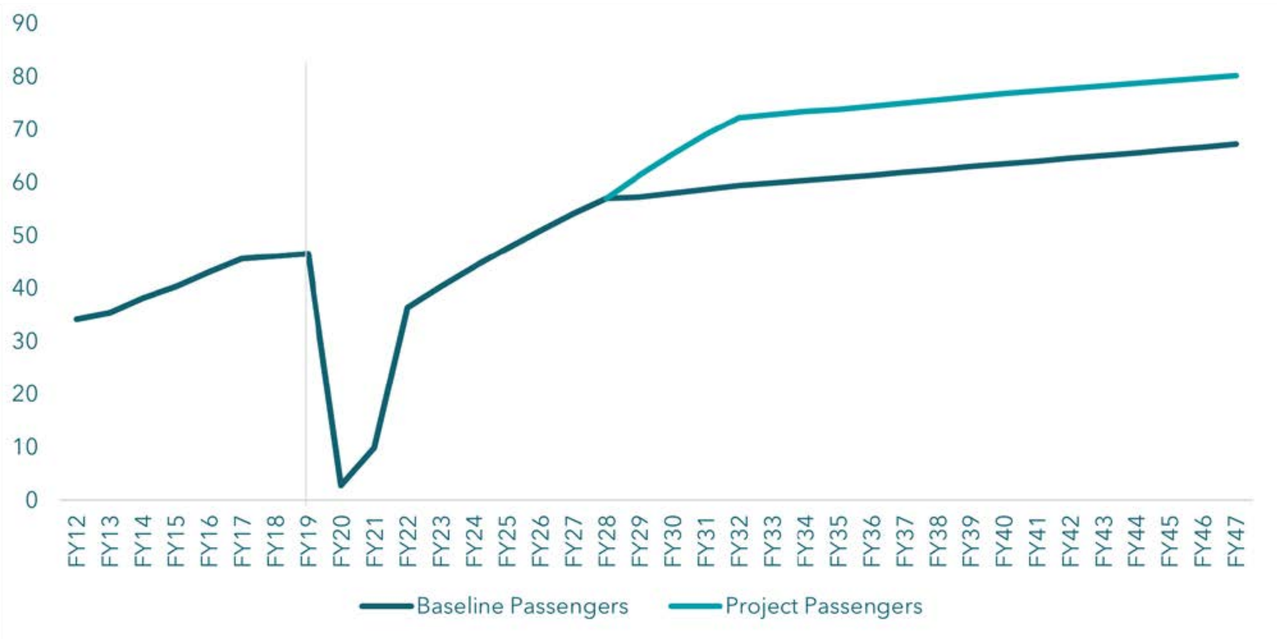
3.4. Air traffic forecast scenarios

3.4.1 Oxera was provided with input forecasts of air traffic for the period from FY2029 to FY2047. Figure 3.4.1 below shows the build-up of passenger volumes with the Project from the scheme opening year of 2029 (with the first full year of operations in 2030) compared with passenger projections in the Baseline (ie without the Project).[36]

3.4.2 The forecasts suggest that, in the scenario where the Project goes ahead, passenger numbers would increase substantially following the scheme opening, with a slight reduction in the growth rate after 2032. The forecasts suggest an incremental increase of 60,000 ATMs and 13 m passengers in FY2047, which is equivalent to about a 20% increase relative to the Baseline.

[31] Department for Transport (2022), 'Flightpath to the Future', May.
[32] The principle of making best use of existing airport capacity has therefore been a longstanding and consistent feature of UK aviation policy since the Future of Air Transport White Paper. Department of Transport (2003), 'The Future of Air Transport', December.
[33] Department for Transport (2021), 'Decarbonising Transport: A Better, Greener Britain', July.
[34] Department for Transport (2020), 'Decarbonising Transport: setting the challenge', March.
[35] Department for Transport (2022), 'Jet Zero strategy: delivering net zero aviation by 2050', July. The current assessment uses average fare data that captures DfT's assumptions around future carbon pricing. This was modelled by, and used by, DfT in the Jet Zero Strategy modelling framework and were provided to Oxera upon request. See Department for Transport (2022), 'Jet Zero: modelling Framework, March, p. 19, and Annex B of Department for Transport (2022), 'Jet Zero: further technical consultation', March.
[36] Forecasts of passenger numbers were received in financial years and were converted into calendar years to match the parameters in the DfT's TAG in the current analysis. Figures were converted by calculating a weighted average between the corresponding financial year and the next reported financial year using the shares of air traffic in the London system in Q1 2019 and Q2-4 2019 as weights. This intends to reflect the seasonality of the air traffic data which is not likely to change on an annual basis. For example, the calendar year 2019 was calculated using a weighted average of FY2019 and FY2020 with the Q1 2019 and Q2-4 2019 shares of air traffic as their respective weights. Data required for the analysis on London air traffic shares was sourced from Civil Aviation Authority (2019), 'UK Airport Data', available at: https://www.caa.co.uk/data-and-analysis/uk-aviation-market/airports/uk-airport-data/uk-airport-data-2019/ (last accessed August 2022).

Figure 3.4.1: Gatwick air traffic forecasts



Note: Figure is in financial years. Financial year 22 is an estimate as of January 2023. Passenger growth in the Baseline scenario reflects assumptions on improved runway utilisation, increased load factors and aircraft sizes. Passenger growth in the Project scenario reflects the same assumptions as the Baseline and additional ATMs enabled by the Project. For more information on the air traffic forecasts and the underlying methodology, see **ES Appendix 4.3.1: Forecast Data Book** (Doc Ref. 5.3).

Source: Civil Aviation Authority and Gatwick statistics.

3.4.3 The main analysis in this report is based on the air traffic forecasts shown in **Figure 3.4.1** above and similar forecasts for other airports in the London aviation market.[37]

3.4.4 **ES Appendix 4.3.1: Forecast Data Book** (Doc Ref. 5.3) explains that the forecasts were prepared with regards to the importance of having a realistic view of the level and characteristics of air traffic growth that would occur at Gatwick, whilst also ensuring that the environmental impacts of Gatwick's growth are not understated. However, it creates a risk that economic benefits could be overstated. For this reason, **Annex A1.4** of this report also provides impact estimates for a sensitivity around these forecasts. The input sensitivity forecasts assume slower passenger growth in the overall London system and at Gatwick. This sensitivity aims to show the effect of lower levels of demand on the estimated economic impacts.

3.4.5 Finally, input forecasts that assume a slower rate of transition of airline fleet at Gatwick were also made available. This does not affect the passenger numbers in the Baseline and Project scenarios but has an effect on the environmental costs associated with the Project. This is discussed in section 7.

3.5. The COVID-19 pandemic and its impact on the economic assessment

3.5.1 The air traffic forecasts presented above take account of the effect that the COVID-19 pandemic has had on Gatwick and other airports over the last few years. Between 2019 and 2020,

[37] For more information on the assumptions made to construct the forecasts, please refer to **ES Appendix 4.3.1: Forecast Data Book** (Doc Ref. 5.3).

passenger volumes at Gatwick Airport dropped by 78%.[38] Passenger volumes decreased further from 10.2 mppa in 2020 to 6.3 mppa in 2021. However, in 2022, the number of passengers at Gatwick reached 32.8 m—more than six times the annual figure in 2021, and 82% of the figure in the equivalent period in 2019, illustrating the recovery of air traffic in the most recent period.[39]

3.5.2 As shown in **Figure 5.3.1**, it is expected that passenger volumes will rebound strongly after 2022, before transitioning to a more steady recovery path and reaching 2019/20 levels of air traffic in 2024/25 (ie approximately 45 m passengers). This is in line with industry forecasts, such as those from IATA, which have estimated that global passenger air traffic will return to pre-COVID-19 levels in 2024, and those from ACI, which predict that European air traffic will return to the pre-pandemic levels by 2025.[40]

3.5.3 By the assumed date that the Project opens in 2029, Gatwick expects that the pandemic will no longer have an impact on the UK aviation sector as a whole, and Gatwick Airport in particular. As a result, the analysis in this report is based on the assumption that the COVID-19 pandemic will not have an influence on passenger air traffic related to the Project in the long run.

3.5.4 The sensitivity in **Annex A1.4**, which assumes slower passenger growth in the overall London system as a result of lower levels of demand, aims to capture a scenario where air traffic does not recover to the same extent after the COVID-19 pandemic, with a long-lasting effect on demand and subsequently on air fares.[41]

3.5.5 Given the uncertainty regarding the long-term impact of the COVID-19 pandemic as well as the lack of post-pandemic data, this assessment relies on 2019 as a reference year for the future state of the economy for inputs to the analysis other than air traffic forecasts.[42]

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[38] Gatwick Airport (2020), 'Gatwick Key Facts [redacted] /
[39] Gatwick Airport (2023), [redacted] January.
[40] IATA (2022), 'Aviation recovery continues despite headwinds', 21 September; Airports Council International (2022), 'Airport Traffic Forecast – 2023 Scenarios & 2023-2027 Outlook', December. Airports Council International (2023), 'Passenger traffic full recovery pushed back to 2025', January.
[41] In particular, the lower growth scenarios assume a slower recovery in Gatwick's passenger numbers after the COVID-19 pandemic and a lower uptake of the additional capacity. The scenarios also assume lower air traffic levels in the long term. For more information see **ES Appendix 4.3.1: Forecast Data Book** (Doc Ref. 5.3).
[42] For example, the analysis uses information on passenger revenue at each airport in the London market from 2019 (or the latest year available before the COVID-19 pandemic), since passenger spending at airports was substantially reduced in 2020 and was still affected by travel restrictions in 2021. It is also noted that the current macroeconomic conditions such as high inflation and recessionary pressures might have an impact on the demand for travel. However, it is considered that these conditions would not be relevant by the time that the Project opens in 2029.

4 Costs of the Project

4.1.1 The Project would lead to additional costs associated with construction, higher levels of air traffic, and surface access schemes as well as other expenditure relevant to the development and operation of new airport facilities.

4.1.2 According to Gatwick forecasts, the Project's capital expenditure (CAPEX) is estimated to be £2.2 bn in current prices. The forecasts relate to expenditure on the airfield, car parks, hangars and terminals, construction, and surface access schemes.[43] For the current cost-benefit analysis the CAPEX forecasts have been discounted and adjusted for inflation and optimism bias.[44] These adjustments are set out in detail in **Annex A1.1**. With these adjustments, the present value of the Project's CAPEX is estimated to be £1.7 bn in 2010 discounted prices.[45]

4.1.3 The additional air traffic associated with the Project would also have an impact on Gatwick's operational expenditure (OPEX).[46] The current analysis uses Gatwick's forecasts of OPEX levels between 2022 and 2026.[47] For the rest of the appraisal period, the analysis models how the Project would affect OPEX by considering increases in passenger air traffic, the real price growth of utilities, labour productivity growth, and the input employment forecasts for Gatwick. The latter component ensures consistency with the analysis and inputs used in **ES Appendix 17.9.2: Local Economic Impact Assessment** (Doc Ref. 5.3). The basis for the assumptions made to forecast OPEX are set out in **Annex A1.1**. Note that this is a high-level exercise for this economic appraisal and it does not represent a detailed estimate of the operational expenditure that would result from the Project. On this basis, the present value of the Project's OPEX is estimated to be £0.5 bn in 2010 prices.

4.1.4 In total, the CAPEX and OPEX costs of the Project are estimated to be £2.1 bn in 2010 prices over the appraisal period—ie 60 years from the scheme opening.[48]

[43] The total CAPEX of the whole Project at £2.2 bn is small compared to the annual size of the construction industry in the UK. For example, the UK Office for National Statistics (ONS) reports that the annual size of new construction works in 2019 was £119 bn. Office for National Statistics (2021), 'Construction statistics, Great Britain: 2019', January. Therefore these expenditures are not expected to have a stimulating effect on the construction industry at a national level, and potential benefits arising from this are not evaluated.
[44] Department for Transport (2022), 'TAG Unit A1.2 Scheme Costs', May. For a detailed description of the adjustments made to the CAPEX forecasts, see **Annex A1.1**. It is noted that the optimism bias parameter used is from TAG factors that are partly based on data from public sector procurement where incentives in achieving cost efficiency may differ from those in the private sector. As a result, the estimated CAPEX of the Project, which is a private sector scheme, might be overstated when using the approach described in TAG. Please see Department for Transport (2022), 'TAG Unit A1.2 Scheme Costs', May, para. 1.1.2; HM Treasury (2022), 'Supplementary Green Book Guidance', p. 2; and Oxford Global Projects (2020), 'Updating the evidence behind the optimism bias uplifts for transport appraisals'.
[45] As mentioned in section 3.2, following TAG all benefits and costs are reported in 2010 prices and 2010 values. The former reflects an adjustment for inflation, while the latter relates to the social time preference, ie the concept that people prefer to receive a benefit now rather than in the future. For simplicity, unless stated otherwise, when the term '2010 prices' is used in the remainder of this report it refers to both of these adjustments.
[46] The Project would also have an impact on the OPEX of the other airports in the London aviation system if air passengers switched to Gatwick Airport due to the Project, ie if fewer passengers travelled from the other airports, they would incur less OPEX. The current analysis does not quantify this reduced OPEX and it may therefore be an overestimate of the Project's OPEX impact on the London airport system as a whole.
[47] Gatwick has provided forecasts of OPEX, which are understood to be based on a relationship between passenger volumes and employment. These forecasts are used for 2022 to 2026. After 2026, the input employment forecasts are used to adjust the OPEX forecasts to ensure consistency with the assessment of the local economic impacts in the EIA. See the **ES Appendix 17.9.2: Local Economic Impact Assessment** (Doc Ref. 5.3).
[48] CAPEX and OPEX estimates do not sum due to rounding.

5 User and provider impacts

5.1. Overview of user and provider impacts

5.1.1 This section assesses the impacts of the Project on users (passengers) and providers (airlines and airports) of aviation services.

5.1.2 Capacity expansion at an airport generates a number of impacts on passengers, airlines and the airport by relieving capacity constraints, including:

- a reduction in air fares due to supply and demand dynamics;
- an increase in air traffic movements (ATMs);
- an increase in passenger numbers resulting from lower fares and more ATMs (higher frequencies);
- a reduction in profits to airlines due to reduced fares, which is partly offset by increased passenger numbers;[49]
- an increase in airport revenues as a result of an increase in the number of passengers and ATMs.

5.1.3 The combination of these effects will have an impact on the value and distribution of the economic benefits generated in an aviation market. For example, a decrease in air fares may reduce the profits earned by airlines; however, the gain in consumer welfare by passengers paying lower fares may be greater than the loss to providers.

5.1.4 Prior to the COVID-19 pandemic, Gatwick Airport was capacity-constrained during peak times. These constraints will return as air traffic recovers. The Project would relieve these constraints and provide additional capacity, including during peak times. As airlines fill this additional capacity with additional air services, ATMs and passenger numbers at Gatwick Airport would increase beyond baseline levels (ie levels without the Project).

5.1.5 Although the expansion would affect primarily operations at Gatwick Airport, its impact would not be limited to the passengers and airlines using the airport. Due to its location and the connectivity that it provides, Gatwick Airport forms part of a wider system of airports in London and the surrounding area.[50] The Project would therefore be expected to have an impact on users at London airports more generally, and the analysis in this report evaluates the impacts of the Project on this system as a whole using input air traffic forecasts for the London airports. There could therefore be impacts on users of other airports. However, according to survey data from the Civil Aviation Authority (CAA) for 2019, more than 80% of Gatwick's terminating passengers were travelling to/from destinations in London or the South East. The majority of the remaining passengers were travelling to/from the East or the South West of England. Hence, it is likely that any impacts on users of non-London airports will be small compared with the impacts on London users.[51]

5.1.6 From an empirical perspective, using changes in London-level air traffic forecasts instead of Gatwick-level air traffic forecasts accounts for airline and passenger substitution between London

[49] In the scenario where the expansion means that there are no more capacity constraints, airlines will make normal profits, which are defined as the profits that airlines would make under competitive market conditions in which sufficient capacity is available to meet underlying demand.
[50] The airports in the London aviation system are London City, Gatwick, Heathrow, Luton, Southend, and Stansted airports.
[51] See **ES Appendix 4.3.1: Forecast Data Book** (Doc Ref. 5.3).

airports with the Project. For example, if some passengers who would travel using other London airports in the Baseline scenario decide to travel using Gatwick Airport as a result of the Project, passenger numbers at Gatwick Airport would increase. However, the change in total passengers at the London system level would be zero—in other words, these additional passengers at Gatwick Airport are not additional to the London system as they would travel in both scenarios, with and without the Project.

5.1.7 As a consequence, any benefits associated with this inflow of passengers from other London airports to Gatwick would not be additional benefits at the London level or the UK level. Instead, there would be a transfer of benefits between airports, as Gatwick Airport would see an increase in passengers that would be the result of a reduction of passengers at other London airports. Therefore, by looking at the London aviation system, the current analysis avoids overestimating the benefits associated with the Project.

5.1.8 The DfT sets out an approach to evaluate the impacts associated with changes in passenger numbers and ATMs, which is described below.

5.2. Approach to quantifying user and provider impacts

5.2.1 The DfT's approach to estimating the user and provider benefits of an expansion in an airport's capacity focuses on measuring benefits to passengers, airlines and airports.[52] These are known as user and provider surplus respectively, and are defined as follows.

- **User surplus** represents the value of aviation services to passengers beyond the actual price that they pay. This surplus is therefore the difference between the maximum amount that passengers would be willing to pay and the actual price that they pay for aviation services.[53]
- **Provider surplus** represents the value to airlines from providing aviation services. An airline's surplus depends on the incremental price that it can charge due to capacity constraints beyond the costs that it incurs. An airport's surplus is the increased value that it receives from providing more capacity.

5.2.2 The DfT's framework to analyse changes in user and provider surplus takes account of features of the aviation market.[54] In this market, passengers demand seats and airlines supply seats up to the total demand or available airport capacity. Airports, in turn, provide capacity and set the maximum number of passengers, or flights, that can take place.

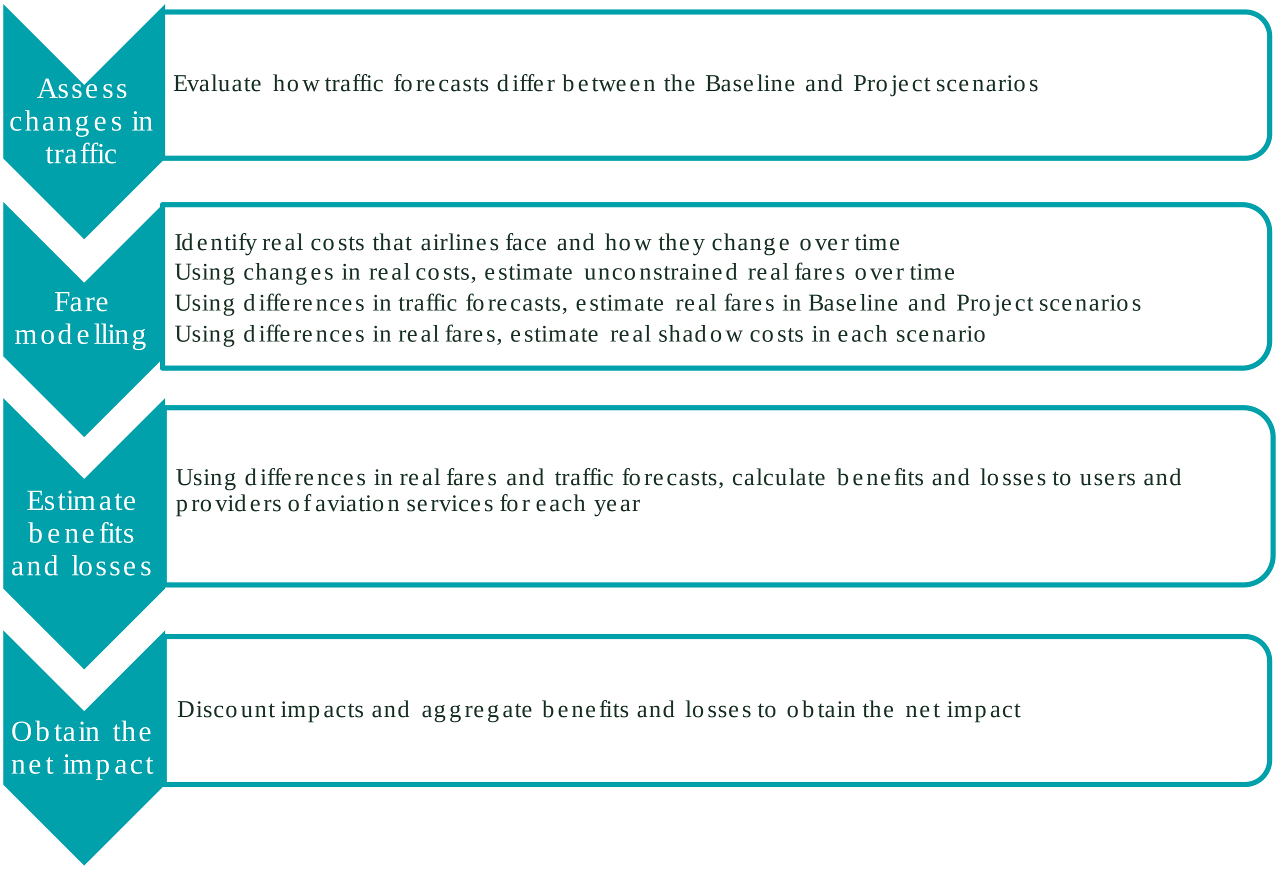
5.2.3 If airport capacity is sufficient to meet total passenger demand, airlines will provide capacity up to the level of demand, and air fares will be at competitive market-clearing prices.[55] Conversely, if airport capacity is less than total passenger demand, airlines will be unable to satisfy the demand.

[52] Department for Transport (2022), 'TAG Unit A5.2 Aviation Appraisal', November.
[53] User benefits generally include benefits to passengers from changes in air fares and frequencies. In this appraisal, benefits arising from reductions in air fares are estimated, and these are referred to as 'user benefits' throughout the report unless stated otherwise. **Annex A1.2** provides a description of frequency effects and their impact on the estimated user benefits.
[54] The DfT's TAG states that, where possible, user and provider impacts should be identified for both UK and non-UK residents. Absent any detailed information on how airport revenues and values of time are distributed between UK and non-UK residents, this exercise has not been undertaken in this report. See Department for Transport (2022), 'TAG Unit A5.2 Aviation Appraisal', November, para. 3.2.10.
[55] This is not necessarily the case, for example, at a route level. Nevertheless, it will generally be true if we look at all air transport movements in the market.

Fares paid by passengers will rise above costs in order to ‘clear the market’. This increase in fares due to a lack of capacity is referred to as the ‘shadow cost’ of air fares.[56]

5.2.4 In this report, the approach to quantifying the user and provider benefits of the Project is based on data on airline costs, air traffic forecasts and 2019 fare levels. The steps in the model used are shown in **Figure 5.2.1**.

Figure 5.2.1: user and provider impacts analysis



Source: Oxera.

5.2.5 Each of these steps is described in turn below, as well as the data used in the assessment.

5.3. Step 1: assess changes in air traffic

5.3.1 First, expected changes in air traffic with the Project are determined. As set out in section 3.4, input air traffic forecasts for Gatwick Airport and the London aviation system are used. These forecasts provide passenger numbers in the assessment years 2029, 2032, 2038, 2044 and 2047 for the Project and Baseline scenarios.[57] Input forecasts were also made available for a hypothetical scenario without any capacity constraints in the London aviation system, ie a

[56] For further detail on this point, please refer to **Annex A1.1**, which provides a graphical illustration of the impact of relieving airport capacity constraints, and the resulting changes to air fares and user and provider surplus.
[57] Values for the years in between are interpolated linearly to align with interpolated estimates for other London airports, and passenger numbers after 2047 are assumed to be constant. This last assumption is consistent with the DfT’s TAG.

scenario where the London aviation market is capable of satisfying all passenger demand. This is referred to as the unconstrained demand scenario.

5.3.2 Given that the Baseline and unconstrained scenarios were produced on an annual basis, the forecasts assume that capacity constraints will be present on average every year. While capacity constraints may vary across peak and non-peak hours and seasons within a year, on average Gatwick Airport, and the London system as a whole, would remain constrained in each year of the assessment period in absence of the Project.

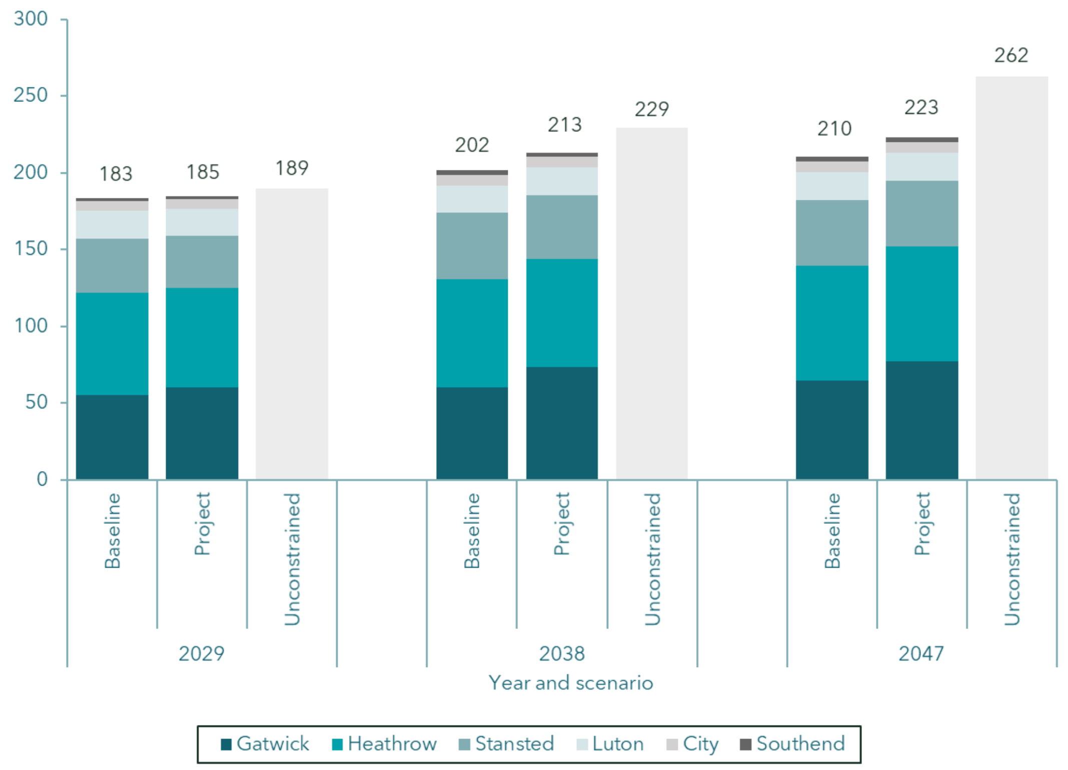
5.3.3 Passenger air traffic in each of these scenarios is disaggregated according to the following market segments:

- origin (UK, foreign);
- journey purpose (business, leisure); and
- type (domestic, short-haul, long-haul).

