

Business Case and Sustainability Assessment – Heathrow Airport Northwest Runway

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Contents

1. Introduction	2
Part 1: Business Case	9
2. Strategic Case	10
3. Economic Case	50
4. Financial and Commercial Case	98
5. Management Case	119
Part 2: Sustainability Assessment	139
6. Sustainability Assessment-Overview	140
Sustainability Assessment – Physical Infrastructure Impacts	147
7. Assessment: Place	147
8. Assessment: Biodiversity	154
9. Assessment: Water and Flood Risk	160
10. Assessment: Community	166
Sustainability Assessment – Operational Impacts	171
11. Assessment: Noise	171
12. Assessment: Air Quality	185
Assessment – Local economic and Quality of Life Impacts	199
13. Assessment: Local economy impacts	199
14. Assessment: Quality of Life	207
Sustainability Assessment – National Impacts	213
15. Assessment: Economy impacts	213
16. Assessment: Carbon	219
17. Annex A: Health Impacts	224

1. Introduction

Commission Objectives and Approach

- 1.1** The Commission's terms of reference set out the following requirements for its *Final Report*:

The Commission should report no later than summer 2015 on:

- *its assessment of the options for meeting the UK's international connectivity needs, including their economic, social and environmental impact;*
- *its recommendation(s) for the optimum approach to meeting any needs; and*
- *its recommendation(s) for ensuring that any needs are met as expeditiously as practicable within the required timescale.*

The Commission should base the recommendations in its Final Report on a detailed consideration of the case for each of the credible options. This should include the development or examination of detailed business cases and environmental assessments for each option, as well as consideration of their operational, commercial and technical viability.

- 1.2** To meet this requirement the Commission developed an *Appraisal Framework*, with objectives refined from its Phase 1 sift criteria. In its *Appraisal Framework*, the Commission set out its intention to construct a *Business Case and Sustainability Assessment* for each of the shortlisted schemes. In November 2014 a *Business Case and Sustainability Assessment* was prepared and published for each of the three schemes under consideration, along with the *Consultation Report* and a suite of detailed background reports.

- 1.3** The Commission then consulted on this evidence base and reviewed it in light of responses received. The Commission's consideration of the responses to consultation is discussed in the *Consideration of Consultation Responses* and where relevant in the particular sections of the *Business Case or Sustainability Assessment* to which the responses referred. The Commission also undertook to take forward three further pieces of work to further supplement this evidence base:

- The high-level air quality modelling presented for consultation enabled a comparison to be made of the scale of impacts and risks associated with each option. The Commission has now supplemented this with more detailed

dispersion modelling, as set out in its *Appraisal Framework*, and has completed a consultation on the new results. This is available as *Air Quality: Local Assessment – Detailed Emissions Inventory & Dispersion Modelling* and the results are discussed in the Air Quality section of the *Sustainability Assessment*.

- The Commission has now completed a fuller economic assessment of each of the shortlisted options with UK aviation emissions constrained to the Committee on Climate Change's (CCC) planning assumption of 37.5MtCO₂. Details of this work are available in *Economy: Carbon Policy Sensitivity* and discussed in particular in the Economic Case.
- At consultation the Commission set out a set of likely potential airline responses in each of the five global scenarios adapted from the *Interim Report* and a qualitative assessment of how these airline responses could affect connectivity provided to various users of aviation and competition in the London and UK-wide airport system. In November 2014, the Commission commissioned a study to quantitatively model the outcomes of this qualitative work. The Commission published this work as an update to the consultation and is available as part of the suite of detailed Strategic Fit analysis reports¹.

1.4 This *Business Case and Sustainability Assessment* takes into account the information provided at consultation, the three pieces of work highlighted above, and other analysis developed as a response to consultation responses. Along with the *Final Report, Consideration of Consultation Responses* and supporting technical documents, it provides the Commission's overall assessment of the Heathrow Airport Northwest Runway (LHR NWR) scheme against the objectives set out in its *Appraisal Framework*.

1.5 At consultation the Commission published a standalone *Business Case and Sustainability Assessment* for each of the schemes under consideration to provide consultees with a consistent assessment of each of the shortlisted schemes. To support the recommendations in its *Final Report*, the Commission has prepared a single over-arching *Business Case and Sustainability Assessment* which focuses on the evidence base for its preferred option, but also includes comparative analysis against the other shortlisted schemes for each appraisal module.

Airports Commission's Scenarios

1.6 This document refers to several scenarios. These are described in the table below.

Table 1.1: The Commission's Scenarios

<i>Assessment of need</i>	Future demand is primarily determined by central projections published by sources such as the Office for Budget Responsibility, OECD ² and IMF ³ .
<i>Global growth</i>	Higher global growth in demand for air travel in the future, coupled with lower airline operating costs.
<i>Relative decline of Europe</i>	Higher relative growth of passenger demand in emerging economies in the future and a strengthened position of far and middle eastern aviation hubs and airlines.
<i>Low-cost is king</i>	Low-cost carriers strengthening their position in the short-haul market and capturing a substantial share of the long-haul market. It also sees higher passenger demand from all world regions and lower operating costs.
<i>Global fragmentation</i>	Economies adopting protectionist policies, with a decline in passenger demand from all world regions, coupled with higher operating costs.

1.7 These scenarios are reflected in the Commission's passenger demand forecasts, and are used to inform the assessments undertaken. All five scenarios described above were discussed in the consultation documents to give an indication of the range of results possible depending on the future demand patterns for air travel. In this document, its *Final Report* and associated evidence base all five scenarios continue to be used where appropriate as sensitives, but the core narrative and analysis is focused more firmly on the *assessment of need* scenario, which is based on central projections of key economic indicators.

1.8 In addition, the Commission has continued to forecast demand based on different approaches to handling carbon emissions from aviation:

- 'Carbon-traded' – These cases assume that carbon emissions from flights departing UK airports are traded at the European level until 2030 and then as part of a liberal global carbon market, consistent with the current Department for Transport (DfT) appraisal methodology. As such these forecasts assume that the total emissions beyond 2030 in the global market are set with reference to stabilisation targets and that society seeks to make reductions where they are

2 Organisation for Economic Co-operation and Development

3 International Monetary Fund

most desirable or efficient across the global economy. The carbon-traded case assumes that carbon is traded at a price equal to the Department of Energy and Climate Change's (DECC) central long run forecast of carbon prices (September 2013 version) for appraisal.

- 'Carbon-capped' – These cases represent the level of aviation demand consistent with the CCC's current assessment of how UK climate change targets can most effectively be met. These forecasts assume no trading of aviation emissions either within the UK economy or internationally e.g. such as under an EU Emissions Trading Scheme or any international global agreement to tackle these emissions.

1.9 The forecast outputs are described in the Strategic Case, for both carbon-capped and carbon-traded systems, and are set out in detail in the document *Strategic Fit: Updated Forecasts*.

1.10 Throughout the *Business Case and Sustainability Assessment*, where relevant, the scheme's performance against different appraisal modules is compared to a do minimum case as well as performance today. This do minimum case reflects a situation where, in the relevant appraisal year, known changes in technology, economic development or other trends have continued compared to today, but no runway is built. This allows a consistent comparison between schemes but can also be helpful to understand what changes are due to the scheme itself, rather than simply the continuation of known trends.

Business Case

1.11 The *Business Case* provides an integrated assessment of the overall case for the Heathrow Airport Northwest Runway scheme. The components of the *Business Case* are as follows:

- Strategic Case – assessing the proposal's alignment with the *assessment of need* set out in the Commission's *Interim Report*, and providing an overview of its wider impacts, both positive and negative.
- Economic Case – assessing the value for money of the proposal, taking into account the full range of potential costs and benefits (including non-monetised as well as monetised impacts).
- Financial and Commercial Case – assessing the overall cost and sources of funding for the scheme and the risks around commercial deliverability, including discussion of the options for public sector contribution.

- Management Case – assessing the potential benefits realisation, risk management, contingency plans and structures that would enable robust management of delivery following the Commission's *Final Report*.

1.12 The Commission's *Business Case* does not precisely follow the Green Book format, but it replicates much of the function of a business case implied by the HM Treasury Green Book, thus providing a starting point for any Government-led business case assessments which might be prepared following the Commission's *Final Report*⁴.

Sustainability Assessment

1.13 The *Sustainability Assessment* provides information about the performance of the Heathrow Airport Northwest Runway scheme against a range of relevant indicators. In line with the principles of sustainable development, this includes examining the likely social, environmental and economic effects of the scheme.

1.14 The Commission's intention is that should the Government decide to use the recommendations in its *Final Report* as the basis for a future National Policy Statement or other delivery mechanism, the information and analysis in the *Sustainability Assessment* would provide a useful foundation for the production of an Appraisal of Sustainability.

Mitigation and Compensation

Terms such as 'mitigation' and 'compensation' can mean different things to different people. Broadly 'mitigation' refers to activity that seeks to reduce a harmful effect or its impacts, whilst 'compensation' seeks to redress the harm done. Sometimes the boundaries are not clear-cut, but throughout this *Business Case* and *Sustainability Assessment* this is how the terms have been used.

Key Impacts

1.15 The whole *Business Case and Sustainability Assessment* together provides an indication of the Commission's judgment on whether the scheme can feasibly meet the Commission's assessment of need and its objectives. Each section is a building block and all need to be present for a comprehensive view of the costs and benefits of the scheme. Figure 1.1 sets out a précis of the geographic scope of some of the impacts that various sections of the *Business Case and Sustainability Assessment* are designed to cover.

Figure 1.1: Key Impact Areas



Part 1: Business Case

2. Strategic Case

Commission Objectives and Appraisal Modules

2.1 The Commission's Strategic Case has been developed to assess the scheme's alignment with the assessment of need set out in the *Interim Report*, and to provide an overview of its wider impacts, both positive and negative. The Commission's objectives for the Strategic Fit Module are for the scheme:

- ***To provide additional capacity that facilitates connectivity in line with the assessment of need;***
- ***To improve the experience of passengers and other users of aviation;***
- ***To maximise the benefits of competition to aviation users and the broader economy;***
- ***To maximise benefits in line with relevant long-term strategies for economic and spatial development.***

2.2 These will be the key objectives considered in the Strategic Case.

2.3 The Strategic Case also considers the other objectives considered by the Commission, in particular Surface Transport, Economy and Local Economy Impact, Quality of Life, Community, Operational Risk and Delivery. Findings arising from other modules on the financing and delivery of the scheme are also relevant to the case, but are chiefly captured through their impacts on Delivery.

Key Impact Areas

2.4 The Strategic Case provides an overview of wider impacts of the scheme. It also specifically focuses on the assessment of how much and what type of connectivity the scheme may provide to the UK and what kind of benefits this connectivity may offer to both future passengers and the freight sector in terms of satisfying the future need for aviation, and on how the scheme aligns with other policies in the UK.

Consultation Evidence Base

2.5 As part of its national consultation the Commission published:

- The Strategic Case for each scheme, as part of each scheme's *Business Case and Sustainability Assessment*⁵
- Technical reports on strategic fit analysis⁶: demand forecasts, a surface access report for each scheme, a ground infrastructure report for each scheme, a report on the competition and connectivity benefits of the schemes and a report on the fit with wider spatial and socio-economic development strategies.
- In December 2014 the Commission published a report: *Impacts of Expanding Airport Capacity on Competition and Connectivity*, with the estimates of potential competition benefits that each of the schemes may produce.
- In January 2015, a new passenger forecasts zip file of data was published, containing data on forecast passenger numbers for a number of smaller regional airports. The information was originally aggregated under the heading of 'other UK airports' in the *Strategic Fit: Forecasts* report.

Updates to Evidence Base

2.6 The Commission has updated its evidence, based on responses to the national consultation. For the Strategic Case the Commission based these updates on a number of technical reviews of the responses submitted during consultation:

- The Commission's Expert Advisory Panel Member, Professor Andreas Schafer, reviewed its and Gatwick Airport Ltd.'s (GAL) demand forecasts. The International Transport Forum (ITF) at the OECD and SEO Economic Research (SEO) report responded to the technical queries and criticisms raised by the stakeholders on the subject of Commission's demand forecasts and scenarios. PricewaterhouseCoopers (PwC) undertook sensitivity analysis of its Spatial Computable Generalised Equilibrium (S-CGE) modelling work and the Commission undertook its own sensitivity analysis of the *Strategic Fit: Forecasts* report.
- The Commission asked the ITF/SEO to analyse in detail the more technical responses on airline competition that were submitted during the consultation, *Competition Impact Analysis*, and to scrutinise the estimates of competition benefits put forward by Heathrow Airport Ltd. (HAL) and GAL. Further work was

5 <https://www.gov.uk/government/consultations/increasing-the-uks-long-term-aviation-capacity>

6 <https://www.gov.uk/government/publications/additional-airport-capacity-strategic-fit-analysis>

also procured with the ITF/SEO, *Market Response to Airport Capacity Expansion: Additional Estimates*, to produce further estimates for the benefits of competition that each option may provide.

- The ITF/SEO also reviewed the responses that commented on the impact of higher aerocharges on passenger demand and ticket prices, *Scarcity Rents and Airport Charges*.
- Another report from the ITF/SEO explored the various options to safeguard or stimulate long-haul or regional connectivity put forward in consultation: *On the mechanisms that can potentially influence connectivity outcomes in the UK*. This work built on the analysis of long-haul route networks in *Discussion Paper 4: Airport Operational Models* and the analysis of domestic connectivity in *Discussion Paper 6: Utilisation of the UK's Existing Airport Capacity*.

Approach

2.7 The main elements of the Strategic Case assessment are detailed in the table below.

Table 2.1: Strategic Case Approach

Objective	Questions to answer	Challenge to be addressed	How and where have we addressed it?
To provide additional capacity that facilitates connectivity in line with the assessment of need	Q1: Does the option provide that additional capacity? What kind of connectivity may the option provide?	Demand for aviation is inherently uncertain so it is important to understand the range of outcomes	Part 1: A set of global aviation scenarios testing a range of potential connectivity outcomes

Objective	Questions to answer	Challenge to be addressed	How and where have we addressed it?
To improve the experience of passengers and other users of aviation	Q2: What kind of experience may the option offer to passengers and what kind of opportunities may it create for the freight sector?	Apart from number of destinations available to the passenger and the freight sector, frequencies of services and fare levels, other aspects of passenger experience and the needs of the freight sector are important considerations	Part 1: A review of how the infrastructure available and other characteristics of each of the options may impact passenger experience and the needs of the freight sector
To maximise the benefits of competition to aviation users and the broader economy	Q3: What kind of benefits of competition to aviation users and the broader economy may the option provide?	Providing extra capacity does not guarantee that it will be taken up by airlines and there are different potential scenarios of airline response	Part 1: A set of likely airline responses for each capacity expansion option and an assessment of impacts on connectivity and competition these responses could generate S-CGE modelling to assess the impacts of airport expansion on the economy
To maximise benefits in line with relevant long-term strategies for economic and spatial development	Q4: How may the option fit with relevant long-term strategies?	Providing extra capacity may interfere with previously established plans for affected areas or, conversely, it may foster some goals set by these plans. In order to produce a recommendation, the Commission needs to have the full picture	Part 2: A qualitative assessments of the options against the relevant long-term strategies for economic and spatial development

Outcomes

Fit with the Commission's Assessment of Need; Strengths and Weaknesses

Q1: Does the option provide additional capacity that facilitates connectivity in line with the assessment of need? What kind of connectivity may the option provide?

- 2.8** All three schemes fulfil the Commission's assessment of need set out in the *Interim Report* i.e. by 2030 they will all provide additional capacity equivalent to one net additional runway. This chapter sets out how the additional capacity provided by Heathrow Airport Northwest Runway (LHR NWR) would facilitate the potential future connectivity outcomes for UK aviation – at the expanded airport, in the London airport system and UK-wide airport network.
- 2.9** Heathrow Airport is currently operating at very close to its maximum capacity, accommodating more than 470,000 air traffic movements (ATMs) in seven of the last ten years. This is more than 98% of its current planning condition limit of 480,000 ATMs, and its practical operational capacity in segregated mode operation, and leaves no scope for any further increases. The airport's terminal capacity has more scope to grow passenger numbers, through larger planes and higher load factors, and it has seen continuing growth in passenger numbers over recent years to reach 73.4 million in 2014. Heathrow Airport has sufficient terminal capacity to accommodate a maximum of 95 million passengers, and the Commission's forecasts show that without runway expansion across the full range of scenarios, both carbon-traded and carbon-capped, the terminal capacity is predicted to be reached by 2050 or earlier.
- 2.10** As passenger numbers grow, Heathrow Airport is forecast to see a continuing decline in the number of domestic and European services. These services will be replaced by the airlines with long-haul routes that potentially generate more revenue per service. In the absence of constraints, hub carriers would not have to make such a radical trade-off, they would be more likely to expand the short-haul and long-haul networks alongside each other as the former supports the latter.
- 2.11** With no scope for growth in ATM numbers, increasing passenger demand at the airport is likely to lead to increasing concentration of services on the most popular routes, with overall destination numbers at the airport declining markedly from roughly 180 currently to 138-158 in 2050. The number of routes seeing at least a daily service would also decline, from around 140 currently to 114-126 across the Commission's forecast scenarios, although this indicates there would be significant

increases in frequency on the thickest and most profitable routes. This pattern is seen at Heathrow Airport across the full range of the Commission's scenarios, including both carbon-traded and carbon-capped forecasts.

- 2.12** The number of international transfer passengers at the airport is also forecast to decline. These passengers generally have a wide range of options available for their journey and are highly price sensitive. Therefore, a combination of increasing costs and a reduction in transfer opportunities due to the declining route network, will make Heathrow a less attractive option for those passengers.
- 2.13** The high level of runway utilisation at the airport leaves almost no scope in the timetable to recover from any unforeseen incident. Heathrow Airport Ltd. (HAL) has put in place a number of measures to increase its resilience, including agreeing mechanisms to reduce flight numbers in periods of adverse weather, and has also trialled a range of other measures such as 'Operational Freedoms' to allow more flexible use of its runways, although these have proved controversial and have not currently been implemented beyond the trial phase. Despite these measures, Heathrow Airport suffers high levels of disruption compared to most other UK and European airports. The Commission made a number of recommendations in its *Interim Report* which might provide some mitigation, but with continuing high runway utilisation, there is no real prospect of resilience being significantly improved.
- 2.14** The capacity and connectivity outcomes of expansion at Heathrow Airport (as would be the case for any of the short-listed schemes) vary depending on the approach taken to managing carbon emissions. Therefore, this analysis treats the carbon-traded and carbon-capped scenarios separately.

Carbon-traded

- 2.15** Under any of the Commission's carbon-traded scenarios, an expanded Heathrow Airport would see higher passenger numbers than any current airport, and similar numbers to the largest airports in planning or under construction today. In 2013, Atlanta's Hartsfield-Jackson Airport carried 94 million passengers, more than any other in the world. The proposed new Northwest Runway would increase ATM capacity from 480,000 currently to 740,000, enabling passenger numbers to reach 133-149 million passengers by 2050, across the Commission's five scenarios.
- 2.16** This compares to plans for Istanbul's new airport⁷, which is being designed to accommodate up to 150 million passengers.

7

<http://centreforaviation.com/analysis/massive-capacity-expansion-is-planned-for-istanbul-airports-withcompeting-private-interests-172557>

- 2.17** High levels of unmet demand for travel at Heathrow Airport would see traffic movements increase rapidly once a third runway came into operation. By 2040, the airport is forecast to be operating at its capacity of 740,000 ATMs across all scenarios except *global fragmentation*, in which it would still see some 716,000 ATMs (still in excess of 95% utilisation). In some scenarios, the airport would reach capacity sooner, including, at the upper end, the *low-cost is king* scenario, in which high global growth rates and an increasing low-cost presence at the airport would see capacity fully utilised by 2030, although this would be dependent on the airport being able to offer an attractive business model for low-cost carriers.
- 2.18** Increasing demand at the expanded airport could see a rise in the number of destinations served. As runway capacity is reached, however, a similar pattern may be seen as in recent years, with the airport increasingly focusing on more popular routes, and destinations declining in the period to 2050 as a result. In most scenarios, the corollary to this is continuing growth in overall destinations at the London level, as demand spills over from Heathrow Airport to other airports.
- 2.19** The passenger forecasts prepared by HAL show passenger numbers rise more slowly than in the majority of the Commission's forecasts, particularly in the early period after a new runway opens. This reflects HAL's view as to the pace at which the aviation industry will be able to respond to the availability of new capacity. By 2040, HAL's forecasts are closer to those prepared by the Commission, although passenger demand does not achieve the levels predicted in the *global growth* or *low-cost is king* scenarios. HAL forecast that the 740,000 ATM limit at an expanded airport would be reached in or around 2040.
- 2.20** Passenger numbers and destinations at Heathrow Airport under a Heathrow Airport Northwest Runway scheme across the Commission's five forecast scenarios are summarised in the table below.

Table 2.2: Heathrow Airport Northwest Runway scheme, terminal passengers and destinations, Airport Commission's carbon-traded forecasts

Scenario	Passengers per annum (m)				Destinations (above do minimum)			
	2011	2030	2040	2050	2011	2030	2040	2050
Assessment of need	70	116	134	138	179	196 (35)	201 (41)	189 (36)
Global growth		125	138	148		200 (39)	196 (46)	183 (37)
Relative decline of Europe		119	129	136		222 (59)	223 (60)	220 (67)
Low-cost is king		129	138	149		230 (69)	229 (79)	216 (78)
Global fragmentation		104	121	133		186 (20)	200 (42)	201 (43)
Heathrow Airport Ltd forecasts		104	130	135				

Source: Airports Commission analysis

2.21 The largest increases in passenger numbers are seen in the *global growth* and *low-cost is king* scenarios, but the effects on the airport's route network differ markedly. In the former, in which strong global economic growth drives increasing demand but industry structures remain broadly as now, growth at Heathrow Airport is concentrated on strengthening the most popular routes and the airport sees an increasing focus on long-haul destinations, which significantly outnumber short-haul at the airport by 2050. Although the number of destinations is only slightly higher in 2050 than in 2014, it should be noted that this is still some 30 destinations more than in the baseline, so without expansion the airport's route network is forecast to shrink significantly.

2.22 In the latter, in which Heathrow Airport sees the establishment of a substantial low-cost presence, Heathrow Airport develops a more diversified route network by 2050, with slightly fewer long-haul destinations but significantly more short-haul routes. Across the London airport system, however, the number of long-haul routes is very similar in each scenario, as low-cost and point-to-point carriers, which are less reliant on transfer traffic, are also able to establish long-haul routes at other airports.

- 2.23** The other scenario in which Heathrow Airport's route network becomes more focused on short-haul routes is the *relative decline of Europe* scenario. In this scenario, there is a significant reduction in the share of international transfer passengers in total passenger numbers as Heathrow Airport's role as a hub diminishes. The result is that the long-haul route network stays broadly static, though with some thickening of routes, but continuing high demand and increased capacity enable a large number of new short-haul routes to be established. In contrast, in the *assessment of need* and *global fragmentation* scenarios, there is some rebalancing towards long-haul, as capacity is used up and price-sensitive short-haul passengers move to other airports, but this is more limited in scale. In both scenarios, the majority of routes are long-haul by 2050.
- 2.24** Without specific measures to incentivise the establishment of new services, the number of domestic destinations served by London airports is not forecast to change significantly compared to the baseline. However, it would facilitate slightly higher overall numbers of domestic passengers to London, and a substantial increase (in excess of 100% in most scenarios) in domestic passengers at Heathrow Airport by 2050.
- 2.25** At the national level, an additional runway at Heathrow Airport would facilitate growth in overall capacity and in the scale of the overall UK route network, with 22-51 million more seats and 67-192 billion more seat-kilometres across scenarios in 2050 compared to the baseline. This would include noticeable increases in capacity to emerging markets⁸ (6-9 million seats) in all scenarios except *relative decline of Europe* where London's declining role as a hub would see noticeably smaller growth in capacity (2 million seats) on these routes. The most significant increases compared to the baseline are seen in the *global growth* and the *low-cost is king* scenarios, both of which see strong global economic growth. The smallest differences are found in the *relative decline of Europe* scenario as the UK network is less dependent on transfer passengers.
- 2.26** All the carbon-traded expansion scenarios entail increases in carbon emissions from aviation above 37.5 MtCO₂ (the Committee on Climate Change's planning assumption for the maximum level consistent with the UK meeting its overall emissions reduction commitments in 2050). This is set out in the table below.

8 Destinations defined as 'newly industrialised countries' or 'less developed countries' in the Commission's forecasting model.

Table 2.3: Heathrow Airport Northwest Runway scheme, Airports Commission's carbon-traded forecasts of UK aviation emissions in 2050 (MtCO₂)

CCC Advice	Assessment of Need	Global Growth	Relative Decline of Europe	Low-cost is King	Global Fragmentation
37.5	43.3	51.5	43.8	51.2	40.8

Source: Airports Commission analysis

2.27 The highest levels of emissions are associated with the *low-cost is king* and *global growth* scenarios, which would see UK aviation emissions in 2050 in excess of 37.5 MtCO₂. If these emissions were not accounted for as part of a liberal global carbon market (as envisaged in this forecasting approach) and needed to be accommodated within any UK specific target this would see aviation emissions account for a larger share of the total and require commensurate reductions elsewhere in the economy.

Carbon-capped

2.28 In the Commission's carbon-capped forecasts, emissions from aviation are constrained to approximately 37.5 MtCO₂ in 2050. This means that levels of growth in aviation are reduced in both the baseline and expansion forecasts. Nonetheless, even with carbon emissions constrained, an expanded Heathrow Airport would still see significant growth in passenger numbers, with ATM capacity reached by 2050 across all scenarios, albeit more slowly than in the carbon-traded forecasts. Under any scenario, an expanded Heathrow Airport would be significantly larger in passenger numbers than any current UK airport.

2.29 As with the carbon-traded scenarios, increasing passenger numbers at Heathrow Airport would drive an increase in destinations served from the airport. The most significant growth in destinations over current levels would be seen in the *relative decline of Europe* and *low-cost is king* scenarios, due in both cases to a substantial diversification of the airport's short-haul route network.

2.30 The table below shows numbers of passengers and destinations at Heathrow Airport with a third runway in place across all five forecast scenarios.

Table 2.4: Heathrow Airport Northwest Runway scheme, terminal passengers and destinations, Airports Commission carbon-capped forecasts

Scenario	Passengers per annum (m)				Destinations (above do minimum)			
	2011	2030	2040	2050	2011	2030	2040	2050
Assessment of need	70	109	128	135	179	192 (31)	203 (45)	198 (47)
Global growth		109	130	139		195 (32)	202 (47)	199 (51)
Relative decline of Europe		111	126	132		220 (55)	227 (68)	248 (94)
Low-cost is king		115	131	138		217 (54)	230 (75)	226 (80)
Global fragmentation		110	128	134		193 (29)	202 (43)	199 (43)

Source: Airports Commission analysis

- 2.31** Across all but one scenario the number of destinations served from Heathrow Airport is higher in the carbon-capped than in the carbon-traded scenarios. This reflects the fact that the lower levels of demand at Heathrow Airport in these scenarios do not drive the same level of concentration on the thickest routes.
- 2.32** Lower demand growth overall due to the cap on emissions also means that there is less growth at other airports in these forecasts. As a result, the overall number of destinations in the London system as a whole is lower than in the carbon-traded scenarios. There is also limited change in numbers of destinations in comparison to the baseline, although overall ATM numbers are higher, indicating a greater average frequency of service.
- 2.33** An important point in respect of the carbon-capped forecasts for a Northwest runway at Heathrow is that the airport sees significantly higher numbers of international transfer passengers than in the baseline (although lower than in the carbon-traded forecasts). This has two effects:
- As many of these passengers transfer from, to or between long-haul services at Heathrow Airport, in most scenarios it supports an overall increase in long-haul connectivity, with national long-haul capacity 3-10 million seats higher in 2050 than in the baseline and long-haul seat-kilometres 23-70 billion higher. This

increase in long-haul connectivity, however, has to be offset by a reduction in short-haul connectivity to keep aviation emissions within 37.5 MtCO₂.

- Scope for growth of passenger numbers travelling to and from, or within, the UK is reduced in order to accommodate the increased numbers of international transfer passengers. This reduction is particularly focused on the leisure market. This is because the passengers who are less price sensitive, for example international business passengers, continue to fly while more price sensitive passengers, such as UK leisure travellers, leave Heathrow or stop flying altogether as carbon cost increase to meet the planning assumption.

2.34 The exception to these patterns is the *relative decline of Europe* scenario, in which growth in international transfer passengers is lower, resulting in a much smaller rebalancing towards long-haul and business travel. In addition, notwithstanding any potential changes in the balance between long-haul and short-haul connectivity, very limited overall change in network size is seen in any scenario by 2050, as carbon emissions are closely correlated with seat-kilometres.

2.35 As with the carbon-traded scenarios, the number of domestic destinations served by London does not change much in these forecasts. The number of domestic passengers into the London airport system would remain broadly static or decline slightly in comparison to the baseline (to offset the rebalancing towards long-haul described above), but domestic passenger numbers to Heathrow Airport would at least double in 2050 compared to the baseline in all scenarios except *low-cost is king*. In this case, a more limited increase is seen due to higher numbers of domestic passengers in the baseline. Some options for how regional connectivity could be enhanced are discussed further in the *Final Report*.

2.36 These carbon-capped forecasts are based on a policy of managing emissions through carbon prices. Since the consultation, the Commission has developed forecasts with the Committee on Climate Change (CCC) to produce do minimum and development option forecasts under alternative policy assumptions, and these are set out in *Strategic Fit: Updated Forecasts*. All of the carbon-capped scenarios keep carbon emissions from aviation below 37.5 MtCO₂ in 2050, consistent with the CCC's advice.

2.37 The Commission received a number of responses relating to its assessment of the future demand for aviation. In GAL's response to the consultation, it was suggested that the Commission should complete two sensitivity tests with respect to demand forecasts. The first was to test the impact of using the *low-cost is king* aviation market specific assumptions, in the *assessment of need* scenario, such as

'seeding' (adding) traffic in the Gatwick Airport Second Runway scheme. The rationale was to remove the element of the scenario that is due to more favourable economic conditions such as higher global gross domestic product (GDP) and isolate the impact of the assumptions representing the broadening of the low-cost model. As part of this sensitivity, the direct impacts on air transport users and providers have also been tested in order to better understand how the resulting forecasts feed through to the economic appraisal. The second was to test the impact of removing the calibration factors from the demand forecasts, which are used to ensure the forecasts align closely with actual data.

2.38 These tests have been carried out for the carbon-traded, *assessment of need* scenario, and detailed results have been added to the *Strategic Fit: Updated Forecasts* report. For the first test, the result is that, as in the low-cost is king scenario published for consultation, Gatwick Airport Second Runway scheme has the highest direct economic benefits of the options, even with the macroeconomic elements stripped out. Therefore, it can be concluded that this is driven by the market-specific interventions, such as seeding at Gatwick. The second test shows that removing the calibration factors does not result in a satisfactory base from which to forecast. The resulting forecasts differ more widely from observed data, and this difference is projected into the future.

2.39 GAL also raised concerns in its consultation response regarding the plausibility of the Commission's forecast outputs. In particular, it argued that the results from the forecasting model did not appropriately reflect the level of growth seen at Gatwick relative to other London airports over the past decade. An independent review was undertaken by the OECD, the results of which are provided in its report, *Review of the Airports Commission Strategic Fit Forecasts and Scenarios*. On the basis of this, the Commission believes that the outputs of its forecasts are plausible in the light of recent performance in the London airports system.

2.40 In addition to this, the Commission has undertaken further work to quality assure the demand forecasts since November 2014. A third sensitivity has been carried out, to test impact of using the most up to date input data in the forecasts, such as new oil prices and GDP forecasts. This shows that the most recent input assumptions cause a small increase in underlying passenger demand of just under 1% in 2050, therefore further supporting the demand case for change. The Commission's Expert Advisory Panel Member has also scrutinised the demand forecasts against those provided by GAL and provided the Commission with a strong recommendation that the evidence submitted by GAL should not be used for decision making purposes. Finally, the Commission's further quality assurance

processes have also resulted in corrections being made to the *relative decline of Europe* and *low-cost is king* demand forecasts in the Gatwick Airport Second Runway scheme. The revised forecasts are contained in *Strategic Fit: Updated Forecasts*.

Q2: What kind of experience may the option offer to passengers and what kind of opportunities does it create for the freight sector?

Passengers

- 2.41** There have been a number of recent infrastructure improvements at Heathrow Airport. In 2008 the new Terminal 5 (T5) opened to the west of the airport, providing significant additional terminal capacity to the benefit of passengers. More recently, a new Terminal 2 (T2), the Queen's Terminal, opened in June 2014. Future proposed infrastructure developments include the demolition of Terminal 1 and eventual closure of Terminal 4 and the shift to 'two front doors' to the West (T5) and East (T2) of the airport, with multiple 'toast-rack' terminal satellites making for a more efficient terminal layout. In terms of terminal space, Heathrow Airport has a relatively high Space Planning Factor⁹ (SPF) of 44m²/Demand Hour Passenger (DHP), higher than other comparable large European hubs. This provides for sufficient room to accommodate the current passenger numbers. Some respondents to the consultation noted that the SPF does not give a complete picture of how much space a terminal provides, due to different sizes of amenities and areas for processing passengers in different terminals. However, detailed designs of new terminals have not been presented to the Commission and the Commission has not changed its view that Space Planning Factor is a useful indication of the passenger experience inside the terminal. Heathrow Airport's terminals also provide passengers with a relatively large number of different leisure outlets for dining and shopping.
- 2.42** The airport contains a number of rail stations reflecting the distributed locations of its terminals and its accessibility via the Great Western Mainline (GWML) and the Piccadilly line. Premium express services (Heathrow Express) and cheaper stopping services (Heathrow Connect) both operate from Paddington and are complemented by the London Underground, providing passengers with the ability to make trade-offs between fare, journey time and comfort. Despite its proximity to the GWML, passengers coming to Heathrow Airport from the west of England must either change at Paddington or Hayes and Harlington, and those from the north,

⁹ The gross terminal floor area per design hour passenger, a standardised measure of the typical space available to passengers in a given airport.

south or east of London must change in central London to access the airport via rail. By road, the airport is situated to the south and east of the M4 and M25 and is well-connected to London being approximately 15 miles from Charing Cross, however the M25 between J13 and J15 carries over 100,000 vehicles daily and is subject to slow average speeds in peak hours. Additional road widening and other changes could reduce congestion on some key routes. Capitalising on its location close to a number of major motorways, Heathrow Airport also features the UK's busiest coach station providing extensive national coach coverage, and it is also served by a number of bus services operated as part of the Transport for London bus network.