5.3.4 For more information on the assumptions made to construct the forecasts, please refer to **ES Appendix 4.3.1: Forecast Data Book** (Doc Ref. 5.3).

5.3.5 **Figure 5.3.1** illustrates passenger forecasts for the Baseline, Project and unconstrained scenarios. It shows how the air traffic in the Baseline and Project scenarios is expected to evolve over time compared with the unconstrained demand.

Figure 5.3.1: the London aviation system passenger forecasts (mppa)

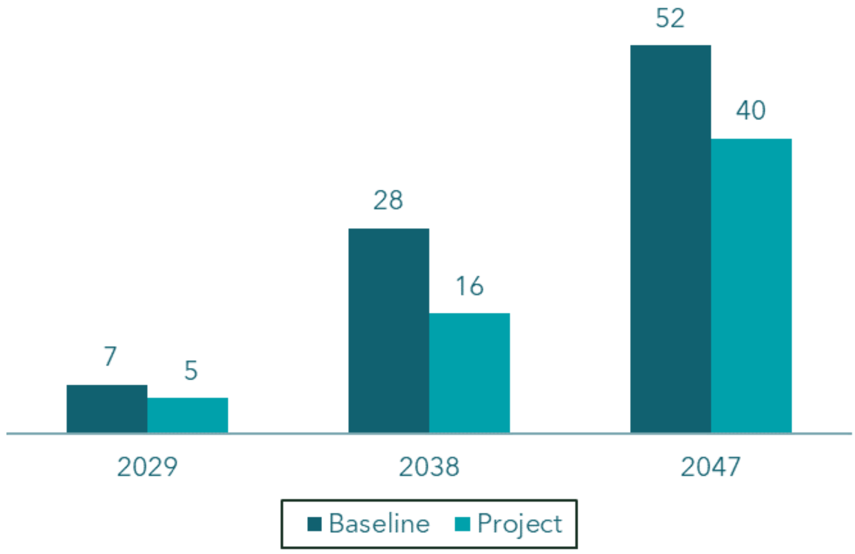


Note: International-to-international transfer passengers are excluded from passenger numbers. The unconstrained scenario reflects the total London aviation market, with no allocation of passengers to different airports.

Source: Gatwick.

5.3.6 In general, the forecasts indicate that the London aviation system is expected to become increasingly capacity-constrained over time. **Figure 5.3.2** below shows forecasts for excess passenger demand in the Baseline and Project scenarios. The figure shows that excess demand in the London aviation system is forecast to be higher in 2038 and 2047 than it is in 2029. While the forecasts indicate that there are capacity constraints under either scenario, by 2047 the Project would contribute to addressing over 20% of the otherwise unmet demand.

Figure 5.3.2: excess demand in the London aviation system (mppa)



Note: The figure illustrates forecast passengers who would have travelled using London airports but cannot due to airport capacity constraints.

Source: Gatwick.

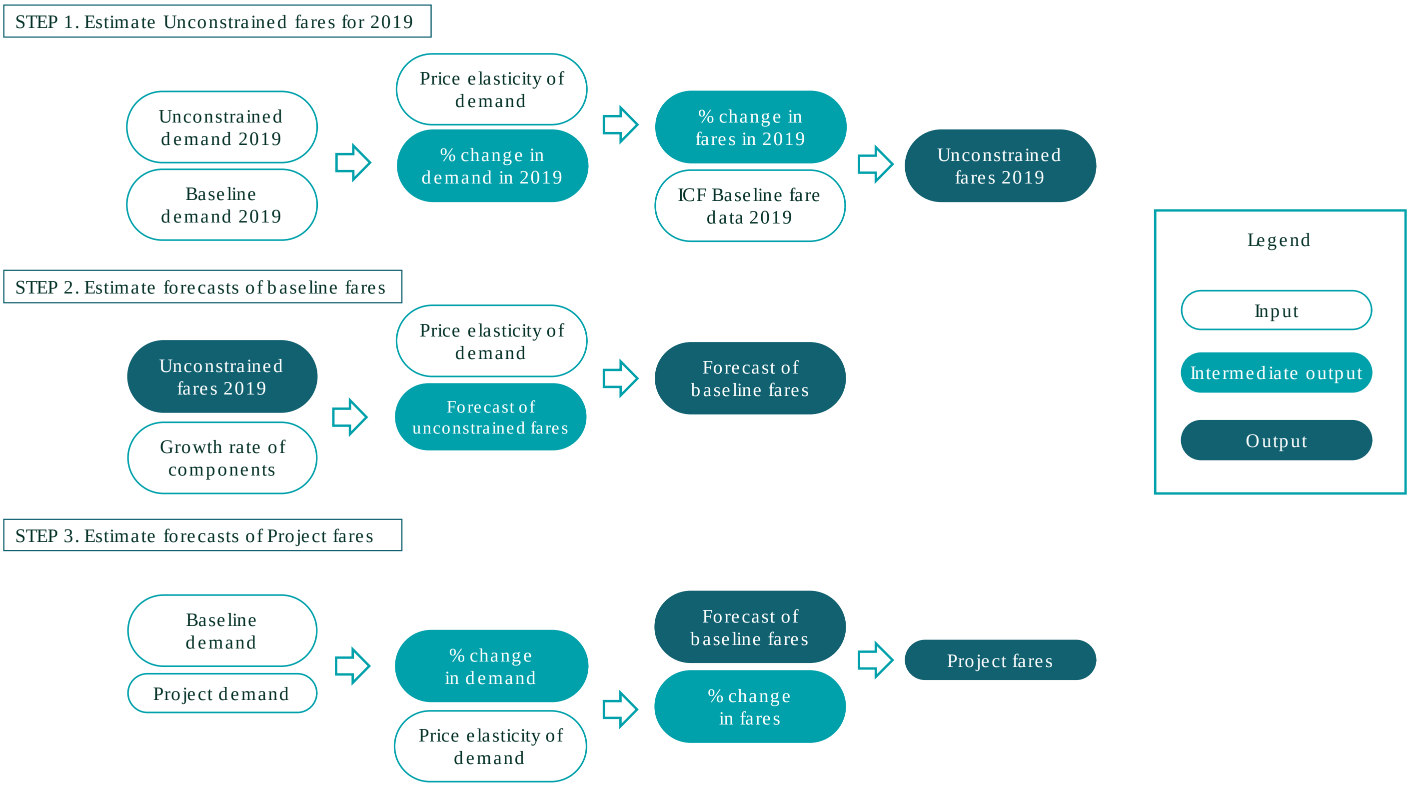
5.3.7 Increased capacity affects air fares as well as passenger demand. The next section describes how air fares have been forecast in the Baseline, Project and unconstrained scenarios.

5.4. Step 2: fare modelling

5.4.1 Fares are an important driver of passenger demand for aviation services and a necessary component of the DfT's appraisal framework. Future fare levels for the Baseline, Project and unconstrained demand scenarios are estimated based on 2019 average London fare levels for each market segment,[58] changes in airlines' costs over time, and air traffic forecasts, and are inputs to the analysis. The fares in the Project and the Baseline scenarios are then compared, which provides an estimate of the impact of the Project on fares. **Figure 5.4.1** below summarises the approach to estimating fares in the unconstrained, Baseline and Project scenarios.

[58] Air fares from 2019 are used as base fares, since this is the latest year unaffected by the COVID-19 pandemic. Forecasting future fares using 2019 base fares would be consistent with assuming that the pandemic will have a limited long-term influence on the aviation market, as discussed in section 3.5.

Figure 5.4.1: fare modelling analysis



Source: Oxera.

5.4.2 The 2019 input average fares data are shown in Table 5.4.1, and the methodology is explained in further detail below.

Table 5.4.1: average fare levels in 2019 for each market segment in the London aviation market

Market segment	Average fare (£)
Domestic	55
Short-haul	80
Long-haul	
Business	1,500
Economy	220
Weighted average long-haul	426

Note: Figures for long-haul fares were received for both business and economy class seats. For consistency with other market segments, a weighted average of these two values is taken weighted by the shares of business and economy class seats on flights in the London aviation market. The data on these shares was obtained from OAG (2019), ‘Flight Schedules data’.

Source: Oxera.

Airlines' costs

5.4.3 In order to forecast air fares, the first step is to evaluate how an important component of air fares—airlines' costs—is expected to evolve over time.

5.4.4 The DfT's Jet Zero Strategy Modelling Framework categorises costs that airlines face as fuel, carbon, APD, and 'non-fuel costs' (which correspond to all fare elements not attributed to fuel, carbon and APD).[59] The DfT has provided forecasts of average UK air fares disaggregated into these four cost components. The forecasts show each component's share in the average air fare and how it is expected to change over time until 2050.[60] As an example, **Figure 5.4.2** shows the share of fare components in 2019 average fare levels, adjusted for the inclusion of 'normal' profit.[61] This data is used to assess costs that airlines are expected to face up to 2050. Thereafter, it is assumed that these costs remain constant in real terms up to 2088, in line with TAG.[62]

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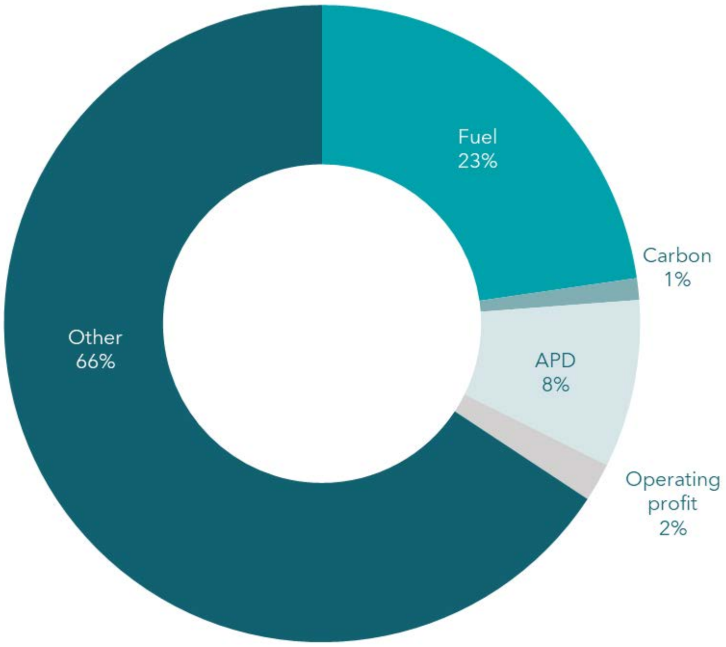
[59] Oxera analysis based on data from figure 6 in Department for Transport (2022), 'Jet Zero: modelling Framework', March, which was received upon request from DfT. Non-fuel costs include shadow costs as they are part of the observed price levels in a constrained system. APD is an excise tax that is charged on the carriage of passengers flying from a UK or Isle of Man airport and is based on where the journey ends. In addition to these cost components, 'normal' profits are allowed for, ie profits that airlines would earn in competitive market conditions in which sufficient capacity is made available to meet underlying demand. In line with historical data pre-COVID-19, this component is assumed to be constant at 2% of turnover. This parameter is sourced from Regional International (2019), [redacted]', March/April, p. 16 (accessed 10 November 2022). The value of this parameter might be a conservative estimate of airlines' normal profits in the London aviation market, given that it results from an average of margins from a wide range of airlines' performance. As such, a sensitivity of the estimates in this report to this parameter is also presented in **Annex A1.4**.

[60] See, for example, Department for Transport (2022), 'Jet Zero: modelling Framework', March, p. 19.

[61] These forecasts reflect recent trends in the pricing of carbon in the Emissions Trading System and the appraisal carbon value by the Department for Business, Energy and Industrial Strategy (BEIS) (current Department for Energy Security and Net Zero). For further details, see Department for Transport (2022), 'Jet Zero: modelling Framework', March, pp. 16–17; and Department for Transport (2022), 'Jet Zero: further technical consultation', March, annex B.

[62] Department for Transport (2022), 'TAG Unit A1.2 Scheme Costs', May.

Figure 5.4.2: share of fare components in 2019 average fare levels in the London aviation market (%)



Note: Values are shares of each component in the weighted average air fare. Values may not sum to 100 due to rounding.

Source: Oxera analysis of DfT (2022), 'Jet Zero: modelling Framework', March.

5.4.5 Table 5.4.2 shows how each cost component is expected to grow over time in real terms for selected years of the DfT's forecast. It is assumed that real APD is constant over time.[63]

[63] The analysis in this report uses APD rates from 2023. The domestic band, band A and band B were used for domestic, short haul and long haul flights respectively, A weighted average of the reduced and standard rates was calculated for each travel distance band. Shares of economy class seats and business class seats in the whole London aviation market were used as weights. Data on seat shares was sourced from OAG (2019), 'Flight Schedules data'. For more information, see HM Government (2022), 'Rates for Air Passenger Duty', 21 July, available at https://www.gov.uk/guidance/rates-and-allowances-for-air-passenger-duty (last accessed November 2022). The assumption of keeping APD rates constant in real terms over time is in line with DfT's approach in its aviation modelling. See Department for Transport (2022), 'Jet Zero: modelling Framework', March, para. 2.23.

Table 5.4.2: year-on-year real growth rates of cost components (%)

	Fuel	Carbon	APD	Other
2029	2.4%	6.9%	0.3%	-1.0%
2032	0.3%	4.4%	0.5%	0.1%
2038	-1.7%	14.9%	-1.0%	-0.4%
2044	-4.0%	4.1%	0.3%	0.0%
2047	-1.7%	4.6%	-0.9%	-0.4%

Note: All growth rates are calculated using values in 2010 prices. Values are growth rates in each spot year. Reductions in fuel prices reflect expected changes in oil prices and increased fuel efficiency of new-generation aircraft. The evolution of the share of carbon costs in average real fares reflects expected fuel efficiency gains over time.

Source: Oxera analysis of forecasts provided by DfT (2022), 'Jet Zero: modelling Framework', March.

Fare levels in the unconstrained scenario

5.4.6 After assessing how airlines' costs are forecast to evolve over time, this information is used to produce forecasts for fares in the unconstrained demand scenario ('unconstrained fares').

5.4.7 The first stage in this process is to estimate unconstrained fares in 2019 using the following information:

- the 2019 input average fare levels for different market segments in the London aviation system ('2019 base fares');
- differences in air traffic forecasts between the baseline and unconstrained scenarios in 2019;
- the elasticity linking fares and passenger demand in each passenger market.[64] These elasticities represent the percentage changes in passenger demand that would result from percentage changes in air fares.[65]

5.4.8 With the aid of these price elasticities, and using percentage changes in passenger demand between the unconstrained and baseline scenarios, the fare change between 2019 unconstrained fares and the 2019 baseline fares can be estimated.[66] The price elasticities employed in this assessment are discussed below. The approach is also discussed in more detail in **Annex A1.1**.

5.4.9 The second stage is to disaggregate the predicted 2019 average fare level into its cost components. Each cost component is forecast separately before the components are aggregated to obtain the forecast fare in the unconstrained scenario.[67] Table 5.4.3 presents a worked example of how fares are estimated for each year in a simplified scenario of two cost components (cost 1 and cost 2).

[64] Air fares from 2019 are used as base fares, since this is the latest year unaffected by the COVID-19 pandemic. Forecasting future fares using 2019 base fares would be consistent with assuming that the pandemic will have a limited long-term influence on the aviation market, as discussed in section 3.5.
[65] In this assessment, changes in passenger air traffic are entirely attributed to changes in air fares. In practice, there could be other explanations for changes in passenger air traffic, such as increases in frequency. We discuss the impact of frequency effects in further detail in **Annex A1.2**.
[66] Passenger demand is assumed to be the same under both the Baseline and unconstrained scenarios and, as a result, unconstrained fares in 2019 are assumed to be equal to the Baseline fares.
[67] UK residents and foreign residents are assumed to face the same fares.

Table 5.4.3: worked example of fare calculations using forecast cost components

	2019	2020
Current average unconstrained real fare (A)	55	
Share of cost 1 (S1)	40%	
Share of cost 2 (S2)	60%	
Real value of cost 1 (B = A*S1)	22	
Real value of cost 2 (C = A*S2)	33	
Yearly real growth of cost 1 (G1)	5%	
Yearly real growth of cost 2 (G2)	-1%	
Forecast real value of cost 1 (D = B*(1+G1))		23.1
Forecast real value of cost 2 (E = C*(1+G2))		32.7
Forecast real fare level (D+E)		55.8

Note: Values are for illustrative purposes only. The actual analysis includes more cost components, as described above.

Source: Oxera.

Fare levels in the Baseline and Project scenarios

5.4.10 The forecast fares discussed above are used as the fares in the unconstrained demand scenario.[68] To obtain fare levels in the Baseline and Project scenarios, the changes in fares are estimated using the differences in air traffic forecasts between scenarios (first unconstrained and Baseline, and then Baseline and Project) and the elasticity linking fares and passenger demand in each passenger market. In particular, fares for each scenario are estimated in two steps, which are described below.

1. First, the difference in air traffic forecasts is calculated between the different scenarios.

2. The changes in fares corresponding to the changes in air traffic are then estimated using a fare elasticity of demand. Baseline and Project fares are calculated in the following two steps.

    i. First, the changes in air traffic between the unconstrained and Baseline scenarios are used to estimate the required fare changes. These are then applied to the forecast unconstrained air fares described in the previous section. This provides an estimate of the air fares implied by the forecasts in the Baseline scenario. This methodology allows differences in forecasts and the price elasticities to predict the 'congestion premium' that will be reflected in the Baseline scenario as a result of capacity constraints, now and in the future.
    ii. Then, the changes in air traffic forecasts between the Baseline and the Project scenarios are used to estimate the fare changes. These are then applied to the forecast Baseline air fares that are estimated. This provides an estimate of the air fares that are implied by the air traffic forecasts in the Project scenario.

[68] The unconstrained scenario refers to air traffic forecasts without any capacity constraints in the London aviation system. Unconstrained prices are used to calculate shadow costs later on in the estimation of benefits and losses. See the next sub-section on the calculation of shadow costs.

5.4.11 For the purpose of the analysis described above, price elasticities sourced from DfT are used for the business, leisure and domestic passenger markets respectively.[69] These are presented in detail in **Annex A1.1**.

5.4.12 Table 5.4.4 illustrates how changes in fare levels are calculated, using the estimated fares for long-haul leisure passengers as an example.

Table 5.4.4: example of fare calculations

	Value
Change in air traffic with the expansion (A)	1.4%
Price elasticity (B)	-1.10
Fare change needed to match air traffic change (C = A/B)	-1.3%
Fare without the expansion (D)	£277.2
Fare implied by elasticities [E = D*(1+C)]	£273.6

Note: Values may not sum due to rounding.

Source: Oxera.

5.4.13 Table 5.4.4 above illustrates the analysis undertaken. The first row considers a change in air traffic of 1.4% for a particular market segment (in this case, long-haul leisure) in a particular year (in this case, 2030) after the Project opening. By applying the corresponding price elasticity to determine the fare change that could explain this demand change, a 1.4% reduction in air fares is obtained. By applying this percentage change to the baseline fare calculated for this particular market segment and year (£277), the fare implied by the elasticity is obtained (£274).

5.4.14 Table 5.4.5 summarises the forecast fares by journey type in the Baseline and Project scenarios.

Table 5.4.5: weighted average forecast fares, by journey type

	Baseline		
	2029	**2038**	**2047**
Domestic	52	62	74
Short-haul	78	100	124
Long-haul	407	555	651
	Project		
	2029	**2038**	**2047**
Domestic	51	57	68
Short-haul	74	79	96
Long-haul	401	427	536

Note: Average fares are in 2010 prices. Numbers of business and leisure passengers in each segment and scenario are used as weights. All values are at the London system level.

Source: Oxera.

5.4.15 Table 5.4.5 above shows that the Project would reduce the air fares that passengers pay, and that airfare savings would grow over time. The greatest difference in air fares between the

[69] Department for Transport (2022), 'Jet Zero: modelling Framework', March, p. 15.

Baseline and Project scenarios would be for long-haul flights, both in absolute terms and relative to other types of flight. This can be explained by the fact that long-haul passengers have less price-elastic demand, together with a greater increase in demand in this segment as a result of the Project relative to other types of passenger.[70]

Shadow costs

5.4.16 Shadow costs represent the 'congestion premium' that arises as a result of passenger demand exceeding airport capacity. The Airport Commission describes shadow costs as scarcity rents that are assumed to accrue to airlines through their 'ownership' of slots at constrained airports.[71] These are assumed to be passed on to passengers through higher fares.

5.4.17 An increase in capacity will result in a reduction of shadow costs. In a competitive airline market, this will result in a reduction in fares and therefore provide benefits to passengers. However, at the same time, the reduction in prices will mean a reduction in airlines' revenues. As a result, this leads to a transfer of benefits from airlines to passengers.

5.4.18 Differences in shadow costs between the Baseline and Project scenarios are calculated as differences in fare levels (adjusted for normal profit):[72]

$$\text{Change in shadow cost} = (1 - \text{share of normal profit}) \times (\text{Fare}_{\text{Baseline}} - \text{Fare}_{\text{Project}})$$

5.4.19 Similarly, shadow costs in the Baseline scenario are calculated using differences between fare levels in the Baseline scenarios and the unconstrained scenario.[73]

5.4.20 Table 5.4.6 shows the passenger demand and weighted averages of estimated fares and shadow costs in the London aviation system. The results suggest that the Project scenario would reduce shadow costs by relieving capacity constraints.

Table 5.4.6: London system excess demand, fares, and shadow costs

	Baseline		
	2029	**2038**	**2047**
Excess demand (%)	3%	12%	20%
Passengers (mppa)	183	202	210
Average fare (£)	163	217	268
Average shadow cost (£)	14	60	95
	Project		
	2029	**2038**	**2047**
Excess demand (%)	3%	7%	15%

[70] Lower elasticities of demand imply that passenger demand is less responsive to price changes. In this setting, this means that a small change in passenger demand will result in a much larger change in air fares.
[71] Airports Commission (2015), 'Economy: Transport Economic Efficiency Impacts', July, para. 3.10.
[72] In line with historical data pre-COVID-19, this component is assumed to be constant at 2% of turnover. This parameter is sourced from Regional International (2019), 'The state of the airline industry in Europe', March/April, [redacted], accessed 10 November 2022. The value of this parameter might be a conservative estimate of airlines' normal profits, given that it results from an average of margins from a wide range of airlines' performance. As such, a sensitivity of the estimates in this report to this parameter is also presented in **Annex A** section A1.4.
[73] In the unconstrained scenario, shadow costs are zero because there are no capacity constraints.

Passengers (mppa)	185	213	223
Average fare (£)	159	171	216
Average shadow cost (£)	10	13	45

Note: Average fares and shadow costs are in 2010 prices. Average values are averages of all market segments weighted by numbers of passengers in corresponding segments and scenarios. All values are at the London system level. International-to-international transfer passengers are excluded from the passenger numbers.

Source: Gatwick data, Oxera analysis.

5.5. Step 3: estimation of benefits and losses

5.5.1 The effect of the Project on capacity and fares in the London aviation system is described above. The Project can have an impact on users and providers through a change in air fares and air traffic and by changing travel times. The calculation of these benefits and losses is explained below.

Benefits and losses through changes in fares and passenger numbers

5.5.2 The Project's impacts on fares and passenger numbers generates benefits and losses through changes in user and provider surplus.

5.5.3 The TAG aviation appraisal unit defines the total change in provider surplus (PS) as the difference in profits that airlines generate through shadow costs between the Baseline and Project scenarios:[74]

$$\text{PS} = n_{Project} \times sc_{Project} - n_{Baseline} \times sc_{Baseline}$$

where $n_{Baseline}$ and $n_{Project}$ are numbers of passengers in the Baseline and Project scenarios, and $sc_{Baseline}$ and $sc_{Project}$ are shadow costs in these scenarios.[75]

5.5.4 The total change in user surplus (US) that passengers receive as a result of a capacity expansion can be calculated using the following relationship:

$$\text{US} = 0.5 \times \left(n_{Baseline} + n_{Project}\right) \times \left(f_{Baseline} - f_{Project}\right)$$

where $f_{Baseline}$ and $f_{Project}$ are fare levels under the baseline and Project scenarios.[76]

5.5.5 With increased air traffic, airport revenues in the London aviation system will increase. In order to estimate this increase, it is necessary to make an assumption on airport charges. Many factors, such as the form of economic regulation, security requirements and macroeconomic developments, could influence how airport charges will evolve over the horizon of this assessment. For this analysis, and for illustrative purposes, it is assumed that airport charges remain constant in real terms. The change in airport revenues with the Project is calculated using the following steps:

[74] Department for Transport (2022), 'TAG Unit A5.2 Aviation Appraisal', November, p. 5.
[75] Shadow costs in the current analysis are evaluated at the market price unit of account. For more information on perceived costs see, for example, Department for Transport (2022), 'TAG Unit A1.1 Cost-Benefit Analysis', Appendix B, November.
[76] An indirect tax correction factor is applied on the provider surplus and user surplus of business passengers to convert the impacts at the market price unit of account. See Department for Transport (2022), 'TAG Unit A5.2 Aviation Appraisal', November, p. 5; and Department for Transport (2022), 'TAG Unit A1.1 Cost-Benefit Analysis', Appendix B, November.

- the average aeronautical revenue and non-aeronautical revenue per passenger are obtained for each London airport based on the latest available information before the COVID-19 pandemic, expressed in 2010 prices;[77]
- it is forecast that real non-aeronautical revenue per passenger from new passengers is equivalent to 80% of non-aeronautical revenue from existing passengers.[78]

5.5.6 The total benefit of an airport expansion to users and providers for a particular year is calculated by summing the benefits to passengers (change in user surplus), airlines (change in producer surplus) and airports (change in airport revenues).

5.5.7 In addition to the impact of changes in fares, academic research indicates that passengers respond positively to increases in flight frequencies.[79] The total increase in demand would be driven by a mix of reduced fares and increased ATMs. Given that the analysis does not capture frequency effects from increased ATMs, this means that the benefits to passengers are attributed only to reduced fares, and therefore that the fare effect is overstated as it encompasses some of the frequency effect. Nevertheless, because benefits accruing to passengers, airlines and airports are omitted from higher frequency effects, the final NPV estimate is likely to be a conservative estimate of the total impact of the Project on users and providers. This is explained further in **Annex A1.2.**

Benefits and losses through changes in surface access costs

5.5.8 Travellers to/from Gatwick could also benefit from lower surface access costs. For example, travelling through Gatwick instead of Heathrow could mean lower expenses on train tickets and fuels and/or less travel time for passengers who live or work closer to Gatwick. These costs are known as ‘generalised costs’. These impacts would occur only to the extent that passengers switch from other London airports to Gatwick as a result of the Project and on the basis that their origin/destination before/after their trip is in closer proximity to Gatwick compared with the airport that they switch from.

5.5.9 Although there would be some diversion of passengers from other London airports to Gatwick with the Project, the diversion is material only in the early years of the assessment.[80] As a result, the impacts on generalised travel costs would be temporary.

5.5.10 Furthermore, the potential welfare gains to passengers would be partially offset by losses in Government revenue. For example, purchasing a cheaper train ticket might result in lower VAT revenues, while spending less on fuel would result in lower Government revenues from fuel taxes.

5.5.11 Surface access providers such as train or bus operators would also be impacted. For example, there might be a net loss in revenue due to the diversion of passengers: a passenger switching

[77] These values are obtained from the airports’ latest available financial statements before the COVID-19 pandemic. Aeronautical revenues are revenues from the processing of aircraft and passengers, and non-aeronautical revenues are revenues from other sources such as retail services and car parks. Real revenue per passenger is assumed to be constant over time at each airport.
[78] This is to reflect the potentially lower spending of passengers who start using aviation services because of reduced fares with the expansion. This assumption yields a conservative estimate of airport revenues. For example, see CEPA (2019), ‘Heathrow Interim H7 Price Control: Review of HAL’s initial submission’, February, p. 38. With the Project, increase in the revenue of only Gatwick Airport is expected. However, some of this increase may be due to passengers diverting between airports. Looking at the whole London aviation market allows for the fact that the total increase in revenue of the whole system would therefore be lower to be accounted for.
[79] For example, see Jorge-Calderón, J.D. (1997), ‘A demand model for scheduled airline services on international European routes’, *Journal of Air Transport Management*, **3**:1, pp. 23–35.
[80] See Table 8.1.1 in section 8.1 below.

from Heathrow to Gatwick airport, might pay less for a train ticket in the Project scenario resulting to a loss of revenue for the train operators. On the other hand, the Project could result in more passengers using public transport and therefore an increase in the operators' revenues.

5.5.12 The modelling of these impacts is complex and requires a number of assumptions to be made due to data limitations. Given that the impacts are expected to be transitory and small in magnitude, these impacts have not been quantified.

5.6. Summary of user and provider benefits

5.6.1 The last step (step 4) in the user and provider impacts analysis is to discount and aggregate the benefits and losses estimated to obtain the net impact of the Project. Table 5.6.1 summarises the present value of the estimated benefits and losses to users and providers in the London aviation market.[81] The total benefits are reported, as well as the split between leisure and business users.

Table 5.6.1: total benefits to users and providers in the London aviation system (£ bn)

Total benefits to users and providers	
Leisure passenger benefits	15.5
Business passenger benefits	134.6
Total user benefits	**150.1**
Airline benefits	-139.3
Change in airport revenues	2.2
Total provider benefits	**-137.1**
Present value of benefits to users and providers	**13.1**

Note: All values are in discounted 2010 real prices. Numbers may not sum due to rounding. International-to-international transfer passengers have been excluded from the passenger numbers and the surplus calculations. Passenger benefits refer to benefits from reduced fares.

Source: Oxera.

5.6.2 The benefits to existing passengers correspond to the additional value to air passengers who would travel at lower fares as a result of the Project. Similarly, benefits to new passengers correspond to the difference between the maximum amount that passengers would be willing to pay and the actual price that they would pay for aviation services. Business and leisure passenger benefits correspond to the sum of benefits to existing and new passengers in each market. The benefits accruing to existing and new users of the London aviation system are estimated at £150.1 bn.

5.6.3 The impact on airlines reflects a welfare transfer from airlines to passengers with the Project as a result of the reduction in economic profits that airlines would receive from providing their services beyond the costs of providing them (including their normal profits). As a result of falling shadow costs, a welfare transfer from airlines to passengers of £139.3 bn is estimated.[82] Nevertheless, airlines would continue to profit from their operations through normal profits.

[81] Discount rates of 3.5% for the first 30 years and 3.0% for the remaining years are used as per the guidance in HM Treasury (2022), 'The Green Book Central Government Guidance on Appraisal and Evaluation', p. 120.
[82] Negative airline benefits represent lower profits with the Project relative to the Baseline scenario and arise from the reduction in the shadow costs of capacity constraints on air fares.

5.6.4 Due to the capacity expansion at Gatwick Airport, airports in the London aviation market are projected to earn higher revenues, valued at £2.2 bn.[83] This increase in airport revenues arises from an increase in air traffic resulting from the Project and the assumptions described above regarding aeronautical and non-aeronautical revenues for existing and new passengers. Airport revenues are analysed at a London level, and therefore the analysis includes potential substitution between London airports. In practice, this means that an additional passenger at Gatwick Airport who switches from another London airport would not generate the same change in airport revenues as an additional passenger at Gatwick Airport who was not previously intending to use one of the airports in the London aviation system.

5.6.5 When the above benefits and losses are combined, it is estimated that the Project would generate additional value to users and providers in the London aviation system of £13.1 bn.

[83] This value is net of reduced revenue at the other London airports due to switching passengers.

6 Wider economic impacts

6.1. Introduction

6.1.1 Wider economic impacts of a transport scheme are impacts that accrue to people and businesses beyond the users and providers of aviation services.

6.1.2 The Department for Transport's appraisal framework and the Airports Commission outline that aviation transport schemes may lead to wider economic impacts such as:[84]

- output changes in imperfectly competitive markets;
- marginal external costs;
- employment effects;
- productivity impacts;
- tourism.

6.1.3 The DfT guidance explains that wider economic impacts of a transport scheme can arise as increased connectivity of businesses is likely to result in benefits outside of the transport market.[85] By increasing global connectivity, an aviation scheme may result in:

- new opportunities to access knowledge, and lower international transport costs, which can reduce production costs;[86]
- increased attractiveness of the area around the airport for businesses that benefit from international connections;[87]
- additional revenue to the Government resulting from APD taxes and taxes on increased profits from higher productivity.[88]

6.1.4 However, in addition to these wider benefits, there may be costs. For example, as passenger volumes at Gatwick Airport increase, road traffic around Gatwick Airport would increase, resulting in additional external costs such as increased congestion.[89]

6.1.5 This section quantifies the benefits and costs arising from the Project beyond its impact on air passengers, airlines and airports (sections 6.2–6.4). It also qualitatively discusses other impacts that the Project may have on the wider economy, but which it has not been able to quantify or which are not included in the NPV due to concerns about double-counting (sections 6.5–6.8). It is estimated that the net present value of benefits to the wider economy and the Government is £12 bn.

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[84] Department for Transport (2019), 'TAG Unit A2.1 Wider Economic Impacts Appraisal', May; Department for Transport (2021), 'TAG Unit A5.4 Marginal External Costs', November. These impacts are discussed and assessed in Airports Commission (2015), 'Economy: Wider Economic Impacts Assessment', July.
[85] Department for Transport (2019), 'TAG Unit A2.1 Wider Economic Impacts Appraisal', May, p. 1.
[86] This would be expected to influence production costs in imperfectly competitive markets. For example, see Airports Commission (2015), 'Economy: Wider Impacts Assessment', July, p. 7.
[87] These opportunities would attract firms in similar industries, resulting in increased agglomeration effects. For example, see Airports Commission (2015), 'Economy: Wider Impacts Assessment', July, pp. 6–7.
[88] With new job opportunities, some individuals in the labour market may find positions with higher productivity, or their existing positions may become more productive, resulting in increased tax revenue.
[89] Department for Transport (2021), 'TAG Unit A5.4 Marginal External Costs', November.

6.2. Benefits arising from output changes in imperfectly competitive markets

6.2.1 By providing additional capacity, the Project would increase international connectivity with other economic centres. This may make it easier for businesses to transport goods and services, reduce travel times for business passengers and costs for international businesses,[90] and provide new business opportunities. For example, the Project could reduce the costs of importing international inputs for production as a result of higher frequencies, or reduce fares and therefore the costs of business travel. This reduction in travel costs would lower production costs for UK and international firms.

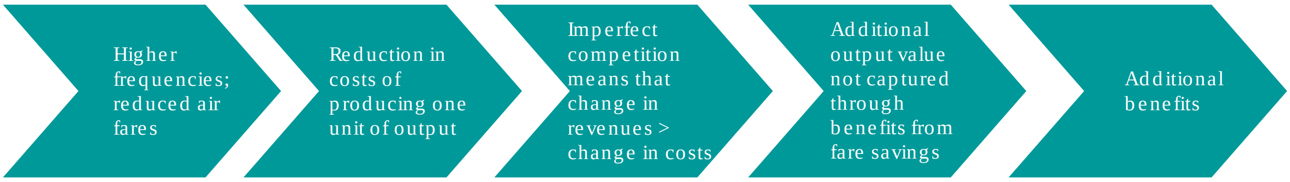
6.2.0 In a perfectly competitive market, these benefits from reduced production costs would be fully captured by the welfare gains arising from the reduction in fares. This is because, in perfectly competitive markets, firms do not generate profits[91] as competition will bring prices down to marginal costs. If the cost of producing one unit of output were to decrease because of a reduction in travel costs, for example, the competitive dynamics in the market would lead to an increase in the level of output. Additional revenues to firms (output value) would therefore equal the change in travel costs—the fare savings associated with the Project, in this case—and generate welfare benefits to the national economy.[92]

6.2.1 However, product markets are usually not perfectly competitive, as indicated by the profitable nature of businesses on average. Firms may face high barriers to entry or significant economies of scale. For example, a small manufacturing firm looking to enter the market may struggle to compete with incumbent larger firms if they are less able to negotiate bulk discounts when importing their products from abroad. Therefore, firms have the potential to set prices higher than the marginal costs of production for their products.

6.2.2 If product markets are not perfectly competitive, firms may not face the same pressure to lower prices when their costs reduce – they can increase output and potentially reduce their prices but still charge at a level above their marginal costs. Therefore, following a transport improvement such as the Project, the costs of production decline and businesses receive higher revenues than their costs when they increase their output—but the change in revenues would be higher than the change in costs (ie travel costs). This implies additional welfare for businesses that is not captured in the fare-saving benefits estimated. In addition, the potential to lower prices when increasing output would generate additional welfare benefits to consumers.[93] The mechanism through which the Project leads to benefits from increasing output in imperfectly competitive markets is illustrated in **Figure 6.2.1**.

[90] As a result of reduced shadow costs in the aviation system.
[91] This refers to supernormal profit. Supernormal profits are defined as all the excess profit that a firm makes above the minimum return necessary to keep the firm in business.
[92] Department for Transport (2020), 'TAG Unit A2.2 Appraisal of Induced Investment Impacts', May.
[93] Department for Transport (2005), 'Transport, Wider Economic Benefits, and Impacts on GDP', Discussion Paper, July, p. 25; and Airports Commission (2015), 'Economy: Wider Impacts Assessment', July, pp. 19–20. The analysis of user benefits in this report does not include benefits from higher frequencies, as discussed in section 5.5.

Figure 6.2.1: benefits arising from output changes in imperfectly competitive markets



Source: Oxera.

6.2.3 The welfare impact of such changes is a product of the magnitude of the quantity change (the increase in firms' output as a result of the transport system improvement) and the price–cost margin applicable to the sector.[94]

6.2.4 Given the difficulties in assessing the level of imperfect competition in the sectors that could benefit from the reduction of travel costs resulting from the Project (and thus the associated price–cost margins and changes in output), the DfT recommends that this benefit is estimated based on a simplified approach of using a 10% uplift to business user benefits.[95] This approach has been used by the Airports Commission in assessing the expansion of Gatwick and Heathrow in the past.[96] In section 5.5, benefits to business passengers are estimated to be £134.6 bn. The benefits from output increases in imperfectly competitive markets are therefore estimated to be £13.5 bn.

6.2.5 A share of these benefits could also be captured by benefits arising from increased trade as a result of the Project. The greater connectivity would bring a greater pool of consumers to British firms, and in turn could lead to greater economies of scale. On the other hand, imports from other regions would lead to greater access of inputs to UK supply chains. These mechanisms would improve efficiency and bring productivity benefits through trade.[97] The same increase in productivity due to access to lower-cost inputs imported from abroad could, however, also lead to increases in outputs in sectors affected by imperfect competition, which would be part of the benefits discussed above. Consequently, the monetised trade benefits are not included in the final NPV figure due to concerns regarding double-counting.

6.3. Impacts on public accounts from APD

6.3.1 Increased activity at Gatwick Airport would have a direct impact on public accounts as tax receipts from aviation, in the form of the APD, would increase as more passengers travel in the London aviation system.[98] The additional APD revenues would represent an increase in welfare that is not captured by the benefits discussed in the earlier sections. However, the increase in APD receipts would be offset by a reduction in consumers' taxable spending elsewhere in the economy, as passengers buying tickets would have less disposable income.

[94] Venables, A.J. et al. (2014), 'Transport investment and economic performance: Implications for project appraisal', October.
[95] Department for Transport (2020), 'TAG Unit A2.2 Appraisal of Induced Investment Impacts', May, p. 17. The uplift is estimated in Venables, A., Gasiorek, M., McGregor, P., Harris, R., Harris, R.I.D. and Davies, S. (1999), *The welfare implications of transport investments in the presence of market failure – The incidence of imperfect competition in UK sectors and regions*, DETR, October.
[96] Airports Commission (2015), 'Economy: Wider Impacts Assessment', July, pp. 19-20.
[97] Airports Commission (2015), 'Economy: Wider Impacts Assessment', July, p. 11.
[98] Department for Transport (2022), 'TAG Unit A5.2 Aviation Appraisal', November, p. 8.

6.3.2 The Government levies APD on all departing passengers from the UK. The Government has recently published new APD rates that will be in place from April 2023 for different travel bands according to the distance of the flight.[99]

6.3.3 APD is levied on airlines and passed through by the airlines to the air fares that passengers pay. It therefore affects passengers' disposable income. In this analysis it is assumed that leisure passengers would be the only passengers affected by a change to their disposable income as, usually, this would be an out-of-pocket expense for them, unlike for most business passengers. Thus, in line with DfT's guidance, the analysis in this report differentiates between business and leisure passengers when estimating the tax impacts of the Project and accounting for the reduced taxable spending by UK leisure passengers.[100] Further detail on the methodology used to calculate this is provided in **Annex A1.1**. Given that only passengers departing from the UK pay APD, only domestic passengers and departing passengers for short-haul and long-haul flights are considered.[101] Real APD rates are assumed to be constant over time.[102]

6.3.4 Table 6.3.1 summarises the estimated increase in tax revenues related to APD with the Project.

Table 6.3.1: impacts on public accounts (£ bn)

Business passengers	0.5
Leisure passengers	2.0
Total	**2.5**

Note: Estimates are in 2010 prices and values. Values may not sum due to rounding.

Source: Oxera.

6.4. Marginal external costs

6.4.1 The increase in passenger volumes with the Project would result in more people driving to and from the airport. The Project's **Transport Assessment** (Doc Ref. 7.4) identifies that there would be increased road traffic on the road network around the airport, which would result in congestion for all travellers, including air passengers and those who are using the transport network for other reasons.[103] These additional costs are referred to as marginal external costs.

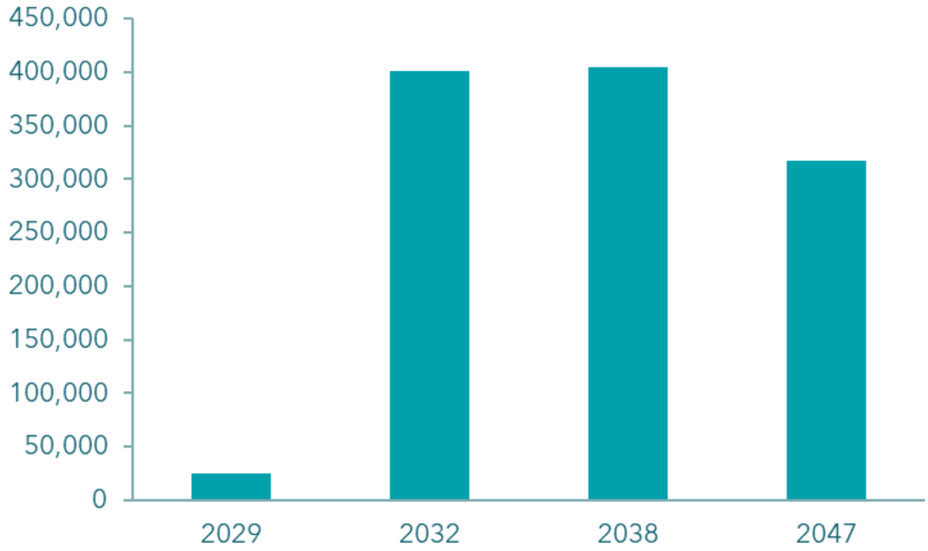
6.4.2 The marginal external costs arising from the Project are estimated in line with TAG.[104] Forecasts of the net change in vehicle kilometres (ie the change in total distance travelled by all vehicles) in Gatwick Airport's surface access network as a result of the Project for 2029, 2032, 2038 and

[99] The APD rates used in the estimations in this report are the currently announced rates applied from 1 April 2023. A weighted average of the reduced and standard rates was calculated for each travel distance band. Shares of economy class seats and business class seats in the whole London aviation market were used as weights. Data on seat shares was sourced from OAG (2019), 'Flight Schedules Data'. For more information, see HM Government (2022), 'Rates for Air Passenger Duty', 21 July, https://www.gov.uk/guidance/rates-and-allowances-for-air-passenger-duty, accessed 2 November 2022.
[100] Department for Transport (2022), 'TAG Unit A5.2 Aviation Appraisal', November, p. 8. The analysis in this report uses new APD rates sourced from HM Government, 'Rates for Air Passenger Duty', available at https://www.gov.uk/guidance/rates-and-allowances-for-air-passenger-duty (last accessed November 2022).
[101] Domestic passengers are considered in this assessment as they depart from the UK and therefore pay APD.
[102] This approach is in line with DfT's modelling. See Department for Transport (2022), 'Jet Zero: modelling Framework', March, p. 16.
[103] An increase in trade and freight with the Project may also result in an increase in light and heavy goods vehicle traffic.
[104] Department for Transport (2021), 'TAG Unit A5.4 Marginal External Costs', November. Marginal external costs also include costs associated with changes in air quality, noise and GHGs. Since these impacts are appraised as part of the environmental impacts (see Department for Transport (2021), 'TAG Unit A5.4 Marginal External Costs', section 4E, November), they have been excluded from the calculation of the marginal external costs in order to avoid double-counting.

2047 were provided as input to this analysis. The TAG data book provides costs associated with a change in vehicle kilometres travelled.[105]

6.4.3 The estimates suggest that the Project would increase the number of kilometres travelled by all vehicles by around 25,000 on an average day in the opening year (2029) and by around 315,000 in the last modelled year (2047). **Figure 6.4.1** reports the net change in all vehicle kilometres per year.

Figure 6.4.1: total net change in all vehicle kilometres for a typical day in a year



Source: Oxera analysis based on surface access input estimates. Figures represent the net change in vehicle kilometres for a typical day in each corresponding year.

6.4.4 From 2024 to 2031, planned highway and airfield schemes are proposed to be constructed as part of the Project. This would impose constraints on the road network around the Airport, affecting the distance travelled by vehicles. The highway construction is projected to take place between 2029 and 2031, while the airfield construction is planned to take place before the Project opens, from 2024 to 2029.[106] Data on the additional vehicle kilometres for each construction scheme for the opening year (2029) was provided as input. Its modelling uses the peak movements of construction vehicles throughout each construction period. The highway construction scenario would lead to an additional 25,000 km travelled by all vehicles in the opening year (2029) at its peak of construction activity, on top of the net change in vehicle km as a result of the Project. The airfield construction scenario is expected to impose an additional 1,000 km travelled by all vehicles at the peak of its construction activity.[107]

[105] Department for Transport (2022), 'TAG Data Book, MECs', May.
[106] Based on information received by Oxera from Gatwick.
[107] In order to obtain a conservative estimate of the overall impact of the construction activity on top of the marginal external costs resulting from the Project, the same peak level of net vehicle kilometres in the highway construction scenario was assumed from 2029 to 2031. Gatwick also provided data on the level of construction vehicle movements during the whole period of construction. This enabled a conservative estimate of additional vehicle kilometres as a result of the Project for the airfield construction period (2024–29). In particular, the growth rate in construction vehicle movements from 2024 to the peak of airfield construction activity was used to represent the overall growth in vehicle movements up to the 2029 levels for the whole airfield construction period. The impacts to the road network related to the highway and airfield schemes were modelled separately, and it is therefore likely that some rerouting of vehicles is not captured. As a result, adding these two impacts has some limitations and the results should be treated with caution.

6.4.5 The input additional vehicle kilometres and summarised above show that the Project would increase vehicle congestion in the vicinity of the airport, which, in turn, would impose marginal external costs on UK society. It is estimated that the marginal external costs arising from the Project would be £4.0 bn over the 60-year appraisal period. Table 6.4.1 below shows the breakdown of this cost, including additional tax revenues as a result of increased fuel use on the surface access network.

Table 6.4.1: marginal external costs (£ m)

Cost type	Costs
Congestion	3,973.3
Infrastructure	9.2
Accidents	9.2
Indirect taxation	-32.7
Total	**3,959.0**

Note: The negative cost value in indirect taxation reflects benefits arising from increased tax revenue. Figures represent the scenario when the planned highway schemes construction goes forward.

Source: Oxera analysis.

6.4.6 In addition to these costs and the benefits described in the previous sections, the Project would result in further benefits to the wider UK economy. These impacts have been quantified and/or qualitatively assessed in the following sections, but are not included in the NPV of the Project due to concerns about double-counting the impacts of the Project.

6.5. Employment effects

6.5.1 The Project would increase demand for labour in the vicinity of the airport. Demand for labour would increase due to the additional local employment generated by the Project through various channels: direct impacts (additional jobs on site at the airport), indirect impacts (additional jobs in the supply chain of the airport), induced impacts (additional jobs generated by additional spending from workers in direct and indirect jobs), and catalytic impacts (additional jobs generated by firms deciding to locate or expand close to the airport due the connectivity it provides). These impacts are set out in **ES Appendix 17.9.2: Local Economic Impact Assessment** (Doc Ref. 5.3).

6.5.2 Demand-side employment effects arising from the Project (ie firms demanding more labour) may generate opportunities for existing workers by creating new positions, ie they may leave their current jobs to start working at new jobs. The new positions may be more or less productive than their current ones. There would therefore be a positive (negative) employment impact arising from the Project if it results in a more (less) productive economy.[108]

6.5.3 The analysis of effects arising from switching between jobs considers jobs created at the airport only.[109] In order to quantify this impact, estimates are used of labour supply impacts and differences in GVA per job between Gatwick Airport and the South East on average for 2029,

[108] The Project is not expected to have material supply-side employment effects that would generate employment impacts at a national level. The analysis of the local employment effects of the Project in **ES Appendix 17.9.2: Local Economic Impact Assessment** (Doc Ref. 5.3) does not estimate national-level additionality and displacement.
[109] Catalytic, induced and indirect jobs are excluded due to a lack of evidence on the productivity differentials between existing and new jobs for these types of employment effect.

2032, 2038 and 2047.[110] The analysis suggests that the Project would yield a present value productivity impact of £0.3 bn in GVA from moves to more productive jobs.[111] This indicates that the value of goods and services produced at Gatwick Airport and within the South East would increase by £0.3 bn in the appraisal period as a result of the impact of the Project on productivity.

6.5.4 Following DfT guidance, the associated welfare impact from this productivity gain is equal to the resulting change in tax revenue. This welfare benefit is calculated by applying a 30% tax rate to the added value of goods and services, resulting in a benefit of £77 m.[112]

6.5.5 However, it is noted that the Project would likely result in some movement of jobs from other locations, which are not accounted for in this analysis. As a result, the welfare benefits estimated should be considered as indicative of potential employment effects arising from the Project and not as net additional welfare benefits to the UK society. For this reason, benefits arising from employment effects are excluded from the final NPV estimate of the Project.

6.6. Productivity impacts

6.6.1 The above section discusses how productivity changes from the Project can occur if workers switch to more productive jobs at Gatwick Airport.

6.6.2 In addition to providing opportunities for switching to more productive jobs, the Project could have impacts on productivity, even in the absence of such an employment effect. Such impacts arise as a result of increased concentration of economic activity at a particular location such that firms can draw from a larger pool of labour and are located closer together, resulting in a greater exchange of ideas and technological spillovers.[113] These types of productivity benefit arising from locating in close proximity to other individuals and firms are called 'agglomeration effects'.[114]

6.6.3 The Project is expected to increase economic activity at the airport and in its vicinity. Overall, this would increase the density of economic activity, not just in airport-related jobs but also in sectors that are attracted to the area around the airport, which would in turn generate agglomeration effects. These benefits can be quantified using elasticities of productivity with respect to a measure of employment density.[115] The methodology in this report for estimating agglomeration effects is based on the DfT's TAG, which is set out below and in more detail in **Annex A1.1**.

6.6.4 Agglomeration benefits are calculated using the largest study area, the Six Authorities Area, to capture a geographic area that is representative of Gatwick Airport's economic significance in the South East.[116] The analysis indicates that the Project is expected to bring almost 12,800

[110] This implies that, for a worker switching to a new job at Gatwick Airport with the Project, the GVA of the previous job is the average GVA in the South East, and the GVA of the new job is the average GVA at Gatwick Airport.
[111] Productivity impacts between modelled years are interpolated linearly, and a real GVA increase is assumed after the last modelled year until the end of the appraisal period. Real productivity growth rates are sourced from Department for Transport (2022), 'TAG Data Book Annual Parameters', May.
[112] Department for Transport (2019), 'TAG Unit A2.3 Employment Effects', May, p. 13. The tax rate is assumed to be 30%, as per the guidance of the TAG Unit.
[113] For example, please see Banister, D. and Berechman, J. (2000), *Transport investment and economic development*, Routledge, p. 95.
[114] The current appraisal does not consider the potential impact of working from home on how agglomeration affects productivity, due to an absence of evidence at this time.
[115] This is according to Venables, A.J. et al. (2004), 'Evaluating Urban Transport Improvements: Cost-Benefit Analysis in the Presence of Agglomeration and Income Taxation', Centre for Economic Performance Discussion Paper No 651.
[116] The impact of the Project on employment in the Six Authorities area is analysed in **ES Appendix 17.9.2: Local Economic Impact Assessment** (Doc Ref. 5.3). The Six Authorities covers the county council areas of West Sussex, East Sussex, Surrey, and Kent as well as the Unitary Authority of Brighton and Hove, and the London Borough of Croydon.

additional jobs to the region by 2047. It is estimated that this increase in employment would result in agglomeration benefits of £0.7 bn.[117]

6.6.5 However, displacement of workers and firms from other locations might affect the agglomeration and productivity levels in these locations. These estimates of agglomeration benefits are therefore only indicative, as they do not factor in displacement at the national level. For this reason, agglomeration benefits are excluded from the final NPV estimate of the Project.