- 2.43** Recent Civil Aviation Authority (CAA) survey results estimated that 87% of passengers at Heathrow were positive about their airport experience¹⁰. As noted in HAL's proposal, Heathrow Airport is currently rated by passengers within the top 10 airports in the world, and Terminal 5 has been voted 'Best Airport Terminal' for four years in a row¹¹.
- 2.44** In terms of Air Traffic Movements, Heathrow Airport is already running at near 98% capacity at peak times. Without expansion, the airport would be reliant on terminal and infrastructure efficiencies to maintain its high passenger experience rating and SPF. Under the Commission's five demand scenarios, without expansion, there is a forecast growth of passengers from 72.3 million in 2013 to 83-87 million in 2030¹². The current terminals have capacity for 90 million passengers per annum, which will thus be constrained by 2030, although there are long-term investment plans in place to increase this to provide sufficient capacity to support up to 95 million passengers.
- 2.45** There are a number of planned surface access infrastructure improvements from which Heathrow Airport passengers will benefit by 2030. The refurbished Piccadilly line, whilst potentially overcrowded during peak times in central sections, will provide more spacious, air-cooled trains at a higher frequency than present. Combined with Crossrail, there will be improved surface access from central London at relatively lower cost to the passenger. Crossrail will link the airport directly to stations in central and east London, including the City (Farringdon) and Canary Wharf with a frequent stopping service. Western rail access will potentially significantly cut journey times from the west removing, for some, the need to change at Paddington or Hayes & Harlington, and High Speed 2 will improve

10 CAA (2013) CAA Passenger Research: Satisfaction with the Airport Experience: Heathrow, Gatwick and Stansted.

11 Skytrax World Airport Awards <http://www.worldairportawards.com/>

12 These forecasts are under carbon-capped and carbon-traded scenarios respectively.

connectivity to the north and midlands via an Old Oak Common interchange with Crossrail and Heathrow Express services to the airport.

- 2.46** There will, therefore, be a range of surface access modes with varying levels of speed, cost and comfort available to passengers travelling to the airport. These improvements are planned for delivery regardless of airport expansion but will still have a beneficial effect on passenger experience on the construction of a third runway. Beyond the baseline, Southern Rail Access from Waterloo via Clapham Junction and Staines would provide an additional corridor for passengers, increasing resilience and improving access for those south of the airport.
- 2.47** With or without expansion, the promoter would continue to progress its plans for the 'toast rack' rationalisation and 'two front door' policy, which are expected to reduce taxiing times and provide for easier access to terminals than the current layout. Should runway expansion occur, the promoter specifies the construction of a new Terminal 6, similar in its design to T2 and T5, with additional T2 satellites. Alongside this, a substantial underground Tracked Transit System (TTS) is also proposed which will reduce inter-terminal transfer speeds and automate luggage transfers to the benefit of transfer passengers. With the new terminals and their satellites are complete the airport will continue to provide a relatively high SPF of 45m²/DHP after expansion, slightly higher than its current 44m²/DHP, and offering a spacious experience for passengers.
- 2.48** Key passenger experience pinch points could include overcrowding on services such as the Piccadilly line and other lines at peak times. The size and distribution of the terminals will lead to some longer transfer times when connecting between different terminals, however given the current prevalence of terminals linked to airline alliances, this would impact the relatively limited number of self-connectors and passengers transferring across alliances more than those who transfer within a single alliance. Transfers from Terminal 4 would be slower as it would not be connected to the new TTS. The open design of terminals, as found at T2 and T5, whilst beneficial in providing space for additional leisure and dining units may lead to slower, less-efficient boarding processes than possible at 'closed gate' terminals.

The Freight Sector

- 2.49** Heathrow Airport currently plays a vital role in the UK's air freight market, handling 1.42 million metric tonnes of freight during 2013, placing it in the top 20 global airports in terms of freight tonnes. The majority of this freight is carried in the bellyhold of commercial passenger aircraft, although a small number of dedicated cargo aircraft movements (on average three per day) continue at the airport. Scarce slot capacity has led to a long-term decline in the overall dedicated freighter presence. Heathrow provides a similar scale of freight tonnes to Amsterdam Schiphol and Chicago's O'Hare Airports, but lower than Dubai (which processes over 2 million metric tonnes) and specialist freighter hubs such as Memphis¹³.
- 2.50** Expansion at Heathrow Airport is likely to be highly beneficial to the air freight sector, both in a carbon-capped and a carbon-traded world. The availability of more slot capacity provides both the potential for enhanced freight capacity on existing routes, as well as the creation of new routes, which would open opportunities for the cargo sector as well as passengers. Expansion would provide this, with 220-260k additional air transport movements a year and 39-43 more destinations served on a daily basis (including 9-10 more long-haul) than in the baseline in 2050 with emissions capped. Freight and logistics companies operating dedicated cargo aircraft may also choose to make use of spare capacity at the site to increase dedicated freighter operations, though it is likely that commercial factors relating to slot prices and aero charges would act as a constraint upon this.
- 2.51** With many freight handling and forwarding companies already having a presence on or near the Heathrow Airport site, the industry would be well placed to respond quickly to a growth in freight capacity there. Heathrow Airport's present surface access is well suited to supporting a major cargo operation, due to its direct access onto major arteries of the strategic roads network, though growing road congestion may present challenges over time.
- 2.52** To improve the freight infrastructure at the airport the scheme promoter has proposed the development of a new cargo consolidation centre with a potential connection to the rail network and a modest expansion and re-planning of the existing cargo area.

13 *The Air freight Industry in the UK*, report for the Airports Commission, December 2013

Q3: What kind of benefits of competition to aviation users and the broader economy may the option provide?

- 2.53** Expanding Heathrow would increase the airport's capacity to 740,000 ATMs per year and its peak-hour capacity from 88 to 128 ATMs per hour. On the one hand, such an increase in capacity could enable the hub carrier to improve its currently constrained ability to run hub operations. On the other, it could also enable other carriers, both legacy and low-cost, to enter the high yield Heathrow Airport market. The future airline response to the capacity increase and, in turn, connectivity offered by the airport depends on the development of global trends that are captured under the Commission's five scenarios that are set out in the introduction to this document.
- 2.54** Based on the analysis of the London airport system and key drivers of airline behaviour conducted on behalf of the Commission by ITF/SEO¹⁴, the Commission has identified three different feasible airline responses to expansion of Heathrow Airport. These responses would be possible under a carbon-capped or traded scenario, and approximately as likely in either.
- Airline response 1: Hub carrier growth at Heathrow Airport, point-to-point growth at Gatwick
- 2.55** The most likely airline response across all scenarios is for the current hub carrier to expand its operations at Heathrow Airport. The additional capacity would enable the hub airline and its partners to grow capacity at Heathrow Airport, potentially expanding the route network, both in terms of higher frequencies of service and new routes. Other carriers, in particular network carriers from the Middle East and South East Asia with hub airports at home, could also increase their presence at Heathrow Airport, taking advantage of available high yield slots. In this airline response low-cost carriers would remain focused at Gatwick Airport and the other London airports.
- Airline response 2: Two hub operations at Heathrow Airport, point-to-point growth at Gatwick Airport
- 2.56** A much less likely response would be for a competing network carrier to develop a hub operation at Heathrow Airport alongside the current hub carrier and its partners, benefiting from the strength of the London origin and destination (OD) market. This response would only materialise under those scenarios that are relatively optimistic for the global route networks (*assessment of need, global*

14 Strategic Fit: Expanding Airport Capacity, Strategic Fit: Impacts of Expanding Airport Capacity, Strategic Fit: Airline Responses to Airport Capacity Expansion

growth). Even then the move into Heathrow Airport could potentially be too risky a strategy for the new hub carrier due to a presumably fierce response from the incumbent coupled with rising airline charges as well as comparatively lower yields at Heathrow Airport due to a reduction of excess demand resulting from expansion. In comparison to response 1, the two smaller hubs would most likely generate a route network smaller in size, but the benefits in terms of potentially lower fare levels could be larger due to enhanced competition between the two hub carriers. Gatwick Airport, in this scenario, remains a predominantly point-to-point airport with an extensive short-haul route network complemented with services to the thickest long-haul leisure destinations.

- Airline response 3: Point-to-point growth at Heathrow and Gatwick Airports, Heathrow Airport remains the network hub

2.57 In this scenario low-cost carriers continue to grow, consolidating their position in the saturated European short-haul market but also successfully entering the long-haul market for aviation, while the role of network carriers diminishes (*low-cost is king* and, to some extent, *relative decline of Europe*). The most likely airline response would see a low-cost carrier entering Heathrow Airport to serve premium short-haul traffic. In doing so, the carrier would either focus on serving the most lucrative short-haul connections or explore the possibility of changing its business model to serve those legacy carriers that currently do not have hub operations at Heathrow Airport with its network of short-haul feeder traffic. While this would most likely result in a smaller long-haul route network than in airline response 1, the short-haul connectivity and domestic connectivity between regional airports and London could be enhanced. Also, fare levels at Heathrow Airport would potentially incur a bigger drop than in the case in which one hub carrier dominated capacity at Heathrow Airport.

2.58 Some of the responses to the consultation pointed out that the airline responses considered by the Commission were focused on extreme cases, while in reality a combination of these responses would materialise. The reason for having such extreme cases was to test the realms of possibility of how the route network may develop and whether and what kind of competition benefits it may deliver. Some other responses criticised the airline responses and proposed alternative ways in which airlines may react to capacity expansion. The Commission considered these points in detail and made adjustments to assumptions in the airline response modelling to accommodate the criticisms, but were found in most cases to make only a small difference to outcomes. Scepticism towards the viability of a potential second hub operation for a network carrier in an expanded London airport system

in a number of submissions was largely supported by the analysis presented in the *Business Case*. A number of submissions questioned assumptions over the viability of low-cost carrier operations, of different sorts, under several of the modelled airline responses. It was suggested by some responses that low-cost carriers (LCCs) should be ruled out of operation at Heathrow Airport. Other responses suggested that a much larger LCC operation should be modelled at the airport. Making adjustments to model assumptions to accommodate the criticisms would not have made a fundamental difference to outcomes.

- 2.59** The different airline responses will have varying impacts on connectivity, competition and reduction of airline rents to users of aviation. That applies particularly to the long-haul market where network carriers have a greater scope to deliver extensive route networks through hub connectivity. These are currently predominantly served from Heathrow Airport and to a limited extent from Gatwick Airport, as opposed to the short-haul routes, both domestic and to Europe, which can theoretically be served by different airline business models and which are already well served from all London airports and from regional airports throughout the UK.
- 2.60** The Heathrow Airport Northwest Runway scheme's strength lies in its ability to provide a large route network of both short-haul and long-haul connections in terms of number of destinations offered and frequencies of service. The scheme's connectivity benefits are likely to be largest if Heathrow Airport's capacity is taken up by the hub carrier and its partners as that would allow for a significant expansion of the route network. This airline response is most likely in the *global growth* and *assessment of need* scenarios.
- 2.61** On the other hand, the benefits of competition in case of the dominant hub carrier expanding are likely to be more limited. These could be larger when the hub carrier and its partners are exposed to competition, either from another hub carrier that would decide to establish a second hub at Heathrow Airport or from a new, low-cost entrant. There would most likely be a trade-off between these larger benefits of competition and potential connectivity impacts, particularly in the long-haul market. Reduction in excess demand at Heathrow could potentially contribute to lower fares at the airport.
- 2.62** Further analysis conducted by the ITF/SEO for the Commission has demonstrated that building the Northwest runway would have positive impacts on competition and that it would produce significant benefit of competition to the passengers, potentially offsetting the rise in aero charges that would be needed to finance the new airport infrastructure. These benefits of competition are much higher for the Heathrow schemes than the Gatwick Airport Second Runway scheme. At an

expanded Gatwick the benefits of competition would depend on whether the airport would be able successfully to attract long-haul carriers in the future which creates a risk around their realisation.

- 2.63** Also, a Northwest Runway at Heathrow Airport would lead to additional significant benefits from a reduction in delays compared with no expansion, of up to £1.0 billion over 60 years in Present Value terms in the *assessment of need* scenario in a carbon-traded world. In the *assessment of need* scenario in a carbon-capped world these benefits would have a Present Value of £1.9 billion over 60 years. The difference is due to the fact that in a carbon-capped world, there is a higher cost of flying for passengers and therefore less demand across the whole of the UK, airports fill up more slowly and delays build up at a slower rate compared to in a situation with no expansion
- 2.64** Airlines responded to the consultation in support of Heathrow, often making an argument that Gatwick faced a risk of being too expensive for its traditional low-cost base and not sufficiently attractive for airlines to compete with Heathrow and other European hubs for long-haul connectivity. Another point raised by the airlines was that the cost of the Heathrow Airport Northwest Runway scheme would be too high by international comparisons and that it would make aero charges very expensive, hence reducing the potential of increasing the UK's route network as marginal routes would not survive.
- 2.65** Airline perspectives on aero charge changes were considered in the ITF report *Expanding Airport Capacity: Competition and Connectivity*, published as part of the consultation. This work argued that changes to aero charges would initially be absorbed by airlines through a reduction in rents, and then that the competitive market between airlines would limit airlines' capacity to pass aerocharge changes on to passengers. A key finding from the work was therefore that aero charge increases would not necessarily feed through to passenger fares, and therefore would have limited impact on passenger demand. Further to reviewing consultation responses the Commission's view of this issue remains unchanged.
- 2.66** Some airlines encouraged the Commission to look into how to optimise the take up of slots to maximise benefits to the consumer, but no single clear theme emerged. Some respondents stressed the importance of fostering the connection benefits of hubbing and releasing slots gradually, others stressed the importance of awarding slots in a way that minimises anti-competitive outcomes, and some stressed the importance of early morning and late evening slots to preserve long-haul connectivity. These points were considered by the Commission, but its conclusion was that it was not necessary or appropriate to reach a view on the approach to

releasing slots at this stage in the project's development. The Commission's recommendations in relation to early morning (pre-06:00) slots are set out in the *Final Report*.

- 2.67** The Commission had received many responses highlighting to the Commission that in the future regional connectivity (i.e. connectivity between London and other UK cities) may not be adequately provided due to constraints at the busiest London airports. The Commission carefully considered these arguments and consulted Airport Coordination Limited (ACL), its legal advisors and the OECD on the subject. A report was commissioned from the OECD to explore different ways in which long-haul or, particularly, regional connectivity could be safeguarded. The Commission concluded that there is no viable legal basis – other than Public Service Obligations (PSO) discussed below – upon which slots could be ring-fenced to protect or limit the operation of particular airlines or aircraft to an expanded airport. Further to considering this analysis the Commission recommended that Government allows the establishment of PSOs between individual airports, and reviews its guidance in relation to these provisions. The Commission also noted that structuring aero charges in order to benefit regional services could be an effective measure. This is discussed in the *Final Report*. Other measures, such as the use of Local Rules and the ring-fencing of slots through planning provisions, were not considered sufficiently credible, implementable or effective.

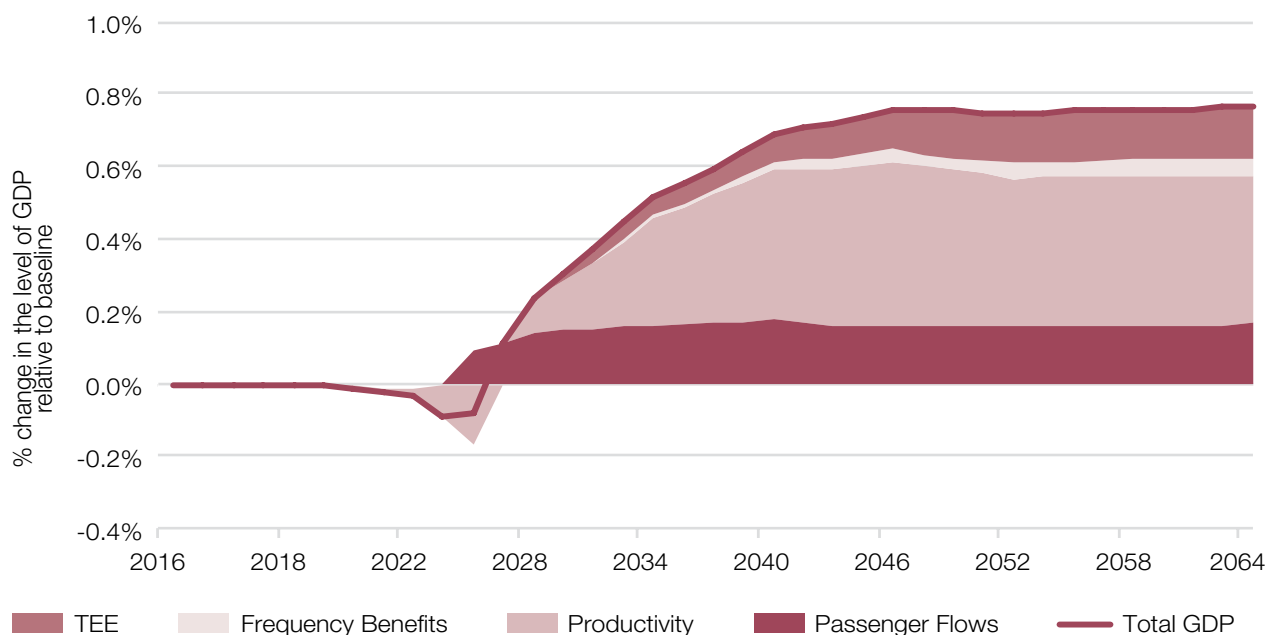
Overall GDP Impacts

- 2.68** Given the scale of capacity that would be delivered under a Heathrow Airport Northwest Runway scheme, a significant positive impact on the UK's economy can be expected via increased consumption, productivity and investment. The Commission has worked with PwC to model the interactions between firms (domestic and international), households and Government using a Spatial Computable General Equilibrium (S-CGE) model to describe the mechanism by which these impact affect the economy and what their possible scale may be¹⁵. This information was initially presented at consultation as part of the Economic Case, but given the national macro-economic focus of the S-CGE the Commission has determined it relates better to the objectives and considerations of the Strategic Case.
- 2.69** This modelling is distinctly different to that presented in the Economic Case. It considers the possible scale of GDP impacts of the Heathrow Airport Northwest Runway scheme and, as such, it is not a conventional economic welfare appraisal.

The S-CGE model developed for this phase of the Commission's work is a significant extension to the S-CGE model used to estimate the impacts in its *Interim Report*. The analysis of the potential economy-wide impacts of airport expansion was moved from the Economic Case to the Strategic Case in response to the comments received in the consultation.

- 2.70** The S-CGE analysis presented here estimates the impacts of second, third, fourth round effects on the economy (e.g., picking up increased prices and changing levels of investment the economy); which are not normally picked up by the conventional economic welfare analysis. The S-CGE approach dynamically models interlinkages between sectors in the economy, accounting for crowding out effects and diffusion, and assumes markets are imperfectly competitive (e.g. it assumes different levels of competitive pressure in different markets and industries). Therefore, these results should not be viewed as additional to those presented in the Economic Case, but as complementary, picking up on different impact mechanisms and based on different theoretical groundings.
- 2.71** The Commission's analysis in the context of S-CGE analysis was undertaken for a carbon-traded world, though a carbon-capped sensitivity test was undertaken following consultation. The transmission mechanisms are numerous and the results included here provide only a summary of the main impacts under the Heathrow Airport Northwest Runway scheme in the *assessment of need* scenario.
- 2.72** The results of the S-CGE modelling suggest that in a carbon-traded world Heathrow Airport Northwest Runway scheme will provide significant benefits to the macroeconomy via the following four channels, as shown in the GDP chart below:
- Productivity impacts associated with changes in the level of trade with other countries;
 - Changes in inbound and outbound traffic affecting spend in the UK and abroad;
 - Savings to the users of aviation filtering through the economy via changes in household/business spending and aviation industry revenues;
 - Improved Total Factor Productivity (TFP) from increased service frequencies.
- 2.73** These results exclude the economic impacts of construction, as it is reasonable to assume that if the construction had not taken place at the airport, other construction projects with a similar economic impact would take place elsewhere in the economy.

Figure 2.5: GDP Results in an *assessment of need* carbon traded scenario on the level of real GDP compared to the do minimum



Source: Airports Commission analysis

2.74 The overall present value of the macroeconomic effect amounts to £147 billion over the 60 year appraisal period. Each of the four channels contributing to the growth of the economy is discussed below.

Productivity impacts associated with changes in the level of trade with other countries

2.75 Productivity impacts are associated with differing levels of trade and how the changes in the level of trade affect productivity. The well-established “endogenous growth” literature concludes that the better businesses are connected to various markets, and in this case globally, the more they can benefit by importing and exporting and from access to more efficient factors of production, such as equipment and technology. Ultimately this will lead to a boost in productivity of the whole economy.

2.76 London Heathrow Airport is well placed to provide a wide choice of short-haul and long-haul connections. While the short-haul markets to Europe account for 50.5% of total UK trade they can be reached from many airports. Heathrow Airport is the only credible alternative providing a wide choice of long-haul services – the Commission’s forecasts suggest that with the additional Northwest Runway Heathrow Airport could offer 75 long-haul daily destinations in 2050 compared to 63 services without runway expansion. These long-haul destinations would have a particularly strong impact on productivity as the UK businesses are already well-integrated with their European neighbours.

- 2.77** Building a new Northwest Runway at Heathrow Airport is estimated to amount to a benefit of 0.44% increase in the level of GDP from this source in 2050 compared to the do minimum.

Changes in inbound and outbound traffic affecting spend in the UK and abroad

- 2.78** Passenger flows account for a sizeable proportion of the GDP impacts in the Heathrow Airport Northwest Runway scheme. This impact has two competing drivers affecting GDP, the first relating to the number of inbound passengers, adding to aggregate demand as they arrive in the UK, and outbound passengers, accounting for leakage of UK consumption into other economies. Outbound tourists have a larger impact (multiplier) as their behaviour affects the supply chain of products which are no longer consumed in the UK (so an increase leads to a negative impact on UK GDP), and inbound tourists have a smaller impact (multiplier) as their expenditure is mostly directed at the sectors with relatively lower productivity levels, such as accommodation and restaurants.
- 2.79** The passenger mix at Heathrow Airport in the International Passenger Survey 2013 was almost 50% inbound, making it one of the airports with the highest inbound-outbound ratio in the UK. This generates some significant passenger spending benefits, particularly when compared to the Gatwick Airport Second Runway scheme. For the purposes of this analysis we have kept this share constant over time for Heathrow Airport Northwest Runway scheme. We have also tested a lower London average inbound/outbound split (42.6% inbound) which is considered the lower-end benefit scenario, especially as the future trends see the inbound share of traffic growing and Heathrow Airport is particularly well-placed to accommodate that growth. The lower passenger inflows in this sensitivity lead to lower foreign expenditure in the UK, dropping from £33 billion to £20 billion over 60 years in Present Value (PV) terms. This however we would consider an underestimate of the stated benefits since we have no reason to believe the current split would change dramatically either way to what is experienced at Heathrow Airport today. The sensitivity test still produces significantly larger net GDP benefits for Heathrow Airport Northwest Runway scheme (£132 billion PV) when compared to the Gatwick Airport Second Runway scheme with the same sensitivity test applied (£119 billion) – sees benefits increase significantly given the current low share of inbound passengers. This would, however, be a very substantial change from Gatwick's current split of inbound and outbound passengers.
- 2.80** Tourism can also be considered a UK 'export'. The modelling suggests there are some such impacts, where the increase in spending is feeding through to the tourism industry hiring more workers into the sector. These are mostly entry level or

part-time jobs which are often taken up by the longer-term unemployed meaning there would be little expected redistribution from more productive sectors of the economy, though the absolute net effect was not modelled.

- 2.81** Building a third runway at Heathrow Airport is estimated to amount to a benefit of 0.16% increase in the level of GDP from this source in 2050, implying that the benefits are due to more inbound traffic

Savings to the users of aviation filtering through the economy via changes in household/ business spending and aviation industry revenues

- 2.82** These transport economic efficiency benefits are driven by both an increase in competition and the emergence of new services and more frequent existing services as new slots become released when new capacity comes on-stream. With the Heathrow Airport Northwest Runway scheme consumers in the UK would experience lower airfares and more connections than otherwise would have been the case. This makes a positive contribution to the economy as higher frequencies of services, greater accessibility of air links, and lower fares decrease input costs to businesses through provide leisure passengers with more disposable income. All of these effects benefit the economy by providing it with a higher level of investment.
- 2.83** The aviation industry could temporarily contract as a result of higher competition pushing down the fare levels and, as a result, airlines revenues. The results of the modelling do show that there are larger multiplier impacts on the economy as a result of the benefits to consumers outweighing those related to those in depressing the aviation sector. The aviation sector however grows rapidly due to size of the sector expanding as more passengers enter the system as a result of new capacity, providing strong positive benefits for the consumer and aviation sector.
- 2.84** Heathrow Airport is already substantially constrained, with a large queue of potential airlines wanting to use its runways already built up. In the Heathrow Airport Northwest Runway scheme there is a very sharp rise in transport economic efficiency benefits as capacity comes on stream, as pent up demand is satisfied. This equally releases capacity across the airport system as passengers are able to travel from their preferred airport and previously suppressed demand is introduced back into the system. The impact on transport economic efficiency is more pronounced and front loaded at Heathrow Airport when compared to expansion at Gatwick Airport.
- 2.85** Building the Heathrow Airport Northwest Runway scheme is estimated to amount to a benefit of 0.13% increase in the level of GDP from this source in 2050.

Improved Total Factor Productivity (TFP) from increased service frequencies

- 2.86** Frequency benefits also start to boost productivity as business passengers experience lower effective journey times as a result of new routes, more frequent flights at more convenient times and higher resilience of flight and airport operations. These benefits only feed through to business passengers as this is the only clear link with GDP.
- 2.87** Building the Heathrow Airport Northwest Runway scheme is estimated to amount to a benefit of 0.03% increase in the level of GDP in 2050 compared to the do minimum. This is in fact slightly lower than experienced in other schemes partly due to the speed with which the Heathrow Airport fills up and starts to encounter delays relating the capacity constraints but also due to the realisation of benefits at Heathrow Airport relating to the short-term measures implemented as a result of the Commission *Interim Report* recommendations.

Sector analysis

- 2.88** Outside of the drivers the S-CGE model also enable us to see how different sectors in the economy could be effected by expansion in the Heathrow Airport Northwest Runway scheme. Table 2.6 below summarises the impacts on each sector as a percentage change from the do minimum baseline for the *assessment of need* scenario in a carbon-capped world.

Table 2.6: Heathrow Airport Northwest Runway scheme breakdown of impact on the level of real GDP by sector, *assessment of need*, carbon traded scenario

	2020	2030	2040	2050	2060
Agriculture and mining	0.5%	0.7%	1.4%	1.5%	1.5%
Manufacturing	-0.1%	1.5%	2.1%	2.0%	1.9%
Utilities	0.5%	0.6%	1.3%	1.4%	1.3%
Construction	0.7%	0.8%	2.0%	2.2%	2.1%
Retail and wholesale trade	0.1%	-0.6%	-0.5%	-0.5%	-0.4%
Air passenger transport and freight	1.5%	8.3%	13.0%	15.4%	12.9%
Other freight	-0.2%	-1.1%	-1.2%	-1.4%	-1.2%
Other passenger transport	-0.4%	-0.6%	-1.1%	-1.6%	-1.2%
Accommodation and food services	0.1%	0.9%	1.3%	1.3%	1.3%
Other services	0.9%	-0.7%	0.1%	0.2%	0.3%
Health, education and public spending	0.2%	0.0%	-0.1%	-0.1%	-0.1%

Source: Airports Commission analysis

- 2.89** Unsurprisingly the air passenger transport and freight sector are expected to experience the highest levels of growth, 15% larger when compared to the do minimum in 2050. Likewise sectors with international linkages are also expected to benefit, with manufacturing, for example, estimated to be around 2% larger in 2050 compared to the do minimum and accommodation and food service around 1.3% larger. This is driven by the lower cost of transport making these sectors more competitive and therefore more productive as well as by the increase in the numbers of visitors to the UK.
- 2.90** The air freight industry will also help facilitate the GDP growth, by connecting UK businesses more efficiently and with suppliers in a greater variety of markets overseas. Analysis of a Heathrow Northwest Runway scheme suggests that the air passenger transport and freight sector's contribution to GDP could be 15.4% higher than the do minimum in 2050. Activity around Heathrow could increase as large and small freight operators build on the existing presence of freight-handling operations there, although other freight locations should also benefit through positive spillovers to the whole freight distribution network.
- 2.91** Growth expected in particular sectors of the economy may trigger slight contraction in other parts of the economy, in the sectors from which the resources, such as labour, would be drawn. This explains why some sectors, notably 'other freight' and 'other passenger transport' are expected to contract by a small amount.

Scenarios and carbon capped analysis

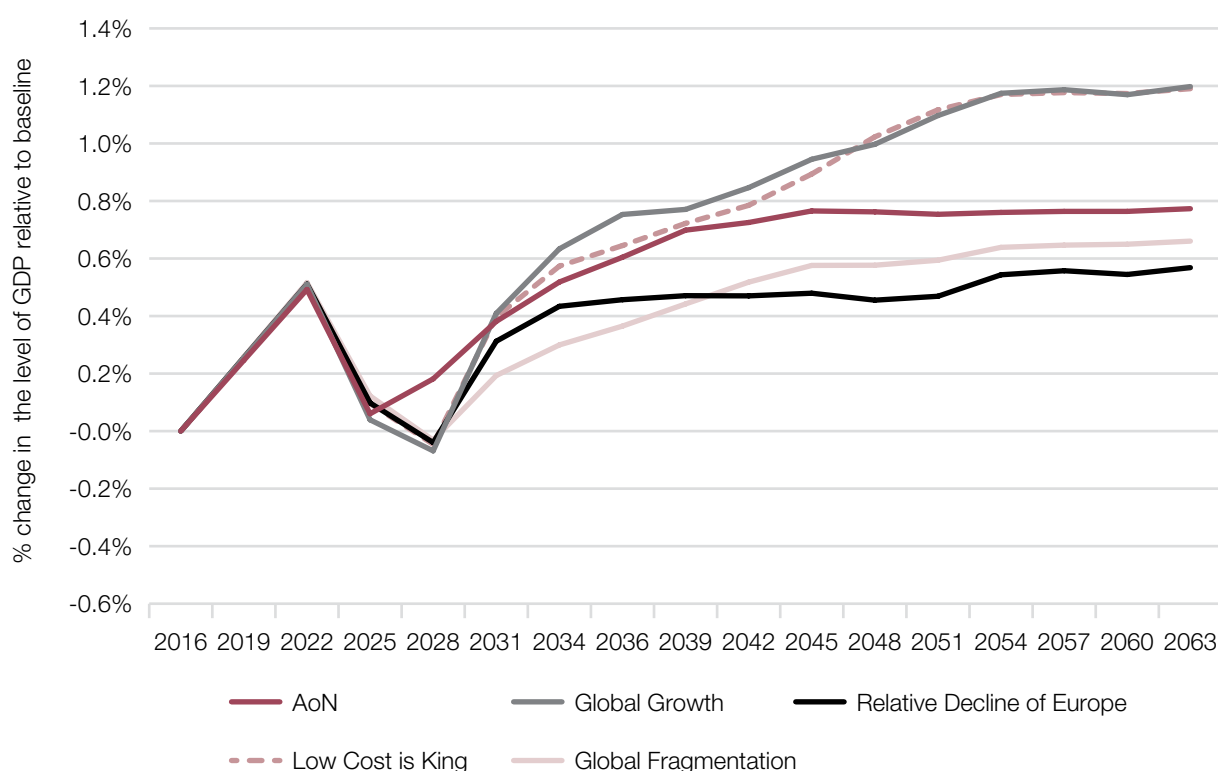
- 2.92** The relative pattern of results and how they transmit their way through the economy is broadly similar across the Commission's scenarios, although the timeframe and the scale of impacts differs due to different levels of aviation demand and its different composition predicted under each of the scenarios. The range of GDP impacts are estimated to generate a range from £118billion to £211billion PV in 2014 prices. In order to better understand how these impacts differ we have calculated a PV in 2014 prices for each scenario, which are presented in Table 2.7 and Figure 2.8.

Table 2.7: GDP impacts across all scenarios, Present Value (£ billion, 2014 prices)

	Total impacts (exc. construction)
Assessment of need	147
Global growth	211
Relative decline of Europe	112
Low-cost in king	210
Global fragmentation	118

Source: Airports Commission analysis

Figure 2.8: Overall GDP impacts for all scenarios¹⁶



Source: Airports Commission analysis

2.93 The Commission has also undertaken some further work since consultation to consider the GDP impacts of the scheme with carbon emissions from aviation constrained to the CCC's planning assumption of 37.5MtCO₂ in 2050. This is important in ensuring that the case for expansion is not dependent on emissions from aviation rising to a level which may not be compatible with the achievement of the UK's broader carbon targets. The carbon-capped approach to forecasting

16 Corresponding breakdowns can be found in the PwC report

described at the beginning of this Economic Case is designed to reflect the planning assumption and has been incorporated into the assessment of delays, noise, environmental and cost impacts for each of the shortlisted schemes.

2.94 The approach used in the S-CGE modelling sensitivity uses a set of forecasts in which underlying demand is reduced to a level at which overall UK aviation emissions with expansion would not exceed 37.5MtCO₂ (and hence lower emissions are seen in the do minimum forecast). Whilst conceptually this would be consistent with UK aviation being subject to some form of international trading scheme, no trading or purchase of offsets has been included to allow UK aviation emissions to rise above 37.5MtCO₂, the results of this approach are presented in table 2.9 below.

Table 2.9: Carbon-capped (demand reduction) sensitivity run impacts on GDP (2014 prices, present values)

Impact	LGW 2R	LHR ENR	LHR NWR
Passenger flows	-8.9	25.6	34.8
Productivity	34.3	57.4	70.3
Frequency benefits	1.6	6.0	6.9
TEE	16.6	13.7	16.8
Total	43.6	102.6	128.9

Source: Airports Commission analysis

2.95 The GDP impacts associated with a carbon cap are relatively similar to the carbon-traded results under both Heathrow schemes, mainly driven by the relatively large increase in additional long-haul flights, which have a more substantial multiplier impact on productivity, crowding out some shorter-haul and low cost routes. The carbon cap has a more significant effect in the Gatwick scheme, where overall GDP benefits fall by around 50%, though the scheme still generates around £44 billion in net GDP benefits. The fall is largely due to the lack of more productive long-haul routes been generated under the Gatwick scheme in the carbon-capped sensitivity compared to those in the carbon-traded.

Sensitivity testing since consultation

2.96 As a result of consultation responses pertaining to this work, a number of sensitivity tests were undertaken. As mentioned above, a new approach to calculating the inbound/outbound splits which as involved using a London average rather than the current airport mix was utilised, along with changes to better reflect the spending patterns based on where inbound passengers are coming from.

2.97 Assumptions of perfectly competitive markets were also tested, as well as the impacts of removing leisure passenger benefits from the transport economic efficiency numbers to better understand the supply-side GDP impacts; and variations in labour supply assumptions ranging from a fixed supply to a far more elastic supply. The results are summarised below in Table 2.10 based on the overall PV results. For further details on how the profile of results changes and more discussion can be found in *Strategic Fit: Updated GDP/GVA Impacts*.