6.7. Trade and foreign direct investment

6.7.1 An airport capacity expansion, such as the Project, could provide increased connectivity in the form of improved access to foreign markets, facilitating and encouraging trade between the UK and the rest of the world. Exports to other countries encourage knowledge and technology transfers from international firms, and also allow British firms to exploit economies of scale by selling to larger international markets.[118] Similarly, imports from other regions encourage competition in domestic markets, leading to a more efficient use of resources and greater access to a range of inputs to UK supply chains, improving productivity.[119] These effects could result in an increase in productivity and economic activity in trade-related sectors of the economy.

6.7.2 The potential magnitude of these trade effects is estimated following the methodology set out in the Airports Commission Wider Economic Impacts Assessment report.[120] This methodology looks at the geographic distribution of additional business passengers generated as a result of the Project as an indicator of the extent to which the capacity expansion could have an impact on trade.[121]

6.7.3 The methodology follows the steps set out in the box below.

[117] Estimates are in 2010 prices and values. An agglomeration elasticity of 0.0535 is assumed, which is the mean of consumer and producer service elasticities as reported in Department for Transport (2021), 'Wider Impacts Dataset', July. Values for GDP per worker are sourced from Department for Transport (2021), 'Wider Impacts Dataset', July. GDP per worker in the Six Authorities study area is calculated as the average GDP per worker in the services sectors in the LADs in the Six Authorities study area.
[118] Airports Commission (2015), 'Economy: Wider Impacts Assessment', July, p. 11.
[119] Airports Commission (2015), 'Economy: Wider Impacts Assessment', July, p. 11.
[120] Airports Commission (2015), 'Economy: Wider Impacts Assessment', July, p. 11.
[121] The analysis in this report uses input Baseline and Project business passenger forecasts at Gatwick Airport for different world destinations.

Box 6.7.1: methodology for estimating trade benefits

Step 1: business passenger air traffic to trade elasticities that differ by trade component (export or import of goods or services) and world region (Asia, Europe, North America and Others) are used to estimate the increase in UK trade.[122] A passenger to trade elasticity describes the percentage change in trade as a result of a percentage change in passenger numbers. Using the additional business passengers at a national level as a result of the Project while differentiating by destination, the elasticity determines the change in exports or imports of goods or services.[123]

Step 2: once the change in trade is captured, the impact on productivity is determined using a trade to GVA elasticity.[124] This elasticity describes the percentage change in the GVA of the trade-related sectors of the economy as a result of percentage changes in trade.

Step 3: the estimated percentage change in GVA is then applied to the Baseline GVA of the trade-related sectors of the economy to estimate the additional GVA.[125]

Source: Oxera.

6.7.4 The additional GVA arising from an increase in trade as a result of the Project is estimated to be between £4 bn and £6.7 bn over the 60-year appraisal period.[126]

6.7.5 This estimate has not been included in the final NPV as it may result in double-counting with other impacts quantified in this appraisal. This double-counting may occur in two ways. First, where trade-induced productivity benefits accrue to a firm, these impacts can be expected to be incorporated in purchasing decisions and thus would be reflected in direct business passenger impacts. Second, because trade studies do not separate out the two effects, the estimated trade impacts will include some impacts that are attributed to output changes in imperfectly competitive markets.[127]

6.7.6 In a similar manner, the improved access to international markets associated with the Project may facilitate foreign direct investment (FDI). Increased connectivity reduces the costs of face-to-face interactions and increases their frequency, resulting in reduced organisational and

[122] Business passenger air traffic to trade elasticities reflect percentage changes in traded exports and imports of goods or services as a result of percentage changes in the air traffic of business passengers. These elasticities are based on all passengers, and they have been applied to business passengers alone. The literature suggests that the trade impacts of greater connectivity are through business passengers, which suggests that these elasticities would be even higher. The trade impacts are therefore potentially an underestimate. For further information on these elasticities, see Airports Commission (2015), 'Economy: Wider Impacts Assessment', July, p. 12.
[123] Displacement of business passengers in the London aviation system is taken into account to determine the additional business passengers at the London level. To be consistent with the rest of the appraisal, the analysis assumes that the Project does not cause any displacement of passengers beyond the London aviation system. These additional passengers were added to the national Baseline passenger forecasts produced by the DfT in Department for Transport (2017), 'UK Aviation Forecasts', October, in the absence of more recent forecasts with a breakdown by purpose of travel.
[124] The elasticity of 0.1 has been used as sourced from the Airports Commission's methodology.
[125] Baseline GVA was forecast according to GDP forecasts available in TAG. GVA historical data was sourced from GVA data published in Office for National Statistics (2022), 'UK trade: goods and services publication tables', November. The definition of traded sectors of the economy is sourced from TAG, which includes manufacturing, consumer services and producer services. Department for Transport (2020), 'TAG Unit A2.4 Appraisal of Productivity Impacts', May, Appendix D.
[126] This range represents the definition of the tradable sectors of the economy used in the assessment. The Organisation for Economic Co-operation and Development (OECD) Regional Outlook 2016 defines tradable sectors as agriculture, industry, information and communication services, financial and insurance activities, and other services. If the OECD definition is used, the total change in GVA resulting from trade benefits is estimated at £4 bn. Alternatively, if the definition is sourced from TAG, trade benefits amount to £6.7 bn. The tradable sectors according to TAG include manufacturing and consumer and producer services. OECD (2018), 'Thinking global, developing local: Tradable sectors, cities and their role for catching up', in OECD, *Productivity and Jobs in a Globalised World*.
[127] Department for Transport (2016), 'Further Review and Sensitivities Report, Airport Capacity in the South East', October.

communication costs within and between multinational firms.[128] Cost reductions resulting from increased connectivity may therefore have an effect on international investment decisions.[129]

6.7.7 However, this impact is difficult to estimate robustly given limited evidence, and it is likely to overlap with both trade benefits and other impacts quantified in this appraisal. For example, increased connectivity as a result of the Project could encourage a foreign business to invest in a production facility in the UK, which could increase trade and ultimately productivity. Therefore, any productivity impacts would be accounted for twice, through the FDI inflow and the change in trade.

6.8. Tourism

6.8.1 For many international travellers, aviation is the only feasible way to reach their destination. Reduced fares and increased services reduce (generalised) travel costs,[130] enabling passengers to travel abroad to see new places and visit their friends and relatives more frequently. This results in welfare benefits.[131] These incremental welfare benefits that result from reduced fares associated with the Project are included as part of the user benefits estimation in section 5. The additional tax benefits resulting from changes in the number of air passengers, including tourists, are calculated in section 6.3.

6.8.2 An increased number of leisure passengers (as a result of the reduced fares) can also lead to 'tourism effects' through an increase in expenditure in the UK by inbound tourists, and overseas by outbound tourists.[132]

6.8.3 With respect to inbound tourism, it is noted that that increased spending in the UK by overseas visitors would directly and indirectly contribute to the UK economy. For example, as part of its assessment of the economic impact of Gatwick Airport, in **Needs Case Appendix 2 - The Economic Impact of Gatwick Airport: A Report by Oxford Economics** (Doc Ref. 7.2) it has been assessed that Gatwick-facilitated tourism as a result of the Project could contribute an additional £1.92 bn in 2038 and £1.98 bn in 2047 to the UK economy.[133] Part of this impact would come from the direct expenditure of visitors, including at hotels and restaurants, which has been estimated at £1.96 bn for 2019 in **Needs Case Appendix 2 - The Economic Impact of Gatwick Airport: A Report by Oxford Economics** (Doc Ref. 7.2).[134] However, these impacts are financial impacts and only part of them would translate to net welfare impacts, which are the focus of this assessment.

[128] McCann, P. (2009), 'Globalisation and Economic Geography: The World is Curved, Not Flat', *Cambridge Journal of Regions, Economy, and Society*, **1**:3, June, pp. 351–370.
[129] For example, Bel and Fageda (2008) shows that the supply of intercontinental flights is associated with corporate headquarter location decisions. Bel, G. and Fageda, X. (2008), 'Getting there fast: Globalisation, intercontinental flights and location of headquarters', *Journal of Economic Geography*, **8**:4, February, pp. 471–495. The current appraisal does not consider the potential impact of an increased proportion of remote meetings in the future absent evidence on the long-term behavioural impact of increased work-from-home schemes globally.
[130] Generalised travel cost is a monetary measure of the disutility from taking a flight and includes all the monetary costs (eg air fares) and the non-monetary costs such as time spent at airports, in-flight time, flight frequency, flight delays and interchange penalties. Department for Transport (2022), 'TAG Unit A5.2: Aviation Appraisal', November, para. 3.2.4.
[131] Airports Commission (2013), 'Discussion Paper 02: Aviation Connectivity and the Economy', March.
[132] See, for example, Oxford Economics (2017), 'The economic impact of Gatwick airport', January, pp. 19–20.
[133] **Needs Case Appendix 2 - The Economic Impact of Gatwick Airport: A Report by Oxford Economics** (Doc Ref. 7.2). Figures are expressed in 2019 constant prices.
[134] **Needs Case Appendix 2 - The Economic Impact of Gatwick Airport: A Report by Oxford Economics** (Doc Ref. 7.2). Figures are expressed in 2019 constant prices.

6.8.4 Welfare impacts would take place if changes in tourism spending result in a relocation of resources between sectors with different labour productivity. For example, higher inward tourism could drive a relocation of labour to sectors servicing tourists. If these sectors have higher productivity, there would be a welfare impact.

6.8.5 In the absence of recent quantitative evidence on how tourism could generate such welfare impacts on the UK economy, no wider economic impacts arising from increased inbound tourism are quantified.[135]

6.8.6 This assessment also recognises that outbound tourism may imply reduced consumption in the UK as individuals may spend money abroad rather than in the UK. However, it is unclear whether this increased spending abroad can be quantified as a welfare loss to UK society, for the following reasons:

- there is no clear evidence that suggests that a UK citizen who could have travelled and spent money abroad would spend similar amounts in the local economy if they remained in the UK. Even if they did spend the same amount, this would be a financial and not a welfare impact of the Project;[136]
- the Project relieves capacity constraints for passengers only by increasing the capacity of services available to them. This means that those who prefer to travel and spend money abroad instead of staying and spending locally receive higher welfare from spending abroad than spending locally (otherwise they would not have travelled). As such, even if a UK citizen travels abroad and spends money, this means that they receive welfare of at least at an equal amount (otherwise they would not have spent money).

6.8.7 In addition, a quantification of the impact of outbound tourism on GDP should take account of any change in the services supported by outbound tourism (ie its supply chain). For example, a study commissioned by ABTA found that that outbound travel contributed £25 bn in direct GDP to the UK economy in 2019.[137]

6.8.8 Given the limited evidence on the mechanisms through which inbound and outbound tourism would affect welfare in the UK, the welfare changes arising from increased tourism as a result of the Project are not quantified.

6.9. Total wider economic benefits

6.9.1 Table 6.9.1 summarises the analysis in terms of the monetised benefits to the wider economy arising from the Project over the 60-year appraisal period.

Table 6.9.1: total benefits to the wider economy and the Government (£ bn)

Type of wider economic benefit	Benefits
Output change in imperfectly competitive markets	13.5

[135] A previous literature review commissioned by the Airports Commission cited gains of 6% of the increase in spending in the UK, from a paper published in 2006. The tourism section and the UK economy are considered to have changed since then and hence the estimates are not fit for purpose. See Steer Davies Gleave (2023), 'Aviation and the Economy – Framework and Evidence', 21 February.
[136] As second- and third-order effects, unspent money could be saved and in turn invested into the economy.
[137] See ABTA (2022), 'Driving Growth: The economic value of outbound travel', available at [redacted] (last accessed March 2023).

Marginal external costs	-4.0
Government revenues	2.5
Present value of wider economic benefits	**12.0**

Note: All estimates are in 2010 prices and values. They may not sum due to rounding.

Source: Oxera.

6.9.2 The results suggest that the present value of benefits to the wider economy and the Government is £12.0 bn. In addition to these monetised benefits, the Project would have the following impacts:

- employment benefits estimated at £0.1 bn;
- productivity benefits estimated at £0.7 bn;
- benefits related to trade, of between £4.0 bn and £6.7 bn;
- impacts related to FDI;
- tourism effects.

6.9.3 These have been set out in the sections above but are not reflected in the NPV of the Project due to concerns about double-counting the impacts of the Project. As a result, the benefits to the wider economy are likely to be larger than £12.0 bn, making the estimated NPV of the Project a conservative estimate.

7 Environmental impacts

7.1. Introduction

7.1.1 This section considers the environmental impacts arising from increased activity at Gatwick Airport as a result of the Project. The DfT provides detailed guidance on appraising such impacts.[138] This section focuses on:

- air quality;
- greenhouse gas (GHG) emissions;
- noise.

7.1.2 The Project's environmental impacts are assessed using the same Baseline and Project scenarios that are used for the economic impacts. The environmental impacts are also assessed in 2010 prices, and include the costs incurred during the Project's development as well as over a 60-year period after the Project's opening.

7.1.3 The rest of this section sets out further details on the assessment of each of these environmental impacts.

7.2. Air quality

7.2.1 The construction of the Project, increased ATMs, ground activity at the airport and surface traffic on the surface access network would generate additional NO_x and particulate matter ($PM_{2.5}$) emissions.[139] The cost arising from these changes in air quality as a result of the Project is assessed.[140]

7.2.2 An input assessment of changes in emission levels of these pollutants for the Baseline and Project scenarios was used for the opening year 2029 and the years 2032, 2038 and 2047.[141]

7.2.3 The UK is legally committed to achieving emission targets for NO_x and $PM_{2.5}$ pollutants to improve air quality.[142] TAG recommends different approaches for assessing the costs of these emissions depending on whether emissions from a scheme would breach legal obligations on emission levels. The assessment of air quality impacts in **ES Chapter 13: Air Quality** (Doc Ref.

[138] Department for Transport (2022), 'TAG Unit A3 Environmental Impact Appraisal', May. The Project is expected to attract passengers from other London airports, as discussed in section 5. This diversion, even if limited, may reduce the environmental costs associated with activity at these airports. The current analysis does not capture this reduction and focuses only on increased environmental costs in the vicinity of Gatwick Airport. In this sense, the assessment is a conservative estimate of the environmental costs of the Project at a national level.
[139] NOx emissions are released when fuels are burned. $PM_{2.5}$ emissions are released from various sources such as fuels, lubricants, and tyre and brake wear. These pollutants have adverse effects on health and the environment. See, for example, Department for Environment, Food & Rural Affairs (2019), 'Emissions of air pollutants in the UK, 1970 to 2017', February.
[140] Department for Transport (2022), 'TAG Unit A3 Environmental Impact Appraisal', May.
[141] Emission figures associated with airfield construction for 2024 and emission figures from the highway construction for 2029 were provided as inputs to this analysis. These figures represented the peak of each corresponding construction activity and were modelled as road traffic-related emissions. In this report it is assumed that emissions are constant until 2029 for the former and 2032 for the latter, in line with the anticipated construction start and end dates. See section 13.5 in **ES Chapter 13: Air Quality** (Doc Ref. 5.1). By extending the peak in construction activity to the construction-related years, the current analysis could result in an overestimation of emissions related to the Project. Nevertheless, these years represent a small share of the total appraisal period so there is unlikely to be a significant effect. Due to data availability, emissions produced by the construction plants could not be modelled, and are therefore not monetised.
[142] European Commission (2016), 'Directive (EU) 2016/2284 of the European Parliament and of the Council of 14 December 2016 on the reduction of national emissions of certain atmospheric pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/EC', *Official Journal of the European Union*, December. Department for Environment, Food & Rural Affairs (2019), 'Clean Air Strategy 2019', January sets out actions to meet these goals.

5.1) has indicated that the Project would not impact the compliance with legal air quality standards in any of the years considered.[143] In such a situation (ie where legal limits are not expected to be breached), DfT recommends two approaches to assessing the value of the Project's impact on air quality: damage costs and impact pathways. In this assessment, the damage costs approach is used due to data limitations on the distribution of pollutants.[144]

7.2.4 The TAG damage costs approach to air quality valuation is based on estimating annual emission levels of each pollutant with and without the Project, and attaching values to account for the effects of changes in emission levels of different pollutants.[145] The approach provides three sets of costs associated with changes in pollutant levels—a central, low and high scenarios. The low and high values of monetary costs reflect differences in the valuation of a life year and are based on different sets of health impacts[146]

7.2.5 Using the central cost forecast, the present value of the cost of increased NO_x and $PM_{2.5}$ emissions with the Project is estimated to be £83.5 m in 2010 prices and values. Table 7.2.1 presents a breakdown of this estimate into emissions from aircraft, other on-site operations and surface access.

Table 7.2.1: present value of monetised air quality impacts (£ m)—central scenario

Source of air quality change	NO_x	$PM_{2.5}$	Total costs
Aircraft	-77.1	-3.8	**-80.9**
Road traffic	1.2	-2.5	**-1.2**
Other on-site operations	-1.4	0.1	**-1.4**
Total	**-77.2**	**-6.2**	**-83.5**

Note: Values are in 2010 discounted prices. They may not sum due to rounding. Estimates refer to changes in pollutant levels with the Project relative to the Baseline.

Source: Oxera.

7.2.6 Costs in the low and high sensitivity scenarios (not featured in the table above) suggest that the monetised impact of changes in air quality with the Project would be in the range of £8.2 m to £314.9 m in 2010 prices. The significant difference between the scenarios represents the wide range of monetary costs of air quality impacts as published by DEFRA.[147]

7.2.7 Air quality emissions data was also received for a sensitivity scenario that assumes that the rate of transition of the aircraft fleet at Gatwick is slower than in the Project and Baseline scenarios,

[143] See section 13.9 in **ES Chapter 13: Air Quality** (Doc Ref. 5.1).
[144] The damage costs approach can be used to monetise the impact of changes in aggregate levels of pollutants without assumptions on how pollutants are geographically distributed. As such, it provides the average impact of the changes in emission levels in the UK. The impact pathways approach results in a more precise estimate of the social cost of changes in air quality, but it requires additional data on the distribution of emissions and affected population. For more information, see Department for Environment, Food & Rural Affairs (2021), 'Air quality appraisal: impact pathways approach', 26 March.
[145] These effects include physical impacts of increased emissions on health, productivity, wellbeing and environment.
[146] Department for Environment, Food & Rural Affairs (2021), 'Air quality appraisal: damage cost guidance', 26 March. The damage costs approach accounts for the impacts of increased emissions on health, productivity and wellbeing on society. Sensitivities include different types and levels of impact of pollution. The low scenario includes well-established effects with low impacts. The central and high scenarios progressively add more effects with higher impacts, resulting in differences for the estimate of changes in air quality. For more information see Department for Environment, Food & Rural Affairs (2023), '[redacted]', 2 March (last accessed April 2023).
[147] Ranges represent low and high values of monetary costs that reflect differences in the valuation of a life year and are based on different sets of health impacts uncertainty in the monetary costs associated with air quality impacts. For more information see Department for Environment, Food & Rural Affairs (2023), 'Air quality appraisal: damage cost guidance', 2 March (last accessed April 2023).

referred to as the 'slow fleet transition' (SFT) scenario across the Environmental Statement chapters. Impact estimates associated with the SFT scenario are presented in the sensitivity annex in this report.

7.3. Greenhouse gases

7.3.1 Aviation is a substantial source of GHG emissions. Increased activity with the Project relative to the baseline would increase aviation's carbon footprint in the UK.

7.3.2 The UK is committed to reducing its carbon emissions to net zero by 2050.[148] This target is monitored through five-yearly carbon budgets.[149] According to the DfT's guidance, in addition to the cost of incremental GHG emissions with the Project, the Project's impact on carbon budgets should be reported.[150] This impact is discussed in **ES Chapter 16: Greenhouse Gases** (Doc Ref. 5.1).

7.3.3 Input forecasts of GHG emissions at Gatwick Airport and in its surface access network for the Baseline and Project scenarios were used in the analysis.[151] The forecasts are broken down by emissions from sectors that participate in the UK Emissions Trading Scheme (UK ETS) and emissions that are not covered by the scheme. The purpose of the UK ETS is to cap the emissions of energy-intensive industries: it sets a quota on the level of emissions of certain sectors ('traded sectors') for a given period and then sells emission allowances to these sectors. Trading sectors must purchase an allowance for the emissions that they generate. This mechanism creates a market for trading carbon allowances and sets a price for emitting carbon, resulting in the internalisation of the cost of carbon emissions into the prices of the traded sector goods. On the other hand, non-traded emissions are those that do not fall within the scope of the UK ETS.

7.3.4 The incremental traded sector emissions as a result of the Project are forecast to be 9.3 m metric tonnes of CO_2 equivalent (CO_2e) over the appraisal period,[152] and include emissions from domestic and outbound flights to countries in the European Economic Area (EEA),[153] airport buildings and ground operations (ABAGO), and the surface access network. The incremental non-traded sector emissions are forecast to be 29.2 m metric tonnes of CO_2e, and include emissions from other outbound flights, other ABAGO emissions, and other emissions from surface access of passengers, staff and freight accessing the airport.[154] In addition to these

[148] HM Government, 'UK becomes first major economy to pass net zero emissions law', June, available at https://www.gov.uk/government/news/uk-becomes-first-major-economy-to-pass-net-zero-emissions-law (accessed November 2022).
[149] Committee on Climate Change website, 'Advice on reducing the UK's emissions', available at [redacted]/ (accessed November 2022).
[150] Department for Transport (2022), 'TAG Unit A3 Environmental Impact Appraisal', May, pp. 33–34.
[151] More information on the assessment of GHG emissions is provided in **ES Chapter 16: Greenhouse Gases** (Doc Ref. 5.1). The estimated traded and non-traded sector breakdown was received for the years between 2018 and 2050. In the current report it is assumed that emissions after 2050 are constant, in line with assumptions about growth in air traffic after 2047.
[152] CO_2e includes CO_2, methane (CH4), nitrous oxide (N_2O) and f-gases (such as refrigerants).
[153] Environmental impacts do not include emissions generated from inbound flights, although these would change as a result of the Project. The approach in this report is considered to be consistent with the emissions accounting methodology underpinning the UK carbon budget where UK international aviation emissions are reported on the basis of all emissions associated with outbound international flights (see Committee on Climate Change (2020), 'The Sixth Carbon Budget – Methodology Report', December, pp. 257–259; BEIS (2020), '2018 UK Greenhouse Gas Emissions, Final figures', 4 February, p. 25). This is also in line with TAG, which specifies that appraisal and reporting of emission estimates should be in line with 'carbon budget accounting and reporting requirements' (Department for Transport (2022), 'TAG UNIT A3 Environmental Impact Appraisal', May, para. 4.4.10).
[154] ABAGO activities refer to energy use for buildings, infrastructure and operations to provide heating, cooling, lighting and power needs; fuels for airside land vehicles; refrigerant losses; water consumption and treatment; and operational waste disposal and treatment. Surface access network refers to emissions from airport-related road traffic. Future baseline and Project emissions for Surface access reflect the fleet and efficiency assumptions that align with the Transport Decarbonisation Plan, and incorporate the

values, forecast GHG emissions include a total of 1.2 m metric tonnes of CO_2e from construction-related activities between 2024 and 2035.[155]

7.3.5 According to the DfT's guidance, when monetising the cost of emissions, economic appraisals should distinguish between emissions from traded and non-traded sectors.[156] The reason for this is that when companies buy emission allowances they will pass this cost through in the prices of their products. Therefore, as the traded carbon cost component is included in air fares (see section 5.4), emissions from the traded sector are reported but are not included in the environmental cost valuation, as their cost is already reflected in the fares that passengers pay.[157]

7.3.6 The approach suggested in TAG to monetise emissions is based on using forecast prices per tonne of CO_2e emissions in the non-traded sector. The DfT provides three carbon price scenarios to reflect uncertainties around the future determinants of carbon prices.[158]

7.3.7 It should be noted that the non-traded aviation emissions include emissions from flights operating under the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) scheme. According to the CORSIA scheme, airlines are required to offset the growth in international aviation emissions above 85% of their 2019 emission levels such that, for example, if an airline's emissions in 2030 are above 85% of the emissions it produced in 2019, the airline should purchase offsets for those emissions above the 2019 threshold.[159] However, CORSIA costs are also included in the modelling of air fares as part of the carbon cost component described in section 5.4, and hence are already internalised in the cost–benefit analysis.[160] As a result, the monetised costs of the Project's GHG emissions from flights covered by the CORSIA scheme are accounted for twice in this assessment. This results in a conservative estimate of the NPV of the Project, as GHG costs are overstated.

7.3.8 In an effort to account for this double-counting, an indicative estimate of the emissions to be offset by CORSIA has been estimated as part of the inputs to this analysis. This is based on a set of assumptions described in **Annex A1.3**, and amounts to 10.5 m–11.6 m metric tonnes of incremental CO_2e emissions as a result of the increased flights associated with the Project over the whole appraisal period.[161] The exclusion of these emissions from the non-traded emissions results in a total of 17.1 to 18.2 metrics tonnes of incremental CO_2e emissions that should be monetised using the cost of carbon provided by TAG. Using the upper bound,[162] the cost of GHG

embedded mitigation measures set out in Gatwick's Surface Access Commitments (SAC). Further information on the modelling of surface access emissions is provided in **ES Chapter 16: Greenhouse Gases** (Doc Ref. 5.1).

[155] Construction emissions include emissions from construction-related transportation, commuting, waste and water management, and material and energy use.

[156] Department for Transport (2022), 'TAG Unit A3 Environmental Impact Appraisal', May. Traded sectors are defined as those sectors that are included in the UK ETS. This includes emissions from power and heat generation, energy-intensive industries, aviation and electricity consumption used in transport.

[157] Department for Transport (2022), 'TAG Unit A3 Environmental Impact Appraisal', May, p. 28. For example, the costs of emissions from aviation are reflected in the air fares.

[158] The carbon prices used in this scenario are provided by the Department for Business, Energy & Industrial Strategy, and are sourced from Department for Transport (2022), 'TAG Data Book, A3.4 Greenhouse Gases', May.