Table 2.10: Total GDP impact (excluding construction) for assessment of need carbon-traded

	LHR NWR
Central estimate	£147bn
Perfect competition sensitivity	£165bn
Business pax sensitivity	£132bn
Varied labour supply elasticity sensitivity (range)	£147bn-£151bn

Source: Airports Commission analysis

2.98 The overall Heathrow Airport Northwest Runway GDP results for *assessment of need* do change as a result of the sensitivity tests but the relative ranking against the other schemes does not. Only when assuming a London average inbound split for Heathrow Airport Northwest Runway scheme (much lower than current) and a London average split for the Gatwick Airport Second Runway scheme (much higher than the current split) does the Gatwick Airport Second Runway scheme come close to the impacts induced by the third runway at Heathrow, though the Heathrow Airport Northwest Runway scheme is still expected to produce £13 billion more. The assumptions used in these sensitivity test are, however, quite unrealistic as extensive discussions with airlines led the Commission to conclude that the inbound/outbound split would not so radically change at the two airports. Even under these extreme assumptions, building a runway at Heathrow Airport produces higher wider-economy benefits than building one at Gatwick Airport.

Overall assessment and limitations and interpretations of analysis

2.99 The analysis does provide a clear indication that there may be substantial positive GDP/Gross Value Added (GVA) effects from investment in aviation capacity and connectivity, though these are to a large extent sensitive to changes in other economic variables and assumptions made in the modelling. The analysis also shows that a rapid increase in GDP impacts, can be expected year-on-year over the first 10-15 years from scheme opening. This would be driven by the transport

economic efficiency and passenger flow numbers. The rate of growth is then expected to stabilise at just under 0.8% in 2040 onwards in *the assessment of need scenario*, with additional gains from transport economic efficiency and frequency benefits realised at this point.

- 2.100** Some caution is needed when interpreting the scale of the results but from a strategic perspective the transmission mechanisms noted are consistent with findings from the literature, and the size of the multipliers under each channel modelled are broadly consistent with estimates found in other studies¹⁷.
- 2.101** Our Expert Advisory Panel Members reviewed the approach and concluded that results provided a complementary piece of analysis to the more standard approach undertaken in the Economic Case. It was also emphasised that the model itself was well tested, also through the further sensitivities undertaken following consultation. Caution was however encouraged when interpreting how the results were spatially differentiated both within the UK and across international borders. The Commission's Expert Advisory Panel Members also noted that while the analysis was a useful indicative input to the Strategic Case, caution was also needed in interpreting the estimates as the model had not been fully developed to a point where significant weighting should be attached to the results, particularly given the complexity relating to inputting a change in accessibility via an increase in airport capacity into the model.
- 2.102** The Commission has published as part of its consultation materials the *Strategic Fit: Updated GDP/GVA Impacts* report setting out the approach taken and the results obtained, along with the modelling assumptions and further testing we have undertaken on the numbers following feedback from consultation.

Wider economic, social and environmental impacts: Opportunities and threats

Q4: How may the option fit with relevant long-term strategies for economic and spatial development?

Local assessments: Growth of employment

- 2.103** The Heathrow Northwest Runway scheme is forecast to support significant growth in local employment. The additional direct, indirect and induced jobs created would increase employment by about 76,700 in 2030 and 78,400 in 2050 in the

¹⁷ More information is available in *Strategic Fit: Updated GDP/GVA Impacts*, with a new section added since consultation

assessment of need scenario in a carbon-traded world. In a carbon-capped world employment would be increased by about 59,300 in 2030 and 74,700 in 2050.

- 2.104** This additional employment could present a valuable economic opportunity for the local area. A number of nearby local authorities, notably Ealing and Slough, have current unemployment levels above the London average (and close to or above the national average), and the employment created through expansion may help to address this.
- 2.105** The Hillingdon Local Plan refers to Heathrow as a ‘key employment area’ and Hounslow’s plan refers to the ‘economic stimulus it provides’. It is important to note, however, that these plans refer to the airport’s current activities and expansion is opposed in both cases. The Hillingdon plan refers to the importance of ‘mitigating the negative environmental and social impacts’ for the airport in its current form. The Heathrow area has been identified in the London Plan as an Opportunity Area with potential for growth but expansion at Heathrow Airport is opposed in the Plan.
- 2.106** Any new direct jobs created as a result of expansion of the airport are likely to be predominantly lower-skilled reflecting the current employment mix, creating opportunities for addressing local unemployment. Local businesses are also potentially well-placed to take advantage of the growth opportunity presented, particularly given relatively high concentrations of aviation-linked and service-sector businesses in the local area.
- 2.107** The size of this opportunity will depend upon future growth scenarios, but the Commission’s estimates indicate that it is likely to be significant even at the lowest end. Surface access developments may mean that employment opportunities at an enlarged Heathrow are open to a wider catchment area. Given high labour market flexibility in London, as well as population demographics in the local area, absorbing this additional employment does not appear to present a significant challenge.

Local assessments: Pressure on housing demand and infrastructure

- 2.108** The additional employment supported by Heathrow’s expansion could lead to a significant additional demand for housing in the area. The Commission’s analysis indicates this demand could theoretically be up to 17,745 by 2030 for direct employment across the local authorities assessed as part of the local economy assessment, but in practice would likely be lower. Any additional housing built in response would also require supporting infrastructure including schools and health care facilities.

- 2.109** Delivering new housing of this scale would present challenges for local authorities, many of whom already struggle to meet housing targets. However labour market flexibility and strong surface access links mean that actual additional housing demand would likely be lower and while new jobs would increase demand for local housing it would not be necessary for housing to be delivered on this scale to ensure that the airport had access to sufficient labour. Housing development should be expected to follow and not precede airport expansion, meaning that it would be delivered over several years, including after the new runway began operations.
- 2.110** Overall, the Commission's analysis is that the delivery of additional housing and associated infrastructure (which may have wider benefits to local communities) is likely to be achievable, given the relative scale of the changes compared to existing housing growth plans, but there are risks of localised constraints at the upper end of the scale, which may affect the overall local impacts of expansion. This is discussed further in the Local Economy *Sustainability Assessment* section.
- 2.111** The construction of the Heathrow Airport Northwest Runway would likely require the loss of a number of homes and community facilities, with the villages of Sipson, Longford and Harmondsworth particularly affected. This would require close engagement with local communities to manage the impacts and identify appropriate mitigations, as well as effective compensation mechanisms. The airport operator has proposed a £550 million fund to pay for compensation to residents. For those remaining, yet impacted by the airport, it proposes to pay for noise insulation. The Commission has considered what it believes to be a reasonable package of compensation and mitigation measures, these are discussed in the *Final Report*.

Local assessments: Environment and land

- 2.112** Heathrow Airport is currently considered in local plans and strategies to have substantial adverse impacts on the local environment, which would be expected to be worsened by the construction and operation of the new Heathrow Airport Northwest Runway scheme.
- 2.113** Expansion of the airport is therefore opposed in many local plans, with Hillingdon's for example stating that 'All new development associated with Heathrow should be challenged to minimise its impacts on air quality as far as possible.' Expansion at Heathrow is also currently opposed in the London Plan for environmental reasons.
- 2.114** Increased environmental impacts as a result of the Heathrow Airport Northwest Runway scheme would be felt in a number of areas. Construction would entail a loss of up to 694ha of Green Belt land, as well as wider, non-Green Belt land take. The increase in aircraft movements would expand the airport's noise profile and

increasing numbers of passenger and air traffic movements would increase impacts on air quality.

- 2.115** Some mitigation of increased noise impacts is possible. Advances in aircraft technology, steeper approaches and the continuation to some degree of respite periods as a result of the additional runway will help, meaning that even with expansion noise impacts by 2030 are expected to be less than current levels (although higher than forecast for 2030 without expansion). The Commission has also recommended banning flights between 23:30 and 06:00.
- 2.116** The impacts of expansion on local air quality, where EU limits are forecast to be exceeded at a number of sites even without expansion and local authorities have Air Quality Management Areas (AQMAs) enforced, are important, as they would be expected to make it harder to address these issues. The airport operator has proposed a number of measures to reduce air quality impacts, including greater use of electrically powered equipment at the airport and steps to incentivise hydrogen and electrical vehicular access to the airport. It has also highlighted the possibility of using a congestion charge to reduce car travel to the airport. The Commission has recommended that the introduction of such a scheme should be considered and that additional runway capacity at an expanded Heathrow should only be released when it is clear that air quality at sites around the airport will not delay compliance with EU limits
- 2.117** The development of the airport would cause the loss of some green spaces and communities. However, mitigation strategies, such as the airport operator's proposed landscaping of the Colne Valley, should mitigate some of the impacts and may in some areas have a beneficial effect.

Regional and wider impacts: Regional

- 2.118** The need to grow the economy to support prosperity for a growing population is identified in national and regional development strategies. Investment in transport infrastructure is acknowledged as a key enabler of economic growth.
- 2.119** Expansion of Heathrow Airport could support further opportunities for growth including in the 'Western Wedge' (an area comprising West London and the Thames Valley including Reading, and Newbury). This is identified as a particular area of economic strength for the country with international connectivity provided by Heathrow a key factor, for example by supporting global technology companies in the area to access markets in the Americas, Europe, Africa and Asia.

- 2.120** The importance of Heathrow to the regional economy is recognised in plans published by several regional Local Enterprise Partnerships (LEPs). For example, the Oxfordshire LEP's Strategic Economic Plan states that 'Oxfordshire's close proximity to Heathrow makes it a great place to do business.' Expansion at Heathrow is explicitly supported by the Enterprise M3 LEP, whose Strategic Economic Plan states that it is 'fundamental to supporting jobs and attracting and retaining businesses within the area.' Similarly, the Thames Valley and Berkshire LEP has identified current capacity constraints at Heathrow as a potential barrier to future investment.
- 2.121** Heathrow's location to the west of London ensures it is reasonably well placed for a number of parts of the UK. Planned surface access upgrades, including a direct link to HS2 at Old Oak Common and the western link from the airport to the Great Western Main Line will improve rail access to the north and west. The completion of Crossrail and the proposed Southern Access route to Waterloo will provide enhanced access to other major rail terminals. Heathrow has good access to the M25, M4 and M40, but the high levels of congestion forecast on these routes may limit the effectiveness of the airport's road links.
- 2.122** Domestic flight connections to Heathrow Airport are recognised by some authorities throughout the UK as being of strategic importance to the international connectivity of their regions. Expansion at Heathrow Airport could provide an opportunity to safeguard these connections, particularly if the airport operator was able to implement specific measures to incentivise the establishment of such services.

Regional and wider impacts: London

- 2.123** London's role as a global city, with strong international trade links, a diverse working population, a strong record as an international exporter of services and a major tourism destination is identified as a strategic strength. Suitable international aviation links are vital to this role and increasingly constrained airport capacity in London and the South East could pose a threat.
- 2.124** Expansion at Heathrow Airport would be likely to see London retain one of the world's very largest airports, even in comparison to planned new airports in the Middle and Far East. It would also allow further strengthening of Heathrow Airport's substantial long-haul route network, potentially enabling the provision of new links to emerging market destinations. Conversely, expansion at Heathrow Airport may not offer the same scope for growth in low-cost aviation, unless Heathrow Airport's business model and costs of operation are able to attract low-cost carriers.

- 2.125** Expansion at Heathrow Airport is not currently supported by the London Plan due to its potential environmental impacts. Nonetheless, the economic opportunities provided would support the ‘East West Axis’ that is identified in the Mayor’s Economic Development Strategy as an ‘engine for growth’. This links the Western Wedge and Heathrow Opportunity Areas in the west to the Thames Gateway and identified priority areas for regeneration in the east. The new transport links provided by Crossrail, which will also provide a direct link from the airport to Canary Wharf and other Opportunity Areas such as at Paddington and Stratford, will be central to this vision.
- 2.126** The Heathrow area has been identified in the London Plan as an Opportunity Area, with potential for 12,000 new jobs and 9,000 new houses even without expansion. The area can support a number of industries, including transport and logistics, business, hotels, tourism, marketing, R&D, bio-science, creative and media. In addition, expansion at Heathrow Airport may further increase the potential for growth at the Old Oak Common opportunity area (including Park Royal and Willesden Junction), building on the benefits provided by the enhanced connectivity to the Midlands and North from HS2.

Risks and Mitigations

- 2.127** Forecasts are never exactly correct. The economy and the aviation industry may develop in the way that the Commission did not predict. For that reason the Commission’s approach was to consider several different (some of them extreme) states of the world and different ways in which the aviation industry may develop, in order to ensure that the recommendation is robust. In addition, not all surface access infrastructure improvements in this document are agreed and funded and it is therefore not guaranteed that all of these improvements will be realised. However, the Commission considers it highly likely that improvements of the nature and scale of those included in the extended baseline will be required to meet background demand growth, regardless of decisions on airport expansion. A full description of the Commission’s baselines and the process used to define them can be found in *Surface Access: Process Overview*.
- 2.128** The Commission has recommended a significant package of measures to mitigate and compensate for the environmental and community impacts of expansion at Heathrow. This is discussed in detail in the Commission’s *Final Report*. It includes ending pre-06:00 arrivals at the expanding airport, the use of a noise envelope to ensure that impacts from expansion are limited, the establishment of an independent aviation noise authority and a statutory Community Engagement

Board, and the introduction of a noise levy to provide increased funds for community compensation. These measures would be additional to, and not a substitute for, the proposals already made by HAL, which include a property compensation scheme and funding for community insulation projects.

- 2.129** It is possible to further develop the national Strategic Case for Heathrow Airport through supporting it in delivering services to regional airports. In order to enhance regional connectivity within the UK the Commission recommends that Government allows the establishment of Public Service Obligations (PSOs) between individual airports, and reviews its guidance in relation to these provisions. In addition to changes to the PSO regulations, the Commission considered what roles airlines and airport operators can play to support regional connectivity, both now and in the future. Detail on these recommendations can be found in the *Final Report*.

Commission Assessment

- 2.130** All three schemes fulfil the Commission's assessment of need set out in *the Interim Report*, by 2030 they will all provide additional capacity equivalent to one net additional runway. The Heathrow Airport Northwest Runway scheme, in common with the Heathrow Airport Extended Northern Runway scheme, is expected to see faster growth in passenger numbers than Gatwick. This view was confirmed by the Commission's extensive engagement with airlines and other stakeholders and is also reflected in the Commission's aviation demand forecasts under almost all scenarios, with all bar *global fragmentation* showing the airport reaching capacity by 2040 in the carbon-traded scenarios. The rapid build-up of additional connectivity at the airport implies that the benefits of expansion will propagate through the economy relatively quickly.
- 2.131** Although the future of the aviation sector will undoubtedly impact the future connectivity outcomes, an expanded Heathrow is expected to deliver a wider and more accessible, due to higher frequencies and potentially lower fares, route network under a variety of future scenarios. This is due to Heathrow's attractiveness to the passengers and the freight handlers and, hence, the airlines. Heathrow's ability to sustain a wide long-haul route network, at the heart of which is its hub operation, will be even more important in the future, as it will help sustain and open up new links with the high-growth economies, which will open up new opportunities for UK businesses, both in London and elsewhere in the UK. Expanding Heathrow is expected to have very significant benefits of competition to users of aviation due to reductions of excess demand at the airport for which demand is highest and an increased competition in the long-haul market which currently suffers from

significant barriers to entry as a result of constraints at the airport. The resulting increases in competition will create pressure on carriers to reduce long-haul fares. In the short-haul market, the impact of fares can also be expected to be significant, particularly if one of more low-cost carriers decide to enter Heathrow – which is likely considering the current trend at other European hubs.

- 2.132** The situation at Gatwick is different. Gatwick would fill more slowly than Heathrow under the majority of scenarios, but in all but one the airport would reach 90% of capacity by 2050. Unlike at Heathrow, it is more difficult to predict the connectivity outcomes of building another runway at Gatwick. While under all scenarios, the airport is expected to deliver significant connectivity benefits to the passengers, the benefits to passengers and the freight sector would depend on the airport's ability to attract long-haul carriers. Even if the airport is successful at achieving that, it is unlikely that the long-haul connectivity at Gatwick would be anywhere close to that at Heathrow's. For that reason, Gatwick's benefits of connectivity can be expected to be limited as there currently already is a lot of short-haul competition in the London airport system and additional short-haul connections would not have a very significant impact on fare levels.
- 2.133** The connectivity benefits at either of the Heathrow options are combined with an airport that delivers high-quality and efficient space and facilities for passengers, and a wide variety of surface access options, though they will be busy and hence the resilience impact of relatively minor events, such as single lane closures, will be amplified compared to the impact on less busy routes. In the future, Heathrow will be even more accessible to the passengers from many different parts of the country. Heathrow is well-placed to accommodate substantial increase in air freight operations resulting from expansion, given the substantial freight operation already at the airport, and the fact that a substantial additional freight-handling infrastructure can be built (either within the airport boundary if a third runway is built, or outside if the northern runway is extended).
- 2.134** At an expanded Gatwick passengers would experience similar level of passenger service to the current one, though there are some risks associated with passenger experience during the building phase. Gatwick is very well-placed to serve passengers especially from the south and London, passengers from the north would have to travel through or around London. Gatwick's surface access options are less resilient to significant surface access failures than those at Heathrow as some disruptions on the Brighton Main Line and M23 can potentially be severe. The increase in freight operations is more uncertain, given the airport's low-cost short-haul profile and the current absence of any substantial freight operations, and

would require a lot of investment by third parties. Surface access at expanded Gatwick would be more focused on some key routes but these will be good quality and become busy less early than at the Heathrow schemes.

- 2.135** Given the scale of capacity that would be delivered under a Heathrow Airport Northwest Runway scheme, it is very likely that there will be a strong positive effect on the UK's GDP. The analysis shows different results across scenarios in the carbon-traded world but all are in the scale of billions of pounds Net Present Value, with the Extended Northern Runway results at a similar scale, though slightly smaller. At Gatwick these benefits are more constrained, with the results across carbon-traded scenarios ranging from £42 billion in *global fragmentation* to £127 billion in *low-cost is king*, compared to £101bn-£214bn for the Heathrow Extended Northern Runway option, and £112bn-£211bn for the Heathrow Northwest Runway option.
- 2.136** Expansion at both Heathrow and Gatwick would also drive benefits locally in terms of additional jobs, and the pressure of this on local infrastructure and land use is likely to be manageable, with more jobs, and hence more infrastructure pressures at either Heathrow scheme, and lower numbers and pressure on less intensively used land at Gatwick. The regional and London benefits would be valuable for any of the schemes, with the geographical areas being different (for instance development at the Western Wedge would be more likely to occur than in the Gatwick Diamond), driving some differences between the schemes. A number of local plans and strategies including the London Plan do, however, oppose expansion at Heathrow for environmental reasons.
- 2.137** In conclusion all of the options deliver positive connectivity and competition benefits, but of different types at either scheme, with the possible outcomes for Gatwick being of a broader range than at Heathrow, and the largest connectivity benefits for Gatwick being dependent on changes to current airline operating models. The GDP benefits are of a larger scale at Heathrow than at Gatwick, but both schemes would support a range of regional and London development priorities (although Heathrow will have a direct link, via Crossrail, to large Opportunity Areas in east London such as Stratford and the Royal Docks, as well as the Local Opportunity Area at Old Oak Common). Overall the Heathrow schemes are likely more securely to deliver the connectivity benefits that deliver the highest value to the UK economy and airline passengers.

3. Economic Case

Purpose of the Economic Case

- 3.1** There are many ways to weigh up the costs and benefits of airport expansion ranging from the commercial assessment for an investor to the assessment of the broader societal impact. Although the Commission is not defining relative financial contributions, it is likely that a large proportion of the total scheme cost will be privately funded. However, some elements of the proposal, notably the associated improvements to road and rail access to the airport, would likely be subject to discussion between the scheme promoter and the government. In assessing the Economic Case for the shortlisted schemes, the Commission has focused on the social benefits and dis-benefits of the scheme, but also taken into account its capital and surface access costs. The commercial merits of the scheme as a whole are considered under the Financial and Commercial Case.
- 3.2** In assessing the Economic Case for the shortlisted schemes, the Commission has where possible used general guidelines on evaluating proposals set out in HM Treasury's Green Book and followed the general principles of standard transport appraisal set out in the Department for Transport's (DfT) transport appraisal guidance (WebTAG). However, some areas of our appraisal are not covered by such guidance so the Commission has supplemented the analysis with new approaches, both quantitative and qualitative. This approach has enabled a fuller consideration of the costs and benefits of airport expansion, given the varied nature of the possible sources of funding and the recommendations we make on planning.
- 3.3** Each scheme has been assessed against the same do minimum set of demand forecasts. The do minimum models a state of the world where no new long-term additional capacity infrastructure is developed. It was developed using the Commission's version of the DfT aviation forecasting model, which has been extensively updated by the Commission in response to comments to its *Demand Forecasting Discussion Paper*¹⁸. Further refinements have been made since, and these area detailed in *Strategic Fit: Upadated Forecasts*.
- 3.4** The future development of the airline industry is inherently difficult to predict, particularly over a 60 year period, therefore, a scenario based approach has been

developed to assess the schemes. In addition, demand has continued to be forecast based on different approaches to handling carbon emissions from aviation:

- ‘Carbon-traded’ – These cases assume that carbon emissions from flights departing UK airports are traded at the European level until 2030 and then as part of a liberal global carbon market, consistent with current DfT appraisal methodology.
- ‘Carbon-capped’ – These cases represent the level of aviation demand consistent with the Committee on Climate Change’s (CCC) current assessment of how UK climate change targets can most effectively be met. Details on these assessments are set out in the introduction to this document.

3.5 The forecast outputs are described in the Strategic Case, for both carbon-capped and carbon-traded systems, and are set out in detail in the document *Strategic Fit: Updated Forecasts*.

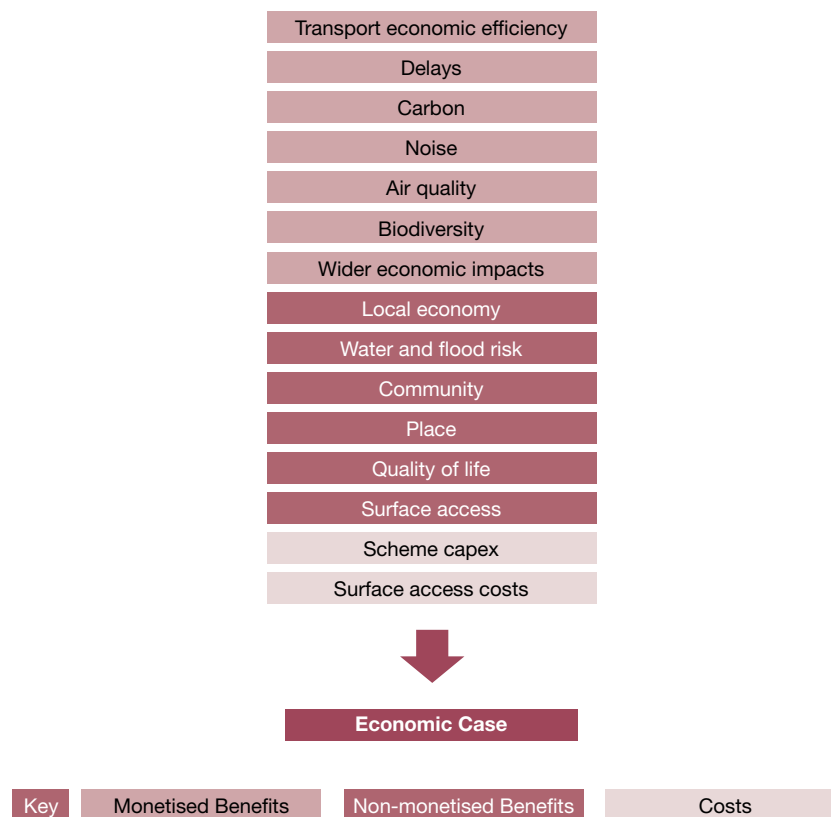
Commission Objectives and Appraisal Modules

3.6 The Commission’s key objective considered in the Economic Case is for the chosen scheme **to maximise economic benefits and support the competitiveness of the UK economy**, covered in the Economic Impacts Module. It will also consider the economic impacts of several other Commission Appraisal modules:

- Local Economy Impacts
- Surface Access
- Noise
- Air Quality
- Biodiversity
- Carbon
- Water and Flood Risk
- Place
- Quality of Life
- Community
- Cost and Commercial Viability

3.7 Figure 3.1 below sets out the how the different parts of the *Appraisal Framework* feed into the Economic Case.

Figure 3.1: Economic Appraisal Framework



Key Impact Areas

3.8 The Economic Case sets out the key benefits and costs to the national economy. It considers both the immediate impacts on the users and airlines as well as the impacts on the wider economy. This includes the impacts on the national economy but also local impacts such as on biodiversity and noise for local people. Wherever possible, these impacts have been monetised and quantified to allow comparison.

Interim Report and Consultation Evidence Base

3.9 In its *Interim Report*, the Commission concluded that there was a need for one net additional runway in the South East by 2030.

3.10 In the second phase of its work, the Commission conducted further analysis to assess the case for each of the shortlisted schemes against the objectives set out in the Appraisal Framework. The Commission published this analysis for a national consultation in November 2014 in order to seek views regarding its analysis from the public. As part of its national consultation the Commission published:

- The Economic Case for each scheme, as part of each scheme's *Business Case*

- The Economy Impacts and Local Economy Impacts Assessment for each scheme, as part of each scheme's *Sustainability Assessment*¹⁹
- Technical reports on the Economic analysis²⁰: a transport economic efficiency impacts assessment report, a delay impacts assessment report, a delay impacts methodology paper a local economy literature review and a wider economic impact assessment paper.

Updates to Evidence Base

- 3.11** The Commission has made a number of changes to various sections of its analysis, based on responses to the national consultation as well as discussions with the Commission's expert panellists, most notably in the following areas:

Wider Economic Impacts

- 3.12** Airport expansion has impacts on the wider economy. In the consultation, the Commission had considered the wider economic impacts of each scheme in the non-monetised section using evidence from a detailed literature review and a Spatial Computable Generalised Equilibrium (S-CGE) model. The S-CGE model estimated how the passenger effects, such as reduced fares, improved competition and better connectivity, feed through the economy to affect prices, wages, productivity, business location, etc. in the wider economy. This model estimated the effects of the first-round direct impacts on the second-round and third-round effects in the economy such as change in prices, wages, business location, etc. These helped the Commission understand the effects of airport expansion on the macroeconomy through impacts on Gross Domestic Product (GDP) and employment. However, these impacts were not additional to the microeconomic welfare analysis.
- 3.13** Following the consultation, the Commission has monetised the wider economic benefits of airport expansion using a welfare-type approach, in order to provide a fuller welfare analysis. The approach is based on impacts identified in DfT's WebTAG Wider Economic Impacts guidance but has been reinterpreted and extended for relevance to airport expansion. The impacts are additional to the direct benefits to the users and providers of air connectivity. Further details are available in *Economy: Wider Economic Impacts Assessment* report published alongside this document.

¹⁹ <https://www.gov.uk/government/consultations/increasing-the-uks-long-term-aviation-capacity>

²⁰ <https://www.gov.uk/government/publications/additional-airport-capacity-economy-impact-analysis>

Economic Impacts and the CCC planning assumption

- 3.14** As set out earlier in this business case, the Commission has considered the costs and benefits of the scheme with carbon emissions from aviation constrained to the CCC's planning assumption of 37.5MtCO₂ in 2050. This is important in ensuring that the case for expansion is not dependent on emissions from aviation rising to a level which may not be compatible with the achievement of the UK's broader carbon targets. The 'carbon-capped' approach to forecasting described at the beginning of this economic case is designed to reflect the planning assumption and has been incorporated into the assessment of delays, noise, environmental and cost impacts for each of the shortlisted schemes. However, for the technical reasons set out in the *Consultation Document*, it was not possible to assess the transport economic efficiency benefits or wider economic impacts using this forecasting approach. The Commission has therefore developed two new approaches to enable it to incorporate the CCC's planning assumption into the assessment of transport economic efficiency benefits and wider economic impacts.
- 3.15** First, a set of forecasts have been prepared in which underlying demand is reduced to a level at which overall UK aviation emissions with expansion would not exceed 37.5 MtCO₂ (and hence lower emissions are seen in the do minimum forecast). Whilst conceptually this would be consistent with UK aviation being subject to some form of international trading scheme, no trading or purchase of offsets has been included to allow UK aviation emissions to rise above 37.5MtCO₂. Further details of this approach are contained in *Economy: Updated Transport Economic Efficiency Impacts* and *Strategic Fit: Updated Forecasts*.
- 3.16** Second, the Commission has considered an indicative set of policies that could enable aviation emissions for each shortlisted scheme to be restricted to a level consistent with the planning assumption, and carried out a sensitivity test to calculate the transport economic efficiency and wider economic benefits on this basis. Further details of the methodology and results are contained in *Economy: Carbon Policy Sensitivity Test*.

Delay Impacts

- 3.17** The methodology used to estimate the impacts of reduced delays as a result of airport expansion has been developed to account for the full range of UK airports, refining the demand to capacity ratios and delay time relationships as well as

including the benefits to I-I²¹ passengers. Further details are available in *Economy: Delay Impacts Assessment*, published alongside this document.

Impacts on greenhouse gas emissions

- 3.18** To present a complete carbon-traded appraisal, analysis has been undertaken to test and monetise the impacts of airport expansion on greenhouse gas emissions in the *assessment of need* carbon-traded scenario. Further details are available in *Carbon: Further Assessment*, published alongside this document.

Quality of Life

- 3.19** Since the consultation, the Commission has undertaken further work to investigate the value of leisure trips and their impacts on quality of life; through channels such as health, differing socio-economic backgrounds, and the value of visiting family and friends. This work has helped the Commission better understand the impact of change in aviation capacity on the wellbeing of passengers travelling for leisure. Further details are available in *Quality of Life: Further Assessment* published alongside this document.

Costs

- 3.20** In response to the consultation, the cost estimates associated with the scheme and surface access have been refined. This includes a reduction in tracked transit system costs in the scheme capex and transfer of Southern Road Tunnel costs to the core capex instead of surface access, further details on this can be found in the Financial and Commercial Case.
- 3.21** In considering the benefits of the scheme for the purpose of the Economic Case, the Commission has focused on how the social benefits and dis-benefits of the scheme weigh up against one and other to test if society will benefit from expansion as a whole, but it has also considered how the net benefits/dis-benefits compare to the scheme's capital and surface access costs. Questions surrounding the financing of airport development (e.g. capex, opex, asset replacement, etc.) are considered in the Financial and Commercial Case, given these are a matter for private financing.

Health and Equalities Impacts

- 3.22** In response to comments received at consultation, the Commission has also developed its existing analysis on the health impacts and equalities impacts of the

21 International to International interliners i.e. passengers who are transferring via a UK airport with their origin and destination outside the UK

scheme. These are set out in Annex A to the Sustainability Assessment and the *Equalities Impact Report*. We have also drawn out this analysis further in the Economic Case.

Air Quality Impacts

3.23 The monetisation of the impacts of air quality have not changed since consultation, as the monetisation is based on the national air quality assessment which has not undergone any further analysis. For information on the further local air quality modelling work please refer to the Air Quality section of the *Sustainability Assessment*.

Outcomes – Carbon Traded

3.24 Unless stated otherwise, all the results presented in this section are for the Commission's *assessment of need* carbon-traded demand scenario. The impacts in a carbon-capped world are discussed in the following section: Outcomes Carbon-Capped. A range of sensitivities around the Commission's other demand scenarios have also been conducted and the results are also reported.

Cost and benefits analysis of the chosen scheme: Monetised benefits

3.25 The impacts in this section have been valued by attributing a monetary value to the impacts on users, providers, the government and local residents.

Transport Economic Efficiency Impacts

3.26 Many of the costs and benefits attached to airport capacity expansion fall directly on airports, airlines, passengers, other users and the public finances. Quantifying such impacts is important as part of the complete economic appraisal. Table 3.2 sets out the estimated transport economic efficiency impacts (including impacts on Government revenues) from a Northwest Runway at London Heathrow, allowing capacity at the airport to increase to 740,000 air traffic movements (ATMs) a year.

3.27 There are significant passenger benefits from expansion as it allows passengers to access the air network more conveniently and/or at lower cost. The expansion lowers the shadow cost²² associated with using airports that are constrained; to the extent the airline market is competitive (and airports are appropriately regulated if necessary), this will lead to a reduction in fares. These reductions in generalised

22 Within the DfT Aviation model, shadow costs represent the extra cost of flying required to reduce passenger demand to a level within an airport's runway or terminal capacity. It can be thought of as a congestion premium, representing a fare increase to passengers or general inconvenience of using an overloaded airport.

costs can be interpreted in many ways. This transfer between the providers and consumers is commonly described as a reduction in scarcity rent, where airlines operating out of the constrained airport (where demand originally outstripped supply giving airlines more power in the market) are now unable to charge such high fares to passengers and users because of more competition in the market. The impact may not change fares but new competition could lead to airlines improving efficiency in the business and operation, leading to a consumer benefits either via passing on cost saving in the form of reduced fares or possibly in increased levels of service. This may also have positive impacts on the airlines profitability, benefiting both the consumer and airline.

- 3.28** As well as providing a direct benefit to those who already use the airport, it also generates further benefits for passengers who now choose to access the newly expanded airport. In addition, passengers enjoy benefits associated with greater frequency – being more likely to be able to travel at their preferred time – and access to a greater range of destinations without having to transfer. The connectivity and competition benefits (from a market concentration perspective) of expansion are discussed in the Strategic Case.
- 3.29** Table 3.1 below splits passenger benefits into UK origin, foreign origin and I to I transfers. The Commission believes that as a proportion of the costs of the scheme (in which some proportion will be privately funded) are likely to be borne by such passengers through higher aeronautical charges, it should include such figures in its appraisal but be mindful of the size of the impacts with and without impacts on I to I passengers. So, to ensure consistency across the appraisal, benefits to such passengers have been considered.

Table 3.1: Passenger benefits split by passenger type, Present Value (£billion, 2014 prices)

Passenger splits	Benefits
UK	33.9
Foreign	14.4
I to I	6.5
Total	54.8

Source: Airports Commission analysis

- 3.30** The passenger benefits are heavily driven by the passenger demand forecasts. So the Commission has tested alternative demand scenarios described in the introduction to this document which provide a range of passenger benefits between £46.7 billion to £137.5 billion (PV, 2014 prices) including I to I passengers in the carbon-traded scenario. The extent of the range should be treated with caution since the demand scenarios at either end of this range are based on extreme assumptions about the economic factors as well as the airline business models, when compared to current trends.
- 3.31** Traditionally the lower fares enjoyed by passengers have been largely interpreted as a direct transfer from providers to passengers and users, as reported in Table 3.2, with the savings for the passengers and users being interpreted as having the same value as the losses for providers. The providers of air transport include not only airports and airlines but also their supply chains such as baggage handlers and catering companies. If reductions in shadow costs caused airlines and other aviation service providers to become more efficient in the face of competition then the producer surplus loss would be lower than the analysis reported in Table 3.2 suggests. In this case, where the producer dis-benefit is lower than presented, it is likely that the passenger and user benefits would remain since these efficiency benefits feed through to fares, but the potential producer surplus loss would be partially offset by improved producer efficiency leading to more revenues and profit potential for the provider. The exact level of benefit is difficult to model but it is reasonable to believe the producer surplus loss is over stated.
- 3.32** Table 3.2 presents the passenger, producer and government impacts of expansion at Heathrow with an additional Northwest Runway for the Commission's *assessment of need* carbon-traded demand scenario.

Table 3.2: Passenger, producer and government impacts, Present Value (£billion, 2014 prices)

Impacts on	Benefits
*These exclude I to I passengers	
Passengers* (lower shadow costs)	45.1
Passengers* (higher frequencies)	3.2
I to I passengers (lower shadow costs)	4.0
I to I passengers (higher frequencies)	2.4
Total passenger benefits (including I to I)	54.8
Government revenue	1.8
Producers	-38.4
Total transport economic efficiency impact	18.3

Source: Airports Commission analysis

- 3.33** The full range of benefits, including producer dis-benefits and government revenue impacts, is £10.3 billion to £42.0 billion (PV, 2014 prices) across the Commission's five carbon-traded scenarios.
- 3.34** Further sensitivities have also been conducted to test other key assumptions such as the carbon price, demand growth and phasing in of capacity; details of which are available in the Commission's *Economy: Transport Economic Efficiency* report.

Delay impacts

- 3.35** The delay impacts capture the benefits to passengers and airlines of a reduction in delays experienced during arrival and departure at airports as a result of increased capacity from expansion at Heathrow. Airlines and their passengers experience delays during departure (in the form of ground holding) and arrivals (in the form of airborne stacking) at capacity constrained airports. These regular delays are built into the airlines' schedules and result in increased operating costs for airlines and longer journey times for passengers.
- 3.36** The expansion results in a reduction in demand to capacity ratio at airports across the UK system, either through increase in capacity at Heathrow or reduction in demand at the other airports. Using relationships between the demand to capacity ratios and delay times in the UK CAA Runway Resilience Study²³, reduction in delay times at the airports is assessed. These reductions are translated into reduced

23 ICF/Helios (2008) UK CAA Runway Resilience Study – Final Report
https://www.caa.co.uk/docs/589/ICF_runway_resilience_final_report_16Feb09.pdf

operating costs for airlines based on the European airline delay cost reference values study²⁴ by the University of Westminster. The benefits to passengers come from the value they place on the reduced journey times.

- 3.37** Table 3.3 below presents the benefits from reduced delays from expansion at Heathrow for the Commission's *assessment of need* carbon-traded demand scenario.

Table 3.3: Benefits from reduced delays to passengers and airlines, Present Value (£billion, 2014 prices)

Benefits to	Benefits
UK business passengers	0.2
UK leisure passengers	0.1
Foreign business passengers	0.2
Foreign leisure passengers	0.0
<i>Total passengers excluding I to I</i>	0.5
I to I passengers	0.1
<i>Total passengers including I to I</i>	0.6
Airlines	0.4
Carbon	0.0
Total benefits	1.0

Source: Airports Commission analysis

- 3.38** The benefits from reduced delays are driven by a combination of delay time savings and the number of passengers or ATMs that these savings accrue to. Alternative demand scenarios described in the introduction to this document have been tested which give a range of delay benefits between £0.8 billion to £1.5 billion (PV, 2014 prices) in the carbon-traded scenario. Compared to the do minimum, the delay time savings are higher when the additional capacity remains spare for longer and so delays do not start to build up again. Opposing this, the delay time benefits are higher when the delay time savings accrue to a larger number of passengers or ATMs in high demand scenarios. Carbon costs capture the costs of emissions from excess fuel consumption when a flight experiences delays, which in turn need to be paid by airlines.
- 3.39** The additional runway at Heathrow would also allow more operational flexibility for the airport operator and improve the resilience of the system, at least for as long as the additional runway capacity does not fill up.

24 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/370532/webtag-tag-unit-a2-1-wider-impacts.pdf

Wider economic impacts

3.40 In addition to the direct consumer, frequency and delay benefits to the users and providers of aviation, airport expansion will have further impacts on the wider economy; from the increase in productivity through trade and agglomeration, increase in output in imperfectly competitive markets and the impact on government's tax revenue. These links were well established in the literature found in the SDG literature review and widely accepted and documented in the evidence base we have collected. The methodology used to estimate these impacts is broadly based on impacts identified in DfT's WebTAG guidance on Wider Economic Benefits²⁵. However, this framework has been modified and improved in order to make the analysis more aviation specific. Further details on this can be found in *Economy: Wider Economic Impacts Assessment*.

3.41 Expansion at Heathrow provides increased connectivity in the form of better access to foreign markets and thus, facilitates 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. Imports from other countries increases the level of competition in the market and lead to more productive/efficient firms and better use of resources in the economy. Some firms will be driven out of the market due to stronger foreign competition – but those that remain in the market will become more efficient due to this competition and increase production. Both these effects result in an increase in the overall level of productivity in trade-related sectors of the economy and have been captured in the trade benefits in Table 3.4. These impacts have been captured using the relationship between the change in business passengers and trade²⁶, and its impact on GVA²⁷.

3.42 Furthermore, the change in connectivity offered by expansion at Heathrow would attract businesses that benefit from the better international links and their supply chains to cluster around the airports. This leads to the creation of agglomerations around the airports, leading to productivity increases in these sectors through knowledge and technology spillovers as well as access to larger input and labour markets. These changes in productivity have been captured in the agglomeration effects in Table 3.4.

25 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/371810/2-economy--wider-impacts-assessment.pdf

26 These relationships are based on elasticities found by PwC in the xxxx report. While these elasticities are based on all passengers, we have used them for the relationship between business passengers and trade since the highest impact of connectivity to trade is likely to be through business connectivity.

27 These elasticities are based on the literature review conducted by SDG for the Commission

- 3.43** These impacts have been captured by estimating the change in effective densities brought about by the change in employment for areas around the 10 largest UK airports. Elasticities between passenger flows and employment found in literature, but adjusted for relevance to the size of airport, have been used to estimate this change in employment. Agglomeration elasticities in WebTAG indicate the effect of the change in effective densities on productivity. In order to capture the changes in agglomerations around the other UK airports, a broad measure of agglomeration benefit per employee was used alongside the average passengers per employee ratio from literature.
- 3.44** The changes in productivity arising from the agglomeration effects in particular sectors increases the returns to labour in these sectors and thus attracts workers to move to more productive jobs in the airport clusters. The increase in productivity translates into higher wages in a competitive market and thereby increases the taxes paid by these workers. These impacts on the government's tax revenue have been captured by assuming a 30% tax rate on the additional wage from employment around the airport in the tax impact in Table 3.4.
- 3.45** The expansion also results in a reduction in the cost of production for firms that use air transport as an input. As per WebTAG guidance, this is calculated to be 10% of the direct benefits to business users – from transport economic efficiency and reduced delays – additional to the direct benefits for imperfectly competitive markets. These impacts have been captured in the increased output in imperfectly competitive markets effects in Table 3.4.
- 3.46** Table 3.4 presents the wider economic benefits from all the channels described above due to the Heathrow Airport Northwest Runway scheme for the Commission's *assessment of need* carbon-traded demand scenario.

Table 3.4: Wider economic impacts from Heathrow Airport Northwest Runway scheme, Present Value (£billion, 2014 prices)

Impact	Benefits
Export	6.1
Import	1.3
Agglomeration	1.7
Increased output in imperfectly competitive markets	1.4
Tax impact	1.1
Total	11.5

Source: Airports Commission analysis

- 3.47** As mentioned above, the wider economic impacts are driven by the passenger flows at airports so the benefits vary based on the demand scenario under consideration. The range of impacts lies between £17.0 billion (PV, 2014 prices) for the *global-growth* scenario and £10.1 billion for the *global fragmentation* scenario.

Impacts on Greenhouse Gas Emissions

- 3.48** The increased capacity available from expansion at Heathrow has implications in terms of carbon emissions from increased air travel, increased use of surface access, reduced ground holding and arrival stacking, construction of new airport facilities and surface access infrastructure, airside ground movements and airport operations.
- 3.49** Table 3.5 outlines the additional level of emissions as a result of expansion at Heathrow for those carbon emission areas that are monetised with an additional Northwest Runway in the Commission's *assessment of need* carbon-traded demand scenario. The carbon emissions presented have been monetised using the central carbon value provided in the Department for Energy and Climate Changes (DECC) Green Book Supplementary Guidance²⁸. However, carbon emissions from increased air travel and reduced ground holding and arrival stacking have not been monetised. This is because in the carbon-traded scenario, it is assumed that the UK is part of an international aviation emissions trading scheme so the overall level of emissions internationally does not increase.

Table 3.5: Additional carbon emissions from expansion, change in MtCO₂(e)²⁹

Area of emissions	Additional MtCO ₂ (e)
Passenger surface access	8.4
Airport operations (energy and fuel use)	2.6
Construction of airport facilities and surface access infrastructure	11.3
Total	22.2

Source: Airports Commission analysis

28 DECC (2014) *Valuation of energy use and greenhouse gas (GHG) emissions*, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/360316/20141001_2014_DECC_HMT_Supplementary_Appraisal_Guidance.pdf

29 Construction emissions are accounted for in terms of CO₂(e). The remaining impacts are accounted in CO₂, however the difference for these resources is less than 1%.

- 3.50** The level of carbon emissions from passenger surface access in this assessment would change broadly proportionally with the level of passenger demand and airport operations under the various demand scenarios described in introduction to this document, assuming no major changes in estimated passenger origins between scenarios and no significant modal shift over time. This assessment does not take into account the proposals for demand management of road traffic at Heathrow discussed in the *Air Quality Sustainability Assessment* section and in the *Final Report*. The level of emissions from construction would remain broadly the same under all demand scenarios.
- 3.51** Table 3.6 presents the monetised value of the additional carbon emissions as a result of expansion in the Commission's *assessment of need* carbon-traded demand scenario.

Table 3.6: Monetised carbon emissions from expansion, Present Value (£million, 2014 prices)

Area of emissions	Benefits
Passenger surface access	-529.3
Airport operations (energy and fuel use)	-155.9
Construction of airport facilities and surface access infrastructure	-253.1
Total	-938.3

Source: Airports Commission analysis

- 3.52** The dis-benefits would increase proportionally based on the level of carbon emissions under the various demand scenarios, as described above. Further sensitivities have been conducted using DECC's high and low carbon values and are available in the *Strategic Fit: Updated Forecasts* report.

Impacts on Noise

- 3.53** The increased travel demand fed by the additional Northwest Runway at Heathrow has implications in terms of increased noise for residents living under, or close to, the flight paths. The Commission has assessed the impacts of expansion at Heathrow on various noise metrics, both at a local and national level.
- 3.54** On a national level, average noise metrics of L_{Aeq16h} (summer daytime); L_{Aeq8h} (summer night time) and L_{den} (24 hour) of 13 UK airports have been considered in 2030, 2040 and 2050 using the Federal Aviation Administration's (FAA) Integrated Noise Model (INM). The local appraisal is based on detailed contour maps modelled

using the UK Civil Aircraft Noise Contour model (ANCON) and considers a wider range of noise metrics for 2030, 2040 and 2050.

- 3.55** The noise contours and population estimates in the local assessment have been used to monetise the noise impacts at Heathrow, for inclusion in the economic appraisal. The effect of noise in terms of annoyance, sleep disturbance, acute myocardial infarction (AMI) and hypertension on the Quality Adjusted Life Years (QALYs) of the population living within the noise contours have been considered. These calculations are based on World Health Organization (WHO) Environmental Burden of Disease guidelines and the ERCD report 1209³⁰. This approach values the noise impacts by estimating the number of years of life lost or spent with a disability, to get the number of QALYs lost, and uses established values for each QALY lost to arrive at the total monetised noise impact. The quantified and monetised impacts of noise cannot fully reflect people's individual experience of noise. Some of the qualitative impacts are discussed in the Noise section, and the Quality of Life assessment also includes noise impacts on peoples' wellbeing.
- 3.56** The noise impacts with Heathrow Airport Northwest Runway in the Commission's *assessment of need* carbon-traded demand scenario is £1 billion (PV, 2014 prices). This figure does not take into account the Commission's recommendation to end scheduled flights in the core night period between 23:30 and 06:00.
- 3.57** Sensitivities have been conducted to consider the noise impacts under a high demand case *low cost is king* carbon-traded demand scenario described in the introduction to this document. Further monetisation sensitivities have also been conducted to consider higher cut-off noise levels for annoyance and sleep disturbance as well as to test different disability weightings which result from the noise impacts.
- 3.58** The Commission recognises aircraft noise has particular impact on children at school and older people can be more susceptible to noise impacts, this is discussed further in Annex A to this document and the *Equalities Impacts Report*.

Impacts on Air Quality

- 3.59** Poor air quality detrimentally affects human health and quality of life, as well as the healthy functioning of natural ecosystems. Airports and their associated activities are potential sources of pollutants that impact on local air quality and contribute towards national emission levels. Thus, the effect of expansion at Heathrow on the air quality at a local and national level has been considered.

30 CAA (2013) ERCD REPORT 1209 <https://www.caa.co.uk/docs/33/ERCD1209.pdf>

- 3.60** The national and local assessments consider the impact of expansion and associated surface transport on the total mass emissions of key pollutants – NO₂, NO_x, PM₁₀ and PM_{2.5} – in 2030, 2040 and 2050. It is important to note that all the measurements and monetisation of Air Quality considered in this Economic Case are related to the unmitigated impacts, and possible mitigations are discussed in the *Sustainability Assessment*. The Commission's May consultation on Air Quality has not had an impact on these figures.
- 3.61** For the air quality impacts for the carbon-traded scenario, Department for Environment, Food and Rural Affairs (DEFRA) values of damage cost per tonne of emissions of NO_x and PM₁₀³¹ have been used to monetise the air quality impacts on health and morbidity as well as damage to buildings. The damage cost per tonne of NO_x is £1,038 in 2014 prices, which is a standard for all sources and a fixed unit across the UK. The damage cost per tonne of PM₁₀ depends on the source of the pollutant and the area within the UK that it is emitted.
- 3.62** Table 3.7 shows the monetised dis-benefits from each pollutant due to expansion at Heathrow with an additional Northwest Runway for the *assessment of need* carbon-traded demand scenario.

Table 3.7: Monetised air quality impacts, Present Value (£million, 2014 prices)

Pollutant type	Benefits
NO _x	-71.6
PM ₁₀	-763.8
Total ³²	-835.4

Source: Airports Commission analysis

- 3.63** Sensitivities were conducted to monetise the maximum air quality impacts in the *global-growth* scenario described in the beginning of this document. The maximum unmitigated impact on air quality with a Heathrow Airport Northwest Runway scheme is £957.8 million (PV, 2014 prices). Furthermore, a simplified pathway approach based on the concentration response coefficients provided by the Defra impact pathway guidance³³ has been applied to the predicted incremental changes

31 NO₂ and PM_{2.5} effects were not monetised since they are subsets of NO_x and PM₁₀ respectively.

32 In higher demand scenarios, such as *global growth* carbon-traded as used in the *Air Quality Sustainability Assessment* section, these results would be higher.

33 The Green Book is to be updated taking account of more recent findings such as the Health Risks of Air Pollution in Europe (HRAPIE) report (available at www.euro.wo.int), and revision of economic parameters, and it is recognised that the Green Book valuation based on emissions of NO_x, does not include the direct effects of local NO₂ exposure.

to pollutant concentrations on the affected population in order to calculate the effects on health of exposure. These health impacts were monetised using the Interdepartmental Group on Costs and Benefits (IGCB) recommended values, converted to 2014 prices, for the Heathrow Northwest Runway scheme and this yielded disbenefits of £1.4-5.2m. Further sensitivities were also conducted using the value of life year and value of statistical life measures to monetise the impact of mass emissions.

- 3.64** These impacts are smaller compared to other monetised elements of the economic case reflecting the limited impact of expansion on air quality at a national level. However, they do not take account of changes in the risk of exceeding regulated limit values at local levels – these considerations are included in the *Sustainability Assessment* and have been informed by the outcomes of the detailed dispersion modelling.
- 3.65** The Commission recognises that populations under 16, over 65 and those of any age with pre-existing medical conditions are particularly sensitive to these impacts. This is discussed further in the *Equalities Impacts Report*.

Impacts on Biodiversity

- 3.66** Any major infrastructure, especially that which may affect a large geographical area, such as an airport and its associated surface access infrastructure, is likely to have an impact on biodiversity, so the Commission has undertaken an assessment of the impact of expansion at Heathrow on biodiversity in the local area.
- 3.67** Firstly, sites, habitats and species of particular interest were identified and assigned a level of Environmental Capital based on an assessment of the ecological trends, susceptibility, replaceability and ecological importance. The effect of the expansion at the airport was then estimated based on the magnitude, duration and reversibility of impact of the scheme on these resources.
- 3.68** The Heathrow Airport Northwest Runway scheme involves direct land take impacts on three local non-statutory designated sites (Old Slade Lake Local Wildlife Site, Lower Colne Sites of Metropolitan Importance for Nature Conservation and Stanwell II Site of Nature Conservation Importance), including potential impact on a nationally rare plant species (Pennyroyal). It would also result in losses of priority habitats including agricultural land, deciduous woodland, traditional orchard and rivers and brooks. The location for the additional runway in closer proximity to the Queen Mother Reservoir is likely to result in increased birdstrike risk if not effectively managed. The Commission is satisfied in light of the evidence base that it is reasonable to conclude that there would be a good likelihood of any Appropriate

Assessment determining that the project would not adversely affect the integrity of any designated site. However, the Commission does recognise that further work will be required to demonstrate this in relation to the birds using the reservoirs to the west of Heathrow and the ongoing management of any mitigation or avoidance measures.

- 3.69** These effects are valued by assessing the costs, achievability and net biodiversity gains of potential mitigation strategies. The outline cost estimate for provision of compensatory mitigation in lieu of direct habitat loss is £1.8 million to £5.5 million (PV, 2014 prices) calculated on the basis of use of management agreement or land purchase options respectively.
- 3.70** In addition, an ecosystem services approach has been used to consider the environment in terms of the benefits it brings to people. The potential habitats impacted by the proposals have been identified, and changes in the value of the ecosystem services they provide due to the proposals are monetised based on a broad habitat approach.
- 3.71** For Heathrow, the replacement value of lost ecosystem services is estimated to be between £6.3 million and £15.8 million (PV, 2014 prices). Impacts are likely on several ecosystem services including aesthetics, opportunities for recreation, waste treatment, lifecycle maintenance and fresh water supply. Due to the innovative nature of this methodology, the compensatory mitigation costs have been included in the economic appraisal but it is worth noting that these impacts are small compared to other monetised effects in the economic appraisal.

Cost and benefits analysis of the chosen scheme: Non-monetised benefits

- 3.72** Building the Northwest Runway at Heathrow has further impacts on the local community and environmental and social capital. These impacts have been considered but monetary values have not been assigned to them.

Impacts on Place

- 3.73** Expansion at Heathrow will require land to be developed for the airport's operations and potentially for surface access infrastructure. It will also generate increased aviation and surface transport traffic, which will impact on the local landscape and townscape, visual amenities and heritage assets. Impacts may be felt particularly on protected landscapes and assets, which are vulnerable to the visual and tranquillity impacts of aviation.

- 3.74** A desk based review was undertaken to consider the direct land take and property loss required for the airport expansion areas. The land take associated with the proposed Heathrow Airport Northwest Runway scheme expansion and the areas potentially affected by surface access construction is estimated as 568.8 ha and 294.2 ha respectively, and a further 42.9 ha for flood storage. Approximately 431 ha of the expanded airport boundary would lie within designated Green Belt land and 121.8 ha of good quality agricultural land (Grade 1, 2 or 3³⁴) would be lost. A total of 783 residential properties³⁵ are likely to need to be demolished and additional residential properties could potentially be lost to the surface access improvements depending on detailed route and construction design.
- 3.75** The landscape, townscape and waterscape assessment was undertaken using the Guidelines for Landscape and Visual Impact Assessment, Third Edition (Landscape Institute and Institute of Environmental Management and Assessment, 2013). For the Heathrow Airport Northwest Runway scheme, Hillingdon Lower Colne Floodplain would experience a permanent significant adverse effect from construction. There would also be a significant adverse effect on Hillingdon Historic Core due to the permanent loss of Longford village and part of Harmondsworth. There will be significant adverse effect on visual amenity in the remaining part of Harmondsworth and in Sipson even after construction. The mitigation measures proposed by Heathrow Airport Limited (HAL) could have slightly beneficial visual impacts on the Colne Valley Regional Park and the public rights of way south of the M4.
- 3.76** The heritage assessment focuses on designated heritage assets identified from existing data sources and the assessment methodology is based on the Design Manual for Roads and Bridges (DMRB, 2010). The assessment of the Heathrow Airport Northwest Runway scheme identified potential direct impacts on 21 designated assets within the scheme land take, comprising two conservation areas, two ancient monuments and 17 Grade II listed buildings; and a further 54 designated heritage assets could be affected within 300m of the scheme area, and 166 more 300m to 2km from the site of the scheme.
- 3.77** The increased generation of waste and its management by the airport operator in the construction and operational stage have been considered. The assessment found that the greater number of passengers would increase the production of

34 Agricultural Land Classification provides a framework for classifying land according to the extent to which its physical or chemical characteristics impose long-term limitations on agricultural use with Grade 1 being excellent quality and Grade 3 being good to moderate quality

35 HAL already own some properties in the area, but HAL's submission to the Commission in May 2014 suggest they expect to need to purchase 747 to enable the London Heathrow Northwest Runway scheme

waste by up to approximately 47,000 tonnes in 2040, assuming no change to current levels of waste generated per passenger. The approach for identification and management of construction and operational waste outlined by the scheme promoter is well considered, and adopts the principles of the waste hierarchy. However, the assumptions have not been substantiated and are therefore subject to a level of uncertainty.

- 3.78** Reducing access to open/green space for physical activity and diminishing the sense of connection to their natural and historic environment can have adverse impact on people's wellbeing. While these impacts were estimated for the *assessment of need* carbon-capped demand scenario, these impacts are unlikely to change significantly based on the demand or carbon scenario under consideration, with their impact being slightly adverse.

Impacts on Community

- 3.79** The expansion at Heathrow will have impacts on communities closest to the airport with implications for housing and community cohesion. The Commission has therefore undertaken an assessment of the impact of the expansion on the local community, taking account of possible mitigation measures.
- 3.80** As noted above, 783 homes are expected to be lost to enable the delivery of the additional runway and further could be required due to associated surface access infrastructure. In addition, a small number of community facilities would also be lost, including a primary school, community centres and a recreation ground. Financial support and the likely availability of alternatives nearby would mitigate the lost facilities, and compensation would need to be provided for housing loss.
- 3.81** Loss of community facilities and supportive networks could lead to adverse impacts on the wellbeing of people since access to these can reduce the likelihood of depression and chronic illness. The unmitigated community impacts would have a slightly adverse impact. If appropriate and effective mitigation is provided, this impact could approach a neutral impact overall. This impact would not be expected to vary significantly across the demand scenarios.
- 3.82** A high level equalities screening identified potential disproportionate impacts on certain groups, but a fuller assessment would be necessary to confirm these initial results. This is discussed further in the Community section.

Impacts on Water and Flood Risk

- 3.83** Airport operations have implications for the water environment and quality. Not only are airports large users of water, and the South East is a water stressed part of the country, processes such as the de-icing of aircraft and runways could damage water quality if run-off reaches local water sources. Changes to rivers and increased impermeable surfaces can have flood risks for surrounding environment.
- 3.84** The assessment is based on a desk-based review of potential impacts of the expansion based on the HAL's proposals and takes account of proposed mitigation measures. The expansion at Heathrow is estimated to create additional demand for 15% more potable water at the airport per year by 2026 rising to 71% more by 2050, compared to 2013, in an area which is already under water stress. Meeting this requirement would require the implementation of water efficiency through recycling and investment in additional water reuse schemes at the airport, and may also require importing additional supplies of water from other sources.
- 3.85** Approximately 12 kilometres of existing watercourse would be replaced with diverted or realigned channels, including rivers such as the Colne and the Longford River. The extensive remodelling of the regime of rivers and streams in the Colne Valley to the west of the airport is likely to have a significant residual impact on water quality. Significant adverse impacts are also expected from combining the River Colne and Wraysbury River into a single culvert and the Duke of Northumberland's and Longford Rivers into a separate culvert where they pass beneath the new runway. Approximately 3km of currently open channels would need to be diverted. There could also be residual water quality impacts arising from polluted runoff which could have adverse impacts if not contained.
- 3.86** Despite recent surface water flooding, construction and operation of the airport scheme itself is not expected to have substantial impacts on flood risk, as long as appropriate suggested mitigations are put in place. The significant changes to the rivers, however, pose significant potential downstream threat of fluvial flooding without suggested mitigations. The mitigation proposed is potentially effective in addressing this risk, but will require further assessment when it is designed in detail. High groundwater levels in the Thames Gravels also have implications for future flood risk and engineering and construction operations would need to be carefully managed with this in mind.
- 3.87** The change in water environment could adversely affect people's wellbeing. Flooding can also cause stress and anxiety as a result of damage to property and belongings, threat of injury to self or family and isolation as a result of severed

transport infrastructure. Based on the assessment of the scheme's impact on water and flood risk, the scheme has a slightly adverse impact on the economic case, which could be reduced by good practice mitigation strategies. This would not vary significantly across demand scenarios.

Impacts on Local Economy

- 3.88** Airports play a significant economic role in their nearby communities, both through the direct employment they provide and the potential to attract businesses that benefit from being close to the airport. The Commission has considered the impacts of the airport, including any associated surface access, on the local employment, land, housing and social infrastructure. For assessment purposes, the 14 local authorities around Heathrow where most of the current workforce come from are used to demonstrate where the impact would be felt. This assessment especially focuses on Hounslow, Hillingdon, Ealing, Slough and Spelthorne, as they are the local authorities with the highest proportion of workers. However, given London's unique nature in terms of its size and developed transport network, the effects will need to be considered in the context of the wider London and South East area.
- 3.89** Past trends in the South East region in general, and London in particular, suggest long-run trends of high population growth reaching up to 10.6 million by 2037. While this reflects the strength of the London economy and jobs market, areas of unemployment and deprivation still remain. As the population grows, the availability and accessibility of new employment opportunities will be important in sustaining the economic success of the city and surrounding region. Increasing housing supply in line with this population growth is also likely to be challenging. While population densities in the capital have increased over time, they are still relatively low compared to other cities such as Berlin and Paris. There is also pressure on services and local infrastructure.
- 3.90** Increasingly across London and the South East, the workforce in this area has been drawn from a larger area, which has been aided by improvements in transport infrastructure. This trend is likely to continue as further enhancements to regional transport networks, such as Crossrail and Thameslink, come into operation. So, while the airport development is likely to have an impact on need for housing and social infrastructure, this impact is only marginally additional to the broader background trends in the London and South East area.
- 3.91** The impacts on employment are calculated through assessing the effect of airport expansion on direct, indirect and induced jobs in the local area using the passenger

forecasts and a ratio of 1,373 passengers per employee in 2011, which is based on current ratios at the airport. Assumptions of productivity based on those produced by the Office for National Statistics (ONS) are also applied to estimate future employment at the airport³⁶.

- 3.92** Table 3.8 below presents the number of additional jobs in the local area due to expansion at Heathrow with an additional Northwest runway for the *assessment of need* carbon-traded demand scenario.

Table 3.8: Additional jobs from expansion at Heathrow

Year	Additional jobs
2030	76,652
2050	78,361

Source: Airports Commission analysis

- 3.93** While a large number of the direct jobs at the airport are likely to be low-skilled, the induced and indirect jobs are likely to be medium to high-skilled jobs. Growth of jobs associated with the airport has the potential to put pressure on housing in the local area. Table 3.9 sets out the theoretical maximum demand for additional housing in 2030 as a result of airport expansion for the Commission's *assessment of need* demand scenario. This assumes all new jobs are taken up by people new to the area, which is a strong assumption as realistically, unemployment and labour market flexibility in the local area would fill some of the new jobs. Of the additional employees, the number seeking residences in the local area is assumed to be consistent with current patterns 63% of all employees³⁷. Improvements to surface access could mean this percentage would be lower as workforce could be drawn from a wider area.

Table 3.9: Theoretical maximum additional housing demand in 2030 from new employees

2030	Additional homes
For direct employees	17,745
For total employees	48,267

Source: Airports Commission analysis

36 In this document we present the central productivity estimate and the focal scenario (*assessment of need*). The full range can be found in the Local Economy Impact Assessment

37 Based on current HAL workforce data and ONS population data.

- 3.94** While the Commission has estimated the theoretical maximum demand for additional housing, the actual level of demand and number of additional houses that may be delivered in response would likely be much lower, depending on the level of population growth, net migration, and the level of unemployment and out-commuting. Housing development would typically take place over several years, including after the runway became operational and across the entire assessment area and beyond. This will reduce the demands on an individual local authority. Any additional housing would need to be supported by a limited amount of additional social infrastructure, which would also be needed to sustain population growth.
- 3.95** If additional housing was delivered to meet this maximum theoretical demand, the likely scale of land required per local authority for the additional housing based on the current housing density is 6,773m² in the *assessment of need* demand scenario. However, increasing the density of housing and population to be brought in line with that of surrounding London boroughs would reduce the need for additional land to 1,635m². Brownfield land redevelopment also provides options for both housing and commercial floor space requirements.
- 3.96** Surface access improvements will result in a reduction in commuting times to several main areas e.g. 40 minute reduction from Reading, which will allow workforce to be drawn from a wider set of local authorities than the 14 considered. That would also have an impact of reducing the corresponding housing and land pressures.
- 3.97** The Commission has conducted sensitivities to consider the local economic effects for the range of demand scenarios described in the introduction to this document. Since these estimates are driven by the level of passenger demand, the impact would be strongest in the *global growth* and *low-cost is king* scenarios, and smallest in the *global fragmentation* scenario.
- 3.98** Alongside this local economy analysis a S-CGE model developed by PricewaterhouseCoopers (PwC) has been used to consider the catalytic job impacts on the wider economy. Catalytic impacts are a result of improving connectivity and reducing travel times, a greater choice of destinations and more regular flights, as well as reduced country to country trade costs. This helps expand the potential markets for businesses and improve efficiency, with impacts on intermediate goods and services. This in turn leads to an increase in employment in the economy, with the largest gains in the manufacturing and services sectors, which are trade intensive. The Commission has estimated the creation of 190,000 jobs by 2060 for the *assessment of need* carbon-traded demand scenario. This catalytic jobs figure is the net impact of the scheme, so takes into account any displacement effects.

- 3.99** Since these impacts are spread across the wider economy, and with improved surface access links to the airport; the corresponding housing and land needs will also be spread around the country. Taking these different impacts in to account overall the local economic impacts are expected to have a positive impact on the overall Economic Case at a national level.

Impacts on the Quality of Life

- 3.100** Several factors affected by airport expansion contribute to, or detract from, quality of life of people – employment, holidays, people’s interaction with their natural environment, to name a few. The Commission has considered the effect of expansion of existing airport infrastructure on some determinants of quality of life, both locally around the airports and nationally. Analysis of this kind for major infrastructure scheme has not previously been undertaken.
- 3.101** The analysis considered quality of life impacts associated with changes in subjective wellbeing measures (life satisfaction, sense of worthwhile, happiness, anxiety and positive affect balance).
- 3.102** Locally, the impacts of airport development include impacts of aircraft noise, loss of parks and other community facilities, employment in and around the airport, local surface transport and ease of access to flights for business and leisure. The literature review suggests that there is significant evidence linking these impacts to people’s subjective wellbeing. Testing this using the Annual Population Survey (APS) and Mappiness data gives some interesting results. For instance, living near an airport has no statistical impact on subjective wellbeing, being near an airport does not have an effect on happiness but is negatively associated with feeling relaxed, living in a daytime noise contour (over 55 dB) is negatively associated with all subjective wellbeing measures while living in a night time aircraft contour was not associated with any effect on subjective wellbeing.
- 3.103** Nationally, the impacts of airport expansion on quality of life would be felt through economic and connectivity benefits for instance catalytic job creation. A consistent finding in wellbeing literature is that employment is positively associated with several measures of subjective wellbeing, even after controlling for income. The Commission’s analysis found no difference in the jobs at airports and those outside.
- 3.104** The analysis found there are both local and national quality of life impacts associated with airport development, but particularly at local level, there is no strong statistical positive or negative impact. Positive and negative effects, whilst felt acutely by individuals, are, perhaps, at an aggregate level, balancing over a larger population.

- 3.105** In addition, based on econometric work using three datasets³⁸, taking holidays and flights is associated with improvements in health and wellbeing across all the indicators used³⁹. This relationship remains constant across different socio-demographic groups except for when assessing by employment status. The association between holidays, flights and improvements in mental health is stronger for unemployed people than it is for employed people.
- 3.106** For the Heathrow Airport Northwest Runway scheme, the overall impact on quality of life is likely to be neutral with negative impacts due to increased carbon emissions, noise etc. balanced against the net positive impact on jobs and increased connectivity for leisure trips. This impact would not vary significantly across demand scenarios.

Impacts from improved surface access

- 3.107** The increase in air travel demand as a result of expansion has a corresponding impact on the surface access links to the airport. The supporting surface access components of the Heathrow Airport Northwest Runway scheme are based on three broad categories of surface transport projects:
- Schemes which are already committed and funded
 - Schemes those which are likely to be required by 2030 to meet background increase in demand, regardless of airport expansion
 - Schemes which are required specifically to support the scheme
- 3.108** The schemes which have already been committed and funded include major investments, such as Crossrail and HS2 (with a shuttle provided between Old Oak Common and Heathrow), as well as more incremental capacity enhancements to infrastructure such as the Piccadilly Line and the M25. The schemes required by 2030 in order to meet background demand include Western Rail Access to Heathrow, as well as further managed motorway projects on strategic links to the airport. The costs of these projects have not been included in the figures presented in the cost of expansion since they also apply in the base case. Accordingly, while there will be economic benefits to airport passengers who use these schemes to access the airport, these benefits have not been associated with the scheme.
- 3.109** Additional surface access schemes are needed specifically to support the airport expansion scheme. For instance, further investments in road capacity will be

38 Understanding Society (covering 2009-2011, 2012-2013), The British Household Panel Study (2008) and Taking Part (five waves)

39 Life satisfaction, general health, GHQ36, depression, happiness, happiness (youth).

needed to ensure that congestion levels do not become unacceptable due to any increase in airport traffic. As these are largely related to ensuring there is no worsening of the baseline experience, they are not assumed to have a noticeable economic benefit. Additional investment is also needed for the redesign of local and strategic roads in the vicinity of the airport site, to accommodate the expanded airport site, including the tunnelling of the M25. In this assessment, these are not assumed to produce any economic benefits in their own right.

- 3.110** One further scheme, Southern Rail Access to Heathrow, has been included as a specific intervention to support the Heathrow Airport Northwest Runway scheme. This scheme would reduce journey times for passengers travelling to the airport from a number of areas, most notably parts of London closer to Waterloo than to Paddington or any of the Crossrail stations. These benefits, however, must be offset against the loss of ability to use the train paths that would be used for Southern Rail Access to meet commuter demand growth on routes into Waterloo.
- 3.111** In addition to Heathrow, there are impacts on the wider transport network across the country especially in terms of access to other UK airports. On the whole, the impacts of supporting surface access schemes on the economic case is estimated to be broadly neutral.