[159] See ICAO's website for more details: [redacted].

[160] The carbon cost component was modelled by DfT based on assumptions on future carbon prices of emissions covered by the UK ETS and the CORSIA schemes. For more information on these assumptions, see Department for Transport (2022), 'Jet Zero: further technical consultation', March.

[161] This range is based on an assumption regarding the proportion of international aviation emissions that will be subject to the CORSIA scheme in the future. The lower range represents a scenario where 90% of all international aviation emissions are subject to the scheme and the upper range represents the results when all international emissions are subject to it. For more information on these assumptions and the methodology used to estimate emissions under the CORSIA scheme, please see **Annex A1.3**.

[162] That is, when it is assumed that 90% of the international emissions are covered under the CORSIA scheme.

emissions is estimated to be £1.3 bn for the central scenario.[163] Table 7.3.1 provides a breakdown of this cost estimate for the low, central and high carbon price scenarios. These sensitivities suggest that costs from carbon emissions with the Project may range from £0.6 bn to £1.9 bn.

Table 7.3.1: present value of monetised impacts of increased GHG emissions (£ m)

	Low	Central	High
Aviation	-585	-1,169	-1,754
Construction	-22	-43	-65
Surface access	-21	-42	-63
ABAGO	-1	-1	-2
Freight	-1	-2	-3
Total	**-629**	**-1,258**	**-1,886**

Note: Values are in 2010 discounted prices. Estimates refer to changes in emission levels with the Project relative to the Baseline. Values may not sum due to rounding. Estimates exclude emissions from aviation covered by CORSIA when 90% of international aviation emissions are assumed to be covered by the scheme. ABAGO and construction estimates correspond to the emission levels following the mitigation targets presented in the **ES Appendix 5.4.2: Carbon Action Plan** (Doc Ref. 5.3).

Source: Oxera.

7.3.9 According to the table above, aviation-related emissions represent the bigger part of the monetised impacts from increased GHG emissions with the Project. If the estimated CORSIA emissions are also monetised as part of the non-traded emissions, the Project's monetised GHG costs increase to £2.3 bn for the central scenario, with the aviation-related emissions costing £2.2 bn. This translates to a range of total GHG costs from £1.2 bn to £3.5 bn using the low and high carbon cost scenarios. However, this is an overestimate of carbon costs given that CORSIA costs are already included in the air fares and hence the cost of the CORSIA emissions is already reflected in the user benefits of the Project.[164]

7.3.10 With respect to the ABAGO emissions, ie the airport's emissions from activities such as fuel used by airport vehicles and energy used for lighting, heating and cooling buildings, the mitigation proposed by Gatwick's Carbon Action Plan (CAP) would lower ABAGO emission costs by £12.8 m, to £1 m.[165]

7.3.11 In addition to the above GHG impacts, aviation may have non-CO_2 impacts, otherwise known as indirect climate change effects from aviation. These include water vapour, particles and nitrogen oxides.[166] Research suggests that these non-CO_2 pollutants have a net positive warming effect,

[163] The monetised emissions from aviation round to £1.1 bn when we assume 100% participation of international emissions covered by the CORSIA scheme.
[164] For the modelling of carbon costs in the air fares see section 5.4.
[165] The CAP is provided in **ES Appendix 5.4.2: Carbon Action Plan** (Doc Ref. 5.3).
[166] BEIS (2022), 'Conversion factors 2022: condensed set', tab 'Business travel – air', June, available at: https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2022 (accessed July 2022).

which can be two to three times that of the warming effect of CO_2 emissions.[167] In 2018, the non-CO_2 pollutants accounted for 66% of the aviation's net warming effect.[168]

7.3.12 However, there is uncertainty around the magnitude of these impacts: the non-CO_2 effects are eight times more uncertain than the warming effects of CO_2 emissions. For this reason, and in line with DfT guidance,[169] the costs arising from non-CO_2 pollutants are not quantified.

7.4. Noise impacts

7.4.1 The increased activity at Gatwick Airport resulting from the Project would increase the noise footprint of the airport. Noise impacts would be greater in the vicinity of the airport, along the flight paths, and through Gatwick's surface access network.[170]

7.4.2 Increased noise can cause increased annoyance and sleep disturbance, and have adverse health effects on individuals.[171] The DfT's approach to appraising costs associated with these effects is based on the number of individuals exposed to particular noise bands during the day and night. All else being equal, there would be a noise cost if a scheme results in some individuals becoming exposed to higher noise bands.[172]

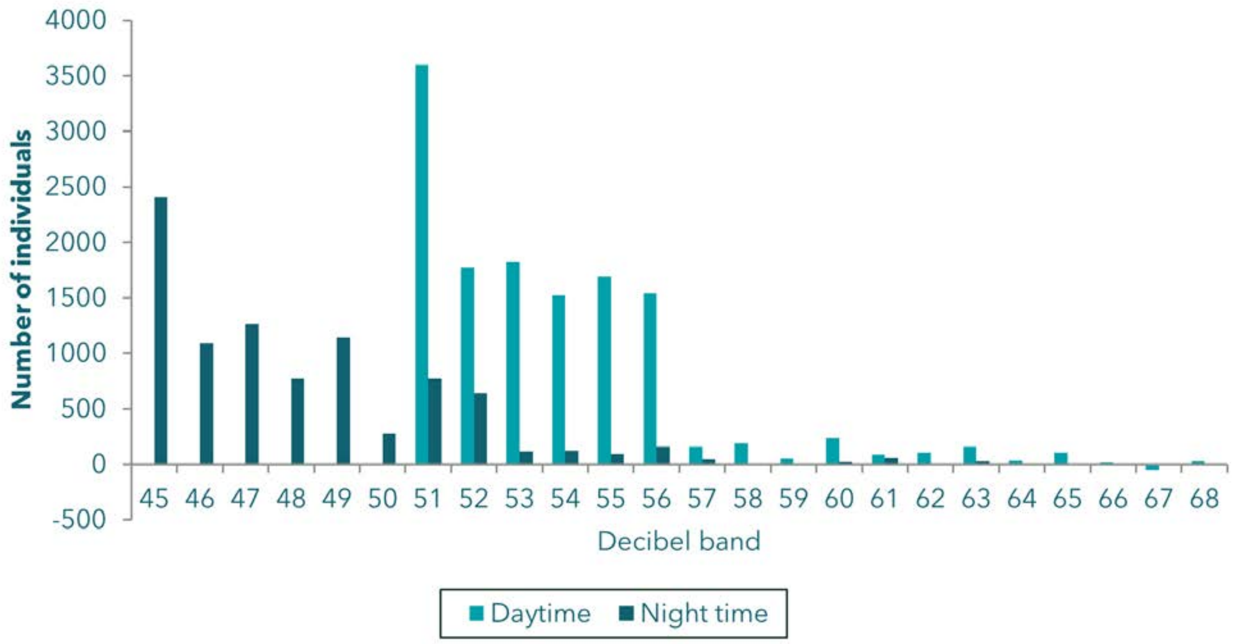
7.4.3 The CAA guidance specifies the noise levels at which adverse effects of noise begin to be detected by a community. These are called the Lowest Observed Adverse Effect Levels (LOAEL) and are recommended for assessing noise impacts from aviation. LOAELs are 51 dB for daytime noise and 45 dB for night time noise. Daytime noise is defined as the average noise level for the period between 07:00 and 23:00 (LAeq16hr). Night time noise is defined as the average noise level for the period between 23:00 and 07:00 (LAeq8hr).[173] The noise impacts arising from increased aviation activity associated with the Project are assessed following the CAA's guidance.[174]

7.4.4 To evaluate impacts of changes in aircraft noise levels with the Project, input forecasts of the number of individuals in each noise band between 45 dB and 81 dB are used for the Baseline and Project scenarios.[175] **Figure 7.4.1** illustrates the net change in the number of individuals in each noise band. For daytime noise, most people switching noise bands are expected to be

[167] The term 'warming effects' is used to refer to the effective radiative forcing, which is the change in the Earth's energy balance since pre-industrialisation. For more information, see Lee, D.S. (2018), 'The current state of scientific understanding of the non-CO_2 effects of aviation on climate', Manchester Metropolitan University, December, available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/813342/non-CO2-effects-report.pdf (last accessed November 2022).
[168] Lee, D.S. et al. (2021), 'The contribution of global aviation to anthropogenic climate forcing for 2000 to 2018', *Atmospheric Environment*, January, p. 244.
[169] Department for Transport (2022), 'TAG UNIT A5.2: Aviation Appraisal', November, para. 3.3.3.
[170] Due to changes in flight paths after the standby runway is enabled for routine use, there may be some individuals who are exposed to lower noise levels with the Project. However, there would be a net increase due to higher activity without a significant change in airspace design.
[171] Civil Aviation Authority (2016), 'Aircraft noise and health effects: Recent findings', March. These health impacts include heart attacks, strokes, and dementia.
[172] Department for Environment, Food & Rural Affairs (2014), 'Environmental Noise: Valuing impacts on: sleep disturbance, annoyance, hypertension, productivity and quiet', November. dB refers to decibel and is a metric used to measure sound level. A higher decibel level means a higher sound level.
[173] Civil Aviation Authority (2021), 'CAA Policy on Minimum Standards for Noise Modelling', January, p. 18.
[174] Many individual factors determine which minimum noise level would cause adverse effects on all individuals. This motivates the use of a community-based LOAEL measure as suggested by the CAA. Empirical evidence suggests that such adverse effects at a community level start to be observed at 51 dB for daytime and 45 dB for night-time noise. For more information see, for example, Civil Aviation Authority (2017), 'UK Airspace Policy: A framework for balanced decisions on the design and use of airspace', February, pp. 45–51.
[175] More information on the noise impacts and the underlying modelling is provided in **ES Chapter 14: Noise and Vibration** (Doc Ref. 5.1).

exposed to 51dB–56dB. For night time noise, most people switching noise bands are expected to be exposed to 45dB–52dB.[176]

Figure 7.4.1: net increase in the number of individuals in each dB band



Note: Values at the x-axis indicate the lower end of the dB band—for example, 51 refers to the 51 dB–52 dB noise band. The negative value at 67 dB means a reduction in the number of individuals exposed to this noise level. Estimates refer to changes in noise levels with the Project relative to the Baseline.

Source: Oxera analysis of input data received.

7.4.5 In addition to noise forecasts, a valuation of the costs arising from increased aircraft noise relative to the baseline using the TAG for the 60-year appraisal period was prepared by the noise consultants. This assessment suggests that the present value of the aircraft noise cost of the Project is £9.9 m.

7.4.6 The Project would also create additional noise costs arising from increased traffic in the surface access network in the vicinity of the airport and from the construction of the Project itself. The assessment provided as input to this analysis suggests that the Project would deliver a reduction in road traffic noise valued at £0.7 m. This is due to small noise reductions associated with the completion of the highway scheme in the area in the vicinity of the airport. The present value of the noise cost associated with the Project is therefore £9.2 m. Table 7.4.1 presents a breakdown of this estimate into sleep disturbance, amenity and health impacts (ie acute myocardial infarction, stroke, dementia).[177]

[176] Daytime figures correspond to the net increase in the number of individuals exposed to noise levels between 51 dB and 81 dB, while night-time figures refer to noise levels between 45 dB and 81 dB. Although there is a net increase in the number of individuals subject to most dB bands with the Project, it is estimated that some individuals may be subject to lower dB bands. For day and night, the vast majority of individuals who shift a band shift by 1 dB. See **ES Chapter 14: Noise and Vibration** (Doc Ref. 5.1) and **ES Appendix 14.9.3: Ground Noise Modelling** (Doc Ref. 5.3) for an assessment of these impacts.

[177] Amenity refers to a detrimental impact on the amenities of the local area (eg public parks).

Table 7.4.1: present value of monetised impacts from increased aircraft noise (£ m)

Noise impacts	Costs
Sleep disturbance	-2.8
Amenity	-4.5
Acute myocardial infarction	-0.1
Stroke	-0.7
Dementia	-1.1
Total	**-9.2**

Note: Values are in 2010 discounted prices. They may not sum due to rounding. Estimates refer to changes in noise levels with the Project relative to the Baseline.

Source: Input noise assessment.

7.5. Total environmental impacts

7.5.1 Increased air and ground traffic as a result of the Project would create environmental costs. The present values of these costs have been estimated by monetising changes in noise, air quality and GHG emissions with the Project, as shown in the table below.

Table 7.5.1: present value of monetised environmental impacts of the Project (£ m)

	Low	Central	High
Noise		**-9**	
Air quality	**-8**	**-83**	**-315**
Aircraft	-8	-81	-307
Road traffic	-0.1	-1	-5
Other	-0.4	-1	-3
GHG	**-629**	**-1,258**	**-1,886**
Aviation	-585	-1,169	-1,754
Construction	-22	-43	-65
Surface access	-21	-42	-63
ABAGO	-1	-1	-2
Freight	-1	-2	-3
Total	**-646**	**-1,350**	**-2,210**

Note: Values are in 2010 discounted prices. Estimates refer to changes in emission levels with the Project relative to the Baseline. Values may not sum due to rounding. Ranges represent uncertainty in the monetary costs associated with GHG emissions.

Source: Oxera.

7.5.2 Table 7.5.1 presents a summary of these costs, which are estimated to be between £0.6 bn and £2.2 bn. The majority of these environmental costs are a result of increased greenhouse gas emissions resulting from the Project. These costs are valued at £0.6 bn to £1.9 bn.

8 Other impacts

8.1. Competition impacts

8.1.1 Competition in the aviation sector can take a number of forms. In particular:

- competition between airports for airline services and passengers; and
- competition between airlines for passengers.

8.1.2 In addition, aviation competes with rail, road and sea transport for some passengers on certain routes.

8.1.3 Increased competition between airports and airlines as a result of the Project can deliver a range of benefits that are additional to the economic impacts discussed elsewhere in this report.[178] Specifically, increased competition could result in:

- a reduction in fares over and above those estimated in section 5.4;
- increases in service quality as airports and airlines try to make their products more attractive to passengers; and
- innovation to discover new cost-effective ways of doing business, and increased efficiency.

8.1.4 The discussion below addresses how the Project would affect competition in the London aviation market, and then considers the impact of the Project on modal competition.[179]

Impact of the Project on competition between airports

8.1.5 As noted in section 3, airports in the London market have overlapping catchment areas. As such, Gatwick competes with other airports, particularly Heathrow and Stansted, for airlines and passengers.[180]

8.1.6 Capacity constraints are an important factor in determining the extent of competition between airports.[181] The additional capacity created by the Project would relieve the capacity constraints at peak times in Gatwick Airport, enabling it to bring in greater competition on other airports in the London market.

8.1.7 The forecasts are used to assess the extent to which air traffic might switch between airports as a result of the Project. This could be an indication of either competition between airports for airlines or competition between airports to attract passengers.

8.1.8 Table 8.1.1 shows the changes to air traffic flows resulting from the Project. The forecasts suggest that the majority of the additional air traffic resulting from the Project would be composed of new journeys, ie passenger journeys that would not be made without the Project. However, in

[178] Airports Commission (2014), 'Appraisal Framework', April, p. 31.
[179] As the London airports are competing with each other in the aviation market, the term 'market' is used instead of the term 'system' used elsewhere in the report to make this explicit while discussing the competition effects. A detailed market definition exercise has not been undertaken for the purpose of this study, and the term 'market' is used to refer to the substitutability of airports in the London area for air passengers and airlines.
[180] Civil Aviation Authority (2014), 'Market power determination in relation to Gatwick Airport – statement of reasons', January. The catchment area of an airport is the geographic area from which the airport attracts passengers. The impact on competition with other airports outside the UK is not assessed, since this is an appraisal of impacts on the UK economy.
[181] Oxera (2017), 'Market power assessments in the European airports sector', November, pp. 23–25.

the first years after the Project's opening, there would be some air traffic absorbed from other airports—in particular, from Heathrow and Stansted.

Table 8.1.1: changes to air traffic resulting from the Project (mppa)

Airport	FY29	FY47
Heathrow	-1.3	-0.1
Stansted	-1.2	0.0
Luton	0.0	0.0
City	-0.2	0.0
Southend	-0.1	0.0
Gatwick air traffic from other airports	**2.9**	**0.1**
Gatwick new air traffic	**0.9**	**12.6**

Source: Oxera analysis of Gatwick air traffic forecasts. Figures are presented for financial years 2029 and 2047.

Impact of the Project on competition between airlines

8.1.9 By creating additional capacity, the Project would lead to greater competition between airlines. This applies both at Gatwick and across the London aviation market more widely.

8.1.10 The precise nature of the additional competitive pressure depends on how the additional capacity at Gatwick is employed. While the forecasts are not sufficiently granular to allow for a detailed assessment, competition could occur through new airlines operating at Gatwick and/or existing airlines expanding their operations. Alleviating capacity constraints during peak times also creates new slots at times with high passenger demand, allowing airlines operating at Gatwick Airport to offer more services at desirable times and to become more competitive relative to airlines operating at other London airports.

8.1.11 In its market power assessment for Gatwick in 2014, the CAA suggested that there was no clear demarcation between the business models of low-cost carriers (LCCs) and full-service carriers (FSCs), especially in terms of demand for facilities at Gatwick Airport.[182] As such, even if the additional capacity made available by the Project is used by a subset of carriers with specific business models (for example, LCCs), there is likely to be an increase in competitive pressure across all airlines.

Impact of the Project on modal competition

8.1.12 Passengers decide how to travel based on the monetary cost of the trip (eg the cost of tickets) and the time they need to spend travelling. This means that the lower fares and higher frequencies of flights as a result of the Project might make flying more attractive for some passengers who would otherwise have chosen to travel by a different mode.

8.1.13 In assessing the extent to which modal competition would be affected by the Project, one must consider competition between air travel and other modes of transport for the different categories

[182] Civil Aviation Authority (2014), 'Market power determination in relation to Gatwick Airport – statement of reasons', January, para. 2.2.

of trip. The analysis in this report considers that other modes (eg road, rail, ferry) are likely to impose a constraint on air travel for domestic and short-haul trips only.[183]

8.1.14 With respect to domestic trips, air travel competes with rail and road for specific journeys within the UK, such as from the South East to Scotland. It is unlikely that the Project would have an effect on the extent of competition between these modes, as the highest air fare reductions in domestic trips arising from the Project during the appraisal period is approximately £6, as shown in Table 5.4.5. This reduction is unlikely to be sufficient for customers to change their travel behaviours and preferences. However, if there are new domestic connections as a result of the Project, some rail passengers may switch to air.

8.1.15 While air fare reductions on short-haul trips would be larger than on domestic trips, competition with road and/or rail would be relevant on only a small subset of routes, such as London to places in France, and to Brussels and Amsterdam. Note that there might be an effect on competition between air and high-speed rail (HSR) in particular on these routes. Lower air fares could attract some passengers from HSR and thus increase competition with HSR. However, the impact on competition would be limited by other factors apart from the cost of the tickets that influence users' travel choices, such as travel time or comfort (which would not change as a result of the Project).

Conclusion on competition impacts

8.1.16 As a result of the Project, Gatwick Airport is likely to attract passengers from other London airports, especially those who would have preferred to travel using Gatwick Airport in the Baseline scenario but are not able to do so due to capacity constraints. Even though the expected shift in air traffic between airports is small in the context of overall air traffic in the London aviation system, this would generate competitive pressure during the initial years of Project opening.

8.1.17 Increased competition between airports and airlines could affect prices, frequencies and quality offered in the London aviation market, resulting in benefits to passengers. To the extent that capacity in the market starts to become fully utilised over time, it is likely that shadow costs would start to increase and competition would take forms other than pure price competition.[184]

8.1.18 Finally, competition with other modes of transport is unlikely to be significantly affected within the UK as a result of the Project. While there might be an effect on competition between air and HSR, rail and/or road on certain short-haul journeys, this is likely to be relevant for only a small number of passengers.

8.2. Resilience impacts

8.2.1 Resilience of an aviation system refers to the system's ability to anticipate, withstand, and recover quickly from unusual day-to-day conditions that may impose disruptions.[185] A lack of resilience can increase journey time variability and the number and extent of delays, which reduces the reliability of air travel. Similarly, a lack of resilience can limit the range of destinations served and

[183] Long-haul flights are not considered to be substitutable with rail and road travel.
[184] Competition and Markets Authority (2016), 'BAA airports: Evaluation of the Competition Commission's 2009 market investigation remedies', May.
[185] For example, day-to-day variation in operations at an airport can be an aircraft arriving at the runway at times which differ from the scheduled time, an aircraft taking longer than expected on the runway, and weather conditions which are less than favourable.

reduce domestic and international connectivity, which constrains the extent to which the aviation sector can deliver benefits to the economy.

8.2.2 Delays have adverse impacts on passengers, airlines and airports.

- Passengers face longer or more unpredictable journey times, which increase travel time costs and cause frustration and stress.[186]
- Airlines may have to factor larger buffers into their flight schedules, compensate passengers if the delays are long, and incur additional operational costs.[187]
- Airports may have to invest in additional facilities, such as waiting areas, to accommodate delayed passengers and to avoid becoming crowded and unpleasant environments for passengers.

8.2.3 The London airport system, and Gatwick airport in particular, is operating close to its limits at several times of the year. With demand for slots exceeding supply, and forecasts showing that this effect is expected to intensify in the future, it is difficult to ensure resilience in the current system.[188] The Project offers the opportunity to increase the level of resilience both at Gatwick Airport and in the London system.

8.2.4 Higher resilience would provide benefits to users and providers in the London aviation system, but through different channels from the fare and time effects discussed in the preceding sections. Increased resilience would not have a direct impact on supply and demand in the London aviation market, but instead would mitigate costs associated with disruptions to the aviation market. Thus, its impact would be additional to the impacts captured in section 5.

8.2.5 The Project could generate increased resilience at Gatwick Airport and in the London aviation system in a number of ways.[189] In particular, the **Needs Case** (Doc Ref. 7.2) describes the resilience benefits of the Project as follows:

- increase overall runway capability from 55 movements per hour to 70 movements per hour, improving the ability of the airport to meet demand and enhancing taxiway and holding capacity;
- improve capacity and recovery for the critical first wave of daily operations and to recover from backlogs, minimising the number of flights which end up off-schedule and delay times;
- increase capability of the northern runway in the event of a disruption leading to closure of the main runway, ensuring continuity of air transport movements and increasing the percentage of demand that can be processed;
- reduce the utilisation of the main runway, de-stressing the main runway operation and absorbing variations in the main runway performance;
- improve resilience offered by the proposed Charlie Box hold and reconfigured taxiways,[190] providing increased runway holding capacity and additional departure aircraft holding for delayed flights; and

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[186] Collaborate Research (2016), 'Consumer attitudes to journey disruption – A qualitative research report', November. This report is prepared for the CAA with the reference CAP1472.
[187] Additional airtime due to delays also increases the carbon and noise footprint of aviation.
[188] See section 7 in the **Needs Case** (Doc Ref. 7.2).
[189] Resilience, particularly during the construction phase of the Project would be lower. This reduction would occur because the northern runway would not provide any capacity in the event of disruption during construction. For further detail on the Project's ability to benefit resilience see section 7 in the **Needs Case** (Doc Ref. 7.2).
[190] The Charlie Box refers to the new proposed aircraft holding configuration that will provide significantly increased aircraft runway holding capacity – for up to 16 departing aircraft - than the current configuration (Alpha Box) hold. This new configuration is also designed to enable independent access to the runway for all held aircraft.

- improving London Airports system resilience, by providing greater capacity in the event of complete or partial closure at other London airports.

8.2.6 The Project would increase the resilience of Gatwick Airport and the London airport system. Having two operational runways and improved airfield infrastructure would increase resilience by reducing delays caused by adverse conditions or incidents, and allow for a quicker recovery. The spare capacity in the short to medium term would also minimise disruptions caused by day-to-day disruptions. Currently, the full use of the runway and the existing airfield layout constraints make it difficult to respond in a fast and effective manner to adverse events and to recover from disruptions. The benefits of the Project would not only apply to Gatwick Airport but would also provide greater system-wide resilience across the London airports, as well as more connectivity to new destinations, giving passengers more options to reach their intended destinations in case of disruptions.

8.3. Freight impacts

8.3.1 In 2019, Gatwick Airport handled 150,000 tonnes of freight.[191] The Project would facilitate an increase in air freight at Gatwick Airport by increasing the number of ATMs and thereby increasing both the frequency and range of destinations served.

8.3.2 Freight traffic at Gatwick Airport is provided by bellyhold rather than dedicated freighter aircraft[192] and, as a result, an increase in the number of ATMs would have a direct impact on opportunities for freight traffic. According to forecasts, air freight traffic would increase by 20% in the long run as a result of the Project when compared with the Baseline. The freight forecasts with and without the Project are presented in Table 8.3.1 below.

Table 8.3.1: Gatwick Airport freight forecasts (thousand tonnes)

	2018/19	2028/29	2031/32	2037/38	2046/47
Baseline	150	228	235	254	290
Project	150	251	305	323	348
Difference (percentage of base case)	–	10%	30%	27%	20%

Source: Gatwick.

8.3.3 Air freight creates new opportunities for trade. For example, the speed of air freight makes it indispensable to time-sensitive supply chains. Where precise timing is required, freight services can be sold on the premise of a guaranteed delivery slot. Such services also often provide up-to-date information on geographical position, estimated time of delivery, details of delays, and revised delivery times.[193] More specialised air freight services combine delivery speed with storage that meets niche requirements, for example relating to temperature, security or industry-specific regulations. Businesses that benefit from these kinds of services include providers of perishable foodstuffs and pharmaceuticals.[194]

[191] Gatwick Airport Limited data (2020).
[192] Airports Commission (2014), 'Gatwick Airport Second Runway: Business Case and Sustainability Assessment', para. 1.41.
[193] Steer (2018), 'Assessment of the value of air freight services to the UK economy', October, p. 4.
[194] Steer (2018), 'Assessment of the value of air freight services to the UK economy', October, p. 4.

8.3.4 The DfT recommends that 'where possible, the impact of aviation policies on air freight should be appraised'.[195] In its guidance, the DfT demonstrates that expansion at a capacity-constrained airport should lead to an increase in surplus for air freight customers. Specifically, by reducing the capacity constraint, the quantity supplied should rise and the unit price should fall.[196] However, the DfT's TAG unit does not provide detailed guidance on how such an appraisal should be conducted. Moreover, a welfare analysis of the impact of the reduced costs on the economic surplus of freight forwarders as a result of the Project would require information on the demand curve and costs of freight forwarders, which is not publicly available. As such, no quantified assessment is provided as part of this study.

[195] Department for Transport (2022), 'TAG Unit A5.2 Aviation Appraisal', November, p. 5.
[196] Department for Transport (2022), 'TAG Unit A5.2 Aviation Appraisal', November, p. 13.