Costs

- 3.112** The Commission has estimated the capital costs associated with the scheme by reviewing the infrastructure plans for the new runway to identify the necessary works and breaking these down, as far as possible, into individual items.
- 3.113** The scheme cost is made up of several elements. On the airport site these include the runway itself, any associated airport infrastructure such as taxiways, aprons, terminals, navigation and other technical equipment, as well as the geological works required to prepare the site. Outside the airport, these costs include any possible compensatory habitats, flood defences or other mitigations that would be necessary as well as additional surface transport infrastructure (over and above any investment to meet background demand growth) that would be required to accommodate additional passengers to and from the expanded airport. The cost estimates associated with the scheme and surface access have been refined since consultation to include a reduction in tracked transit system costs in the scheme capex and transfer of Southern Road Tunnel costs to the core capex instead of surface access, further details on this can be found in the Financial and Commercial Case.

- 3.114** As part of its surface transport appraisal process, the Commission identified two baselines. The “core baseline” contains surface transport schemes which are already committed and funded, while the “extended baseline” contains those schemes which the Commission considered it was likely Government would need to fund before 2030 to meet background demand on the transport networks, regardless of decisions on airport expansion. Surface transport interventions contained within either baseline have not been included in the Commission’s cost estimates for airport schemes. Thus, only surface transport costs which are required to support expansion specifically have been included in the assessment of scheme costs such as the Southern Rail Access, M25 tunnelling, M4 works among others. Though some of these schemes are airport specific, some will be required in the future due to background demand, the airport in fact just brings forward the date where they are required.
- 3.115** Table 3.10 outlines the Commission’s view of the costs of building the Heathrow Airport Northwest Runway scheme and the supporting surface access in its *assessment of need* carbon-traded demand scenario. In addition, the Commission has included appropriate allowances for risk and a range of values for optimism bias in these scheme cost estimates. The scheme costs include 20% risk and 20% mitigated optimism bias. The surface access costs include 44% optimism bias applied for road infrastructure, 66% for rail capex and asset replacement and 41% for rail opex.

Table 3.10: Scheme costs, (£billion, 2014 prices)

	Costs
Scheme capex (Real)	17.6
Scheme capex (PV)	12.8
Surface access costs (Real)	5.0
Surface access costs (PV)	3.3
Total cost (Real)	22.6
Total cost (PV)	16.1

Source: Airports Commission analysis

Outcomes – incorporating the CCC planning assumption

- 3.116** The last section explored the detailed costs and benefits of the scheme in a future in which carbon emissions from aviation are traded through an international permit arrangement in which carbon costs are consistent with the DECC central assumptions. The Commission has also considered the costs and benefits of the

scheme with carbon emissions from aviation constrained to the CCC's planning assumption of 37.5MtCO₂ in 2050. This is important in ensuring that the case for expansion is not dependent on emissions from aviation rising to a level which may not be compatible with the achievement of the UK's broader carbon targets.

- 3.117** The 'carbon-capped' approach to forecasting described at the beginning of this economic case is designed to reflect the planning assumption and has been incorporated into the assessment of delays, noise, environmental and cost impacts for each of the shortlisted schemes, which are contained in this section. The Commission has also developed two new approaches to enable it to incorporate the CCC's planning assumption into the assessment of transport economic efficiency benefits and wider economic impacts, as the technical issues discussed in the consultation documents prevented the use of the carbon capped forecasts for this purpose.
- 3.118** First, a set of forecasts have been prepared in which underlying demand is reduced to a level at which overall UK aviation emissions with expansion are restricted to 37.5MtCO₂ (and hence lower emissions are seen in the do minimum forecast). Whilst conceptually this would be consistent with UK aviation being subject to some form of international trading scheme, no trading or purchase of offsets has been included to allow UK aviation emissions to rise above 37.5MtCO₂. Further details of this approach are contained in *Economy: Transport Economic Efficiency Impacts* and *Strategic Fit: Updated Forecasts*.
- 3.119** Second, the Commission has considered an indicative set of policies that could enable aviation emissions for each shortlisted scheme to be restricted to a level consistent with the planning assumption, and carried out a sensitivity test to calculate the transport economic efficiency and wider economic benefits on this basis. This approach also responds to criticisms made by some environmental non-governmental organisations (NGOs) in the national consultation that it is not enough simply to assert that emissions will be restricted to 37.5m CO₂ in 2050 and that it is important also to demonstrate how this might be achieved. Further details of the methodology and results of this approach are contained in *Economy: Carbon Policy Sensitivity Test*.
- 3.120** The transport economic efficiency and wider economic impacts in these two approaches are provided in this section. The remaining monetised impacts relate to the carbon-capped approach to forecasting as set out earlier in this document.
- 3.121** In general, the definitions and transmission mechanisms described in the carbon-traded appraisal sections also apply in this carbon-capped section, and so are not

repeated unless they are substantively different. Similarly, any areas where non monetised benefits do not differ substantially in a carbon-capped world (for instance Place impacts, which are not sensitive to demand levels) the analysis is not repeated.

- 3.122** The resulting transport economic efficiency and frequency benefits to passengers in the *assessment of need* carbon-capped scenario are presented below.

Table 3.11: Passenger benefits split by passenger type, Present Value (£billion, 2014 prices)

Passenger splits	Benefits (demand reduction sensitivity)
UK	19.1
Foreign	8.4
I to I	6.2
Total	33.6

Source: Airports Commission analysis

- 3.123** The impacts on passengers, producers and Government revenue as a result of Heathrow Northwest Runway scheme in *assessment of need* carbon-capped scenarios is presented in Table 3.12 below. A carbon-capped policy mix sensitivity was undertaken involving a combination of higher carbon pricing, improved operational efficiency incentives and increased uptake of biofuels with an additional estimated cost of £4.5 billion, which would need to be offset against the benefits. The net impact was calculated to be £10.2 billion (PV, 2014 prices)⁴⁰.

Table 3.12: Passenger, producer and government impacts, Present Value (£billion, 2014 prices)

Impacts on	Benefits (demand reduction sensitivity)
*These exclude I to I passengers	
Passengers*	27.5
I to I passengers	6.2
Total passenger benefits (including I to I)	33.6
Government revenue	1.9
Producers	-25.8
Total transport economic efficiency impact	9.7

Source: Airports Commission analysis

40 For further information see *Economy: Carbon Policy Sensitivity Test*

- 3.124** There are additional benefits from reduced delays to airlines and passengers. These benefits as a result for the Heathrow Airport Northwest Runway scheme are presented below for the Commission's *assessment of need* carbon-capped demand scenario.

Table 3.13: Benefits from reduced delays to passengers and airlines, Present Value (£billion, 2014 prices)

Benefits to	Benefits (carbon-capped scenario)	Benefits (demand reduction sensitivity)
UK business passengers	0.9	0.6
UK leisure passengers	0.4	0.3
Foreign business passengers	0.4	0.2
Foreign leisure passengers	0.1	0.1
<i>Total passengers excluding I to I</i>	1.9	1.1
I to I passengers	0.1	0.1
<i>Total passengers including I to I</i>	1.9	1.2
Airlines	1.0	0.6
Carbon	0.1	0.0
Total benefits	3.0	1.9

Source: Airports Commission analysis

- 3.125** The wider economic impacts as a result of the Heathrow Airport Northwest Runway scheme for the Commission's *assessment of need* carbon-capped demand scenarios are presented below. An additional sensitivity test was undertaken involving a combination of higher carbon pricing, improved operational efficiency and increased use of biofuels. The net impact of this was £11.8 billion⁴¹.

41 For further information see *Economy: Carbon Policy Sensitivity Test*

Table 3.14: Wider economic impacts from expansion at Heathrow, Present Value (£billion, 2014 prices)

Impact	Benefits (demand reduction sensitivity)
Export	3.6
Import	0.8
Agglomeration	1.6
Business Outputs benefits	0.8
Tax impact	0.9
Total	7.7

Source: Airports Commission analysis

- 3.126** The impacts on the carbon emissions as a result of the Heathrow Airport Northwest Runway scheme for the Commission's *assessment of need* carbon-capped demand scenario are presented below.

Table 3.15: Additional carbon emissions from expansion, change in MtCO₂

Area of emissions	Additional MtCO ₂ (e)
Passenger surface access	5.7
Airport operations (energy and fuel use)	2.2
Construction of airport facilities and surface access infrastructure	11.3
Total	19.2

Source: Airports Commission analysis

- 3.127** The carbon emissions presented above have been monetised using the central carbon value provided in the DECC Green Book Supplementary Guidance⁴². However, carbon emissions from increased air travel have not been monetised for the carbon-capped scenarios. This is because in the carbon-capped scenario, the overall level of carbon emissions have been capped to 2005 levels and thus, there is no increase in the overall level of emissions from expansion. There are also additional benefits due to decrease in carbon emissions of 0.7MtCO₂ from reduced stacking and ground holding due to a reduction in delays. These are not treated as additional and are assumed to fall within the CCC's carbon planning assumption, although the reduction in costs to airlines is included as a delays impact.

42

Table 3.16: Monetised carbon emissions from expansion, Present Value (£million, 2014 prices)

Area of emissions	Benefits
Passenger surface access	-358.8
Airport operations (energy and fuel use)	-135.3
Construction of airport facilities and surface access infrastructure	-253.0
Total	-747.1

Source: Airports Commission analysis

3.128 The impacts on noise, under different mitigation options are presented below.

Table 3.17: Monetised noise impacts under different mitigation options, Present Value (£ billion, 2014 prices), assessment of need, carbon-capped

	Benefits
Noise impacts, minimise total people affected	-1.5
Noise impacts, minimise newly affected people	-3.7
Noise impacts, respite operating mode	0.2

Source: Airports Commission analysis

3.129 The monetised impacts on air quality based on DEFRA values of damage cost on health and morbidity as well as damage to buildings per tonne of emissions, are presented below.

Table 3.18: Monetised air quality impacts, Present Value (£million, 2014 prices)

Pollutant type	Carbon-capped
NO _x	61.9
PM ₁₀	722.3
Total	784.2

Source: Airports Commission analysis

3.130 The impacts on biodiversity are the same under a carbon-capped scenario and the outline cost estimate for provision of compensatory mitigation in lieu of direct habitat loss is £1.8 million to £5.5 million (PV, 2014 prices) calculated on the basis of use of management agreement or land purchase options respectively.

3.131 Table 3.19 below provides a summary of the monetised carbon-constrained benefits using the Commission's *assessment of need* scenario and the demand reduction approach described above.

Table 3.19: Summary monetised benefits, Present Value (£billion, 2014 prices)

Appraisal results	Carbon-capped
Transport economic efficiency	9.7
Delays	3.0
Wider economic impacts	7.7
Impacts on greenhouse gas emissions	-0.7
Impacts on noise	-1.5
Impacts on air quality	-0.8
Impacts on biodiversity	0.0
Total	17.4

Source: Airports Commission analysis

3.132 The non-monetised impacts remain largely unchanged under the carbon-capped scenario. However, impacts on the local economy might be slightly different due to the difference in passenger numbers, as presented in table 3.20 and 3.21 for the *assessment of need* carbon-capped demand scenario.

Table 3.20: Additional jobs from expansion at Heathrow

Year	Additional jobs
2030	59,343
2050	74,717

Source: Airports Commission analysis

Table 3.21: Additional homes required for employees in 2030

2030	Additional homes
For direct employees	13,738
For total employees	37,368

Source: Airports Commission analysis

- 3.133** The likely scale of land required per local authority for the additional housing based on the current housing density is 5,244 m² in the Commission's *assessment of need* carbon-capped demand case. However, increasing the density of housing to be brought in line with that of surrounding London boroughs would reduce the need for additional land to 1,266m².
- 3.134** Table 3.22 below outlines the Commission's view of the costs of building Heathrow Airport Northwest Runway scheme and the supporting surface access in its *assessment of need* carbon-capped demand scenario. The scheme costs include 20% risk and 20% mitigated optimism bias. The surface access costs include 44% optimism bias applied for road infrastructure, 66% for rail capex and asset replacement and 41% for rail opex.

Table 3.22: Scheme costs (£billion, 2014 prices)

	Costs
Scheme capex (Real)	17.6
Scheme capex (PV)	12.7
Surface access costs (Real)	5.0
Surface access costs (PV)	3.3
Total cost (Real)	22.6
Total cost (PV)	16.0

Source: Airports Commission analysis

Risks & Mitigations

- 3.135** Like all economic analysis of this nature, the Economic Case is based on a set of assumptions. A key input is the demand forecasts. If the demand is lower or higher than expected then the economic impacts will be affected. In order to deal with this risk, the Commission has considered the range of economic impacts under several possible demand scenarios and has also undertaken further sensitivities to test other key assumptions, details of which are available in the technical reports published alongside this document.
- 3.136** The Commission has also considered several different approaches to value the economic impact of the scheme. For instance, the Commission has taken a microeconomic and macroeconomic perspective in valuing the benefits of airport expansion. While the microeconomic perspective uses traditional welfare analysis, further developed by the monetisation of wider economic impacts since the national consultation, the macroeconomic perspective uses a S-CGE model to assess the

impacts on airport expansion on key macroeconomic variables, presented in the Strategic Case. The Commission has also considered the impacts of the scheme on the quality of life of people, providing a further wellbeing perspective.

3.137 There are several options for securing some specific economic benefits that could be seen as particularly valuable. There is discussion in the *Final Report* about the possibilities for supporting regional airports to develop or consolidate connections into the capital and on to overseas markets, and working with the community to develop opportunities for local employment.

3.138 It is worth noting that the approaches used to monetise the environmental impacts, although based on well tested supplementary Green Book guidance and established practises, is in constant development and under debate both in the academic and policy world. Thus, there is a risk that these monetised impacts, as is common when valuing an impact with no existing market value, do not fully capture the all possible environmental damage resulting from any airport scheme.

Commission Assessment

The London Heathrow Northwest Runway scheme

3.139 There are many ways to weigh up the pros and cons of airport expansion, the Financial Case views the question through the prism of the commercial investor whilst this economic case looks at the proposal from the broader perspective of the social costs and benefits. Table 3.23 below summarises the Commission's economic appraisal for the Heathrow Airport Northwest Runway scheme for the Commission's *assessment of need* carbon-traded and carbon-capped demand scenarios.

Table 3.23: Appraisal results for Heathrow Airport Northwest Runway scheme, Present Value (£billion, 2014 prices)

Appraisal results	Assessment of Need	
Carbon-traded (CT)/capped (CC) ⁴³	CT	CC
Monetised (*indicates the demand reduction sensitivity results)		
Consumer surplus (includes removal of scarcity rents and frequency benefits)	54.8	33.6*
Producer surplus	-38.4	-25.8*
Government revenue	1.8	1.9*
Delays	1.0	3.0
Wider economic impacts	11.5	7.7*
Noise	-1.0	-1.5
Air quality	-0.8	-0.8
Carbon emissions	-0.9	-0.7
Biodiversity	0.0	0.0
Total benefits	69.1	46.2
Total dis-benefits	-41.1	-28.8
Net social benefit	28.0	17.4
Scheme capex and surface access cost	-16.1	-16.0
NPV (net social benefits and PVC)	11.8	1.4
Non-monetised		
Surface access	Light green	
Quality of life	Neutral	
Community	Light red	
Place	Light red	
Local economy	Dark green	
Water and flood risk	Light red	

Source: Airports Commission analysis

- 3.140** To assess the non-monetised impacts colour coding is used to represent the Commission's view as to the likely direction of the impact compared to the do minimum. Dark red is strongly negative, light red is slightly negative, grey is neutral, light green is slightly positive and dark green is very positive. All numbers in the text

43 The UK's climate commitments are likely in future to be extended beyond the 2050 timeline of the Climate Change Act and the Commission's demand forecasts. The calculation of benefits is applied over a standard transport appraisal timeframe of 60 years from scheme opening meaning that a proportion of benefits are generated in the period after 2050. The sensitivity of these impacts to assumptions about demand growth beyond 2050 has been tested and did not alter the Commission's conclusions. Further details are available in *Economy: Updated Transport Economic Efficiency Impacts*.

below are presented in present value terms over a 60 year appraisal period from scheme opening in 2014 prices, unless otherwise stated.

- 3.141** Considering the scheme by the overall net social benefit the analysis shows there is a strong case for a Heathrow Airport Northwest Runway in a carbon-traded world, with a total value £28.0 billion.
- 3.142** This is largely driven by the significant benefits accruing to passengers via lower fares, better access to their preferred airport, higher quality services and enhanced competition between providers accruing to £54.8 billion. The wider economic impacts, associated largely with increased productivity from increased trade and agglomeration, are also substantial totalling £11.5 billion. Our local economy analysis also found a significant positive impact on jobs, with additional 78,400 direct, indirect and induced jobs in 2050, though these jobs are generated rapidly after scheme opening.
- 3.143** At the national level, the Heathrow Airport Northwest Runway would facilitate growth in capacity and connectivity, with both seat capacity and the overall size of the UK route network growing compared to the do minimum. Heathrow also has the unique ability to serve a large number of daily long-haul routes due to the airlines ability to operate as a hub, providing further benefits, particularly in terms of trade. Further details of the connectivity impacts can be found in the Strategic Case.
- 3.144** These significant benefits are however offset to a degree by producer surplus losses from lost scarcity rents and the environmental dis-benefits. Environmental dis-benefits include: noise totalling £1 billion, associated with additional annoyance and sleep disturbance to residents along with their related health impacts on coronary heart disease, stroke and dementia; air quality dis-benefits totalling £0.8 billion as a consequence of additional traffic emissions from transport surrounding the airport, along with increased on-site emissions; and carbon cost relating to surface access and building the scheme totalling £0.9 billion. In addition to these impacts we also found there to be a negative biodiversity impact, along with negative qualitative assessments for Place, Community and Water and Flood Risk.
- 3.145** To consider the net social benefits of the scheme against the scheme capex and surface access cost, as would be considered under a government investment appraisal, the London Heathrow Northwest runway provides a strong Net Present Value (NPV) mounting to £11.8 billion⁴⁴. The airport operator has indicated that the

44 The Commission makes no judgement as to who should bear these costs, however the airport operator has indicated that the cost of the airport scheme would be financed privately and offset via rising aero charges levied on the passengers and users of the airport, leaving the surface access costs, which historically been split between the public and private sectors. We have not disaggregated this any further or suggested a split, rather we have left the government to negotiate an appropriate arrangement.

cost of the airport scheme would be financed privately and offset via rising aero charges levied on the passengers and users of the airport (not accounted for in this calculation), leaving the surface access costs, which historically been split between the public and private sectors.

- 3.146** The Commission has also considered the costs and benefits of the scheme with carbon emissions from aviation constrained to the CCC's planning assumption of 37.5MtCO₂ in 2050. This is important in ensuring that the case for expansion is not dependent on emissions from aviation rising to a level which may not be compatible with the achievement of the UK's broader carbon targets. The carbon-capped approach to forecasting described at the beginning of this Economic Case is designed to reflect the planning assumption and has been incorporated into the assessment of delays, noise, environmental and cost impacts for each of the shortlisted schemes.
- 3.147** The Commission has developed two new approaches to enable it to incorporate the CCC's planning assumption into the assessment of transport economic efficiency benefits and wider economic impacts, as the technical issues discussed in the consultation documents prevented the use of the carbon-capped forecasts for this purpose.
- 3.148** First, a set of forecasts have been prepared in which underlying demand is reduced to a level at which overall UK aviation emissions with expansion would not exceed 37.5MtCO₂ (and hence lower emissions are seen in the do minimum forecast). Whilst conceptually this would be consistent with UK aviation being subject to some form of international trading scheme, no trading or purchase of offsets has been included to allow UK aviation emissions to rise above 37.5MtCO₂. Under this approach, as Table 3.23 shows, the net consumer, producer, government revenue and wider economic impacts using this approach are around 59% of those in the carbon-traded case but environmental dis-benefits are similar in size when compared to the carbon traded scenario. The net social benefit using this approach is £17.4 billion and when accounting for the scheme capex and surface access costs the scheme delivers a NPV of £1.4 billion.
- 3.149** Second, the Commission has considered an indicative set of policies that could enable aviation emissions for each shortlisted scheme to be restricted to a level consistent with the CCC's planning assumption, and carried out a sensitivity test to calculate the transport economic efficiency and wider economic benefits on this basis. This produces higher benefits to the approach mentioned above, but the costs of the policy measures adopted need to be offset against these and the net impact is £4.6 billion higher with respect to transport economic efficiency and wider economic benefits than in the first approach.

- 3.150** Given the technical difficulties in modelling the transport economic efficiency benefits using the Commission's carbon-capped forecasts (in which emissions reach 37.5MtCO₂ in both the do minimum and do something forecast), the Commission has also considered the case for expansion if this element of the benefits was reduced to zero. This would be an extreme assumption, but even in this case, expansion would still be commercially viable and would deliver improved reliability and resilience and enhanced competition in the London airports system. It would improve access to London's exceptional international connectivity from the English regions and from Scotland and Northern Ireland. Crucially, it would also enable the UK airport system to provide higher levels of long-haul capacity, which will be increasingly crucial to the UK's long-term prosperity as the world's economic centre of gravity shifts eastwards. Therefore, even in this extreme scenario the Commission's judgement is that the strategic case would justify proceeding.
- 3.151** In addition to uncertainties about carbon policy, it should be noted that the overall net benefit is likely to be an underestimate. For example, benefits accruing to other users of the surface access, such as commuters benefiting from higher frequency services on rail or reduced journey times for other non-airport traffic from road improvements, have not been estimated in this analysis, though air quality and carbon dis-benefits for surface access have.
- 3.152** In addition, we have been conservative in our assumptions regarding the calculation of economic impacts. For example, due to the nature of the agglomeration methodology the estimated impacts may have not fully captured the benefit to high value added international sectors where aviation is a key input enabling clustering of enterprises and people in particular locations. Expert Advisory Panel Members noted this point in the context of highly international integrated business in the City of London. As noted earlier in the Economic Case the lost producer surplus calculated in the transport economic efficiency modelling is likely to be overestimated, reducing the overall NPV. Lower fares enjoyed by passengers have been largely interpreted as a direct transfer from providers to passengers and users. However, if reductions in shadow costs translated through to airlines/providers becoming more efficient in the face of competition then the producer surplus loss could be offset by improved efficiency, leading to higher provider revenues and profits, which is not currently reflected in our analysis. If, for example, we assumed that 20% of lost producer surplus in our modelling was offset with improvement in efficiency leading to high provider returns, the overall net social benefits and NPV would increase by just under £8 billion in the carbon-traded analysis and around £5 billion for carbon-capped.

Assessment of other options

3.153 The table 3.24 and 3.25 below summarises the Commission's economic appraisal for each of the alternative options under the Commission's *assessment of need* carbon-traded and carbon-capped demand scenarios⁴⁵.

Table 3.24: Appraisal results for Gatwick Airport Second Runway scheme, Present Value (£billion, 2014 prices)

Appraisal results	Assessment of Need	
	CT	CC
Monetised (*indicates the demand reduction sensitivity results)		
Carbon-traded (CT)/capped (CC)	CT	CC
Consumer surplus (includes removal of scarcity rents and frequency benefits)	47.1	27.2*
Producer surplus	-41.8	-24.7*
Government revenue	2.5	1.0*
Delays	2.4	2.6
Wider Economic Impacts	8.1	5.5*
Noise	-0.4	-0.4
Air quality	-0.2	-0.1
Carbon emissions	-1.0	-0.6
Biodiversity	0.0	0.0
Total benefits	60.1	36.3
Total dis-benefits	-43.3	-25.8
Net social benefit	16.8	10.5
Scheme capex and surface access cost	-6.0	-5.0
NPV (net social benefits and PVC)	10.8	5.5
Non-monetised		
Surface access	<i>Light green</i>	
Quality of life	<i>Neutral</i>	
Community	<i>Light red</i>	
Place	<i>Light red</i>	
Local economy	<i>Light green</i>	
Water and flood risk	<i>Light red</i>	

Source: Airports Commission analysis

⁴⁵ The economic benefits of LGW 2R in the *low-cost is king* scenario have been updated since November 2014 due to a revision in the forecasts. Further detail is provided in *Strategic Fit: Updated Forecasts* and the Technical Economic reports.

Table 3.25: Appraisal results for Heathrow Airport Extended Northern Runway scheme, Present Value (£billion, 2014 prices)

Appraisal results	Assessment of Need	
Carbon-traded (CT)/capped (CC)	CT	CC
Monetised (*indicates the demand reduction sensitivity results)		
Consumer surplus (includes removal of scarcity rents and frequency benefits)	46.5	29.1*
Producer surplus	-31.6	-21.9*
Government revenue	1.5	1.3*
Delays	0.8	2.4
Wider Economic Impacts	10.0	6.6*
Noise	-1.4	-1.1 ⁴⁶
Air quality	-0.6	-0.6
Carbon emissions	-0.8	-0.6
Biodiversity	0.0	0.0
Total benefits	58.7	39.3
Total dis-benefits	-34.4	-24.3
Net social benefit	24.4	15.1
Scheme capex and surface access cost	-14.1	-14.0
NPV (net social benefits and PVC)	10.2	1.0
Non-monetised		
Surface access	Light green	
Quality of life	Neutral	
Community	Light red	
Place	Light red	
Local economy	Dark green	
Water and flood risk	Light red	

Source: Airports Commission analysis

46 Since consultation the Commission remodelled Heathrow Extended Northern Runway with Heathrow Northwest Runway routes. This work was undertaken using carbon-traded numbers but not carbon-capped. We have therefore assumed a that the carbon-capped number would be of a similar level to carbon-traded, though it is likely that due to lower levels of traffic under a carbon-capped scenario that this will overestimate the size of the noise dis-benefit.

- 3.154** The benefits to passengers and users and the wider economy are significant across all three schemes and once the dis-benefit from noise, air quality, carbon are accounted for all produce substantial net benefits in a carbon-traded scenario with or without scheme costs included. However, there are differences in the type and scale of benefits and dis-benefits delivered.
- 3.155** The Heathrow Airport Extended Northern Runway scheme would have capacity for around 40,000 fewer ATMs than the Northwest Runway scheme. This means that benefits are reduced by a similar scale, whereas other Heathrow characteristics remain fairly consistent with the Northwest Runway scheme, for example, long haul route growth and new capacity filling up rapidly. The costs of the Extended Northern Runway scheme are also c. £2 billion lower than the Northwest Runway scheme, but this reduction in cost is not sufficient to offset the reduction in benefits. On this basis the assessment mainly focuses on the difference between Heathrow Airport Northwest Runway and the Gatwick Airport Second Runway.
- 3.156** We have concentrated in the assessment on the consideration of a net social benefit and NPV rather than a benefit cost ratio which is sometimes used in the appraisal of road and rail investment decisions, particularly those of a much smaller scale. The overall size and scale of the benefits accruing under a net social benefit are more relevant to a consideration around whether a National Policy Statement or Hybrid Bill should be passed through parliament, given that a large proportion of the cost will be funded privately rather than by the public purse (where normally government might want to prioritise funds based on the value for money of other transport schemes or investments across other government departments). Furthermore, those elements which might be most likely to be publicly funded, such as surface access interventions, would need to be judged on the basis of a wider benefit to cost ratio (BCR) calculation incorporating, for example, broader benefits to non-airport users from improved surface access.
- 3.157** The net social benefit however is significantly greater under the Heathrow options, with Heathrow Airport Northwest Runway delivering £28.0 billion net social benefit compared to Gatwick Airport Second Runway scheme delivering £16.6 billion, which are over 70% larger (with a similar difference in a carbon capped world). When considering the cost of the scheme and surface access and netting this off against the net social benefit, the Heathrow Airport Northwest Runway scheme delivers an NPV of £11.8 billion with Gatwick around £1 billion lower in a carbon-traded world but Gatwick Airport Second Runway outperforms Heathrow Northwest Runway by around £4 billion in the carbon-capped scenario.

The commercial merits of each scheme are discussed in the Financial and Commercial case.

- 3.158** The speed at which passengers fill up new capacity, the development of the route network (long and short haul split) and the number of business passengers served all drive the difference on the economy impacts between the Heathrow and Gatwick schemes. Gatwick Airport Second Runway scheme traffic growth in the 2030's takes some time to build up, due to new routes being generated at a slower pace and traffic from other airports taking sometime to switch to the new Gatwick runway. The modelling does however suggest that Gatwick traffic grows rapidly in the 2040's under their second runway option, generating 238 million passengers per annum in the London system in 2050 nearing that of the Heathrow Airport Northwest Runway options which generates 245mppa in the London system in 2050 under carbon traded. This shows up in the transport economic efficiency results where the net benefits for both Heathrow schemes amount to over double the size of those experienced at the Gatwick option.
- 3.159** The benefits for the Heathrow schemes include a larger proportion of benefits accruing to international interliners, when compared to Gatwick, particularly under a carbon-capped scenario. International interliners contribute critical passengers to enable airlines to increase frequencies and routes benefiting UK passengers directly, however, the Heathrow Airport Northwest Runway scheme still delivers higher net social benefits than the other schemes even when excluding benefits to international interliners. In the Commission's view including international interliners from any NPV calculation wouldn't be appropriate since they contribute to funding the scheme.
- 3.160** The composition of traffic is different between the Heathrow options and Gatwick Airport Second Runway scheme. Heathrow is currently a very well-connected airport in the short-haul and long-haul market. Under the Northwest Runway the Commission's modelling suggests there will be 75 daily long-haul service in 2050 compared to 63 services in do minimum, which when compared to the Gatwick Airport Second Runway scheme. Gatwick only attracts one new daily long-haul destination to a total of 21 in 2050 when compared to the do minimum.
- 3.161** These long-haul destinations are arguably the most valuable as trade is more sensitive to long-haul air connectivity, given (a) a lack of alternative means of interacting with supply chains and businesses, and (b) the productivity benefits may be higher when companies are exposed to markets currently largely untapped by UK companies, which tend to be further afield. Europe will however continue to be an important market for the UK and Gatwick does attract a large number of new

short-haul destinations, though these are delivered to a similar degree under a Heathrow option, albeit over a larger range of airports. This enables the Gatwick Airport Second Runway to generate substantial trade productivity benefits of £6.3 billion, which is on par with that of the Heathrow Airport Extended Northern Runway. However the Heathrow Airport Northwest Runway generates £7.3 billion in trade benefits, largely driven by enabling business passenger similar levels of access to short-haul destinations but in addition reaching those highly valuable long-haul destinations, such as the far east, to a larger extent.

- 3.162** The difference between the Heathrow and Gatwick options is also evident when considering how many people move to more productive jobs as a result of clustering and agglomeration, where under the Heathrow Airport Northwest Runway scheme the net agglomeration benefit amounts to £1.7 billion and for Gatwick Airport Second Runway to around £0.6 billion in a carbon-traded scenario, with a similar pattern evident under a carbon-capped scenario. The S-CGE modelling in the Strategic Case also found, accounting for further benefits associated with multiplier impacts across sectors, productivity benefits to be substantial with the Heathrow Airport Northwest Runway, Heathrow Airport Extended Northern Runway and Gatwick Airport Second Runway achieving productivity impacts from trade amounting to, respectively, 0.44%, 0.36% and 0.32% increases in GDP in 2050 compared to the do minimum.
- 3.163** Gatwick does however perform relatively better when considering the noise and air quality dis-benefits, which total £0.4 billion and £0.2 billion (2014 prices, 60 year PV) respectively. The carbon impacts associated with each scheme are similar, amounting to around £1 billion across all schemes, although the Gatwick Airport Second Runway scheme has lower emissions across the scenarios in non-monetised terms. Though the Gatwick option does deliver lower environmental impacts, the overall economic benefits outweigh these to much larger degree.
- 3.164** In terms of non-monetised impacts, such as creating local employment all schemes have a considerable impact with Heathrow Airport Northwest Runway providing the greatest number of jobs in 2050 at 78,400, Heathrow Airport Extended Northern runway just below this at 65,600 and then Gatwick at 32,100. The larger number of jobs at the two Heathrow schemes relate to both the larger number of passengers at the airport and the hub and long-haul operation attracting a higher numbers of employee per passenger. Local jobs are also delivered sooner under both Heathrow schemes compared to the Gatwick Airport Second Runway, given expected passenger growth. In addition we also found there to be a negative biodiversity

impact, along with negative qualitative assessments on Place, Community and Water and Flood Risk at all options.

Conclusion

- 3.165** The Heathrow Airport Northwest Runway scheme provides £54.8 billion of benefits to passenger and users with additional benefits spreading across the economy, with UK businesses, locally to the airport and nationally, seeing benefits from the increase in productivity through trade and agglomeration amounting to £11.5 billion, in a carbon-traded scenario. These need to be balanced against the dis-benefits to society, such as the noise and air quality impacts on the local community amounting to £1.8 billion combined or the loss of scarcity rents to the airlines and providers of around £38 billion. Overall the scheme provides net social benefit of £28.0 billion and when accounting for scheme and surface access costs an NPV of £11.8 billion, outperforming the other schemes.
- 3.166** With carbon emissions constrained in line with the CCC's planning assumption, the benefits of expansion are reduced, but the scheme still shows a significant net social benefit of £17.4bn and a positive NPV even when the scheme and surface access costs are taken into account. The net social benefits of the scheme continue to outweigh those of the other proposals with carbon emissions constrained. The NPV of the Gatwick scheme incorporating scheme and surface access costs would however be higher than that of the Heathrow options in this context, although it is important to note that these costs would be expected to be met in large part or in full by the private sector. This is discussed further in the Financial and Commercial Case.
- 3.167** It is possible for the promoter and other stakeholders to limit some of the dis-benefits of the scheme, for instance the air quality impacts, where the introduction of a congestion charge, if implemented, would further reduce the dis-benefit but also reduce demand on the road network, potentially negating the need for surface access improvements in some cases. In addition some aspects of the appraisal, such as the calculation of producer surplus losses, missing agglomeration impacts to highly international integrated businesses and having not estimated the positive impacts of surface access to non-airport users, potentially increase the overall net benefit beyond those presented here.

- 3.168** The benefits of a Heathrow Airport Northwest Runway are compounded by the speed at which passengers fill up new capacity enabling the benefits of new capacity to be realised earlier; the continued development of the UK's short-haul routes with its well established trading partners and importantly increasing the number long-haul daily routes opening up new opportunities in markets around the world, boosting UK productivity; and better serving business passengers needs with more flight frequencies and a mix of lower fare and better quality services.
- 3.169** For these reasons, the Commission's overall view is that the economic case for the Heathrow Northwest Runway option is stronger than that for the other shortlisted proposals, although there is a positive Economic Case for all three schemes.

4. Financial and Commercial Case

Commission Objectives and Appraisal Modules

- 4.1** The Commission's objective for the Cost and Commercial Viability Module is for the scheme ***to be affordable and financeable, including any public expenditure that may be required and taking account of the needs of airport users***. This will be the key objective considered in the Financial and Commercial Case. The Financial and Commercial case will also consider the impact of the cost of meeting the Commission's Surface Transport and Operational Efficiency Objectives⁴⁷.
- 4.2** The Financial and Commercial case has been structured to provide responses to the three key themes below, in answering the Commission's objective:
- The Commission's assessment of demand forecasts and the resulting scheme costs (including any costs outside the boundary of the airport that may require public expenditure);
 - The overall commercial viability for the scheme, looking at the funding and financing requirement for the scheme and thus the affordability implications of the schemes to the consumer and the taxpayer; and
 - The financeability of the scheme.