9 Summary results of cost-benefit analysis

9.1. Net social benefits of the Project

9.1.1 Increased air traffic facilitated by the Project generates benefits for passengers, providers, the wider economy, and the Government. These are offset to some extent by environmental costs. By subtracting the costs from the benefits it is possible to calculate the net social benefits, which is a cost–benefit metric measuring the social impacts of the Project. This figure does not include scheme costs, given that the scheme is not publicly funded. As such, the present value of net social benefits should be interpreted as the impact of the Project on society as a whole.

9.1.2 The net social benefits of the Project are estimated at £23.7 bn when the central estimate of environmental costs is used. Table 9.1.1 presents a breakdown of these benefits, including a low and high range reflecting the uncertainty regarding the environmental costs (air quality and GHG) presented in Table 7.5.1. The low and high estimates represent the minimum and maximum net social benefits arising with the Project: the lower bound includes the higher environmental costs, and the upper bound includes the lower environmental costs.

Table 9.1.1: net social benefits of the Project (£ bn)

	Low	Central	High
Total benefits to passengers, producers and the wider economy	–	164.3	–
Welfare transfers from airlines to passengers	–	-139.3	–
Environmental costs	-2.2	-1.4	-0.6
Present value of net social benefits	**22.8**	**23.7**	**24.4**

Note: All estimates are in 2010 prices and values. They may not sum due to rounding. Ranges in environmental costs represent uncertainty in the monetary costs associated with air quality and GHG emissions.

Source: Oxera.

9.2. Net present value of the Project

9.2.1 Gatwick proposes to privately finance and fund the construction, capital and operational costs arising from the Project to enable the £23.7 bn of social benefits (central estimate). In section 4, these scheme costs have been valued at £2.1 bn. Considering these additional costs, the NPV of the Project is estimated to be £21.6 bn by subtracting the construction, capital and operating costs from the quantified benefits. Table 9.2.1 presents the quantitative estimates of the costs and benefits of the Project in 2010 prices. Ranges for the NPV of the Project reflect the minimum and maximum benefits that the Project may generate, similarly to the net social benefits in the section above.

Table 9.2.1: summary of net present value of the Project (£ bn)

	Low	Central	High
Passenger benefits	–	150.1	–
Provider benefits	–	-137.1	–
Wider economic impacts	–	12.0	–
Environmental costs	-2.2	-1.4	-0.6
Scheme costs	–	-2.1	–
Net present value of the Project	**20.7**	**21.6**	**22.3**

Note: All estimates are in 2010 prices and values. They may not sum due to rounding. Negative provider benefits represent welfare transfers from airlines to air passengers and include benefits to airports from increased revenues. Ranges in environmental costs represent uncertainty in the monetary costs associated with air quality and GHG emissions. Ranges for the NPV of the Project reflect the minimum and maximum benefits that the Project may generate: the lower bound includes the higher environmental costs, and the upper bound includes the lower environmental costs.

Source: Oxera.

9.2.2 There are other benefits and costs arising from the Project that the NPV does not capture. In particular, the Project's potential impacts on tourism, competition, resilience and freight have been discussed above. An illustrative quantification of the benefits arising from a potential change in trade as a result of the Project has also been provided.

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10.1.90 **ES Appendix 4.3.1: Forecast Data Book** (Doc Ref. 5.3).

10.1.91 **ES Appendix 5.4.2: Carbon Action Plan** (Doc Ref. 5.3).

10.1.92 **ES Appendix 14.9.3: Ground Noise Modelling** (Doc Ref. 5.3).

10.1.93 **ES Appendix 17.9.2: Local Economic Impact Assessment** (Doc Ref. 5.3).

10.1.94 **ES Chapter 13: Air Quality** (Doc Ref. 5.1).

10.1.95 **ES Chapter 14: Noise and Vibration** (Doc Ref. 5.1).

10.1.96 **ES Chapter 16: Greenhouse Gases** (Doc Ref. 5.1).

10.1.97 **Needs Case** (Doc Ref. 7.2).

10.1.98 **Needs Case Appendix 2 - The Economic Impact of Gatwick Airport: A Report by Oxford Economics** (Doc Ref. 7.2).

10.1.99 **Planning Statement** (Doc Ref. 7.1).

A1 Annex A

A1.1. Detailed methodology

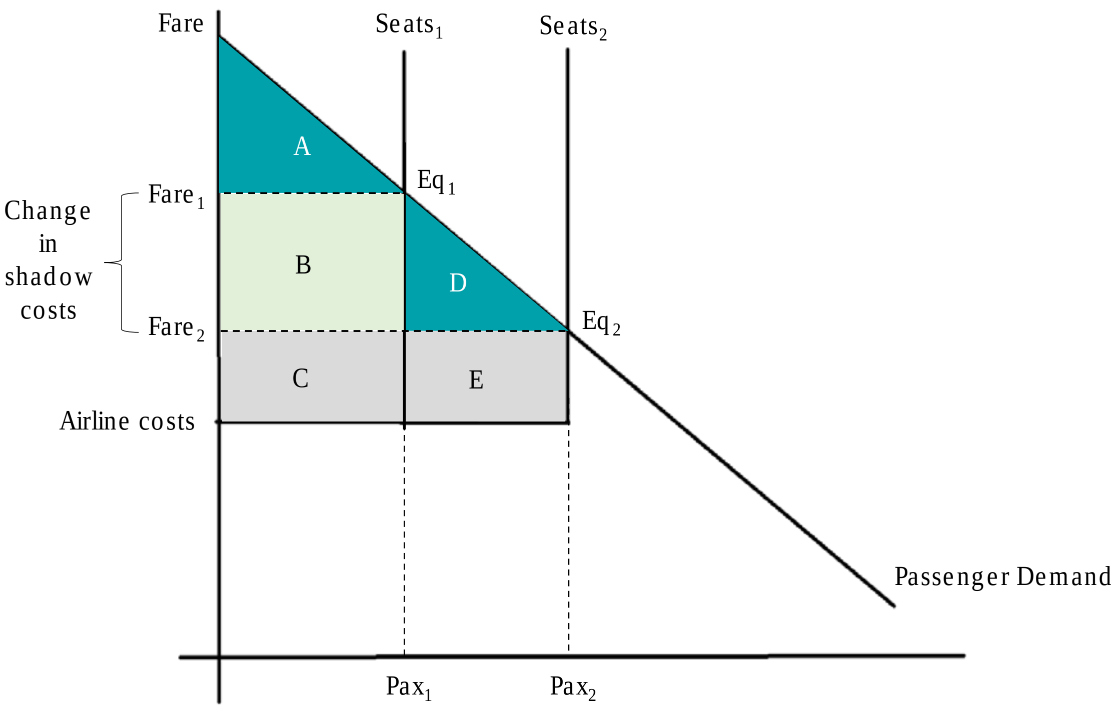
The DfT's conceptual framework

A1.1.1 The DfT's approach to estimating the user and provider benefits of an expansion in airport capacity focuses on measuring benefits to passengers and airlines.[197] These benefits are referred as user and provider surplus as discussed in section 5.

A1.1.2 The DfT's framework to analyse changes in user and provider surplus takes account of various features of the aviation market. In this market, passengers demand seats, and airlines supply seats, up to the total demand or available airport capacity. Airports, in turn, provide capacity and set the maximum number of passengers, or flights. As discussed in section 5, a market is constrained if the airport capacity is less than the total passenger demand and therefore, airlines are unable to satisfy the demand for seats. In this case, fares paid by passengers will rise above costs in order to clear the market. This increase in fares due to a lack of capacity is referred to as the 'shadow cost' of air fares.

A1.1.3 The table below illustrates how an increase in capacity at an airport can lead to a change in shadow costs, and the resulting changes to user and provider surplus.

Figure A1.1.1: the DfT's conceptual framework



[197] Department for Transport (2022), 'TAG Unit A5.2 Aviation Appraisal', November.

Note: The figure illustrates the relationship between passenger demand and air fares in an aviation market. Subscripts 1 and 2 indicate scenarios without and with an expansion, respectively. Pax_1 and Pax_2 are the number of passengers using aviation services. $Seats_1$ and $Seats_2$ represent the supply of aviation services by airlines. Eq_1 and Eq_2 are the market clearing price and demand levels at these prices in each scenario. Teal areas represent user surplus. Grey areas represent producer surplus. Green areas represent a transfer of surplus from producers to users with the capacity expansion.

Source: Oxera based on Department for Transport (2018), 'TAG Unit A5.2 Aviation Appraisal', May, p. 13.

A1.1.4 **Figure A1.1.1** above illustrates demand and supply curves for an aviation market with capacity constraints. Before the capacity expansion, the market is at point Eq_1 with passenger numbers at Pax_1 and air fares at $Fare_1$. The market is constrained and the airport is operating at full capacity. Here, passenger surplus is represented by the area A while provider surplus is depicted by the area B+C.

A1.1.5 With a capacity expansion, the line representing capacity (Seats_1) moves to the right to Seats_2, fares fall from Fare_1 to Fare_2 and the number of passengers increases from Pax_1 to Pax_2. As a result, user surplus increases by B + D and becomes A + B + D, and provider surplus changes to C + E from B + C. The expansion in capacity causes a redistribution of the existing surplus but also generates new surplus. This corresponds to the areas D + E. While airports incur the costs of the expansion, they may earn higher revenues from the additional passengers.

A1.1.6 The capacity expansion also produces a change in shadow costs, ie the difference between actual fares and fares if there were no capacity constraints. This change in shadow costs is represented by the difference between Fare_1 and Fare_2. Generally, such an expansion in capacity would bring the market closer to the unconstrained level and therefore, shadow costs in the Project scenario would be lower than those in the Baseline scenario.

CAPEX

A1.1.7 Gatwick has provided Oxera with forecast CAPEX for the Project scenario for 2022 to 2040.

A1.1.8 To ensure consistency with the TAG cost assessment module, several adjustments have been made to the CAPEX forecasts, as follows:[198]

- costs have been deflated and discounted to the DfT's base year, 2010;[199]
- to estimate additional CAPEX in the future arising from activities such as additional maintenance required for the new runway, real costs between 2040 and 2088 are assumed to grow in line with real GDP;[200]
- an indirect tax correction factor of 1.19 has been applied to convert factor costs into market prices;[201] and
- a 44% optimism bias is applied to uplift CAPEX estimates.

[198] Department for Transport (2022), 'TAG Unit A1.2 Scheme Costs', May.
[199] Deflation rates are sourced from DfT (2022), 'TAG Data Book Annual Parameters', May. Annual discount rates are sourced from HM Treasury (2022), 'The Green Book Central Government Guidance on Appraisal and Evaluation', p. 46 as 3.5% for the first 30 years starting from the current year and 3.0% for the rest of the appraisal period. An annual discount rate of 3.5% is applied to discount values from the current year to the DfT's base year.
[200] Department for Transport (2022), 'TAG Data Book Annual Parameters', May.
[201] Department for Transport (2021), 'TAG Unit A1.1 Cost-Benefit Analysis', July, p. 3.

OPEX

A1.1.9 The additional air traffic associated with the Project would increase OPEX for Gatwick.[202] How the Project would affect OPEX has been modelled by considering increases in real factor costs, efficiency, and passenger throughput. The basis for these assumptions is set out below. This is a high-level exercise for this economic appraisal. It does not represent a detailed estimate of the operational expenditure that would result from the Project.

A1.1.10 Projections have been constructed for the incremental OPEX with the Project (ie the difference between the Baseline and Project scenarios). The projection is derived through the following steps:

- the projection starts with forecasts, received from Gatwick, of OPEX until 2026/27 excluding depreciation;
- deflate 2021 to 2026 OPEX to 2010 prices;
- convert OPEX from financial years to calendar years;
- apply an indirect tax correction factor of 1.19 to convert factor costs into market prices;[203]
- input employment forecasts are used to determine the increase in employment at Gatwick with the Project from 2026 up to 2047;
- real wage per employee is assumed to grow with forecast real wage to reflect increasing labour productivity over time.[204] As the level of air traffic is assumed to be constant after 2047, real OPEX for employment is assumed to be constant after 2047;
- real price of utilities is assumed to grow with forecast real cost of industrial electricity supply;[205]
- real price of other OPEX items is assumed to be constant in real terms, ie to grow with forecast inflation in nominal terms;
- consumption of non-employment items is assumed to increase as passenger air traffic increases based on a relationship taken from Gatwick Airport's historic regulatory determination;[206]
- operational efficiency improvements of 1% per annum are assumed for OPEX for non-employment items;
- expected OPEX of the other new infrastructure with the Project is added based on cost forecasts received from Gatwick; and
- values are discounted to 2010 values.

Fare elasticities of demand

A1.1.11 As described in section 5.4, an air fare elasticity-based analysis is used to estimate the air fares in the Project and unconstrained scenarios.

[202] The Project would also have an impact on the OPEX of the other airports in the London aviation system if air passengers switched to Gatwick Airport due to the Project—if fewer passengers travelled from the other airports, they would incur less OPEX. The current analysis does not quantify this reduced OPEX and therefore it may be an overestimate of the Project's OPEX impact on the London airports as a whole.
[203] DfT (2021), 'TAG Unit A1.1 Cost-Benefit Analysis', July, p. 3.
[204] Office for Budget Responsibility (2022), 'Long-term economic determinants - March 2022 Economic and fiscal outlook', March.
[205] Department for Business, Energy & Industrial Strategy (2021), 'Valuation of energy use and greenhouse gas emissions for appraisal - Data tables 1 to 19: supporting the toolkit and the guidance', March.
[206] Specifically, using an elasticity of 0.3 based on Civil Aviation Authority (2014), 'Economic regulation at Gatwick from April 2014: Notice granting the licence', February, p. 166.

A1.1.12 A fare elasticity of demand is defined as the percentage change in demand as a response to a 1% change in fare levels:

$$\text{fare elasticity} = \frac{\text{\% change in demand}}{\text{\% change in fare}}$$

A1.1.13 This formula can be rearranged to give the required change in fare levels to rationalise differences in passenger numbers between two scenarios:

$$\frac{\text{\% change in demand}}{\text{fare elasticity}} = \text{\% change in fare}$$

A1.1.14 Fares are derived for the Unconstrained and Project scenarios using this relationship and differences in air traffic forecast volumes. DfT's price elasticities for the business, leisure and domestic passenger markets are also used as shown in Table A1.1.1 below.[207]

Table A1.1.1: DfT demand elasticities for air fares

Business	Leisure	Domestic
-0.2	-1.1	-0.6

Source: DfT (2022), 'Jet Zero: modelling framework', March, p. 15.

A1.1.15 Elasticities represent the strength of the demand response to changes in prices. For example, a -1.1 elasticity for leisure passengers implies that, if prices for leisure passengers increase by 1%, demand from these passengers will decline by 1.1%. In the event that some passengers are not particularly responsive to a change in price (ie as elasticities get closer to zero), large changes in prices may be required to explain large differences in demand across different scenarios. For example, to lead to a 1% increase in demand in the domestic market, prices need to decline by 2.0% using an elasticity of -0.2.

Estimation of agglomeration effects

A1.1.16 Agglomeration effects are calculated based on a measure of the density of employment in an area with one or more geographic units. Literature often refers to this as the 'effective density' of an area.

A1.1.17 The DfT recommends a measure of effective density that focuses on appraising agglomeration benefits from rail and road schemes, which affect the generalised cost of travel between regions. However, as commuting via air travel is unlikely, agglomeration impacts of aviation schemes occur through different channels.

[207] DfT (2022), 'Jet Zero: modelling framework', March, p. 15.

A1.1.18 Assuming that the surface access investments associated with the Project accommodate only the increase in passenger numbers, aviation schemes are unlikely to have a material impact on the cost of travel between regions. Instead, they increase density in a given geographic region by creating additional jobs through direct, indirect, induced and catalytic effects. These employment effects are discussed in **ES Appendix 17.9.2: Local Economic Impact Assessment** (Doc Ref. 5.3).

A1.1.19 A measure of effective density, sourced from Graham (2007), is used that takes into account changes in employment at a given geographic location, and, if there are multiple locations, distances between them.[208]

A1.1.20 Effective densities are calculated for the Baseline and Project scenarios. The following formula is used to assess the agglomeration benefits of the Project:

$$\text{Agglomeration benefit}_{\text{i}} = \left[\left(\frac{ED_i^{Project}}{ED_i^{Baseline}}\right)^{\epsilon} - 1\right] \times GDP\ per\ worker_i \times E_i^{Baseline}$$

A1.1.21 where $E_i^{Baseline}$ is the baseline employment in region i, ϵ is the elasticity of output with respect to changes in agglomeration, $GDP\ per\ worker$ is the baseline GDP per worker in region i, and EDs are effective densities of the Baseline and Project scenarios as calculated above.[209]

Estimation of Government revenues

A1.1.22 The Government levies APD on all departing passengers from the UK. The Government has recently published new APD rates that will be in place from 2023 for different distances of travel.[210]

A1.1.23 APD is passed through by airlines to air fares, and therefore, according to DfT it affects the disposable income of leisure passengers.[211] As a result, estimates of tax revenues should account for the reduced taxable spending by leisure passengers. Thus, different formulas are used for business and leisure passengers to estimate the tax impacts of the Project. The formula for business passengers is:

$$(1+t) \times \sum \left(n_{Project}^{B} \times APD - n_{Baseline}^{B} \times APD\right)$$

and for leisure passengers, a similar formula is used which accounts for the reduction in disposable income:

$$(1+t) \times \sum \left(n_{Project}^{L} \times APD - n_{Baseline}^{L} \times APD\right) - t \times \left(fare_{Project}^{L} \times n_{Project}^{L_{UK}} - fare_{Baseline}^{L} \times n_{Baseline}^{L_{UK}}\right)$$

[208] Graham, D.J. (2007), 'Agglomeration, productivity and transport investment', *Journal of Transport Economics and Policy*, **41**:3, September.
[209] This formula is sourced from DfT (2020), 'TAG Unit A2.4 Appraisal of Productivity Impacts', May.
[210] The APD rates used in this report are currently announced rates applied from 1 April 2023. A weighted average of the reduced and standard rates was calculated for each travel distance band. Shares of economy class seats and business class seats in the whole London aviation market were used as weights. Data on seat shares was sourced from OAG (2019), 'Flight Schedules Data'. For more information, see HM Government (2018), 'Rates for Air Passenger Duty', 29 January, https://www.gov.uk/guidance/rates-and-allowances-for-air-passenger-duty, accessed 2 November 2022.
[211] Department for Transport (2018), 'TAG Unit A5.2 Aviation Appraisal', May, p. 8.

A1.1.24 where t is an indirect tax correction, and n is the number of business (B) and leisure (L) passengers in the Baseline and Project scenarios.[212]

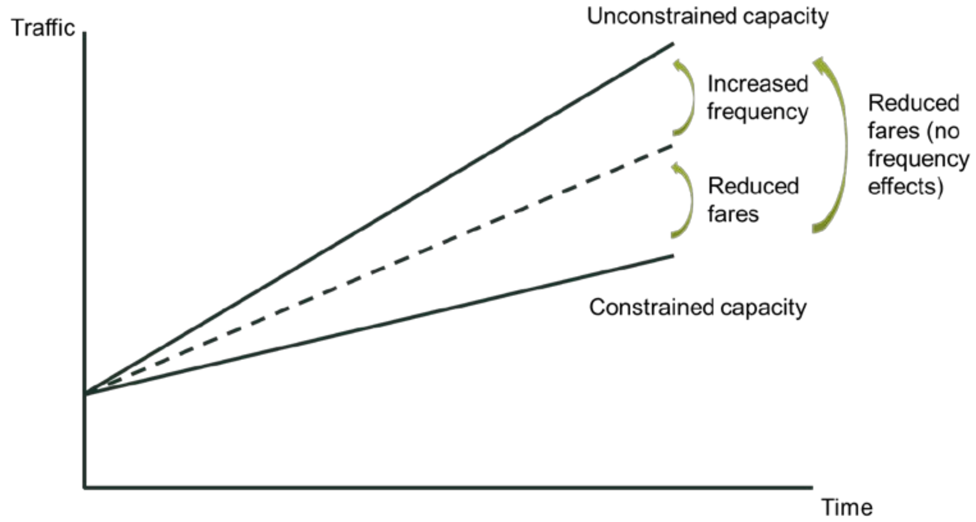
A1.2. Frequency effects

A1.2.1 As discussed in section 5, academic research indicates that, beyond demand effects as a result of reduced fares, passengers also respond positively to increases in flight frequencies.[213] Consequently, the increase in demand in the passenger forecasts cannot be fully attributed to reduced fares but would be driven by a mix of reduced fares and increased frequencies.

A1.2.2 The analysis is not able to capture frequency effects because air traffic forecasts do not differentiate between additional passenger demand induced by fare reductions vs increased frequencies.[214] As such, in the analysis, the increase in passenger demand is fully attributed to a reduction in fares. This does not affect expected passenger volumes. However, it does mean that the impact of the change in fare levels, and therefore the benefits arising from changes in air fares (but not the overall benefits), will be overstated. This section describes why, for a given change in the number of passengers, this overestimation of benefits arising from changes in air fares is lower than the omitted benefits arising from changes in frequencies and therefore results in a conservative estimate of the total impact of the Project on users and providers.

A1.2.3 When the effects of changes in frequencies are omitted, required changes in prices that equate supply and demand are overestimated: all changes in demand are attributed to changes in fares. **Figure A1.2.1** below illustrates this relationship.

Figure A1.2.1: fare reductions without frequency effects



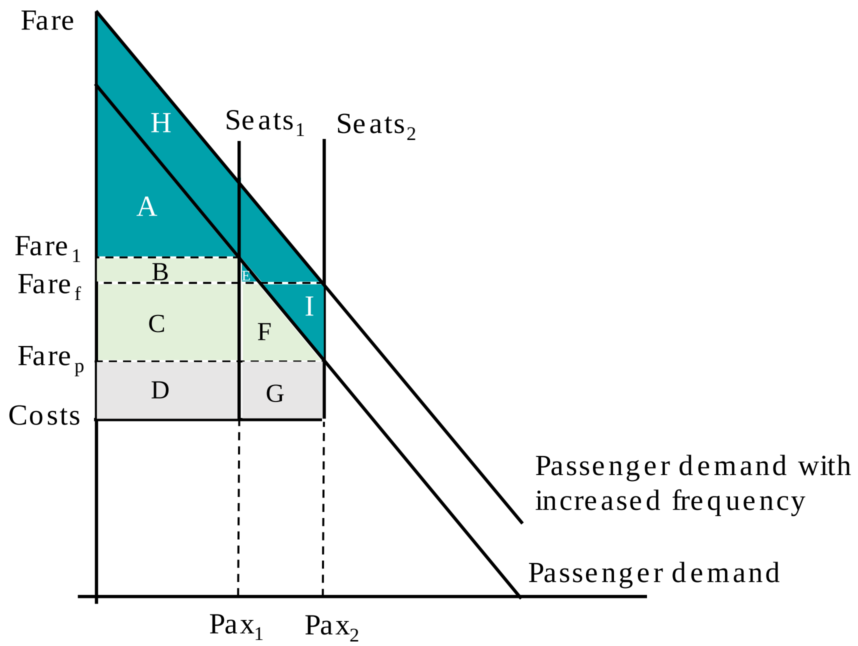
Note: The figure above presents a simplified illustration of how capacity constraints affect air traffic levels through frequency and price effects. If frequency effects are not accounted for to rationalise differences between two given air traffic forecasts, changes in air traffic are fully attributed to reduced fares.

[212] Department for Transport (2018), 'TAG Unit A5.2 Aviation Appraisal', May, p. 8. The subscript UK refers to the UK subset of leisure passengers. Only departing passengers are considered. The analysis uses new APD rates sourced from HM Government, 'Rates for Air Passenger Duty', https://www.gov.uk/guidance/rates-and-allowances-for-air-passenger-duty , accessed 25 Nov 2022.
[213] For example, see Jorge-Calderón, J.D. (1997), 'A demand model for scheduled airline services on international European routes', *Journal of Air Transport Management*, **3**:1, pp. 23–35.
[214] The analysis of user and provider impacts therefore constitutes benefits generated through fare reductions only.

Source: Oxera.

A1.2.4 The impact of this omission is a conservative estimate of the total benefits that arise from a capacity expansion. This can be seen by extending the framework from section A1.1 with frequency effects as shown in **Figure A1.2.2** below.

Figure A1.2.2: extending the framework with frequency effects



Note: The figure illustrates the impact of a capacity expansion with and without frequency effects. Fare_1 is the fare level without an expansion. Fare_f and Fare_p are fare levels after an expansion with and without frequency effects, respectively. Pax_1 and Pax_2 are numbers of passengers before and after an expansion. Teal areas represent consumer surplus. Grey areas represent producer surplus. Green areas represent a transfer of surplus from producers to users with the expansion.

Source: Oxera.

A1.2.5 The figure illustrates the impact of frequency effects as an outward shift of the demand curve, which implies an increase in demand at all fare levels, as airlines will provide more services. Before an expansion, the market is at an equilibrium with fare level Fare_1 and number of passengers Pax_1. In this base case, the following areas characterise user surplus (US) and provider surplus (PS):

- $\text{US}_{\text{base}} = A$
- $\text{PS}_{\text{base}} = B + C + D$

Total $\text{surplus}_{\text{base}} = \text{A} + B + C + D$

A1.2.6 After the expansion, if there are no frequency effects, the market is at an equilibrium at price level $Fare_p$ and number of passengers Pax_2. Total benefits without frequency effects are therefore:

- $\text{US}_{\text{p}} = A + B + C + E + F$
- $\text{PS}_{\text{p}} = D + G$
- Total $\text{surplus}_{\text{p}} = A + B + C + D + E + F + G$

A1.2.7 If frequency effects are accounted for, the market is at an equilibrium at price level $Fare_f$, which is higher than $Fare_p$. The total benefits after the expansion become:

- US$_f = A + B + E + H$
- PS$_f = C + D + F + G + I$
- Total surplus$_f = A + B + C + \mathrm{D} + E + F + G + H + \mathrm{I}$

A1.2.8 These values indicate that, as a result of a capacity expansion, total benefits increase by $E + F + G$ if frequency effects are not accounted for, and by $E + F + G + H + I$ if frequency effects are accounted for. The omission of frequency effects therefore yields a conservative estimate of total benefits by $H + \mathrm{I}$.

A1.2.9 Although the relation between frequency and fare effects can be assessed conceptually, there is no data available on the frequency of flights on a route level that would allow the quantification of these benefits.

A1.3. Modelling of CORSIA emissions

A1.3.1 As discussed in section 7.3, non-traded Aviation emissions monetised in the assessment include emissions from flights under CORSIA. According to this scheme, airlines are required to offset the growth in international aviation emissions above 85% of 2019 emission levels.[215] The costs of these offsets have been included in the modelling of air fares and therefore these costs are already internalised in this assessment. In an effort to account for the double-counting of costs from the aviation emissions to be offset under the CORSIA scheme, indicative estimates of the emissions to be offset by CORSIA were modelled as part of the input data to this analysis.[216]

A1.3.2 CORSIA emissions have been estimated by looking at the additional international aviation emissions projected relative to the CORSIA baseline. For this, the level of the emissions for international flights in 2019 was used. This was the CORSIA baseline set by ICAO in June 2020 and was valid until October 2022. Therefore, this is the baseline that is currently reflected in the carbon prices modelled by DfT and in turn modelled in the air fares of this assessment. ICAO has revised this baseline to 85% of the 2019 emission levels, but given that the purpose of this exercise is to address the double-counting of the GHG costs reflected in the air fares, the modelling of CORSIA emissions based on the previous baseline is adopted. The threshold over which international emissions should be offset was estimated at 2.9 m metric tonnes of CO_2e.

A1.3.3 By assuming that CORSIA is projected to occur in both the Baseline and Project scenarios over the whole of the appraisal period,[217] CORSIA emissions were calculated for each scenario by estimating the excess emissions over the 2019 emissions threshold. The remaining emissions (ie below the 2019 emissions threshold) represent the non-traded emissions that were then monetised in the sensitivity that aims to address the double-counting of CORSIA costs.

[215] See ICAO's website for more details: [redacted]
[216] Emissions covered by CORSIA had not originally modelled and were therefore, included in the non-traded emissions received by Oxera.
[217] The assumption about the duration of the CORSIA scheme is based on DfT's assumptions in the modelling of carbon prices in the Jet Zero strategy. See Department for Transport (2022), 'Jet Zero: modelling Framework, March, p. 19 and Annex B of Department for Transport (2022), 'Jet Zero: further technical consultation', March.

A1.3.4 It should be noted that CORSIA does not apply to all flights. Exemptions include:[218]

- flights to/from Least Developed Countries (LDCs); Small Island Developing States (SIDS); and Landlocked Developing Countries (LLDCs);[219] or
- Flights to/from states whose individual share of international aviation activities in air traffic volumes in year 2018 was below 0.5% of total air traffic volumes, or states that are not part of the list of member states but account for 90% of the total air traffic volumes.[220]

A1.3.5 In general, it is expected that international flights from Gatwick are more likely to be to larger countries, ie those that will need to participate. Therefore, for this assessment it is assumed that the emissions covered by CORSIA will range between 90% and 100% of the total international emissions.

A1.4. Sensitivity analysis

A1.4.1 In the main analysis set out in this report, a number of parameters are used to estimate the benefits arising from the Project to users and providers of aviation services. In this section, the sensitivity of the results to these parameters is tested. Later in this annex, two sensitivities of the estimated user and provider benefits to air traffic forecasts are also presented by using alternative scenarios that assume slower growth in passenger demand and capacity expansion at other London airports.

Sensitivity to the level of normal profit of airlines

A1.4.2 Normal profits refer to profits that airlines would earn in competitive market conditions in which sufficient capacity is available to meet underlying demand. In the main analysis, this is assumed to be constant at 2% of turnover. In this section, for illustration, the impact of a higher normal profit level, of 5% of turnover, is tested on the estimated impact of the Project.

A1.4.3 As discussed in section 5.4, unconstrained fares are estimated by aggregating the different cost components of fares. Given that airlines make normal profits, an assumed share of normal profits needs to be included within the unconstrained fares. A higher assumed share of normal profit means that the unconstrained price that airlines would set would be higher. This would have the following impact on the benefits that accrue to the users and providers of aviation services:

- lower user benefits in some markets, as prices with the Project would be higher and there would therefore be a reduced welfare transfer from airlines to existing air passengers;
- higher airline benefits, or less loss, as the welfare transfer from airlines to passengers is lower, and airlines can offer higher prices; and
- the total impact on the user and provider benefits would depend on the magnitude of these two effects.

[218] See ICAO (2022), ‘Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) – Frequently Asked Questions’, December, p. 18.
[219] Although these countries can voluntarily participate at the scheme. See ICAO (2022), ‘Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) – Frequently Asked Questions’, December, p. 18.
[220] By air traffic volumes it is meant the volume of air transport activity measures as utilised capacity for passengers and cargo expressed in metric tonnes and multiplied by the distance travelled. This is known as Revenue Tonne Kilometres. See ICAO (2022), ‘Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) – Frequently Asked Questions’, December, p. 18.

A1.4.4 Table A1.4.1 below illustrates the estimated user and provider benefits using a profit level of 5%. Other estimated benefits would be identical to those reported in Section 9 as they are not affected by the change in normal profits. These results suggest that, in the event that airlines can maintain a 5% profit margin compared with a 2% profit margin, the Project would yield £10.7 bn benefits to users and providers of aviation services in the London aviation system, compared with £8.5 bn benefits estimated in the main analysis. That is, if airlines were to make a 5% profit on turnover instead of 2%, the benefits from the Project would increase, primarily for providers, as they would be able to charge higher prices and attain the same passenger levels in some passenger segments. Therefore, the total impact of the Project is estimated to be higher.

Table A1.4.1: sensitivity to higher normal profits—user and provider benefits (£ bn)

Total benefits to users and providers	Sensitivity	Main Assessment
Total passenger benefits	**150.1**	
Airline benefits	-135.0	-139.3
Airport revenues	2.2	
Total provider benefits	**-132.8**	**-137.1**
Present value of benefits to users and providers	**17.3**	**13.1**

Note: All values are in 2010 prices and values. Values may not sum due to rounding. International-to-international transfer passengers have been excluded from the passenger numbers and the surplus calculations.

Source: Oxera.

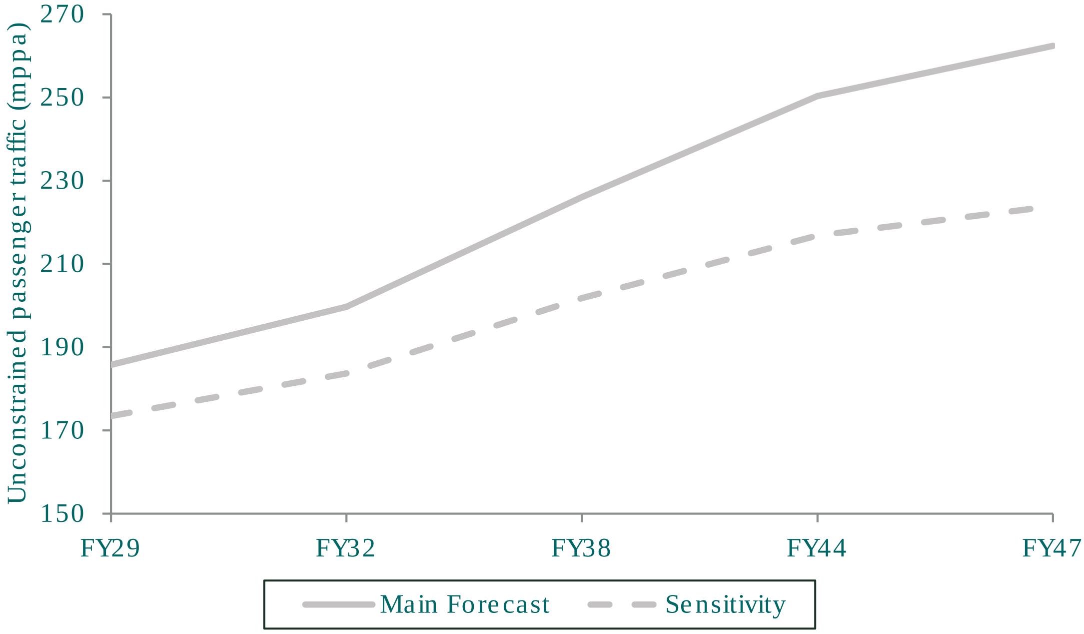
Slow growth sensitivity

A1.4.5 This annex considers the sensitivity of the estimates of the Project's economic benefits and costs with respect to the air traffic forecasts. In particular, the analysis is undertaken using alternative input forecasts.

A1.4.6 These forecasts assume a slower recovery in Gatwick's passenger numbers after the COVID-19 pandemic and a lower uptake of the additional capacity created by the Project. In the long term, the sensitivity leads to lower air traffic compared to the main case.[221] **Figure A1.4.1** below shows the difference in air traffic growth between the main ('core') forecast and the sensitivity scenario.

[221] For more information on the slower growth air traffic forecasts, see Annex 2 in **ES Appendix 4.3.1: Forecast Data Book** (Doc Ref. 5.3).

Figure A1.4.1: core and sensitivity forecasts of unconstrained demand in the London aviation market

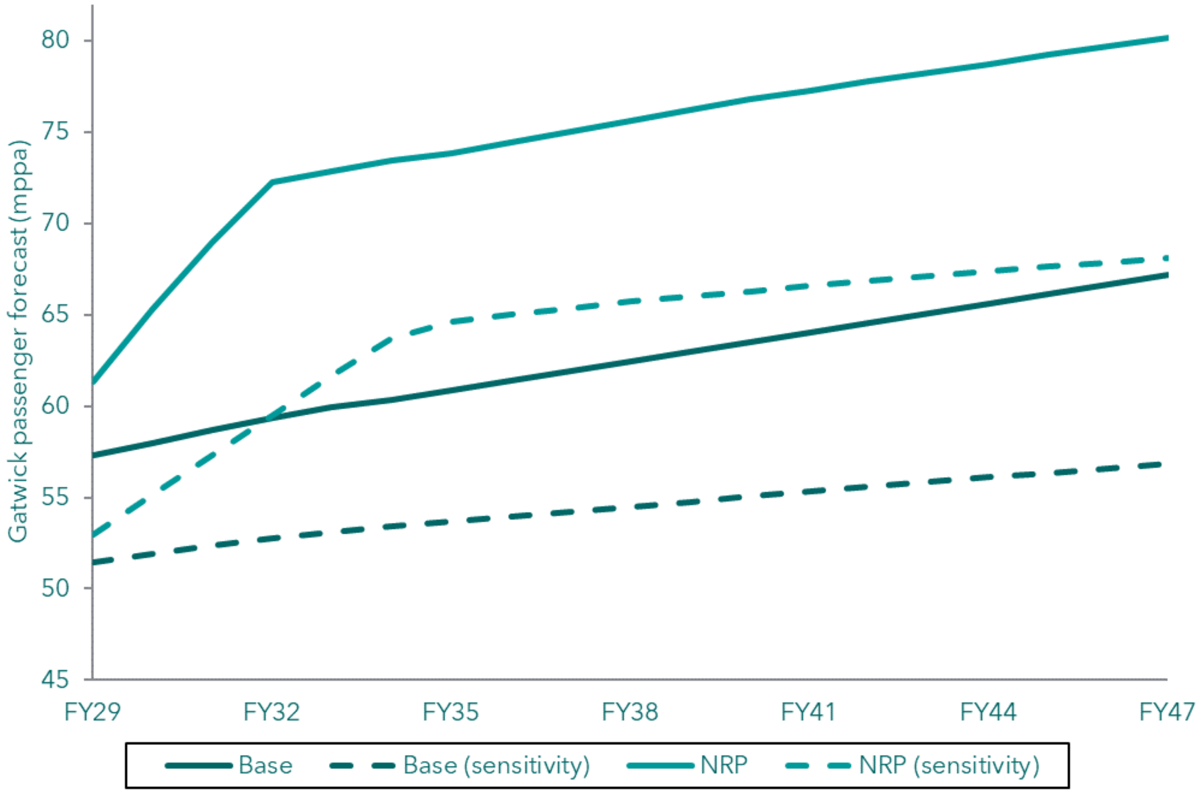


Note: Axis does not start at zero. Main forecasts refer to unconstrained air traffic forecasts for the whole London system (consisting of Gatwick, Heathrow, London City, Stansted, Luton, and Southend airports). Sensitivity refers to adjusted unconstrained air traffic forecasts with a slower growth assumption.

Source: Gatwick air traffic forecasts, Oxera analysis.

A1.4.7 **Figure A1.4.2** below shows the air traffic forecasts for Gatwick for the sensitivity scenario. Compared to the main ('core') air traffic forecasts, the sensitivity forecasts show slower passenger growth and lower additional air traffic from the Project compared to the baseline. For instance, in FY2047, the main forecast of passengers is 67.2 m in the base scenario and 80.2 m in the NRP scenario; while in the sensitivity, the passenger numbers are 56.8 m in the base scenario and 68.1 m in the NRP scenario.

Figure A1.4.2: air traffic forecasts for Gatwick Airport: main and sensitivity scenarios



Note: Axis does not start at zero. Base and NRP refer to Baseline and Project air traffic forecasts for Gatwick Airport. Sensitivity refers to adjusted Baseline and Project air traffic forecasts with a slower growth assumption.

Source: Gatwick air traffic forecasts, Oxera analysis.

A1.4.8 Slower air traffic growth would result in the additional capacity being used later than suggested by the main air traffic forecasts, meaning that benefits would occur at a later stage. This is likely to reduce the estimated impact of the Project on UK society.

A1.4.9 The analysis in this report suggests that in this sensitivity, the Project would deliver a NPV of £10 bn–£11.6 bn compared to £20.7 bn–£22.3 bn in the core scenario. This is a conservative estimate of the NPV of the Project as the environmental and marginal external costs associated with the Project would be lower than in the core scenario due to lower passenger air traffic in Gatwick Airport, but this has not been accounted for.

A1.4.10 The next subsections present further breakdowns of the different categories of impact (eg user and provider impacts, wider impacts) in the sensitivity scenario.

User and provider impacts sensitivity

A1.4.11 Table A1.4.2 below sets out the present value of benefits to users and providers in the London aviation market using the sensitivity passenger forecasts. The benefits for the central estimate are presented.

A1.4.12 According to the analysis, the lower level of passenger air traffic in the sensitivity would result in a reduction in the user and provider benefits. However, the Project would still bring benefits to users of aviation services over the 60-year appraisal period, which are estimated at £4.3 bn compared to £8.5 bn in the main scenario.

Table A1.4.2: total benefits to users and providers in the London aviation system—sensitivity results (£ bn)

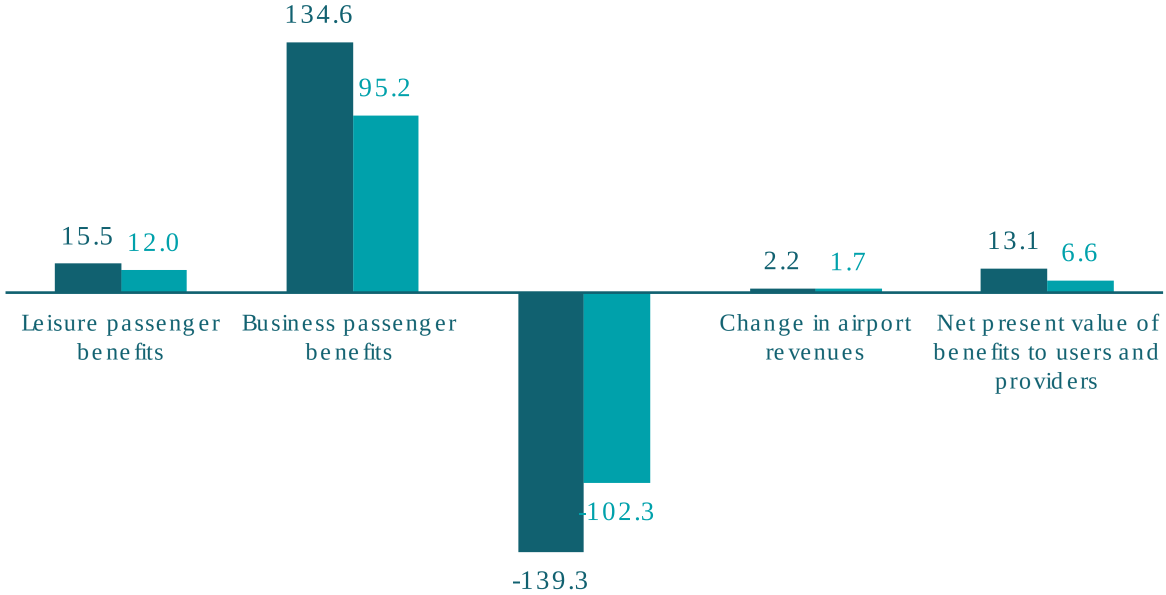
Item	Estimates (£ bn)
Leisure passenger benefits	12.0
Business passenger benefits	95.2
Total user benefits	**107.2**
Airline benefits	-102.3
Change in airport revenues	1.7
Total provider benefits	**-100.6**
Present value of benefits to users and providers	**6.6**

Note: All values are in discounted 2010 real prices. Numbers may not sum due to rounding. International-to-international transfer passengers have been excluded from the passenger numbers and the surplus calculations. Airline benefits reflect a welfare transfer from airlines to passengers with the Project.

Source: Oxera analysis.

A1.4.13 **Figure A1.4.3** below provides a comparison of the benefits to users and providers of aviation services between the main and the sensitivity scenarios, illustrated in dark and light teal columns respectively.

Figure A1.4.3: user and provider benefits for main and sensitivity scenarios (£ bn)



Note: All values are in discounted 2010 market prices.

Source: Oxera analysis.

A1.4.14 As explained in section 3, the Project is expected to create benefits to the wider economy, such as productivity gains through people moving to more productive jobs. It is also expected to bring benefits to the Government through increasing tax revenues from the APD paid by the additional passengers. Table A1.4.3 summarises the benefits to the wider economy with the sensitivity passenger forecasts.

Table A1.4.3: benefits to the wider economy—sensitivity (£ bn)

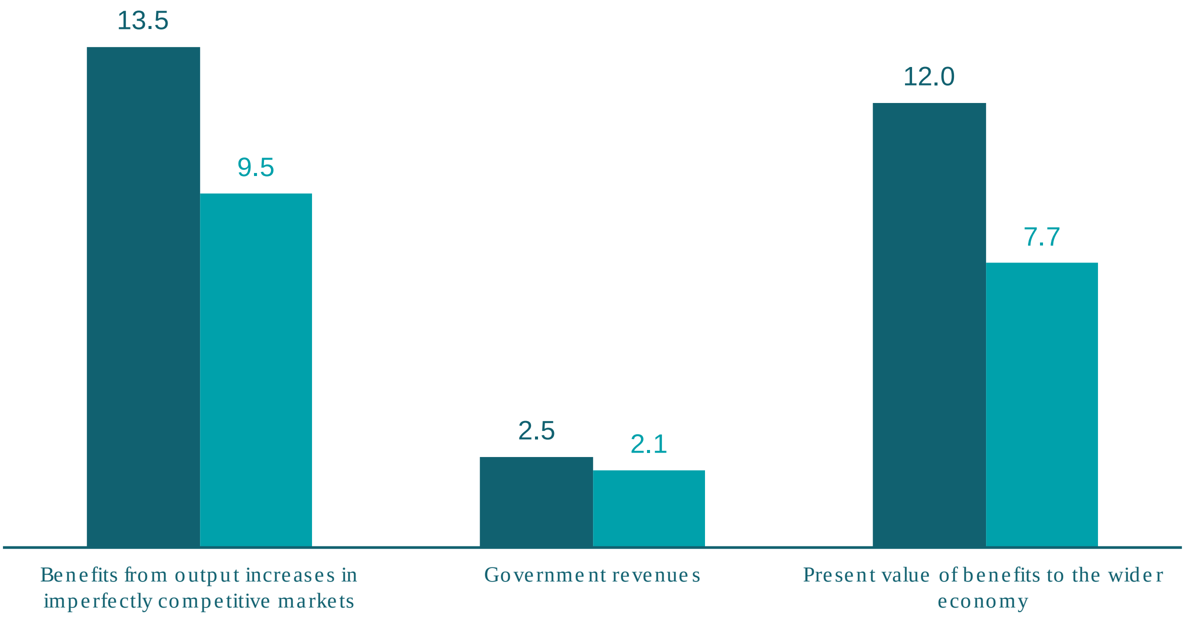
Item	Estimates (£ bn)
Output change in imperfectly competitive markets	9.5
Government revenues	2.1
Marginal external costs	-4.0
Present value of benefits to the wider economy	**7.7**

Note: All values are in discounted 2010 real prices. Numbers may not sum due to rounding. For this sensitivity, the marginal external costs calculated in the main assessment have been used, due to the unavailability of surface access data associated with this sensitivity passenger air traffic forecast.

Source: Oxera analysis.

A1.4.15 It is estimated that the wider economic impacts of the Project and the additional tax revenues would be £7.7 bn compared to £12.0 bn in the main ('core') assessment scenario analysis. **Figure A1.4.4** below compares the different components of these benefits for the main (dark teal) and the sensitivity (light teal) scenarios.

Figure A1.4.4: benefits to the wider economy and the Government for main and sensitivity scenarios (£ bn)



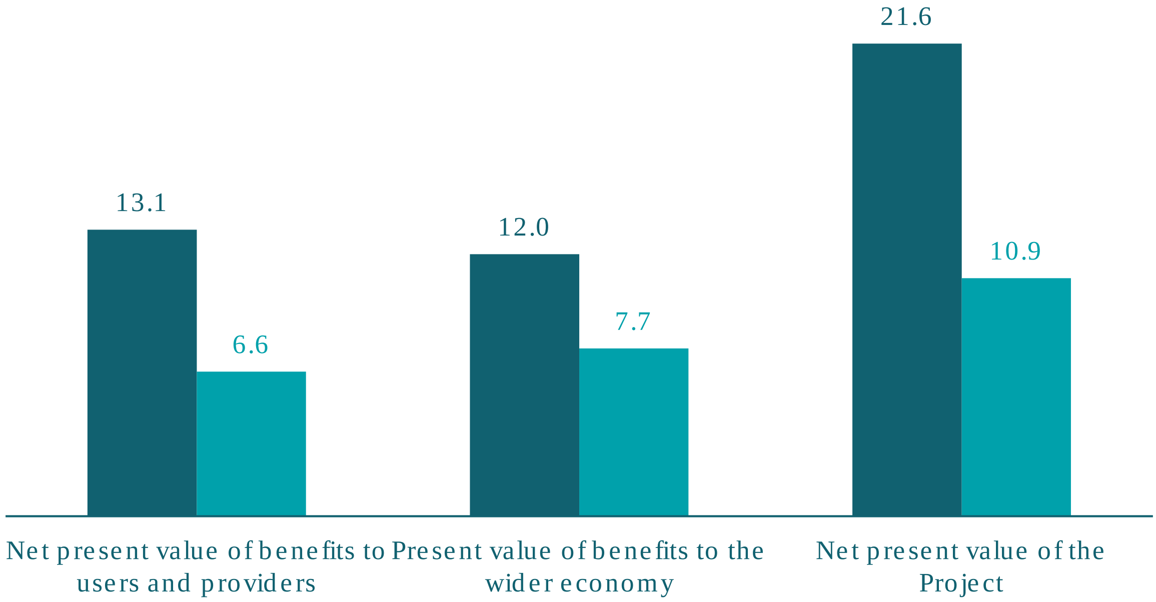
Note: All values are in discounted 2010 real prices. The present value of benefits to the wider economy includes marginal external costs associated with the Project. These costs are assumed to be equal to the main assessment scenario in absence of data regarding the impact of lower passenger demand on additional vehicle kilometres travelled as a result of the Project. Given that these marginal external costs are higher than they would be under a slow growth scenario in passenger demand, the present value of benefits to the wider economy is likely to be underestimated.

Source: Oxera analysis.

A1.4.16 In addition, OPEX estimates have been adjusted for this sensitivity involving slower passenger growth in Gatwick Airport. Under this sensitivity, OPEX is estimated to be £0.4 bn compared to £0.5 bn in the main assessment scenario.

A1.4.17 Combining the present value to passengers, producers and the wider economy with scheme and environmental costs, the analysis suggests that in this sensitivity, the Project would deliver a central NPV of £10.9 bn compared to £21.6 bn in the main ('core') assessment scenario. This is a conservative estimate of the NPV of the Project as the environmental and marginal external costs associated with the Project would be lower than in the main assessment scenario due to lower passenger air traffic in Gatwick Airport, but these have not been accounted for.

Figure A1.4.5: present value of benefits for main and sensitivity scenarios (£ bn)



Note: All values are in discounted 2010 market prices. The net present value of the Project includes the present value of environmental and scheme costs on top of the present value of benefits to users, providers and the wider economy. Environmental costs are assumed to be equal to the main assessment scenario in absence of data quantifying the impact of lower passenger demand on the environment. Given that environmental costs are higher than they would be in a scenario with slower growth in passenger demand, the net present value of the Project is likely to be underestimated.

Source: Oxera analysis.

A1.5. Policy context

A1.5.1 This Annex summarises the key planning policy documents that inform the national Economic Impact Assessment approach and set out its relevance as part of the application for development consent. For additional information on the broader planning policy context, please refer to **ES Chapter 2: Planning Policy Context** (Doc Ref. 5.1) and **Planning Statement** (Doc Ref. 7.1)

Airports National Policy Statement

A1.5.2 The Planning Act 2008 requires that in deciding applications for development consent, regard must be given to any National Policy Statement (NPS) which has 'effect' in relation to development of the description to which the application relates (a 'relevant national policy statement').

A1.5.3 On 26 June 2018, the Government designated the Airports NPS (Department for Transport, 2018a). The NPS only has 'effect' in relation to the delivery of additional airport capacity through the provision of the Heathrow Northwest Runway project. This includes new terminal capacity between the new runway and the existing northern runway at Heathrow Airport, as well as the reconfiguration of terminal facilities in the area between the two existing runways at Heathrow Airport (paragraph 1.40). Paragraph 1.41 of the NPS makes it clear that it does not have 'effect' in relation to an application for development consent for airport development unrelated to the Heathrow Northwest Runway. However, paragraph 1.41 continues by stating that

'Nevertheless, the Secretary of State considers that the contents of the Airports NPS will be both important and relevant considerations in the determination of such an application, particularly where it relates to London or the South East of England. 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'.

A1.5.4 As a result, whilst the Airports NPS does not have direct effect for the purposes of the Project, it is an 'important and relevant' consideration for the determination of the application for development consent.