Key Impact Areas

- 4.3** The costs of the scheme and how it is financed will affect how much money the airport operator will need to raise through aero revenues to meet investor returns. These revenues for the airport are charges raised against airlines operating at the airport, but also could feed through to the costs incurred by passengers when paying for a flight. This is discussed more in the Strategic Case, but the Commission's analysis suggests that the airport operator will need to raise additional revenue from current or new airlines, who will also be impacted by the costs of the scheme. The Financial and Commercial Case also considers the

⁴⁷ To maximise the number of passengers and workforce accessing the airport via sustainable modes of transport; to accommodate the needs of other users of transport networks, such as commuters, intercity travellers and freight; and to enable access to the airport from a wide catchment area; to ensure individual airport and airports system efficiency; to build flexibility into scheme designs; to meet present industry safety and security standards; and to maintain and where possible enhance current safety performance with a view to future changes and potential improvements in standards.

surface access costs – if the Government determined that it was to pay any proportion of these costs there would also be a cost implication for the Government and the taxpayer.

- 4.4** Ultimately, if the Financial and Commercial Case is not sound the airport operator may be unable to raise the money it needs to build the scheme.

Consultation Evidence Base

- 4.5** As part of its national consultation the Commission published:

- The Financial and Commercial Case for each scheme⁴⁸, as part of each scheme's *Business Case and Sustainability Assessment*.
- Technical reports on the cost and commercial viability analysis⁴⁹: a literature review, a cost and revenue identification paper for each scheme, the financial modelling input costs, and a funding and financing paper.
- In January 2015 there was a revision to the underlying indexation assumptions for the core capex and asset replacement costs for the Heathrow Airport Northwest Runway scheme (LHR NWR) and the Heathrow Airport Extended Northern Runway scheme (LHR ENR). An updated paper was published but the cost and commercial viability reports were not updated. At this time, the underlying data behind the charts in the technical reports were also published.

Updates to Evidence Base

- 4.6** The Commission received comments on the scale of the costs for the schemes, their commercial viability and financeability. To provide further assurance of the evidence base for this module the Commission has developed a series of new pieces of work on all schemes in light of consultation responses. The main elements of additional work are as follows:

- A review of the scheme and related costs to establish updated baseline cost profiles as set out in the *Cost and Revenue Identification Update* report ("the Cost Update report") – in this case for Heathrow Airport Northwest Runway;
- A review of options to reduce the costs of individual schemes and the potential impact of this on the passenger experience, see the *Reduced Scope Scenarios* report;

48 <https://www.gov.uk/government/consultations/increasing-the-uks-long-term-aviation-capacity>

49 <https://www.gov.uk/government/publications/additional-airport-capacity-cost-and-commercial-viability-analysis>

- A review of the baseline financing assumptions, which combined with the baseline costs feed into an updated funding and financing report, see the updated *Cost and Commercial Viability: Financial Modelling Input Costs Update* report and the updated *Cost and Commercial Viability: Funding and Financing Update* report;
- A series of sensitivities run on the financing models developed as part of the consultation process, see the *Cost and Commercial Viability: Additional Sensitivities and Scenarios* report;
- A market sounding exercise with current and potential future providers of finance and related market participants on availability of finance, key risks and potential mitigation measures to support deliverability of finance to the proposed scheme, see the *Cost and Commercial Viability: Sources of Finance* report;
- Additional analysis – a series of short papers on topics relating to the Cost and Commercial Viability module: the approach taken to use of risk and optimism bias, enhanced compensation proposals and land costs, the State aids implications of the proposed schemes and the availability of alternative sources of finance from the European Investment Bank (EIB) or UK Government support. These are included in the *Cost and Commercial Viability: Additional Analysis* report.

Approach and Outcomes

Approach

- 4.7** The Commission has assessed the major factors influencing funding and financing for each scheme. These are: the overall projected costs of the scheme; the passenger demand forecasts (which drive overall costs and revenue); and the potential funding and financing arrangements. They are summarised here, and more detail is provided in the Cost and Commercial Viability reports.
- 4.8** Alongside this, the Commission has developed a risk framework that identifies the key risks associated with these factors (see report *Cost and Commercial Viability: Literature Review Update* for further detail). The Commission has used this framework to assess the impact of these risks on the overall affordability and commercial deliverability for each scheme.

Table 4.1: The Commission's Financial and Commercial Risk Framework

Risk	Description
1. Demand and Revenue	The risks associated with the demand for new capacity, its make-up, the type of aircraft and passenger, prospective growth, and the volatility of this growth. These directly impact the level of certainty around future revenues and operating costs, and hence the subsequent pricing and availability of finance.
2. Cost and integration	The risks associated with the construction and operation of the additional runway, with key risks being whether the price is higher than forecast and whether the various elements of the project are properly integrated together. Important here is the size and complexity of all the proposed schemes.
3. Contracting	The risk associated with the approach to contracting for the delivery of the schemes. The scale means that it may not be possible to sub-contract all the risks. In this event, the associated level of exposure will remain with the airport operator.
4. Financing	The risks around the capacity and ability to raise finance, taking into account the scale of investment the scheme promoters will be looking to access as well as the cost of finance.
5. Investment	The Regulatory Asset Base (RAB) ⁵⁰ model requires that assets are procured economically and efficiently. Inefficient expenditure may not qualify for addition to the RAB and the airport cannot then earn a regulatory return on that asset. Scheme promoters would be required to manage this risk as well as consider the question as to how the cost of capital for an investment of this scale is treated under a RAB model should this model be used.
6. Regulatory and policy	Delivery of airport capacity will take several years, and there are risks associated with possible changes to the wider regulatory and policy environment (including economic, environmental and safety regulations, and operational delivery considerations e.g. airspace design) during that time. These risks are discussed in full in the Delivery: Risk Assessment and Mitigation Report, but it is important to note here that investors will price to take account of such risks.
7. Timing and delivery	Linked to a number of the categories above, there are risks associated with the speed with which the project is implemented, the revenue built up to the forecast levels and the overall affordability.

Source: Airport Commission analysis

50 The RAB is a proxy value for the operating assets agreed with the CAA, on which the airport operator may earn a return and recover cost through depreciation in setting area charges. It may differ from the asset value reported in the airport operators accounts.

Demand Forecast & Costs

4.9 Table 4.2 below illustrates the passenger demand forecasts⁵¹ used by the Commission and Heathrow Airport Limited (HAL). These passenger forecasts drive the costs of the scheme by dictating the point at which the airport requires new capacity, and therefore the profile of the airport's capital and revenue requirements. Further analysis of demand and pricing is set out in the Strategic Case.

Table 4.2: Passenger demand forecasts used by Airports Commission and HAL

Scenario		Passengers per annum (m) Carbon-traded			Passengers per annum (m) Carbon-capped		
	2011	2030	2040	2050	2030	2040	2050
<i>Assessment of Need</i>	70	116	134	138	109	128	135
<i>Global Growth</i>		125	138	148	109	130	139
<i>Relative Decline of Europe</i> ⁵²		119	129	136	111	126	132
<i>Low-cost Is King</i> ⁵³		129	138	149	115	131	138
<i>Global Fragmentation</i>		104	121	133	110	128	134
<i>HAL forecast</i>		104	130	135			

Source: Airport Commission analysis and HAL.

4.10 For the purposes of the Financial and Commercial Case, a subset of these demand forecasts was taken to assess the costs associated with the scheme under different demand scenarios, and the implications of these forecasts on the projected aero charges that would need to be paid to the airport. The four demand scenarios used for Heathrow Airport Northwest Runway scheme reflected a range that encompasses the range of demand forecasts generated in the scenario modelling of the Airports Commission and are as follows:

- *Assessment of need* – carbon-capped (AoN-CC)
- *Assessment of need* – carbon-traded (AoN-CT)

⁵¹ The analysis undertaken in the Financial and Commercial Case analysis is based on the forecasts published in the November consultation as these haven't changed significantly enough to impact upon this assessment. The Commission has undertaken further analysis into a carbon-capped world and used a number of different approaches, some which yield marginally different demand numbers, further details can be found in the *Strategic Fit: Updated Forecast report*.

⁵² Not used for modelling costs for LHR NWR

⁵³ Not used for modelling costs for LHR NWR

- *Global growth* – carbon-traded (GG-CT)
- *Global fragmentation* – carbon-capped (GF-CC)

4.11 The new sensitivity and scenario testing post consultation, has focused on the AoN-CC scenario. The Commission and HAL have a similar view on passenger forecasts, although the Commission’s forecast predicts growth to occur more quickly following the opening of the new runway in 2026, and therefore projects that HAL will be able to take advantage of the increased capacity opportunities more quickly. HAL assumes a phased release of slots at the airport.

4.12 The overall costs of HAL including the Heathrow Airport North West Runway scheme are a function of the following categories:

- 1) The costs required to deliver the new capacity:
 - a) Scheme capex: the capital expenditure associated with building both the additional runway capacity and the ancillary infrastructure required to deliver this capacity.
 - b) Surface access costs: the capital expenditure, investment and operating expenses associated with building the transport links to and from the airport.
- 2) Core capex: the capital expenditure associated with the airport’s existing infrastructure, and which would be incurred irrespective of a decision to adopt the proposal for new capacity.
- 3) Asset replacement: The capital investment required to maintain or replace the capital assets of the airport as it is developed and to update the infrastructure to retain a modern airport.
- 4) Operating expenditure (Opex): The expenses associated with operating the airport, including staff costs, facilities management and utilities.

4.13 The Commission adopted the same approach to each scheme, drawing on the costs in the promoter’s proposals, financial statements and regulatory settlements along with its own independent assessment of costs to establish the cost profiles, under a range of demand scenarios, set out in the *Cost and Revenue Identification* reports issued for consultation.

4.14 Following consultation there have been some changes to the baseline cost position, which are reflected in the cost update report supporting this Business Case⁵⁴.

54 *Costs and Revenue Identification Update: Heathrow Airport Northwest Runway*

The main change to the cost elements since the November consultation has been the transfer of c £570 million (including optimism bias) in respect of the Southern Road Access Tunnel into the core capex category. The tunnel was previously included in the surface access category. The other significant change was a reduction in the level of mitigated optimism bias (OB) as discussed below.

- 4.15** Additional sensitivity analysis has also been carried in response to consultation responses.
- 4.16** Whilst the Commission considers that the range of costs generated by this analysis, and taking account of consultation responses, provides a sound basis for the robust assessment of the commercial viability and financeability of the schemes, it recognises and expects that the actual outturn scope and costs of the selected scheme will be a matter for discussion between stakeholders including the airport, airlines and the Civil Aviation Authority (CAA). The current process of constructive engagement should help shape the actual scheme that best meets market needs.
- 4.17** Just as the Commission gave a great deal of consideration to how best to reflect risk and uncertainty in its costings there was significant attention given to the matter in consultation responses. The Commission's view, which remains unchanged, is that in addition to the risks inherent in any major construction project, there is a particular degree of uncertainty introduced to these project costs because of the risks described in predicting the likely costs of additional capacity that will not be operational for over a decade. The Commission has reflected these risks and uncertainties by including a risk premium in its cost estimates and a further allowance for OB. The OB allowance reflects that a project sponsor's initial risk evaluation and pricing tends to assume relatively positive outcomes for the project, whereas in practice the overall price may prove to be higher, particularly for a complex project such as this where a number of risks interplay.
- 4.18** Whereas economic regulation may allow for an airport operator to pass on these costs to consumers in the event that they materialise, the Commission needs to consider the likely costs that consumers may be required to bear to support additional capacity. This is in line with the HM Treasury Green Book guidance, which recognises that a range of different outcomes are possible, with this range of outcomes focusing down as the scheme is developed. The result should be a reduction in the allowance for OB with time as costs move into the baseline, become identified risks or are actively managed down through the delivery process.

- 4.19** Respondents to consultation made a wide range of points both on the principles (including whether OB was applicable to a private sector project) and on the technical approach to calculating OB. The Commission is clear that given the uncertainties and the public interest in the schemes that inclusion of OB is absolutely necessary. But it has reflected on the other responses made, reviewed its analysis and a reduction in range has developed accordingly. The details are set out in the risk and optimism bias paper in the *Cost and Commercial Viability: Additional Analysis* report but the key change was a reduction in the level of OB applied to scheme capex in the financial modelling from 20% to 15%.
- 4.20** The total project costs vary depending on the demand scenario, sensitivities run and the risk premia and OB applied. Table 4.3 below summarises the range of projected cost requirements for Heathrow Airport Northwest Runway associated with each of the four demand forecast scenarios used in this analysis. It should be noted that whilst the total scheme capital costs as set out are the same for each scenario the profile of those costs is slightly different. Full detail of how these costs were derived is provided in the *Cost and Commercial Viability: Cost and Revenue Identification Heathrow Airport Northwest Runway Update* report.

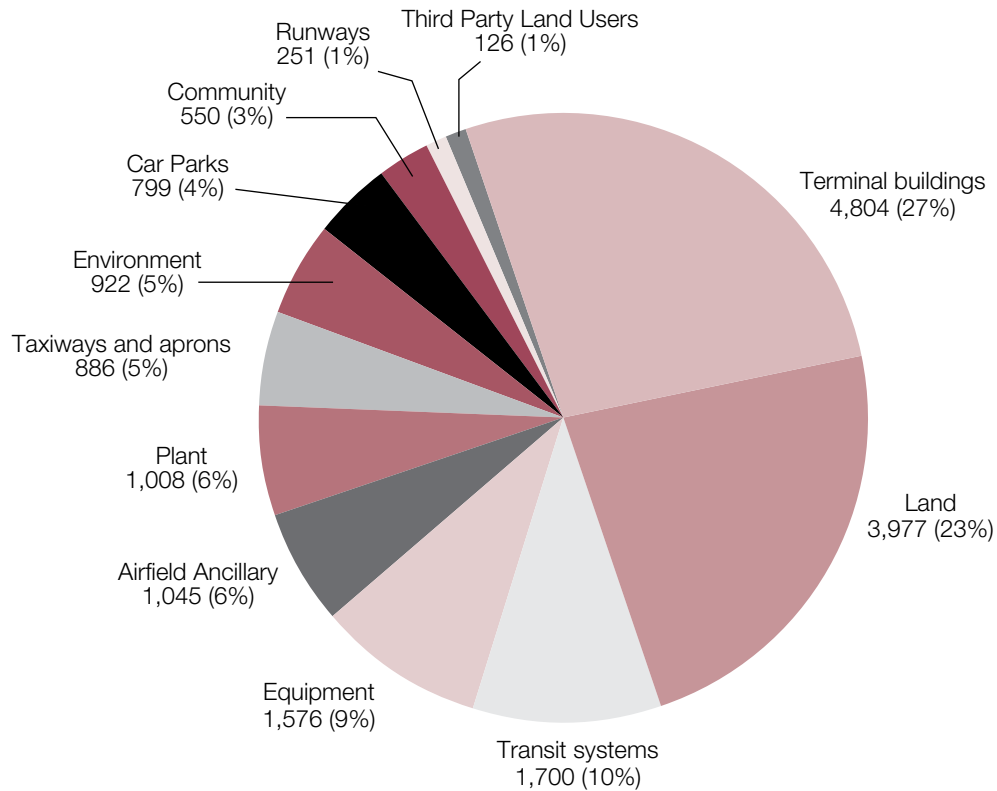
Table 4.3: Heathrow Airport Northwest Runway scheme capex cost estimates (all costs in £billion (2014 prices))

	AoN-CC	AoN-CT	GG-CT	GF-CC
Scheme Costs				
Scheme Capex, base costs	£12.8	£12.8	£12.8	£12.8
<i>Risk</i> ⁵⁵	£2.6	£2.6	£2.6	£2.6
<i>OB</i>	£2.3	£2.3	£2.3	£2.3

Source: Airports Commission analysis

55 Different base costs have different levels of optimism bias and risk assigned, for example core costs have a lower optimism bias applied, as they are better understood, whereas scheme costs have a higher amount because of the early stage of design

Figure 4.1: Scheme capex breakdown (£m), AoN carbon-capped scenario



Source: Airports Commission analysis

4.21 With respect to the scheme capex costs, as can be seen from figure 4.1 above, about half total cost relates to terminal buildings and land, with the other cost sources all much smaller parts of the total.

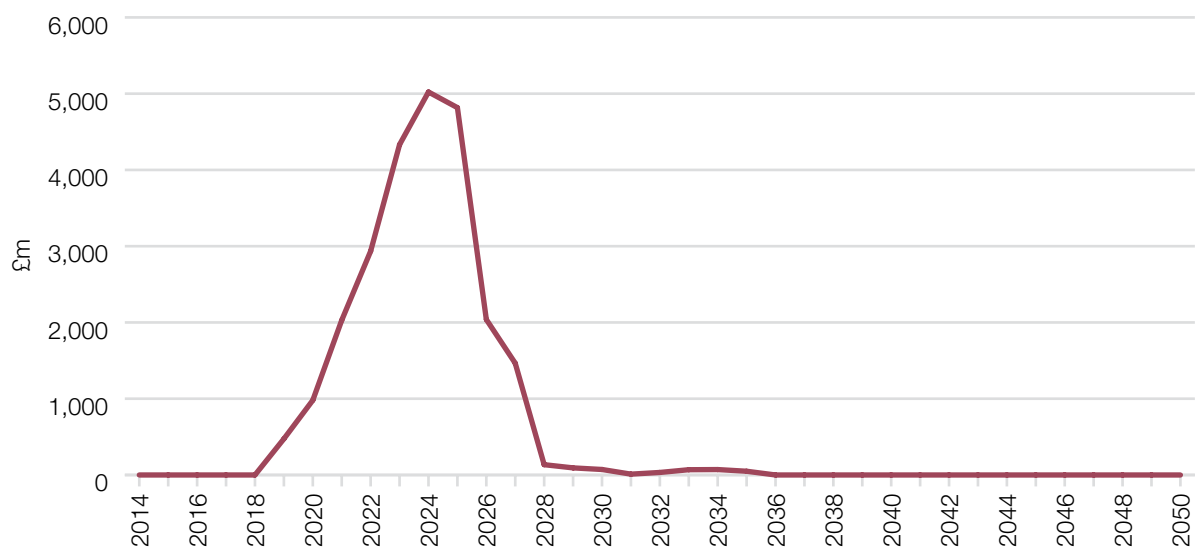
Table 4.4: Heathrow Airport Northwest Runway – cost estimates (including risk and optimism bias) (all costs in £billion (2014 prices))

	AoN-CC	AoN-CT	GG-CT	GF-CC
Scheme Costs				
Scheme Capex (see table 4.3)	£17.6	£17.6	£17.6	£17.6
Other Airport Costs				
Core Capex	£13.4	£13.4	£13.4	£13.4
Asset Replacement	£16.5	£17.1	£17.8	£16.6
Opex	£49.9	£50.8	£52.1	£49.9
Surface Access Costs				
Surface Access Costs	£5.0	£5.0	£5.0	£5.0

Source: Airports Commission analysis

4.22 Figure 4.2 below describes the profile of the estimated scheme capex requirements in real terms, based on the Commission's AoN-CC demand scenario. This is towards the low end of the Commission's demand forecasts. In a scenario where the new runway will be built between 2019 and 2025 (as proposed by HAL in their construction plan), the majority of costs would likely be incurred between 2018-2028 as the various phases of development at Heathrow (terminal, satellite and runway works) will need to be concurrent to some degree to ensure that the developed capacity can meet the growth in passenger demand. HAL's construction plan suggests that terminal and satellite works will follow construction of the runway.

Figure 4.2: Scheme Capex requirement under the AoN-CC demand scenario (£m) 2014 prices



Source: Airports Commission analysis

4.23 The Commission has also considered a range of surface access works that would be required if the runway scheme is implemented. HAL's scheme proposal includes those works that it believes would be appropriate for the airport operator to contribute to. The actual allocation of surface access costs would be a matter for negotiation between the public and private sector and is discussed further later in this report and in the *Final Report*. The analysis considered by the Commission reflects both no and full surface access cost contributions by the airport operator. The outputs of the sensitivity analysis for the scenario in which surface access costs are funded by the airport operator can be found in the *Funding and Financing Update Report*. It assumes that such costs would be accepted by the regulator as necessary and therefore as part of the RAB. This supports the view that the scheme

remains commercially viable and financeable where the costs of surface access are funded by the airport operator.

- 4.24** Finally, and in response to consultation, the Commission's consultants have looked at options to deliver the scheme, but with a reduced scope and considering the impact of this on the passenger experience. The bulk of these savings relate to lower terminal building and land costs. Again there is a range of outcomes to this analysis, but this work suggests that savings of the order of up to £2.35 billion (including £0.65 billion Risk and Optimism Bias) would be possible, albeit with a reduction in the quality of the passenger experience. The delivery of such savings, along with the optimisation of phasing of construction, would be a matter we would expect that the airport operator would take forward, in discussion with its customers and/or the CAA where that is appropriate.

Commercial Viability

- 4.25** The costs of the scheme, the ongoing costs of the airport and the financing required to support this (discussed in the next section) are met through a combination of aero and non-aero revenues. For a given demand scenario, the aero revenue can be used to determine the average per passenger charge that would be needed to meet the financing requirements. The resulting impact on passenger aeronautical charges across the Commission's four demand scenarios for Heathrow is an increase from c. £20 per passenger to a weighted average charge of c. £28-30 per passenger and a potential peak of up to c. £31 as summarised in the table below.

Table 4.5: Estimated passenger aero charges across the Commission's four demand scenarios

Scenario	AoN-CC	AoN-CT	GG-CT	GF-CC
Weighted average (2019-2050)	£29.7	£29.0	£28.2	£29.6
Weighted average (2014-2050)	£29.0	£28.3	£27.6	£28.9
Charge peak	£31.2	£29.7	£29.0	£31.0

Source: Airports Commission analysis

- 4.26** As noted in the Strategic Case, it is likely that the increase in competition arising from increased capacity addressing excess demand will support an overall reduction in available fares with aero charges being absorbed by airlines in setting prices. Moreover, airlines are expected to have the ability to structure fares such that whatever impact there is falls to a greater extent on business passengers for whom charges are in any case a small proportion of the ticket price. The level of aero charges has not changed materially from the level at consultation⁵⁶.

Financeability

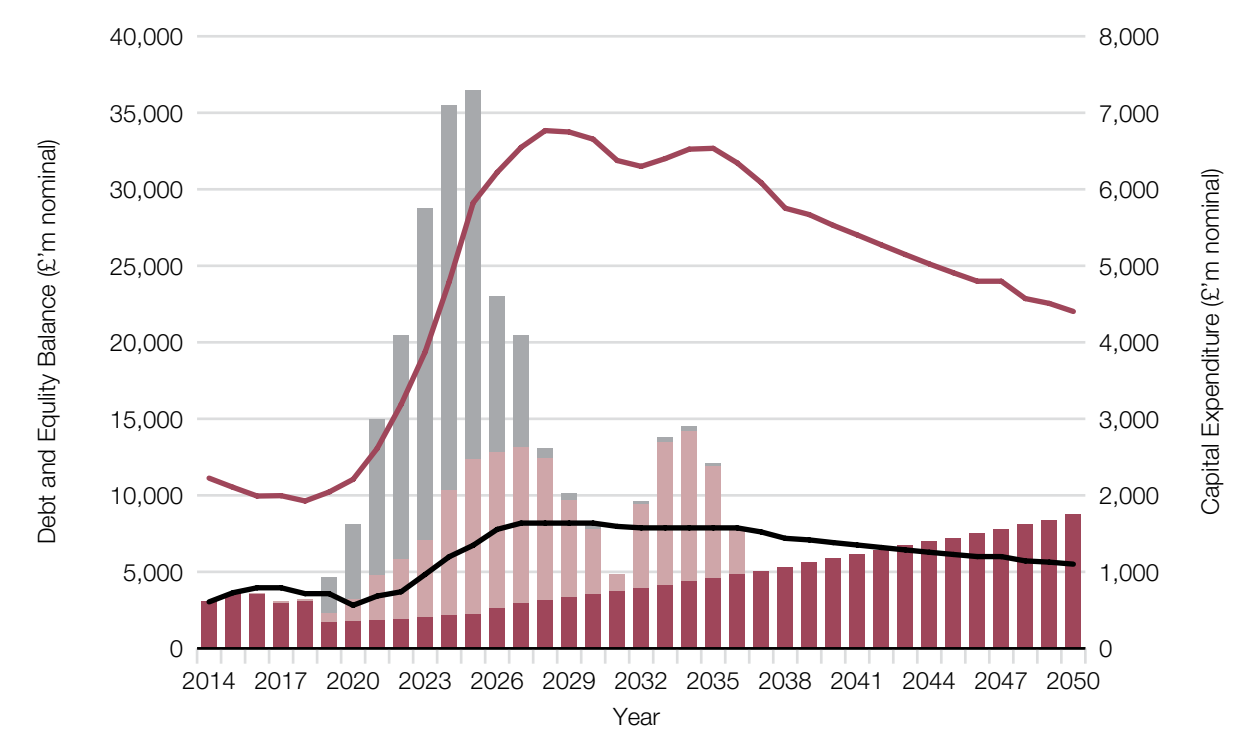
- 4.27** Heathrow Airport is privately owned and operated by Heathrow Airport Holdings Ltd. It is predominantly financed through the bond market, with current debt of c. £11.7 billion made up of A- and BBB bonds. It also has £275 million of revolving credit facilities. It has equity of c. £2.7 billion in ordinary share capital. Its current capital structure is summarised in the *Literature Review Update* and *Funding and Financing Update* report.
- 4.28** As an airport assessed to have substantial market power, Heathrow Airport is subject to price controls on the aero charges it makes by the CAA. These charges are calculated on the basis of the airport's RAB. The return on this asset base (its regulatory cost of capital), allowing for depreciation and efficient operating expenditure, is used to derive an allowable average revenue yield per passenger – the price that the airport is permitted to charge the airlines per passenger. A full description of how this aero charge is calculated is provided in the *Literature Review Update*.
- 4.29** The Commission has assumed a corporately financed cash flow approach, with the existing operator developing the scheme. It is assumed that charges are passed on to airlines in the year in which the expenditure is incurred. The Commission undertook a review of this approach in response to comments during consultation, and remains content with using this approach.
- 4.30** Taking the profile for scheme capex, and coupling it with the airport's core capex, asset replacement, opex RAB depreciation and non-aero revenues, the Commission has assessed one financing structure that it believes could plausibly meet the requirements to deliver the scheme through the issuance of bonds at a scale and structure to allow HAL to maintain its current A- credit rating⁵⁷. Where this is not possible, equity is injected. The subsequent build-up of debt and equity is

56 For example, the weighted average charged was only c.6p higher following consultation under the AoN CC scenario.

57 Details of the approach used to assess this are found in *Cost and Commercial Viability: Funding and Financing Update* report.

illustrated for the AoN-CC demand scenario in Figure 4.3 below and summarised for the four demand scenarios used in Table 4.6. This assumes no Surface Access cost contributions from HAL (discussed further below). The Commission has reviewed the assumptions about the availability of debt and equity to meet the requirements of the proposed scheme with a number of market participants. In addition to addressing the available capacity, this additional work has also considered the key risks from the perspective of these participants and the mechanisms that may be adopted to mitigate these risks, albeit recognising the difficulties inherent in predicting market conditions at the time when capital will need to be accessed⁵⁸. The Commission remains content with its assumptions about the availability of finance based on this analysis, as well as highlighting some of the risks and opportunities that may impact on availability that are presented later in Table 4.6 and discussed in the *Final Report*.

Figure 4.3: Heathrow Airport Northwest Runway Debt and Equity Balances vs. Capex for AoN-CC demand scenario



Source: Airports Commission analysis and PwC

58 For detailed information on this work please see *Sources of Finance*

Table 4.6: Additional nominal debt and equity requirements for the delivery of the scheme under the Commissions four demand forecast scenarios⁵⁹

Scenario	AoN-CC	AoN-CT	GG-CT	GF-CC
Additional debt requirement	£22.1bn	£24.5bn	£27.0bn	£23.6bn
Additional equity requirement	£5.5bn	£6.0bn	£7.0bn	£5.6bn

Source: Airports Commission analysis

- 4.31** Across the four scenarios funding the scheme would require additional debt financing in the range £22.1-27.0 billion; and additional equity in the range £5.5-7.0 billion. The illustrated increase in debt and equity required over the assessment period (2014-2050) reflects the likely availability of debt during that period. In the early stages, the scale of operations restrict the quantum of debt that can be realised, requiring greater equity injections. By contrast, at the later stages of expansion the capital expenditure is funded by a greater proportion of debt. Debt represents a slightly reduced proportion of additional financing in relation to equity compared to consultation as a consequence of responses received leading to an update in the approach to financial modelling by the Commission.

Application of Risk Framework

- 4.32** The table below applies the Commission's risk framework described earlier in this case to the overall cost and financing requirements for Heathrow Airport Northwest Runway scheme.

⁵⁹ Full details of how these have been calculated are found in *Cost and Commercial Viability: Funding and Financing Report*.

Table 4.7: Applying the Commission's Financial and Commercial Risk Framework

Risk	Description
Demand and revenue	Heathrow Airport is currently operating at full capacity and there is high demand for this capacity, resulting in low current volatility surrounding its passenger forecasts, although long-term forecasting is inherently uncertain. There are equity risks associated with the level of aero charges the airport can apply under a future regulatory framework and within a competitive operating environment. The projected estimates of aero charges at a weighted average of c. £28-30 ⁶⁰ and a potential peak of c. £31 per passenger are significantly higher than current charges across the UK. Whilst this is a significant increase in aero charges in a context where HAL will be competing with other airport operators, the Commission's review of the assumptions about the availability of debt and equity suggest that market participants believe this risk is manageable. This is consistent with the Commission's assessment of demand in the Strategic Fit module.
Cost and integration	For a project of such scale and complexity, the impacts of the price of construction and operation being higher than forecast and of the different elements not integrating properly would have significant implications on the cost exposure of the airport and on the financing and contracting risks. The Commission's forecasts include 15% for OB. The Commission has carried out further work which identifies the potential for cost reduction and moreover, HAL's cost projections are lower, and if deliverable would reduce this level of exposure.
Contracting	For an investment of this scale, it is unlikely to be possible to sub contract and so transfer all the risk as the level of risk implied is likely to be too great for the balance sheets of the contractors. The airport may therefore retain a large portion of the cost risk, and contracts would be based on a form of risk share arrangement or target price arrangement rather than a traditional fixed price arrangement. The level of exposure to this risk will depend on the extent to which it is recognised via the regulatory mechanism. It should be noted that HAL has experience in managing and delivery complex infrastructure projects, such as Terminal 2 and Terminal 5.

⁶⁰ Rounded.

Risk	Description
Financing	<p>The RAB based approach provides a level of certainty to credit rating agencies and investors and would to an extent facilitate attraction of lower cost and longer term finance. HAL may have to raise an additional c. £5.5 billion in equity and c. £22.1 billion of debt (based on the Commission's AoN-CC scenario). As described in more detail under the financing risk below, this will put HAL at the high end of the range of financing for infrastructure projects in the UK. The total size of investment grade bonds issued by UK corporates in 2013 was c. £46 billion. In any given year, the debt funding requirement for the Heathrow Airport Northwest Runway scheme peaks at around £7 billion, or 13% of 2013 total bond issuances. This is much larger than the biggest individual bond issuance for 2013 of £3.5 billion by Vodafone. Financing of this scale could make HAL of comparable scale to Network Rail (with a long-term debt of c. £35 billion) and larger than National Grid (c. £25 billion), both of which also operate in regulated environments. Network Rail's debt was guaranteed by the UK Government, making it easier to access a large amount of financing. However, the Commission's discussions with debt market participants so far suggest that there remains substantial interest in providing financing for a scheme at Heathrow, given the costs and structuring assumptions inherent in the Commission's analysis and the scheme is considered to be financeable.</p>
Investment	<p>A major element of investment risk for the scheme is how investment of this scale will be treated when determining the costs of capital, and therefore the returns on investment, under a RAB based model were this to be used. The scale of investment means that to access sufficient liquidity HAL would need to issue bonds in a number of different currencies (its bond programme currently includes GBP, USD, EUR, CAD (Canadian Dollars) and CHF (Swiss Franc) bonds) and the financing will have to command sufficient returns under any future regulatory framework to attract the required wide range of investors. The Commission's discussions with plausible future investors so far suggest that there remains substantial interest in investing in a scheme at Heathrow, although the structure of the regulatory system would be a key factor in their decision-making. Understandably, this view is expressed in the expectation that there will be a stable regulatory structure that balances efficiency requirements with the risk placed on operators.</p>

Risk	Description
Regulatory and policy	Risks associated with changes to the wider regulatory and policy environment and their consequent impact on pricing will need to be considered by the operator, along with the CAA, government and any other stakeholders. The CAA has begun discussions with its stakeholders on its plans for the economic regulation of new runway capacity, through its October 2014 consultation and March 2015 Policy Statement (CAP1279)
Timing and delivery	For an investment of this size the key element may be whether timing can be used to mitigate risk: HAL's proposals already allow for phased development; and completing revenue-generating elements such as the new runway as quickly as possible will support this.

Source: Airports Commission analysis

Risk and Mitigations

- 4.33** As discussed above the Commission has factored risk and OB into its costings. The OB assessment considered how risks could be mitigated (eg early contractor engagement, the right project management skills etc) and this is set out in more detail in the *Cost and Revenue Identification Update* report.
- 4.34** The risk framework also identifies a number of risks associated with the Heathrow Airport Northwest Runway scheme around cost and integration, contracting and financing and demand and revenue. Raising additional debt of up to c. £27 billion and additional equity of up to c. £7 billion would be significant; and passenger aero charges of c. £28-30 on average, or a potential peak of c. £31 are significantly higher than current charges across the UK and globally, based on our analysis.
- 4.35** The Commission has considered several options that may mitigate this level of challenge, identifying measures that could be implemented to support delivery of the scheme including constructive engagement with airlines and including the regulator. Some measures are discussed further in the Delivery module, others included below.

Financing Structure

- 4.36** The responsibility for delivering the scheme is expected to lie with the airport operator, and there are several possibilities for HAL to structure the financing to reduce risks. Measures could include: ensuring that the revenue-generating elements of the scheme are completed as early as possible or investigating the

possibility of pre-funding; taking steps to increase non aero revenues at the airport so that they contribute a larger proportion of total scheme costs; or value engineering to control the costs of construction (for instance through possibilities discussed in the *Reduced Scope Scenarios Costs* report. Ultimately, it will also be up to the operator of the airport to determine the most appropriate way to finance the scheme given its commercial situation and the state of the investment market at the time, with discussions where appropriate with the CAA and the UK Government.

Role of UK Government

4.37 From the Commission's market soundings, based on the range of sensitivities presented at consultation, the scheme is considered to be financeable in a situation where all of the surface access costs are borne by the scheme promoter, however the Government may decide, for instance in a situation where the risks noted above increase, to contribute funding to some or all of the surface access requirements, and a commitment to do so may provide investors with a level of assurance and so reduce the price they place on the risks discussed. The Commission has not found evidence to suggest that the scheme requires the use of a government guarantee mechanism to be financeable, but notes that the availability of such a mechanism could help to mitigate financing risks. There may be other options for public sector involvement that the government of the day wishes to explore but the Commission's analysis suggests that this sort of proactive partnering is not a requirement for the scheme to be financed. Some consultees have raised concerns about whether UK government involvement in the scheme, of any of the types discussed, would be incompatible with European State Aid rules. The details would need to be discussed with the European Commission and the Government but so far the Commission remains confident that a reasonable and controlled amount of government engagement could be defined in a way that remained compatible with the rules. Further discussion of all of these issues, and the wider topic of the appropriate delivery vehicle, is covered in the *Final Report*.