A1.5.5 Paragraph 1.39 of the NPS states that:

… the Government has confirmed that it is supportive of airports beyond Heathrow making best use of their existing runways. However, we recognise that the development of airports can have positive and negative impacts, including on noise levels. We consider that any proposals should be judged on their individual merits … taking careful account of all relevant considerations, particularly economic and environmental impacts. (paragraph 1.39)

A1.5.6 Paragraph 4.4 of the Airports NPS provides further detail of the considerations for weighing adverse impacts against benefits for any airport development:

'In considering any proposed development, and in particular when weighing its adverse impacts against its benefits, the Examining Authority and the Secretary of State will take into account:

▪ *Its potential benefits, including the facilitation of economic development (including job creation) and environmental improvement, and any long term or wider benefits; and*

▪ *Its potential adverse impacts (including any longer term and cumulative adverse impacts) as well as any measures to avoid, reduce or compensate for any adverse impacts.'*

A1.5.7 The Government's policy framework for airports (other than Heathrow), which sets out the Government's support for making best use of existing airports and their capacity, is described below.

Aviation Policy Framework

A1.5.8 In 2011, the Government commenced the process of preparing a new policy framework for UK aviation to replace the 2003 Future of Air Transport White Paper (Department of Transport, 2003). This was a national aviation policy which set out a strategic framework for the development of airport capacity, supporting the development of new runways at Heathrow and Stansted, and making the best use of other existing airport capacity.

A1.5.9 This led to a draft Aviation Policy Framework being published in July 2012 and the final Aviation Policy Framework in March 2013 (Department for Transport, 2013). The Aviation Policy Framework sets out the Government's objectives and principles to guide plans and decisions on airport development at the local and regional level.

A1.5.10 The Aviation Policy Framework recognises that the aviation sector contributes significantly to the UK economy. In particular, Paragraph 1.16 of the Aviation Policy Framework highlights the benefits of outbound tourism in the UK:

… The Government believes that the chance to fly abroad also offers quality of life benefit including educational and skills development. Overall the Government believes continuing to make UK tourism more attractive is a better approach both for residents and attracting new visitors. (paragraph 1.16)

A1.5.11 The policy document also notes that airports in the South East of England (including Heathrow and Gatwick) face capacity challenges. The Aviation Policy Framework identifies a number of other challenges in the aviation sector, noting that aviation needs to grow, delivering benefits essential to economic wellbeing, while respecting the environment and protecting quality of life.

Beyond the Horizon – The Future of UK Aviation: Making Best Use of Existing Runways

A1.5.12 In late 2012, during the preparation of the Aviation Policy Framework, the Government set up the Airports Commission. Included within the Airports Commission's brief was the requirement to examine the nature, scale and timing of any requirements for additional airport capacity to allow the UK to maintain its position as Europe's most important aviation hub. Amongst the recommendations of the Airports Commission was the need to make more intensive use of airport infrastructure.

A1.5.13 The Government published Beyond the Horizon - The Future of UK Aviation: Making Best Use of Existing Runways (HM Government, 2018) in June 2018. The document forms part of the Government's aviation strategy and sets out its policy support for airports making best use of their existing runways:

… 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. (paragraph 1.29)

A1.5.14 The principle of making best use of existing airport capacity has therefore been a longstanding and consistent feature of UK aviation policy since 2018, and remains so today.

A1.5.15 In addition, in its consultation document 'Aviation 2050 – the Future of UK Aviation' (December 2018), the Government clarified that it supports the aviation industry growth and the benefits that it delivers, provided that growth takes place in a sustainable way, with actions to mitigate the environmental impacts.

Flightpath to the Future

A1.5.16 'Flightpath to the future' is a strategic framework for the aviation sector that supports the Department for Transport's vision for a modern, innovative and efficient sector over the next 10 years (Department for Transport, 2022a).

A1.5.17 The report defines ways the UK wants to be seen as the best place in the world for General Aviation. One of the key objectives is supporting an innovative, environmentally sustainable sector and encouraging the use of new technology. This document highlights the Government's continued commitment to the sustainable growth of the aviation sector. It also recognises aviation's vital importance to the UK, in terms of economic contribution, jobs, and the personal value it provides to individuals. In addition, it sets out key priorities for the next 10 years, including a 10-point plan for delivery, and how the Government will work closely with the sector, including through the new Aviation Council, to implement the commitments established through this framework.

A1.5.18 The Government recognises that the sector is still recovering and there are a number of challenges ahead.

Decarbonising Transport

A1.5.19 Decarbonising Transport: A Better, Greener Britain (Department for Transport, 2021) was published in July 2021 and sets out the Government's commitments and the actions to decarbonise the transport system in the UK.

A1.5.20 The plan includes details regarding:

- a pathway to achieving net zero transport in the UK;
- the wider benefits net zero transport can deliver;
- the principles that underpin the Government's approach to delivering net zero transport.

A1.5.21 The plan follows on from Decarbonising Transport: setting the challenge, published in March 2020, which identifies the scale of additional reductions needed to deliver transport's contribution to legally binding carbon budgets and delivering net zero by 2050.

Jet Zero Strategy: Delivering net zero aviation by 2050

A1.5.22 The Jet Zero Strategy (Department for Transport, 2022b) sets out the Governments proposed approach and principles to reach net zero aviation by 2050. The ambition is to:

- decarbonise aviation in a way that preserves the benefits of air travel; and
- maximise the opportunities that decarbonisation can bring.

A1.5.23 It proposes a suite of policies to support industry to reduce and, where possible, eliminate carbon dioxide emissions from aviation. These policies span five different measures that aim to:

- improve the efficiency of our aviation system;
- accelerate the development and deployment of sustainable aviation fuels;
- support the development of zero emission flight;
- ensure that markets are used to drive down emissions in the most cost-effective way; and
- influence the behaviour of consumers.

A1.5.24 The Strategy sets out commitments: 'to support airport growth where it can be delivered within our environmental obligations' and 'keep under review whether further guidance is needed to assist airport planning decision-making, with particular reference to environmental impacts'. In implementing these commitments, the strategy notes that applicants should engage with the relevant planning authority at an early stage of the planning process to agree an appropriate approach.

A1.5.25 The delivery plan states that 'applicants should therefore provide sufficient detail regarding the likely environmental and other effects of airport development to enable communities and planning decision-makers to give these impacts proper consideration'.

A1.5.26 The Strategy sets out a commitment that the DfT 'will work with airports, other government departments, local authorities, and other interested bodies to help airports in England improve their surface access through developing Master Plans and Surface Access Strategies'. The aim is that the right policies are in place to encourage passengers and employees to travel by sustainable modes of transport to and from the airport where possible.

A1.5.27 The strategy also states that the DfT will 'keep under review whether further guidance is needed to assist airport planning decision-making, with particular reference to environmental impacts'.

Other Relevant Policy

A1.5.28 In addition to the above, the following documents set out airports policy relevant to the Project and have been considered, where appropriate, as part of the EIA process either within the scope of this assessment or in the process of producing the inputs used in this assessment:

- Beyond the Horizon: The Future of UK Aviation. Next Steps Towards an Aviation Strategy (HM Government, 2018b);
- Aviation Strategy Green Paper: Aviation 2050 – The Future of UK Aviation (Department for Transport, 2018b); and

- The National Infrastructure Delivery Plan: 2016 2021 (Infrastructure and Projects Authority, 2016).

A2 Annex B

A2.1. Summary of sensitivity analysis, uncertainties and unquantified impacts affecting the NPV of the Project

A2.1.1 The estimated benefits and costs presented in this report provide the likely magnitude of impacts arising from the Project subject to a set of inputs and assumptions. However, as there is some uncertainty around these estimates, it is relevant to undertake sensitivity analysis to consider how different inputs and/or assumptions could affect the net benefits attributable to the Project.

A2.1.2 In addition, there are several impacts that have not been quantified due to methodological limitations or data availability, or have not been included in the NPV due to concerns regarding double-counting and additionality. It is therefore important to consider these impacts alongside the estimated benefits and costs of the Project to understand the potential additional value that the Project would bring to the UK economy and society.

A2.1.3 This Annex sets out the quantitative and qualitative sensitivity analysis that Oxera has undertaken with respect to the benefits and costs of the Project. It consists of five sections setting out different sensitivities, as follows:

- the sensitivity of the benefits to inputs used in the modelling of air fares;
- an overview of the sensitivities undertaken in relation to the environmental costs of the Project;
- the sensitivity of the user and provider benefits to the passenger demand forecasts for the London aviation market;
- the benefits described in section 6 that are not included in the NPV due to concerns regarding double-counting and additionality; and
- an overview of impacts that are not quantified but are qualitatively assessed in the report.

Air fares modelling

Sensitivity to the assumption on fare elasticity of demand

A2.1.4 The fare elasticities of demand used in this assessment are a key element in modelling air fares in the unconstrained, baseline, and Project scenarios. As described in section 5.4, the main assessment of this report uses elasticities from DfT.[222]

Sensitivity to assumption on the share of normal profits within air fares

A2.1.5 Normal profits refer to profits that airlines would earn in competitive market conditions in which sufficient capacity is available to meet underlying demand. As described in section 5.4, our modelling of air fares incorporates the normal profits that airlines will make under competitive conditions. This is assumed to be constant at 2% of turnover.[223]

[222] DfT (2022), 'Jet Zero: modelling framework', March, p. 15.
[223] This parameter is sourced from Regional International (2019), 'The state of the airline industry in Europe', March/April, https://www.iata.org/en/iata-repository/publications/economic-reports/state-of-the-airline-industry-in-europe, accessed 10 November 2022.

A2.1.6 An assumption on the share of normal profits within air fares will affect the predicted level of fares which, in turn, will impact the benefits and losses to passengers and providers. As such**, Annex A1.4** presents a sensitivity test where a share of normal profit of 5% at turnover is assumed instead. This analysis shows that the present value of benefits to users and providers is £17.3 bn compared to £13.1 bn in the main analysis.

Environmental costs

Uncertainty in the monetary costs of emissions

A2.1.7 The environmental costs associated with the increase in NOx, $PM_{2.5}$ and CO_2e emissions as a result of the Project are monetised using values published by DfT. The DfT publishes central, low and high monetary costs.

A2.1.8 Regarding air quality (ie NOx and $PM_{2.5}$ emissions), the low and high monetary costs reflect differences in the valuation of a life year and are based on different sets of health impacts.[224] As a result, there is a significant difference between the low/high and the central estimates. Using the low and high values shows that the air quality costs from an increase in NOx and $PM_{2.5}$ emissions would range from £8.2 m to £314.9 m compared to £83.5 m in the central scenario.

A2.1.9 With respect to the carbon costs, DfT has published sensitivity carbon values which range from 50% below to 50% above the central estimate. The use of these low and high estimates results in GHG costs ranging from £0.6 bn to £1.9 bn compared to the central estimate of £1.3 bn.

Assumptions about CORSIA

A2.1.10 The GHG costs presented in section 7 exclude costs of emissions which would be offset by airlines in the context of the CORSIA scheme. This is because these costs are already reflected in the air fares modelled in this analysis and hence have been internalised in the NPV of the Project. Therefore, monetising the CORSIA emissions in the environmental impact costs would result in double-counting the costs of these emissions.

A2.1.11 In order to exclude the costs of the CORSIA emissions from the monetised costs of non-traded emissions which are already internalised in the fares, an indicative range of CORSIA emissions was constructed based on assumptions about the proportion of international aviation emissions that will be subject to the CORSIA scheme. This was assumed to be between 90% and 100% of all emissions from international aviation, which results in 17.1 m–18.2 m metric tonnes of incremental CO_2e emissions generated by the increased flights associated with the Project over the appraisal period. The methodology used to model these emissions is described in more detail in **Annex A1.3**.

A2.1.12 The main assessment presented in this report, as well as in the sensitivities above, uses the upper bound of these estimates, assuming that 90% of international emissions will be offset by the CORSIA scheme and therefore should not be monetised to avoid double-counting. The total GHG costs in the main assessment are £1.3 bn (central estimate). However, if it is assumed that all international flights participate in the CORSIA scheme (ie we assume 100% instead of 90%), the central estimate of GHG reduces to £1.1 bn.

[224] For more information see DEFRA (2023), [redacted]', 2 March (last accessed April 2023).

Slow fleet transition scenario

A2.1.13 The noise, air quality and GHG emissions produced from aviation are based on specific assumptions about aircraft technology used in the air traffic forecasts. In order to test the impact of these assumptions on the estimated environmental impacts and costs, a sensitivity scenario that assumes a slower transition of aircraft fleet to next generation aircraft (slow fleet transition scenario, ie SFT scenario) was produced.[225]

A2.1.14 Table A2.1.1 presents a breakdown of air quality estimates for aircraft operations by type of emission.[226] In the SFT sensitivity scenario, the total air quality impacts of the Project would cost £85.3 m, 2.2% higher than the main scenario.[227]

Table A2.1.1: present value of monetised air quality emissions (£ m)—Slow Fleet Transition central scenario

	NO_x	$PM_{2.5}$	Total costs
Aircraft	-78.6	-4.1	**-82.7**

Note: Values are in 2010 discounted prices. They may not sum due to rounding. Estimates refer to changes in pollutant levels between the Project and the Baseline scenarios in a sensitivity scenario where the rate of transition of the aircraft fleet at Gatwick is assumed to be slower than in the main assessment scenario.

Source: Oxera.

A2.1.15 The sensitivity of costs associated with aviation emissions in the SFT scenario are presented in the table below.[228] In contrast with the main assessment, emissions offset by the CORSIA scheme are monetised and included in the present value of impacts. Therefore, the SFT impacts are not directly comparable to the monetised impacts in the main assessment, which exclude CORSIA emissions.

A2.1.16 CORSIA emissions are included in the SFT scenario as their costs are not fully reflected in the air fares modelled in section 5. This is because there would be more CORSIA emissions in the SFT scenario, such that the carbon cost components of air fares would in theory be higher as airlines would have to purchase more offsets compared to the main assessment. Therefore, not monetising the CORSIA emissions in this case would lead to an underestimation of GHG costs given that the air fares and consequently the net user benefits do not reflect the higher emissions associated with the slow fleet transition scenario.

[225] More information on these forecasts is provided in Annex 3 in **ES Appendix 3.3.1: Forecast Data Book** (Doc Ref. 5.3).
[226] Air quality emissions were modelled in the slower fleet transition scenario up to the year 2038. It has been assumed that 2038 emissions grow at the same rate as in the core scenario in order to calculate air quality emissions for the year 2047.
[227] Total air quality costs from aircraft operations with the Project using the low and high damage costs values would be £7.9 m and £313.7 m respectively in 2010 prices. Low and high damage cost values reflect differences in the valuation of a life year and are based on different sets of health impacts. Uncertainty in the monetary costs associated with air quality impacts. For more information see DEFRA (2023), 'Air quality appraisal: damage cost guidance', 2 March (last accessed April 2023).
[228] Greenhouse gas emissions were modelled in the slower fleet transition scenario up to the year 2038. It has been assumed that 2038 emissions grow at the same rate as in the core scenario in order to calculate greenhouse gas emissions for the year 2047.

Table A2.1.2: Present value of monetised impacts of increased GHG (£ m)—Slow Fleet Transition scenario

	Low	Central	High
Present value of monetised impacts of increased GHG emissions in aviation	-1,111	-2,222	-3,333

Note: Values are in 2010 prices and values. Estimates refer to changes in emission levels with the Project relative to the Baseline.

Source: Oxera.

A2.1.17 Table A2.1.3 below presents a breakdown of noise impacts into sleep disturbance, amenity, acute myocardial infarction, stroke and dementia in this sensitivity scenario. Overall aircraft noise impacts are estimated to be £11.5 m.

Table A2.1.3: present value of monetised impacts from increased aircraft noise, Slow Fleet Transition scenario (£ m)

Noise impacts	Costs
Sleep disturbance	-4.2
Amenity	-5.2
Acute myocardial infarction	-0.0
Stroke	-0.8
Dementia	-1.3
Total	**-11.5**

Note: Values are in 2010 discounted prices. They may not sum due to rounding. Estimates refer to changes in noise levels with the Project relative to the Baseline.

Source: Input noise assessment

A2.1.18 Table A2.1.4 below summarises SFT environmental impact estimates presented above and compares the environmental impact categories between the main and the SFT scenarios. The low, central and high values represent the uncertainty in the monetary costs discussed in the previous section.

Table A2.1.4: NPV of monetised environmental impacts in the main and Slow Fleet Transition scenarios (£ m)

Environmental impact	Slow fleet transition scenario			Main assessment		
	Low	Central	High	Low	Central	High
Noise from aviation		**-12**			**-9.9**	
NOx from aviation	-7.0	**-79**	-302	-6.9	**-77**	-296
$PM_{2.5}$ from aviation	-0.9	**-4.1**	-12	-0.8	**-3.8**	-11
GHG emissions from aviation	-1,111*	**-2,222***	-3,333*	-585	**-1,169**	-1,754
Total environmental costs	**-1,175**	**-2,407**	**-3,798**	**-646**	**-1,350**	**-2,210**

Note: Values are in 2010 prices and values. Estimates refer to changes in emission levels with the Project relative to the baseline. The low, central and high scenarios reflect uncertainties and different assumptions in the valuation of emissions made by DfT and DEFRA.
*The SFT scenario monetises CORSIA emissions which are excluded from the monetised emissions in the main assessment.

Source: Oxera.

Air traffic forecasts

Slower passenger growth

A2.1.19 A set of forecasts were prepared which assumed slower growth in demand in the London aviation market and lower passenger growth at Gatwick. An overview of these forecasts is presented in **Annex A1.4** of this report and in the **Needs Case** (Doc Ref. 7.2).

A2.1.20 In **Annex A1.4,** it is estimated that the Project would deliver a central NPV of £10.9 bn with the slower growth forecasts compared to £21.6 bn in the core scenario. This central estimate of the slower growth scenario uses the environmental and marginal external costs estimated in sections 7 and 6.4 for the core scenario. However, if passenger growth is lower, it is likely that these costs would also be lower compared to the core scenario. As a result, this sensitivity analysis provides a conservative estimate of the NPV of the Project to the national economy.

Capacity expansions at other London airports

A2.1.21 The core air traffic forecasts used in this report assume that there are no major capacity expansions at other London airports during the appraisal period. However, capacity expansion at other London airports could affect the benefits and costs of the Project to the national economy quantified in this report. In particular, two expansion schemes may have an effect on the benefits of the Project: the planned development of Luton airport and a third runway at Heathrow.

A2.1.22 Luton Airport has proposed to increase the capacity of the airport to 32 million passengers per year by expanding existing terminal capacity (phase 1) and constructing a new terminal (phase 2), with the scheme opening in the late 2030s.[229] This would increase available capacity in the London aviation system and, therefore, reduce the existing capacity constraints discussed in section 5.3 to some extent.

A2.1.23 Nevertheless, it is forecast that there would still be excess demand in the London aviation market even after the Project is complete, and by the time that Luton expands. In addition, there is limited overlap between Gatwick and Luton airports' core catchment areas (ie the areas from which passengers are drawn). This suggests that capacity expansion at Luton Airport would be unlikely to have a significant impact on the number of additional passengers resulting from the Project at Gatwick.[230] As a result, a Luton expansion scenario would be expected to have only a marginal impact on the benefits generated by the Project, leading to similar benefits to those quantified in section 9.

[229] Luton Rising (2023), [redacted] February.
[230] See section 6 in the **Needs Case** (Doc Ref. 7.2).

A2.1.24 With respect to Heathrow expansion, a proposed third runway at Heathrow (the 'R3' scheme) was adopted as UK Government policy in 2018.[231] Heathrow Airport Holdings Ltd (HAHL) – the owner and operator of Heathrow - commenced work on the extensive studies that would be required to support a Development Consent Order application to seek formal consent for Heathrow R3. However, it suspended its work in 2020 as a result of the COVID-19 pandemic. Since then, HAHL has not announced any timeframe for recommencing its work and there is no indication that work will be recommencing in the short term.[232] Even if HAHL does restart work soon, it is now considered unlikely that Heathrow R3 could be operational much before the early/mid-2030s as a result of the delays to the consenting process, which would be expected to delay the anticipated opening date. The Heathrow R3 project is therefore not currently being progressed and there is significant uncertainty surrounding when, or indeed if, a third runway will be developed at Heathrow.

A2.1.25 Similar to the Luton airport expansion, if Heathrow Airport's proposal for R3 was to come forward and be consented, excess demand in the London aviation market would be lower compared to the excess demand in the core assessment scenario of this report. Given the magnitude of the expansion, R3 would lead to a greater reduction in capacity constraints, and therefore shadow costs, compared to the proposed capacity expansion at Luton Airport. The R3 expansion would also result in fewer additional passengers, and in particular long-haul passengers, arising from the Project at Gatwick reflecting Heathrow's leading position in this market segment today. Therefore, compared to the Luton expansion, R3 would have more significant effects on the Project's benefits and costs (eg marginal external costs and environmental costs). However, the magnitude of these effects would largely depend on the timing of the opening of R3 and of any planned phasing of release of additional capacity, which is at present subject to significant uncertainty.

Quantified impacts not included in the NPV

A2.1.26 In section 6, a set of wider economic benefits arising from the Project are described and quantified. However, not all are included in the NPV due to concerns about double-counting or additionality. As a result, the estimate of the NPV of the Project is likely to be conservative because it does not include these benefits which are summarised in Table A2.1.5 below.

[231] Department for Transport (2018), [redacted]', June.
[232] See Heathrow airport's webpage [redacted]' (last accessed April 2023).

Table A2.1.5: summary of benefits excluded from the NPV

Impact	Summary	Reason for exclusion from the NPV
Employment effects	As set out in **ES Appendix 17.9.2: Local Economic Impact Assessment** (Doc Ref. 5.3), the Project would increase demand for labour in the vicinity of the airport. Section 6.5 describes the productivity impacts associated with this change in demand: existing workers may leave their current jobs to start working at new more productive positions. The associated welfare impact from this productivity gain is equal to the resulting change in tax revenue, which leads to a benefit of £77 m.	Since job displacement from other locations has not been modelled, these employment effects should be considered as indicative of potential welfare benefits arising from the Project and not as net additional welfare benefits to UK society. For this reason, this type of benefit is not included in the final NPV which is therefore an underestimate of the potential net benefits to the national economy.
Agglomeration impacts	As a result of increased concentration of economic activity in the Six Authorities Area, the Project would result in further productivity benefits, known as 'agglomeration effects'. As described in section 6.6, these agglomeration benefits would amount to £0.7 bn.	The Project would likely attract workers and firms from other locations, affecting the agglomeration and productivity levels in these other locations. As these displacement impacts have not been modelled, these benefits should be regarded as indicative and are excluded from the NPV of the Project, which thus represents a conservative estimate of the net national benefits of the Project.
Trade impacts	The increased connectivity brought by the Project would improve access to foreign markets and increase the UK's imports and exports. As described in section 6.7, this could result in an increase in productivity and economic activity in trade-related sectors of the economy. The productivity benefits associated with trade effects of the Project are estimated to range from £4.0 bn to £6.7 bn.	The productivity impacts related to trade occur through the same channels as other benefits which are included in the NPV and therefore, there is a risk of double-counting, in particular with business user benefits.

Source: Oxera.

Unquantified impacts

A2.1.27 The Project is likely to have additional impacts to the UK economy and society through a number of different channels. However, absent quantitative evidence or a standard methodology it is difficult to robustly quantify all of the net welfare effects arising from the Project.

A2.1.28 Where possible, this report discusses these effects qualitatively. A summary is provided in Table A2.1.6 below.

Table A2.1.6: summary of unquantified benefits

	Summary
Frequency effects	As discussed in section 5, passengers respond positively to both reduced fares and increases in flight frequencies. As a result, an increase in demand associated with the Project would be driven by a mix of reduced fares and increased frequencies. Given that the passenger forecasts do not differentiate between these two effects, frequency effects have not been quantified. Instead, the analysis attributes all the increase in demand to changes in air fares. As such, the benefits arising from changes in air fares (but not the overall benefits) will be overstated. Nevertheless, **Annex A1.2** explains how this is likely to result in an underestimation of the benefits to users and providers of aviation services. This is because a part of the benefits attributed to having more frequent flights is not reflected in the reduction in air fares and would therefore be additional.
Tourism effects	The Project would facilitate tourism in the UK and abroad which would result in changes in UK expenditure. According to analysis in **Needs Case Appendix 2 - The Economic Impact of Gatwick Airport: A Report by Oxford Economics** (Doc Ref. 7.2), the Project could contribute an additional £1.98 bn to the UK economy in 2047. Welfare impacts associated with tourism would be realised if changes in tourism spending results in structural changes in the economy, for example a relocation of labour to more productive jobs. However, absent sufficient evidence on the mechanisms through which tourism affects productivity in the UK, these welfare impacts have not been quantified.
Competition impacts	As described in section 8, the Project would affect competition between airports and between airlines in the London aviation market and would deliver additional benefits to the UK economy. These include a further reduction in fares; an increase in service quality as well as increased efficiency and innovation. Competition impacts have not been quantified due to lack of disaggregated data in order to be able to robustly estimate these impacts.
Foreign Direct Investment (FDI) impacts	In a similar manner to trade, the Project could facilitate FDI through improved access to international markets. For example, increased connectivity would facilitate face-to-face interactions and costs of firms could decrease, thus affecting international investment decisions. However, because trade and FDI benefits materialise through the same channels, it is difficult to robustly estimate the additional FDI-related productivity benefits. As a result, these are not quantified.

Freight impacts	Increased air services resulting from the Project would facilitate the transport of goods. Quicker and more reliable air freight movements create benefits to businesses who rely on these services, such as providers of perishable foodstuffs and pharmaceuticals. The welfare benefits of the Project would be reflected in the productivity gains associated with the improvement of air freight services. However, absent a standard methodology for quantifying such impacts and limited evidence, this benefit is not quantified in this analysis.
Non-CO_2 effects	The increase in GHG emissions from aviation as well as other sources as a result of the Project are quantified and monetised. However, aircraft also emit other non-CO_2 pollutants that can have a net positive warming effect two to three times the warming effect of CO_2 emissions. Due to significant uncertainty around the magnitude of these impacts,[233] the costs arising from non-CO_2 pollutants are not quantified in this assessment.

Source: Oxera.

Conclusion

A2.1.29 The estimated benefits and costs presented in this report provide the likely magnitude of impacts arising from the Project subject to a set of inputs and assumptions. There are uncertainties around assumptions and inputs to the estimates set out in this report, which influence the quantified benefits and costs of the Project. In addition, there are unquantified benefits that for lack of available data or robust methodology have not been assessed but should also be considered in assessing the impact of the Project.

A2.1.30 An assessment of the impact of the Project under all scenarios would need to account for the impact that the Project would have on user and provider benefits, wider benefits, costs (environmental, marginal external costs, and scheme costs if relevant), and other benefits that are challenging to quantify but still expected to occur. Overall, taking all the sensitivities and uncertainties set out in this annex into account, the Project would be expected to deliver net benefits to users and the broader UK economy.

[233] DfT (2022), 'TAG UNIT A5.2: Aviation Appraisal', November, para. 3.3.3.