Role of the European Investment Bank (EIB)

4.38 The EIB is the European Union's bank, owned by and representing the interests of the European Union Member States, including the UK. The EIB provides finance for investment projects which contribute to furthering EU policy objectives, including airports and HAL does have existing loans outstanding with the EIB. There may be an opportunity for the scheme to secure financing from the UK allocation of EIB

lending, which could be used to supplement any debt required from the private market.

- 4.39** The Commission's analysis suggests that this could well be valuable as a part of the mix of finance to deliver the scheme, but recognises that any loan would need to reflect the policy requirements of the EIB as part of its overall mandate and assessment criteria.

Regulatory Structure

- 4.40** To derive an understanding of aero charges and financing required, the Commission has modelled a corporately financed cash flow expansion of the scheme within the existing airport operator. It is assumed that aero charge revenues will increase as required in the year in which costs are incurred. Using this set of assumptions the scheme can be effectively financed. This is a level of pre-funding consistent with the development of Terminal 5, but the Commission recognises that a range of outcomes are possible. Some market participants have noted that for equity in particular, a longer term review period could reduce perceived risks in investing in the scheme, with a term extending until, for instance, the runway was in full use. Any considerations of this nature are a matter for the CAA, but have a material bearing on the ability to finance the scheme.

Commission Assessment

- 4.41** As set out in the Strategic Case, Heathrow has low passenger forecast volatility and so a high degree of stability, and operates in a well-known and understood regulatory structure, making it an attractive opportunity for investors. The Commission's analysis is that the scheme is commercially viable and financeable without government support. That remains true even in the case where HAL would be required to pay 100% of the surface access costs associated with the scheme.
- 4.42** There are risks associated with this result, as there would be for any undertaking of this type. The scale of debt and equity requirement that would need to be raised would be extensive compared to other infrastructure projects. This is true both of the requirements over the life of the scheme (at c. £5.5 billion in equity and c. £22.1 billion of debt in the AoN-CC scenario) but also taking into account individual bond issuances, which would represent, at peak a level equivalent to 13% of 2013 investment grade bonds issued by UK corporates. Such a scale of investment relies on the commercial proposition being attractive to large scale institutional investors, and the Commission's analysis, particularly the market-sounding exercises since consultation, suggests that there is appetite for the scale of investment at Heathrow

from such investors, subject to a stable regulatory environment and ongoing political support.

- 4.43** The scale of the costs also drive an increase in aero charges at an airport where these are already high (from £20 moving to a weighted average of £29) compared to its international competitors. However, these charges remain a relatively small aspect of the ticket cost, (and may well not all be passed on to passengers) and the analysis undertaken suggests they would not reach a level that would deter legacy airlines from operating at the airport (although low-cost carriers may find these charges harder to meet given their business models).
- 4.44** There are also several opportunities to manage these risks. The operator can work with its contractors and customers to value engineer the proposition bringing costs, and so the requirement for financing, down. The operator can also work with government to support the delivery of any surface access development and with the regulator to maintain stable and clear regulatory settlement, both of which can give confidence to investors. Responsibility for delivering the scheme and managing these risks is expected to lie with HAL.
- 4.45** In comparison, the Heathrow Airport Extended Northern Runway scheme has lower build costs, translating into lower aerocharges and financing, as can be seen in the table below.

Table 4.8: Aero charge and debt and equity requirements for the three schemes, compared to current carbon-capped 2014 prices

	Weighted average aero charge (current)	Peak equity (current)	Peak debt (current)
LGW 2R	£16 (£9)	£2.7bn (£0.3bn)	£11.5bn (£1.6bn)
LHR ENR	£28 (£20)	£7.3bn (£2.7bn)	£30.4bn (£11.7bn)
LHR NWR	£29 (£20)	£8.2bn (£2.7bn)	£33.8bn (£11.7bn)

Source: Airports Commission analysis

- 4.46** The broad scale of the costs are similar, and the investment would be at the same airport, so despite this slight difference the risks and opportunities faced by the scheme would be broadly similar.

- 4.47** At Gatwick the costs are much lower, and the commercial proposition of the airport very different, which drives a different analysis. Clearly the scale of the debt and equity requirement is lower and consequently the risk for the Heathrow schemes simply in terms of the scale of the funding requirement would not be present. The scale of aero charge increase at Gatwick would still leave it very competitive against Heathrow, and the Commission's analysis does not suggest at the moment that they could not be met by the low-cost carriers that currently serve Gatwick.
- 4.48** The risks for Gatwick are more focused on the demand side. The Commission's forecasts show a wider range of results across different demand forecast scenarios, and Gatwick also faces much more competition in its current short-haul low-cost provision than Heathrow faces for its legacy long-haul focus. This high demand risk would be a consideration for investors and lenders. However, the financial market-testing carried out suggests that while this risk is present, it is manageable.
- 4.49** Overall the Commission considers that the Heathrow Airport Northwest Runway scheme performs strongly against the objective to be affordable and financeable, including any public expenditure that may be required and taking account of the needs of airport users. While the issues around demand risk for the Gatwick scheme were considered to be slightly more significant by the investor community than the market capacity risks faced by the Heathrow proposals, all three scheme are commercially viable and financeable, and perform strongly against this objective.

5. Management Case

Commission Objectives and Appraisal Modules

5.1 The Management Case has been developed to assess the overall achievability of each scheme, including its engineering and operational viability, and the associated risks. The Commission's objectives for the Operational Efficiency Module are for the scheme:

- ***To ensure individual airport and airports system efficiency;***
- ***To build flexibility into scheme designs;***
- ***To meet present industry safety and security standards; and***
- ***To maintain and where possible enhance current safety performance with a view to future changes and potential improvements in standards.***

5.2 The objective for the Operational Risk Module is for the scheme ***to enhance individual airport and airports system resilience***. The objectives for the Delivery Module are for the scheme:

- ***To have the equivalent overall capacity of one new runway operational by 2030; and***
- ***To actively engage local groups in scheme progression, design and management.***

5.3 These will be the key objectives considered in the Management Case.

5.4 The Management Case will also consider overall achievability and operational viability of the Commission's Surface Access Objective⁶¹, and considers the operational effects of the Commission's objectives with respect to Place and Water and Flood Risk. The Commission's objective to actively engage local groups in scheme progression, design and management is considered in detail in the *Final Report*.

5.5 For simplicity and comparability with the materials published for consultation, the Management Case has been structured around three key questions:

⁶¹ To maximise the number of passengers and workforce accessing the airport via sustainable modes of transport; to accommodate the needs of other users of transport networks, such as commuters, intercity travellers and freight; and to enable access to the airport from a wide catchment area.

- **Question 1: Do the design components of the scheme as now envisaged have a credible level of potential to satisfy the Commission's assessment that there is a need for one net additional runway's worth of capacity, capable of delivering 170,000-200,000 additional air traffic movements (ATMs) annually, by 2030?**
- **Question 2: How would the transitional steps towards the delivery of new infrastructure be managed and can the Commission be satisfied that robust structures are in place to allow these steps to proceed?**
- **Question 3: What are the key risks (in terms of planning, financing, construction, public and political deliverability and resilience to legal challenge) that must be mitigated if the scheme is to be delivered?**

Key Impact Areas

5.6 Whether the scheme can actually be delivered and operated to meet the Commission's assessment of need of one net runway's worth of capacity by 2030, will have a knock on effect on all of the various costs and benefits of the scheme. If the capacity cannot be achieved because of, say, airfield design pinch points or planning issues, then the number of ATMs delivered could be reduced or delayed, leading to reduced economic and connectivity benefits. Delays due to key risks to the delivery of the scheme coming to pass may stop the airport being delivered at all or increase costs of the build. The operations of the airport will also have airspace impacts which could impact on other airports in the London system and passengers if inefficiencies cause delays. Local communities will also be impacted by the delivery of the scheme and how they are engaged – this is discussed in detail in the *Final Report*.

Consultation Evidence Base

5.7 As part of its national consultation the Commission published:

- The Management Case for each scheme, as part of each scheme's *Business Case and Sustainability Assessment*⁶².
- Technical reports on the operational efficiency, operational risk and delivery analysis: an airspace efficiency report, a ground infrastructure report for each scheme, a preliminary safety review from NATS, an airspace resilience report and a risk assessment and mitigation report.

- The consultation report also drew on Surface Access, Place and Water and Flood Risk detailed analysis.

Updates to Evidence Base

5.8 The evidence base has been reviewed in light of consultation responses. New work was carried out to enhance the evidence base in seven particular areas:

- Dynamic network modelling of surface access impacts, which was used to validate the results of the analysis the Commission published for consultation in respect of schemes' performance against surface access objectives. The results of the dynamic network modelling in respect of the Heathrow Airport Northwest Runway (LHR NWR) scheme did not significantly differ from the results of the static modelling that informed the documents published for consultation. The dynamic modelling was also used to inform air quality dispersion modelling and to identify the impacts of expansion upon congestion on specific local and strategic roads in the vicinity of the airport. This work largely validated the results of the work published for consultation, but has also provided an evidence base that could be used to inform later discussions regarding local road enhancements and any HAL contribution to them in the event of this scheme being progressed.
- Assessment of the impacts of the increased levels of road freight expected to arise as a result of shortlisted schemes; which was used to identify the impacts on roads in the vicinity of the airport arising from an increase in road freight movements following a rise in air freight at the expanded airport. In the case of the Heathrow Airport Northwest Runway scheme, the impacts of increased freight on overall road congestion were not found to be significant, but the work did identify a number of communities which might suffer adverse quality of life impacts due to an increased number of goods vehicles on their roads.
- Further analysis of the resilience of shortlisted schemes' surface access links; which was used to test how the airport's surface access strategy would respond in the event of significant disruption. In the case of the Heathrow Airport Northwest Runway scheme, this work identified some concerns about the impact of minor disruption on levels of road congestion. The work did, however, identify that the number of road and rail links serving Heathrow provides the airport with good resilience against a major incident requiring the closure of one of those links.

- Analysis of the scope for demand management techniques to promote further mode-shift towards public transport (with specific relevance to Heathrow) which was used to test the demand management scenarios that would be required to produce sufficient mode shift that there were no more airport-related trips on the road network in 2030 with expansion than in 2013.
- Fast Time Simulation of the airspace impacts of shortlisted schemes which has identified the level of challenge associated with accommodating the increase in traffic arising from both background demand growth and airport expansion within the UK's airspace systems.
- Analysis of the crash risk associated with shortlisted schemes.
- Review of delivery timescale assumptions for all three schemes

Approach and Outcomes

Question 1: Do the design components of the scheme as now envisaged have a credible level of potential to satisfy the Commission's assessment that there is a need for one net additional runway's worth of capacity, capable of delivering 170,000-200,000 additional air traffic movements (ATMs) annually, by 2030?

5.9 During 2014, the Commission developed its understanding of the proposal to a greater extent than it had prior to its *Interim Report*. It was assisted in this process by the Updated Scheme Design submitted by Heathrow Airport Ltd (HAL) during May 2014. In November 2014, the Commission published the details of the scheme as it was then understood. HAL have continued to develop their scheme design since this point and that further design work would be necessary before any construction begins.

5.10 The Commission's understanding of the scheme and its implications has been further enhanced by responses to its national consultation exercise and by work carried out in response to that exercise. The Commission has now, therefore, updated its assessment of the scheme's performance against the following criteria:

- Whether the proposed airport infrastructure (runways, terminals, taxiways and other ground infrastructure) is likely to be capable of supporting safely at least an additional 170,000-200,000 ATMs.

- Whether it is likely that airspace structures can be delivered to accommodate additional traffic at this level, taking into account any impacts the scheme may have on other airports in the London and South East system.
- Whether the proposed surface transport infrastructure and services present a credible means of supporting the growth in capacity without undue impacts on other users of surface transport networks.
- Whether there are credible solutions to other challenges associated with airport expansion, such as increased waste output and increased need for water resources.

Airport Infrastructure

- 5.11** HAL indicated in its Updated Scheme Design that it estimates that the scheme would allow the airport to accommodate 740,000 ATMs, an increase of 260,000 on the airport's current capacity in two-runway segregated-mode operations. Analysis carried out by the Commission's consultants prior to the national consultation exercise confirmed that this was a realistic estimate of the capacity provided and consistent with maintaining or improving current levels of resilience at Heathrow.
- 5.12** Some responses to the consultation sought to call into question the estimated level of capacity that would be provided. The Commission asked its technical consultants to review these responses. On the basis of the runway and taxiway configuration, and the proposed method of operation, the Commission remains of the view that 740,000 ATMs represents a credible estimate of the level of the additional capacity the scheme could provide. This is discussed further in the *Operational Efficiency: Post Consultation Phasing and Facilities Review*.
- 5.13** The masterplan presented in the Updated Scheme Design is compatible with a full range of future fleet mix scenarios. Some responses to consultation questioned whether the proposed airfield would be able to accommodate a significant increase in low-cost carrier traffic. The Commission asked its consultants to review this and is satisfied that there are plausible airline-stabling strategies to allow the airfield to satisfy the needs of low-cost carriers in a scenario where such traffic represents the major component of demand growth.
- 5.14** The scheme promoter has proposed a phased introduction of terminal capacity, with new terminal facilities and the redevelopment of existing terminals being introduced as required by growth in demand. The Commission is currently satisfied that the phasing proposed by the promoter is credible and should, taken alongside

improvements scheduled to occur regardless of decisions on new runway capacity, improve on the present passenger experience.

- 5.15** The Commission has taken advice from the Civil Aviation Authority (CAA) on the safety of the proposed infrastructure. The CAA has undertaken a preliminary safety review, which has identified a number of issues that would need to be resolved via detailed design. These are, however, issues of a nature and scale which would normally be expected at this stage in the process of planning new airport infrastructure and the Commission is satisfied that they do not present a challenge to the overall credibility of the proposal. This view has not been materially altered by responses to the national consultation exercise.
- 5.16** The scheme requires constructing the new runway over the M25 motorway. On the basis of the evidence available following consultation, the Commission believes that while this would represent a major project, it can nevertheless be managed in a manner which is safe and does not cause undue disruption to users of the M25 or other roads in the vicinity.
- 5.17** The proposed airfield expansion would require the removal and replacement of the Lakeside Energy from Waste plant. The plant, while not of national importance, nevertheless plays a significant role in regional and local waste management and has a valuable capability to process clinical waste and other contaminated material. Its replacement is not considered an optional component of the scheme. The planning and construction of an Energy from Waste plant is a substantial exercise in its own right, whose timescales are not substantially shorter than the delivery of new runway infrastructure. The process of planning and provision of an alternative facility would, therefore, need to begin soon after a decision to proceed with airport expansion. The Commission has noted that the scheme promoter has begun discussions with the owners of the facility. This is a positive step, as the issue would require rapid resolution in the event of a decision to move forward with this scheme.
- 5.18** Responses to consultation have also indicated that the scheme would impact upon the Colnbrook Freight Branch and its goods yard. Network Rail has said that this yard is an important site for managing the flow of aggregate goods into London and that its replacement would be required. This would need to be taken forward as part of the detailed design process.
- 5.19** The Commission's assessment is that considering the likely planning, legal and construction stages, the new runway might plausibly be delivered by 2026. A number of responses to the consultation, including responses from other scheme promoters, called this date into question. The Commission has reviewed evidence

submitted to it and considers that, on the basis of the assumptions it has documented regarding the time needed for planning and legal processes, which have been applied consistently across all three schemes, the estimated opening date of 2026 remains credible. This assessment is based on plausible estimates of time required for planning and decision making processes: the construction of the scheme is well understood and while the placement of the M25 into a tunnel would be a substantial process there is no reason to believe that the scheme would be subject to significant delays once construction has commenced.

- 5.20** As with any project of this scale, estimated delivery dates must be treated with a degree of caution at this stage. On the available evidence, the Commission believes that the largest risks to the 2026 date may arise from the tunnelling of the M25 and the relocation of the Energy from Waste plant. These risks might, however, be managed in a way which ensures delivery by 2026 and the Commission believes that the extent of the risk that the scheme could not provide one additional runway's capacity by 2030 is very low. New terminal infrastructure would be delivered in a phased manner in line with demand. This is compatible with the Commission's assessment of need.

Airspace Structures

- 5.21** NATS have advised on the airspace structures that would be required to support the scheme. At the point of consultation, NATS had conducted a desk-based study. This has since been supplemented by Fast Time Simulation, which has provided greater clarity regarding the airspace structures required and the impact upon the wider airspace system.
- 5.22** NATS have confirmed that the promoter's estimated capacity increase can plausibly be delivered within the required timescales. The delivery of any new capacity within the London and South East system will require substantial redesign of current airspace structures and Heathrow's interactions with other airports such as London City and London Luton will need to be addressed at the design phase.
- 5.23** Following Fast Time Simulation, the scheme is not expected to have a negative impact upon the capacity of any other major commercial airport in the London airspace system. However, advice from NATS has identified a high likelihood that the new runway would have significant operational impacts on RAF Northolt, a military airfield six miles north of Heathrow, which also accommodates a number of civilian movements. Possible mitigations may range from tighter co-ordination between the control towers of Northolt and Heathrow or the limitation or removal of civilian traffic at Northolt. The loss of civilian traffic at Northolt would have no

significant impact upon overall levels of traffic within the London and South East system, though Northolt's military role is more significant.

- 5.24** Recent trials of revised flight paths at Heathrow and Gatwick have met with considerable public opposition. Processes for discussion of and consultation on new flight path designs will need to be considered carefully to ensure the delivery of a credible final airspace design. The Commission's *Final Report* sets out recommendations for how these processes might be improved in future, including through the establishment of an independent aviation noise authority.

Surface Transport

- 5.25** The scheme promoter's Updated Scheme Design set out a range of surface transport improvements that would support the proposal, containing a mix of already committed schemes and bespoke works to support expansion. Some of the already committed schemes, such as Crossrail, are extremely significant additions to Heathrow's surface transport mix. Western Rail Access, which lacks a final funding agreement but is otherwise a highly developed scheme expected to be delivered regardless of decisions on airport expansion, dramatically improves journey times for rail passengers travelling to Heathrow from the west. Connectivity to the north would be enhanced by a rail link from the HS2 interchange at Old Oak Common.
- 5.26** The scheme promoter has further proposed a Southern Rail Access Link. The Commission's *Interim Report* recommended that Government launch a study into such a link. This study is ongoing and the scheme promoter has not, therefore, provided a detailed design for the Southern Rail Access Link.
- 5.27** The Commission received a number of consultation responses regarding the Southern Rail Access Link. Some of them acknowledged its importance, but also highlighted the design issues that had undermined the previous Airtrack scheme. As part of their more detailed dynamic network modelling, the Commission's consultants decided upon a specific option, which assumes that no additional train paths could be provided through Richmond, due to the need to provide reasonable time for traffic to navigate level crossings; an issue that was key in undermining support for the previous Airtrack scheme. This has provided sufficient certainty that a credible and deliverable option for the scheme can be identified, though longer term capacity issues may require further upgrades to the line beyond 2030.
- 5.28** The Commission's appraisal, based on the currently available evidence, has indicated that even with an additional runway, Heathrow's contribution to crowding on the rail lines serving the airport is marginal. However, background demand

growth on these lines presents a challenging picture, with the Piccadilly Line expected to be highly congested by 2030 (though within capacity limits) and Crossrail expected to be essentially operating at or beyond full capacity. The track access rights for the Heathrow Express service are due to be renegotiated in 2023 and while the Commission has, for appraisal purposes, made an assumption that the service will continue on its present basis, it has noted that demand growth pressures on the Great Western Main Line (GWML) means that this assumption must be treated with a degree of caution. The Commission has noted the potential for a number of changes to the Heathrow Express service, including changes to its fare structure.

- 5.29** Even with likely incremental enhancements, sections of the GWML will have more demand than they can accommodate after 2030, although airport expansion would still only be a small contributing factor. With diminishing scope for incremental capacity improvements over time, more substantial infrastructure investments may be required. The Commission's consultants have identified some of the possible options for this (though their list is not exhaustive) and it is clear that these options all bring significant challenges. On the basis of the available evidence, however, the Commission believes that given the timescales involved, it is likely that a suitable solution can be identified and implemented.
- 5.30** The relative diversity of routes that will serve Heathrow by 2030 presents opportunities for rebalancing passenger flows through fares structures and other demand management measures.
- 5.31** In terms of road access, the scheme promoter identified a number of changes to local roads required to accommodate the expanded airport site, as well as managed motorway schemes (most of which are already planned) and alterations to junctions expected to serve the airport. In the light of ongoing air quality issues in the vicinity of the airport (driven chiefly by background traffic rather than airport traffic), the scheme promoter has made limiting the number of additional road vehicles resulting from expansion a key priority.
- 5.32** At the point of consultation, the Commission had identified a possible need for significant road widening above and beyond that identified by HAL, particularly in respect of the M4. HAL's consultation response has set out objections to this identification. The Commission has, therefore, carried out more work to help it understand the nature and scale of the road interventions required.

- 5.33** The more detailed network modelling carried out by the Commission has largely validated the findings of its pre-consultation work; a number of key road links are expected to go over capacity in 2030 as a result of airport expansion. The Commission has, therefore, continued to attach the costs of the widening required to alleviate this problem to the scheme. The Commission recognises, however, that road widening represents only one potential solution to the issue of over-congested road links. The Commission asked its consultants to undertake more work to understand the demand management measures that would be likely to be effective in achieving the scheme promoter's target of "no additional airport related traffic on the roads in 2030 compared to today".
- 5.34** The analysis has shown that assuming the airport takes reasonable steps to encourage employees to use public transport, an access charge of £20 for private cars and taxis accessing the airport site would allow the airport to realise its target. The Commission supports such a measure and this is discussed further in the *Final Report*. However, while such a scheme may be within the scheme promoter's ability to deliver (though likely to be more effective if backed by Government action), wider demand management measures affecting the M4 and M25, and other roads, could produce greater impacts, potentially at a lower cost to individual road users (and would reflect the fact that the airport is only a small factor in demand growth and congestion). Such demand management schemes, however, would require local and national government co-operation.
- 5.35** More broadly, the detailed network modelling has confirmed that many of Heathrow's surface access links are likely to be highly congested by 2030. Even though the airport's impact on this increase in congestion is only marginal, the level of congestion is such that even a minor increase cannot be discounted. Using demand management measures to shift road users onto rail would increase the impacts of expansion on those rail links. The Commission's work would indicate that removing the premium price for travel on the Heathrow Express, allowing an otherwise under-utilised service to carry a larger share of demand, would be a highly desirable measure.
- 5.36** In response to points raised in consultation, the Commission conducted further analysis around the impact of increased air freight on Heathrow's road network and of the resilience of Heathrow's surface access links, as well as more general work on the impact of expansion on local roads.

- 5.37** In respect of road freight, forecast growth in air freight at an expanded Heathrow would not have a noticeable impact on levels of road congestion. The increase in freight traffic would, however, result in a noticeable increase in the number of goods vehicles using roads through some local communities. This is discussed in more detail in the *Economic Case and Sustainability Assessment*. In May 2014 HAL suggested operational measures to mitigate against these impacts. These options would require further development as detailed designs and operational plans are developed.
- 5.38** In terms of resilience, the further work has demonstrated that levels of congestion on the road network in the vicinity of Heathrow will mean that relatively minor incidents (single lane closures) will result in significant temporary spikes in congestion. On the other hand, the diversity of road and rail links serving the airport means that it is reasonably well placed to handle a major incident (an all-lanes closure or the temporary loss of a railway line), even though congestion and crowding will increase for the duration.
- 5.39** The additional work on local road impacts has highlighted a number of areas in which increased congestion would be possible as a result of expansion. The precise impacts would become clearer during the detailed design process and it would be most appropriate for them to be addressed at that stage. The scheme promoter should engage with relevant local authorities to discuss their appropriate funding contribution to these works, but does not expect the cost of this to materially affect the case for the scheme.

Heathrow Hub Station

In its *Interim Report*, the Commission also said it would consider the “hub station” proposition advanced by Heathrow Hub Ltd (HHL) as a detachable concept which could be attached to either of the proposed airfields.

Accordingly, both of the proposed Heathrow airfield designs were subjected to a core appraisal based on a surface access package similar to that proposed by HAL, while a separate appraisal report on the “hub station” concept was published for consultation.

The report identified a number of likely impacts of the “hub station” concept. These included some positives, such as improved journey times for passengers arriving at the airport from the west and the potential to reduce road congestion by bringing passengers off the M4 and M25 at different junctions. There were also some negatives identified, such as the journey time penalty suffered by passengers from the west travelling to central London, the higher capital cost than the alternative Western Rail Access to Heathrow scheme and the potential loss of air quality benefits if further commercial development around the station site turned it into a trip-magnet.

Responses to consultation were mostly unsupportive of the “hub station” concept. Some airline responses were critical of the increased cost and more complicated passenger experience. Local authority responses indicated that the scheme did not align with established long-term transport plans and worried that it would result in increased road congestion on vulnerable links.

Other Challenges

- 5.40** Flood risk mitigation: the proposed airfield expansion would, absent mitigating actions, somewhat increase the severity of an already extant flood risk to properties in the vicinity of the Heathrow site, principally to the west and south west of the site. The Commission believes that appropriate mitigating actions are possible and would need to be developed at the detailed design stage. The Commission’s view on this issue has not been materially affected by responses to consultation.

Question 2: How would the transitional steps towards the delivery of new infrastructure be managed and can the Commission be satisfied that robust structures are in place to allow these steps to proceed?

5.41 The delivery of new airport infrastructure is not a simple process. The Management Case covers the specific processes required to deliver the components of the scheme, specifically:

- Airport Infrastructure
- Airspace Design
- Surface Transport

5.42 The Commission has revisited its earlier assessments of the deliverability of these components in light of responses to its consultation.

Airport Infrastructure

5.43 The scheme in its current form reflects well-understood international standards and principles. Perhaps the most complicated issue relating to the design is the requirement to place the M25 motorway into a tunnel under the new runway. This is reflected in the indicative 2026 opening date.

5.44 Following a decision to move forward with the scheme, HAL would continue with detailed design work, resulting in further refinements of the proposal, though not to the extent of substantially changing the design's capacity. The Commission expects that this process would take place in parallel with political and planning processes.

5.45 The Commission notes the well-understood nature of the scheme and does not believe that there would be any particular problems associated with the procurement of specialist resource to undertake detailed design and construction.

5.46 The Commission's view on these issues has not been materially altered by responses to its consultation.

Airspace Design

5.47 UK airspace systems are already undergoing substantial redesign as part of the Future Airspace Strategy and London Airspace Management Programme. The airspace design work for the Heathrow Airport Northwest Runway scheme could be integrated into these programmes to ensure timely delivery. Careful management of

these programmes, some elements of which require sign-off from the Secretary of State for Transport, will be important.

- 5.48** The Fast Time Simulation exercise that NATS carried out during the consultation period has emphasised the importance of a comprehensive programme of airspace redesign, regardless of whether new airport capacity is delivered. The Heathrow Airport Northwest Runway scheme presents a lower challenge than the do minimum scenario, as it continues the trend towards treating Heathrow as a “centre of gravity” in the UK’s airspace system, and the provision of extra runway capacity is useful in managing the forecast increase in traffic.
- 5.49** The Commission notes the difficulties associated with recent trials of airspace design changes at Heathrow and is clear that better involvement of noise-affected communities in the airspace design process will have an important role to play in mitigating risks in this area. The Commission’s *Final Report* sets out recommendations for improving these processes.

Surface Transport

- 5.50** Rail infrastructure funding decisions in the UK are, with the exception of certain very large projects (such as HS2), made within the framework of a regulatory system which fixes outputs and funding over five year control periods. Some of the enhancements required to support the Heathrow Airport Northwest Runway scheme form part of the Control Period 5 (2014-2019) settlement. HS2 and Crossrail are major projects which are being delivered outside of the Control Period system. The Southern Rail Access project would need to be procured via a later Control Period settlement, most likely Control Period 6 (2019-2024) or Control Period 7 (2024-2029).
- 5.51** Rail services are specified in franchise agreements, between the Secretary of State for Transport and a Train Operating Company. Franchises relevant to Heathrow are expected to be renegotiated prior to the planned 2026 opening date for the new runway, allowing for any service pattern changes required to be specified in advance. Track Access Rights for the Heathrow Express are due to be renegotiated in 2023, which may result in changes to the service specification (including potential integration with Western Rail Access).
- 5.52** The Commission’s view is that the UK’s processes for planning and delivering rail infrastructure and services are sufficient to allow confidence that the improvements assumed to form part of the Heathrow Airport Northwest Runway scheme could be delivered.

- 5.53** In respect of road infrastructure, the Commission has noted that while the UK has not previously had a system parallel to that which exists for planning rail infrastructure, much progress has been made on aligning the Highways England funding and forward planning processes over the last year. The Highways Agency is continuing to develop its strategic plans for the network and the nature and scale of the improvements required to support the Heathrow Airport Northwest Runway scheme, while challenging, are compatible with what might reasonably be delivered through current planning and delivery mechanisms.
- 5.54** The delivery of surface access improvements may require negotiations between Government and HAL regarding the allocation of costs. The Commission has tested a range of scenarios regarding the funding of surface transport infrastructure but eventual decisions on such funding will be a matter for discussion between the Government and HAL.

Risks and Mitigations

Question 3: What are the key risks (in terms of planning, financing, construction, public and political deliverability and resilience to legal challenge) that must be mitigated if the scheme is to be delivered?

- 5.55** The report published for consultation covering Module 16: Delivery identified the key risks associated with the schemes under consideration. Some of these risks were common to all schemes, as they reflect general risks associated with airport expansion schemes. Some risks, however, were specific to the schemes at Heathrow, or the Heathrow Airport Northwest Runway (LHR NWR) scheme. The Commission has identified a number of such risks, of which the highlights are:
- 5.56** *Local airspace design likely to be complicated:* Trials of airspace change at Heathrow during 2014 highlighted the difficulties involved in making changes to established traffic management procedures. The lack of change in London airspace over a period of decades reflects the difficulty of making changes of this type. As with other schemes, the successful delivery of new capacity at Heathrow is likely to be dependent upon the successful delivery of the Future Airspace Strategy and London Airspace Management Programme.
- 5.57** *Tensions regarding utilisation of rail links:* These are likely to be seen as early as 2023, when the track access rights for the Heathrow Express service are due for renegotiation. The Commission's dynamic network modelling of surface access impacts has emphasised the congestion pressures across Heathrow's networks by 2030. It is clear that with or without airport expansion, Government will need to take

decisive action to address long term capacity issues arising from background demand growth. This may involve the provision of new infrastructure, demand management, or a combination of the two. The additional challenges presented by airport expansion are not a transformative factor that would significantly change the scale of these challenges. The diversity of links serving Heathrow allows some scope for demand balancing.

5.58 *Rules on air quality may present challenges:* There are three main risks related to this scheme in relation to air quality. First, the risk that fleet-turnover does not produce the expected reduction in relation to per-vehicle emissions. Second, the risk that the anticipated shift towards sustainable modes of transport does not occur to the extent expected. Third, the risk that European rules on air quality are further tightened during the delivery period. The scheme promoter has further identified demand management measures such as road vehicle access charging which, while not forming part of the core surface transport package, could be used to promote further mode shift or the use of less polluting vehicles to access the airport. The Commission's further work carried out in response to consultation has indicated that these measures may be successful, although it is clear that given the balance between background and airport traffic, a Government-led measure applicable to background traffic would be more effective than a site-specific measure applied by the scheme promoter.

5.59 In response to the Commission's Air Quality consultation several respondents raised a concern that, due to legal requirements surrounding EU limit values, development at Heathrow could be subject to legal challenge, and hence the delivery of the runway in line with the Commission's assessment of need could be compromised. This is discussed in detail in the Air Quality section of the *Sustainability Assessment and the Air Quality Consultation Summary* report but in summary the Commission recommends that new runway capacity at Heathrow Airport should only be released when it is clear that air quality at sites around the airport will not delay compliance with EU limits and that this should be a legally binding planning condition. The Commission's assessment is that the air quality issue around Heathrow is a manageable part of a wider problem, the underlying causes of which will need to be addressed by the UK Government. The recent Supreme Court ruling requiring the UK Government to submit an action plan to the European Commission detailing how it will comply with limit values for NO₂ creates a supervised process for national and regional measures required to resolve the background air quality issue. Active monitoring during the design and implementation process for the runway as well as an appropriate form of risk-sharing and liability between Government and the airport may be required.

- 5.60** The November 2014 Management Case for each of the Heathrow schemes, published for consultation, acknowledged that the need to achieve compliance with EU limit values may present delivery risks. This remains the case, but taking into account the scope for mitigation identified in its more detailed air quality analysis, the Commission's view is that the level of delivery risk is not considered excessive for the Heathrow Airport Northwest Runway scheme. In relation to the Heathrow Airport Extended Runway scheme the updated analysis has indicated that these risks are greater than previously identified and therefore of greater concern than for the Northwest Runway. This is a material factor that has been taken into account in its assessment of the comparative performance of these two schemes.
- 5.61** *Local stakeholder support:* The Commission has noted opposition to and support for airport expansion from many several local government bodies and some community organisations in the vicinity of the Heathrow site although. Regional business groups are largely supportive. The Commission has recommended that a congestion or access charging scheme for road vehicles should be considered and that new runway capacity at Heathrow Airport should only be released when it is clear that air quality at sites around the airport will not delay compliance with EU limits.
- 5.62** All of the above risks, as well as the wider group of risks discussed in Delivery present significant challenges that would need to be considered and, where appropriate, mitigated to ensure the delivery of new capacity by 2030. However, the Commission's view on the basis of the available evidence and having reflected on consultation responses is that none of the risks are, in isolation or combination, insurmountable and that the overall scale of risk to the scheme is not unexpected for a project of this nature at this stage of development. The most complicated risk arises from legal limits on air quality; this will need continued monitoring and assessment and is discussed in detail in the *Final Report* and the Air Quality section of the *Sustainability Assessment*.

Commission Assessment

- 5.63** On the basis of the evidence compiled for consultation, the responses to that consultation and further work done as a result of those responses, the Commission's view is that the updated design of the Heathrow Airport Northwest Runway scheme provides a credible option for the delivery of capacity in line with the Commission's assessment of need.

- 5.64** There are a number of risks and challenges, but they are not of an unusual nature or scale for a project of this type at the current stage and may be considered moderate for an airport expansion proposal. None of these risks are significant enough to undermine the viability of the scheme.
- 5.65** Airspace development, and managing the airports interaction with other airports and the LAMP programme, would be time consuming and complex, but achievable by the opening date and deliverable through well-understood processes. The challenges in airspace terms at Heathrow and Gatwick are somewhat different, with the volume of traffic at the only three runway airport in the country driving a level of complexity at Heathrow (and interaction with Northolt for the Heathrow Airport Northwest Runway scheme specifically) contrasting with a simple two runway operation but the development of a second “centre of gravity” to manage in the London airport system at Gatwick. The overall complexity, or deliverability of airspace design and structures is not a major point of difference between the Heathrow schemes, but the slightly more novel runway configuration at the Heathrow Airport Extended Northern Runway scheme could require more analysis and regulatory consideration.
- 5.66** With respect to surface transport the Heathrow Airport Northwest Runway scheme will have a broad range of surface transport options for passengers, which provides both resilience in the event that one method is compromised, and also provides passenger choice. The majority of the change between now and 2030 would take place with or without expansion, and plans for much of the development are well in train, or would be simple to make part of standard processes going forward. The Heathrow schemes are very similar in this regard. At Gatwick the number of transport options are smaller, with heavier resilience on one train line (the Brighton main line) in particular. This makes the Gatwick scheme more susceptible to impacts from a large scale event on this line, but its performance will be significantly improved, as part of already ongoing programmes, over the coming years.
- 5.67** Two of the key risks for the Heathrow Airport Northwest Runway scheme are the tunnelling of the M25 and the removal and replacement of the lakeside energy from waste plant. The complexity of the M25 tunnel is shared with the Heathrow Airport Extended Northern Runway scheme, and is a serious undertaking, but the Commissions analysis suggests it is achievable within required timescales if design and planning work commences quickly after any decision. The Energy from Waste plant is also a substantial planning, demolition and construction challenge and the successful delivery of the Heathrow Northwest Runway scheme would be dependent on a solution. Again, prompt work after any decision would be required

but given this proviso it can be achieved in line with the requirements for a 2026 opening date.

- 5.68** The transitional arrangements would be complicated and would require rapid action by both the scheme promoter and Government following the Commission's *Final Report* if a 2026 opening date were to be achieved. On the basis of the available evidence, however, the Commission believes that extant planning and delivery mechanisms are sufficient to ensure the timely delivery of the scheme
- 5.69** In terms of these ground infrastructure challenges the Gatwick Airport Second Runway scheme is simpler and has less risks to manage. The simple airport infrastructure, lack of associated planning and construction challenges of the scale of the M25 tunnel or Energy from Waste plant, and the use of land already safeguarded all contribute to a simple ground scheme. However, all schemes, including Gatwick, would be subject to the challenge of managing their impact on the local community and environmental and social assets that they could affect.

Part 2: Sustainability Assessment

6. Sustainability Assessment-Overview

Commission Objectives and Appraisal Modules

- 6.1** The *Sustainability Assessment* has been developed to provide robust information about the performance of each scheme against a range of relevant environmental, social and economic indicators. Where potential significant adverse effects are identified, the *Sustainability Assessment* is intended to review and take account of options for avoiding or mitigating them. The process also allows for the identification of opportunities to undertake social, economic and environmental enhancement. Some environmental aspects can be monetised, and these are also included in the *Business Case* along with other economic, connectivity and commercial factors.

Table 6.1: Sustainability Assessment Modules and Objectives

Module	Objectives
Place	To minimise impacts on existing landscape character and heritage assets.
Biodiversity	To protect and maintain natural habitats and biodiversity.
Water and Flood Risk	To protect the quality of surface and ground waters, use water resources efficiently and minimise flood risk.
Community	To manage and reduce the effects of housing loss on local communities. To reduce or avoid disproportionate impacts on any social group.
Noise	To minimise and where possible reduce noise impacts.
Air Quality	To improve air quality consistent with EU standards and local planning policy requirements.
Local Economy Impacts	To promote employment and economic growth in the local area and surrounding region. To produce positive outcomes for local communities and the local economy from any surface access that may be required to support the scheme.
Quality of Life	To maintain and where possible improve the quality of life for local residents and the wider population.
Economy Impacts	To maximise economic benefits and support the competitiveness of the UK economy.

Module	Objectives
Carbon	To minimise carbon emissions in airport construction and operation.
Health Impacts	ANNEX A

- 6.2** The *Sustainability Assessment* plots scheme performance against the projected sustainability (social, economic and environmental) trends associated with the do minimum case. For each module, performance is measured in relation to the baseline and these projected trends, and defined in terms of the following five levels:

Table 6.2: Commission Assessment Levels

Highly supportive: positive impacts are substantial, or substantially accelerate an improving trend, or substantially decelerate a declining trend.
Supportive: positive impacts are notable, or accelerate an improving trend, or decelerate a declining trend.
Neutral: no impacts, or on balance (taking account of positive and negative impacts) a neutral outcome occurs.
Adverse: negative impacts are notable, or decelerate an improving trend, or accelerate a declining trend.
Highly adverse: negative impacts are substantial, or substantially decelerate an improving trend, or substantially accelerate a declining trend.

- 6.3** These impacts are defined and considered both in relation to the model of airport operations central to the Commission's assessments, and in relation to potential further mitigations that might be applied.
- 6.4** Where appropriate, the Commission has undertaken this measurement against a number of demand forecasting scenarios, in order to identify a broad range of potential impacts. In some cases we expect different scenarios will have no substantive impact on the result but where there are substantive differences these are noted below.

6.5 Assessments are based on evidence-based analysis and judgement. For example, judgement on whether an impact will be ‘notable’ or ‘substantial’ with respect to the levels above is based on a range of considerations, depending on the subject in questions, such as:

- with regard to a feature under consideration:
 - its strategic importance;
 - its intrinsic value;
 - its susceptibility to change; and
 - its uniqueness or replaceability;
- with regard to the nature of the impact likely to occur:
 - the magnitude of the impact;
 - the probability of the impact occurring;
 - the temporal scale of predicted impacts;
 - the spatial scale of predicted impacts;
 - the duration of the predicted impacts;
 - the durability or reversibility of any predicted impacts; and
 - cumulative impacts.

6.6 This *Sustainability Assessment* is not intended to be a means of defining a total scheme impact (for example, through the process of summing predicted impacts), and the Commission will not process its assessment outputs in this manner. Neither does poor performance in one area or a number of areas imply that a scheme is not suitable for progression. The process does allow, however, for a consideration of the cumulative impacts of a scheme, in line with the principles of the Strategic Environmental Assessment Directive.

6.7 The judgements in the *Sustainability Assessment* rely on the methodologies set out in the following appraisal modules: Economy Impacts, Local Economy Impacts, Surface Access, Noise, Air Quality, Biodiversity, Carbon, Water and Flood Risk, Place, Quality of Life and Community. Summary information on the Commission’s approach is included in this document, and information on the technical detail of the methodologies used in these assessments please refer to the relevant consultancy reports and the Commission’s *Appraisal Framework*.

Key Impact Areas

- 6.8** Different areas of the *Sustainability Assessment* will impact different geographical areas and groups of people, dependent on the nature of the impact they create. Place, Biodiversity, Water and Flood Risk, Air Quality and Community will have the strongest impact very locally to the airport boundary for people and businesses within a short distance. However, their impacts could, and do, extend further, for instance the effect of downstream flood risk or the impacts of additional air pollutants on national levels of NO_x, PM₁₀ etc. These impacts are generally negative for the people living around the airport, and the *Sustainability Assessment* discusses how these can be mitigated and improved.
- 6.9** Local Economy, Quality of Life, and Noise impacts affect a wide area of London and the surrounding counties, and will be affected by how the airport is run, for instance the final design of flightpaths. In some instance the impact will be wider. Some of the Local Economy impacts will be positive for people and businesses but others, such as Noise, will be negative.
- 6.10** The Economy Impacts and Carbon will have impacts for the whole country, as the operations of the airport will add to the UK-wide carbon budget and filter through the economy to businesses across the UK.

Evidence Base

- 6.11** As part of its national consultation the Commission published:
- The *Sustainability Assessment* for each scheme, as part of each scheme's *Business Case and Sustainability Assessment*⁶³
 - Technical reports on Noise: a baseline, a local assessment and a national assessment, along with supporting figures; reports on Air Quality: a baseline, national and local assessment and associated figures; reports on Biodiversity: A baseline, assessment and ecosystem services report, with associated figures; reports on Carbon: a baseline and assessment; reports on Water and Flood Risk: a baseline, a water quantity and quality assessment and a flood risk assessment; reports on Place: a Baseline, Assessment and associated figures; a Quality of Life Assessment and a Community Impact Assessment.
 - In December 2014 an addendum was added to the Noise assessment containing more in-depth technical information on the Air Traffic Movement (ATM)

Schedules related to Standard Instrument Departures and Standard Arrival Routes⁶⁴.

- 6.12** The *Consideration of Consultation Responses* sets out the key outcomes from consultation. Where it is relevant in the sections below, some of the outcomes of consultation that have led to the Commission undertaking new pieces of analysis are set out.

Overview

Physical Infrastructure Impacts

- 6.13** The Commission's Place, Biodiversity, Water and Flood Risk and Community modules will have the strongest impact very locally to the airport boundary for people and businesses within a short distance. However, the impacts could, and do, extend further, for instance the effect of downstream flood risk or the impacts of noise disturbance on biodiverse sites.
- 6.14** There are some positive impacts possible in these areas, such as the new open green space proposed by the promoter. However, in general these areas will have a negative impact that can be mitigated to greater or lesser extents. The mitigated Biodiversity and Water and Flood Risk impacts will not be fully understood until detailed designs and mitigation packages are available, and are considered here at a level designed to enable an informed judgement on comparison between schemes at this stage of design, but there are several good opportunities for the promoter to improve the outcomes in the local area. However, the Place and Community impacts of the scheme, while susceptible to some levels of mitigation, will have a significant and long-lasting effect on the people around the airport, even with best-in-class mitigation. The Commission considers these impacts, and possibilities for compensation, further in the *Final Report*.

Operational Impacts

- 6.15** The Noise and Air Quality effects of the scheme, while strongest locally, could be felt across a wide area of London and the surrounding counties, and will be influenced by how the airport is run, for instance the final design of flightpaths. In some instances the impact will be wider, for example the impact on national air quality targets, although our analysis shows that this would be very limited.

64 Further detail on the methodology is available in the methodology appendix of the Noise technical reports published in November

- 6.16** While additional ATMs will increase noise compared to a do minimum, on some noise metrics the impacts will actually be less than they are now. Improvements in plane technology, and other operational mitigations have a substantial effect, and there are opportunities with the new layout of the airport and carefully designed flightpaths, to shift noise effects substantially. Overall while noise is clearly a negative impact for most communities it is very susceptible, if not to overall mitigation of the “total” impact, to changing how different communities experience noise at different times of day or week. Furthermore, for most noise contours, the additional work undertaken following consultation has indicated that it may be possible to reduce the future population affected further. Local communities should be given the opportunity to shape these possible options, along with any possible options for compensation or insulation, as discussed in the *Final Report*.
- 6.17** Air quality impacts of the scheme are part of a wider London and national picture. Airport expansion will increase emissions from planes and from cars and lorries going to and from the airport, and stringent mitigation measures would be needed to limit this impact. However, in relation to those receptors specifically placed to measure impacts on human health, the Commission’s analysis has not identified any exceedances of the EU limit value, though there could be exceedances, if no mitigation were put in place, at Pollution Climate Mapping (PCM) sites. Furthermore, the impact of air quality on people’s health in areas of west London is a function of much wider system of road networks and infrastructure development, and firm action would be required by local and national government to support the achievement of EU targets, with or without expansion at the airport.

Local Economic and Quality of Life Impacts

- 6.18** The Local Economy and Quality of Life impacts of the airport will, in common with Air Quality and Noise, be felt intensely locally but also spread over a wider regional area.
- 6.19** The impact on the Local Economy will be positive, with opportunities for local businesses and employment opportunities in some areas near the airport that show relatively high levels of underemployment. People near the airport are concerned that the positive economic outcomes locally could put pressure on housing and other facilities for local people. Our analysis so far suggests that these impacts could be managed, particularly given that Heathrow’s strong transport links should ensure that the economic and employment benefits, and associated infrastructure needs, are widely spread. The Quality of Life analysis shows a more mixed result – with the positive impacts of access to employment and leisure travel having to

be weighed against the negative impacts of noise and other health and environmental concerns.

National Impacts

- 6.20** Expansion at Heathrow would have a significantly positive national economic result. This is discussed in detail in the Economic Case for the scheme but in summary across the demand scenarios considered by the Commission development at Heathrow would drive benefits across a broad geographical area and a wide variety of sectors in the economy.
- 6.21** The impact of expansion at Heathrow in terms of the impact on national carbon emissions is less positive. However, in common with air quality, carbon emissions are best understood and considered at a national or international level. While expansion at Heathrow certainly concentrates emissions, national policies and international management schemes will be key to ensuring that this concentration is contained within levels consistent with limiting the impacts of climate change.

Sustainability Assessment – Physical Infrastructure Impacts

7. Assessment: Place

Updates to Evidence Base

- 7.1** Several respondents requested further detailed analysis of the impact of associated mitigation measures. These will be required for whichever scheme is taken forward as part of the planning process but given the stage of design would not be possible or appropriate to undertake them now. This is discussed in the Risks and Mitigations section below. No further technical analysis has been undertaken for Place as a result of the consultation responses.

Approach and Outcomes

Approach and Baseline Conditions

- 7.2** The Commission considered four key areas with respect to the place impacts of the scheme:
- The direct land take impacts
 - Landscape, townscape and visual impacts
 - Heritage impacts
 - Waste impacts
- 7.3** The landscape around Heathrow is more mixed than might be expected, with developed urban areas existing alongside areas of high sensitivity, including long-established villages and assets such as the Colne Valley Regional Park, that are of high value to the local community. As such, further development at the airport will have a varied impact in terms of place, dependent on the specific areas being impacted.

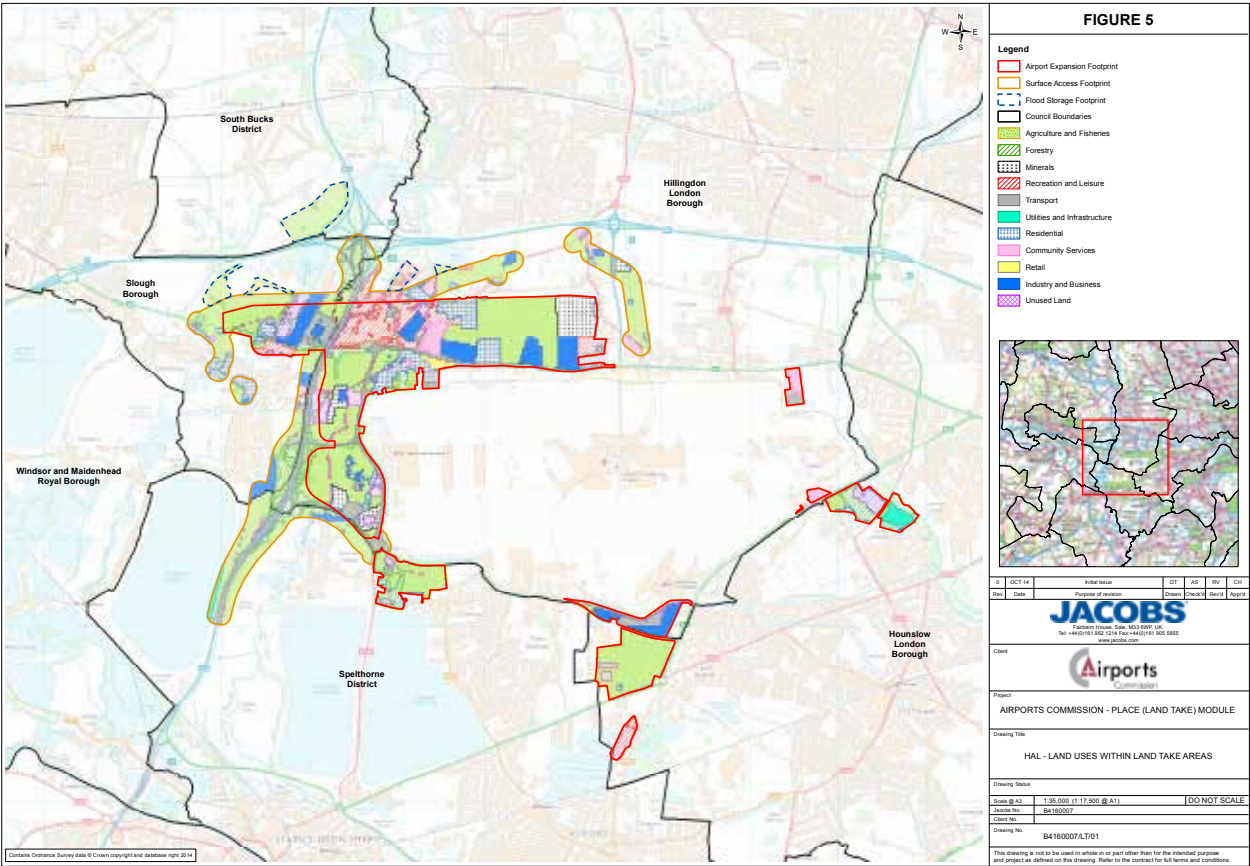
Land take

- 7.4** The land take of the expanded airport extends in all directions, but has a particular impact to the north of the airport where houses and amenities would be acquired,

including the whole of Longford, much of Harmondsworth, some properties in Sipson, and commercial development along the Bath Road. A total of 569ha for the airport development, 43ha for flood storage areas and up to an additional 294ha for related surface access improvements and flood storage areas would be required. This area would encompass a mix of land types, with just under half being agricultural (much of it good quality) and the remainder having a variety of commercial, residential and recreational uses.

7.5 A total of 783 residential properties lies within the airport land take footprint and would be likely to be demolished. Further housing loss would be required as a result of surface access works. The unmitigated high-end estimate for this surface access housing loss is set out in the *Place: Assessment* report at 289 properties, but HAL have reported they are confident this number can be substantially reduced through detailed design, which the Commission considers is a reasonable expectation. Approximately 694ha of the scheme’s potential land take lies within the Metropolitan Green Belt and the development would significantly change the land use within this area.

Figure 7.1: Heathrow Airport Northwest Runway land take by land type

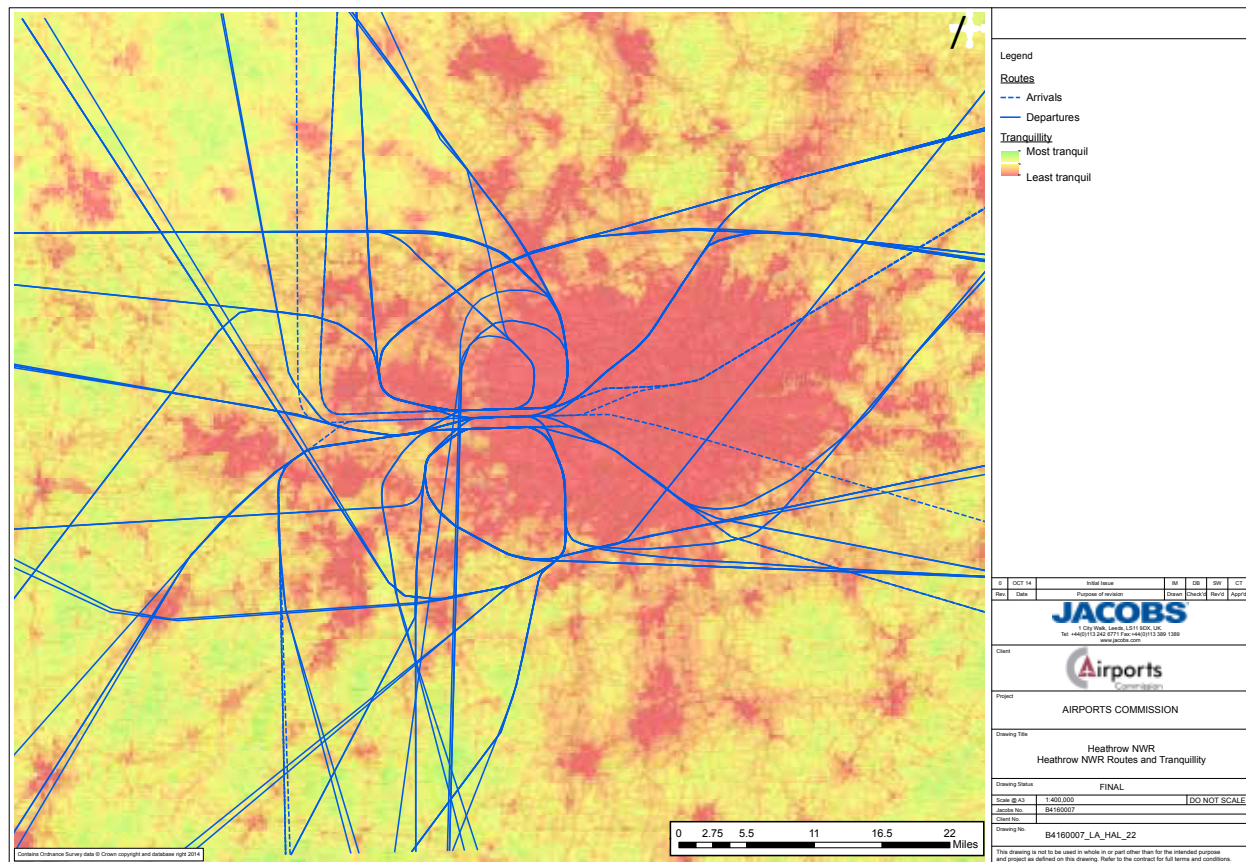


Source: Airports Commission analysis and Jacobs

Landscape and Townscape

- 7.6** The unmitigated impact on the landscape would be dispersed due to the large land take required for the scheme. Several areas, including the Colne Valley Regional Park, Hillingdon historic core, Hillingdon Lower Colne floodplain, Stanwell, Harmondsworth and Sipson, would experience major or moderate visual impacts, especially during construction of the new runway and other infrastructure. These impacts would reduce during operation (in particular, the loss of part of the Colne Valley Regional Park would be compensated by extensive mitigations proposed by Heathrow Airport Ltd (HAL) which may actually provide a beneficial effect on landscape), but significant impacts remain. The Hillingdon Lower Colne floodplain in particular would continue to experience a major adverse effect, and residential areas of Sipson and the remaining part of Harmondsworth outside the expanded airport boundary would have very close views of the new runway. While it is proposed to mitigate this by construction of bunds, this would in itself have a significant visual impact. These landscape and associated waterscape impacts could have an impact on people's wellbeing, as their experience of the local landscape would change, although the possible loss of recreation space for physical activity in the Colne Valley Regional Park would be mitigated by the compensatory green space HAL has proposed.
- 7.7** The noise impacts are discussed in detail in the Noise section. In relation to place, potential noise impacts on tranquil areas have been examined. The indication is that some areas of moderate tranquillity to the west, north and south of Heathrow (including parts of the Chilterns Areas of Outstanding Natural Beauty (AONB)) may be overflowed by aircraft at medium height approaching or departing from the airport, if flightpaths are not optimised to avoid this. As definitive flight paths are designed, it may be possible to optimise them in order to mitigate these impacts to some degree.

Figure 7.2: Heathrow Airport Northwest Runway indicative arrival and departure routes, mapped over current tranquillity map



Source: Airports Commission analysis and Jacobs

Heritage

7.8 A total of 21 designated heritage sites has been identified within the land take footprint, with a further 120 in the wider study areas around the airport. Those assets located within the land take footprint, comprising 17 Grade II Listed Buildings, two Scheduled Ancient Monuments and two Conservation Areas, are at greatest risk from physical impacts (i.e. whole or partial removal of fabric or remains) during construction of the scheme. Several mitigations proposed by HAL to limit the impact on heritage sites, non-designated archaeological remains and historic landscapes are both feasible and practical but, particularly for Harmondsworth and Longford, are limited in how much they can mitigate the impacts. Longford Conservation Area and the individual Listed Buildings within it are likely to be removed entirely, along with much of the Harmondsworth Conservation Area.

- 7.9** Beyond the land take footprint, eight heritage assets are identified as being at risk from physical impacts arising from the proposed surface access routes associated with the scheme depending upon detailed design. They include the Grade I Listed Harmondsworth Great Barn. There may be significant impacts on the settings of other heritage assets as a result of the development, most notably in the part of Harmondsworth that lies just outside the boundary of the expanded airport. Heritage assets throughout the study areas may also be subject to tranquillity impacts resulting from aircraft operations, and the removal of these assets could also impact people's enjoyment of their local area, and hence their wellbeing.

Waste

- 7.10** The Heathrow Airport Northwest Runway scheme increases the amount of waste created by Heathrow Airport, simply by increasing the number of passengers flowing through it. The amount is dependent on whether, and by how much, the amount of waste generated per passenger changes over time. The waste mitigations proposed by the promoter (during both construction and operation) are in line with national good practice. The application of solutions which reduce waste at source and increase levels of recycling appear to be appropriate. Confirming the full impact of these mitigations would be dependent on a detailed Site Waste Management Plan and this is currently not available (and would not be expected to be at this stage of design).
- 7.11** Adoption of the scheme would necessitate the removal of the Lakeside Energy from Waste facility to the north of Colnbrook, which has an important regional waste management role. HAL has proposed its relocation to an adjacent site, although obtaining the necessary consents is likely to be a lengthy process. This is discussed further in the Management Case.

Risks and Mitigations

- 7.12** The assessment of the Heathrow Airport Northwest Runway scheme has taken a conservative approach in assuming a landtake footprint extending for 100m either side of the centreline of the surface access proposals associated with the scheme. This would be refined as the new road and rail access links are designed in detail, and in some cases the amount of land required is likely to be reduced in extent, other areas may be required on a temporary basis only to permit construction works.

- 7.13** HAL has proposed extensive mitigation to address both the loss of existing land necessary to permit expansion of the airport and the visual impact of the new runway and associated infrastructure. Its proposals include extensive landscaping and the creation of recreational green space to the north and west of the airport. Bunds may be created along the airport boundary to mitigate both visual impacts and noise from aircraft manoeuvring on the ground. The proposed mitigation would need to be worked up in detail in order fully to understand its effectiveness at a local level.
- 7.14** Further detailed study will also be required to assess the visual and tranquillity impacts of the scheme, especially on nationally designated landscapes such as AONBs and on heritage assets. This work would form part of a detailed Sustainability Impact Assessment which would be required for later in the planning process, and which would consider both the detailed design and operational plans, and also how mitigation plans could be developed and implemented in detail.

Commission Assessment

- 7.15** Given the high impacts of land take, landscape issues (particularly during construction) and on heritage sites the unmitigated impact of the Heathrow Airport Northwest Runway scheme on the Place objective **to minimise impacts on existing landscape character and heritage assets** would be assessed as **SIGNIFICANTLY ADVERSE**, but the promoter has included significant mitigations in the scheme design to limit these negative impacts. Taking these into account, the impact of the scheme on the Place objective overall has been limited to **ADVERSE**.
- 7.16** When considered alongside the other shortlisted schemes across the range of Place topics, the Heathrow Airport Northwest Runway scheme has several substantial challenges.
- 7.17** The land take impact of the Northwest scheme is the most significant, especially in terms of the number of residential properties that would be lost.

Table 7.1: Housing Loss associated with each scheme

Scheme	Housing Loss (airfield)
LGW 2R	167
LHR ENR	242
LHR NWR	783

Source: Airports Commission analysis

- 7.18** The Heathrow Airport Extended Runway scheme has a more constrained housing loss, due partly to the smaller site footprint but also the proposed placement of the runway over more industrial land and open space than residential areas. The Gatwick Airport Second Runway scheme housing loss impact is smaller again, and focused on already safeguarded land. The *Place: Assessment* report also sets out an unmitigated high-end estimate for possible surface access housing loss, which would be additional to the numbers presented in Table 7.1.
- 7.19** The Heathrow Airport Extended Runway scheme's constrained footprint also reduces the number of heritage assets it impacts, limited to seven, while the Heathrow Airport Northwest Runway scheme will have impacts in the Conservation Areas at Longford and Harmondsworth, and have a total of 17 Grade II listed buildings lost and two Ancient Monuments. This is a similar number of lost listed buildings to Gatwick, where 19 listed buildings (6 at Grade II*) would be lost. The Heathrow Airport Northwest Runway scheme does not perform well against this aspect of assessment, but HAL has set out comprehensive mitigation and compensation plans that accord with best practice (as did the other scheme promoters). Similarly the Heathrow Airport Extended Runway and Gatwick Airport Second Runway schemes would have more limited landscape impact, due to the constrained sites at the Heathrow Airport Extended Runway and topography and vegetation at Gatwick Airport Second Runway.
- 7.20** The waste impacts are a function of scale and the levels of long-haul passengers, and as such while the scale of waste generated at either of the Heathrow schemes is larger than that at Gatwick, changes in passenger type could change this result. All schemes would need to develop best practice waste management strategies to deal with the growth, including investment in new waste handling facilities.
- 7.21** Overall the Heathrow Airport Northwest Runway scheme performs least well against this objective compared to other schemes, but the extensive mitigations through new green space, and plans for best practice management strategies will limit the impact, though not to the extent of bringing its impacts in line with the post-mitigation versions of the Heathrow Airport Extended Runway and Gatwick Airport Second Runway schemes.

8. Assessment: Biodiversity

Updates to Evidence Base

- 8.1** During consultation several respondents requested further detailed analysis but given the stage of design it would not be possible or appropriate to undertake this at this stage of scheme design. However, future planning processes and detailed design would be an appropriate time for some of these issues to be considered, this is discussed in the Risks and Mitigations section below. However, this further analysis would be unlikely to change the broad scale of the unmitigated disbenefits set out here.
- 8.2** As an example, some detailed comments were provided from Natural England on Ecosystem Services, which recognise the value of including the novel approach and suggest improvements that could refine the assessment to further levels of detail, that were at a level of granularity not required for the Commission's assessment at this level of design, but could be relevant for assessments at a more detailed design stage.

Approach and Outcomes

Approach

- 8.3** The Commission considered three key areas with respect to the biodiversity impacts of the scheme:
- The direct landtake impacts e.g. any designated sites that will be lost due to the physical development of the scheme
 - Non landtake impacts – for instance noise, air quality and water quality impacts
 - Ecosystems Services impacts

What are Ecosystem Services?

The UK Government has in recent years been encouraging the adoption of an Ecosystem Services Approach to environmental assessment and management. This approach adopts a perspective on the environment focusing on these services and the functioning ecosystems which support them, rather than interpreting the environment as a static asset.

Ecosystem Services are the processes which provide the environmental goods and services on which human life is dependent. Within literature and common understanding, ecosystem services are widely accepted to fall under the following four categories:

- Provisioning services – these are physical goods such as food, biomass for energy generation and water resources.
- Regulating services – these are benefits obtained from the regulating function of ecosystem processes, such as the regulation of water quality and water flow, the filtration of air and the sequestration of carbon.
- Cultural services – these are non-material benefits that people obtain from ecosystems, such as a sense of place or inspiration and recreational benefits.
- Supporting services – these are the services that are necessary for the production of all other ecosystem services, including biodiversity. For example, pollinating insects provide a supporting service that contributes to the delivery of provisioning services such as food.

Land Take Impacts

- 8.4** The proposal involves three local non-statutory designated sites, including potential impact on a nationally rare plant species (Pennyroyal), and would result in small-scale losses of priority habitats including deciduous woodland, traditional orchard and rivers. The impact on designated sites, habitats and species will have different magnitude, duration and reversibility impacts but the landtake for designated sites in particular will have high impact, long-term duration and low reversibility.

Non Landtake Impacts

- 8.5** There will also be impacts that are not the result of land take, for instance from noise, air quality and water quality, as well as an impact on bird populations from potential bird strike mitigations. The unmitigated magnitude, duration and reversibility of these non-landtake impacts are shown in the table below.

Table 8.1: Magnitude, Duration and Reversibility of non landtake impacts on Biodiversity, associated with the Heathrow Airport Northwest Runway scheme

Impact	Magnitude	Duration	Reversibility
Noise	Low	Short-term effect repeated over long-term period	High
Air Quality	Low	Long-term	Medium
Water Quality	High	Long-term	Medium
Bird strike	Low	Short-term effect repeated over long-term period	High

Source: Airports Commission analysis

- 8.6** With good provision of alternative sites the biodiversity impacts above could be compensated. However, it is important to note that given the high ecological value and low replaceability of some of the sites directly affected by the proposal (e.g. the River Colne Site of Metropolitan Importance), and the potential impact on Pennyroyal, providing extra land does not entirely compensate these impacts.
- 8.7** On birdstrike specifically the expanded airport footprint will remove a number of agricultural fields that currently attract significant numbers of pigeons and particularly Canada geese, but this is likely to be offset by the fact that the western threshold of the new runway will be significantly closer to the Queen Mother reservoir, which supports a very large gull roost as well as a significant number of other waterfowl. Birdstrike, as well as the other operational impacts, can be mitigated to an extent with good operational practices. HAL already effectively manage birdstrike as part of their current operation, suggesting that it is plausible to assume they will continue to do so.

Ecosystem Services Impacts

- 8.8** The proposed development may impact on the Ecosystem Services present through the creation of new assets (such as fens, marshes and swamp), the loss of existing ecosystems (such as areas of arable land) and hydrological change and pollution.

Table 8.2: Ecosystem services impacts with respect to the Heathrow Airport Northwest Runway scheme

Broad Habitat	Total Land Lost/Gained	Total Assessment Period Loss (PV, £'000 2014)	Total Assessment Period Mitigation (PV, £'000 2014)	Total Assessment Period Net Value (PV, £'000 2014)
Rivers and Lakes	25ha loss/49ha gain	£1,923 to £9,594	£874 to £6,865	-£319 to -£2,729
Inland Wetlands	<1ha loss/1ha gain	£8 to £367	£6 to £286	-£2 to -£81
Grasslands	9ha loss/18ha gain	£75 to £964	£58 to £752	-£16 to -£212
Woodlands	60ha loss/120ha gain	£26 to £11,467	£13 to £5,869	-£13 to -£5,598
Sub-Total				-£350 to -£8,619
Agricultural Land	431ha loss	£5,954 to £7,145		-£5,954 to -£7,145
Total				-£6,304 to -£15,764

Source: Airports Commission analysis and Jacobs

- 8.9** The Commission's assessment finds an overall negative impact on the provision of Ecosystem Services, but this impact has the potential to be reduced by the detailed mitigation provided by the promoter. A key impact in terms of Ecosystem Services is loss of agricultural land, for which no mitigations are identified.

Risks and Mitigations

- 8.10** The airport operator would need to develop detailed mitigation plans for all of the impacts noted above. At this stage of design the Commission has estimated that for direct landtake impacts a replacement of sites at a 2:1 ratio is required. This represents a total of 198.7ha or 203.5ha (including a 10% contingency for indirect impacts). HAL has assumed 400ha of land take mitigation is required: this is based on a commitment from the promoter to ensure adequate community and biodiversity mitigation, rather than a breakdown of the scale of impacted sites and a multiplier as per the Commission's methodology, which explains the difference in number. HAL has also suggested mitigation plans for the negative impact on Ecosystem Services, for instance some of these flood compensation areas will provide inland wetland habitats, and these are one of the more beneficial in terms of Ecosystem Service provision. But, a key impact in terms of Ecosystem Services is loss of agricultural land, for which no mitigations are identified.
- 8.11** For all of the elements of the Biodiversity assessment a detailed Sustainability Impact Assessment (and possibly Appropriate Assessment under The Conservation of Habitats and Species Regulations 2010) would be required for later in the planning process, which would both consider in more detail the effects of the proposal, and also how mitigation measures could be developed and implemented. The Commission's analysis has been undertaken at a level of detail appropriate for determining the broad impacts of the scheme, and using the information currently available. The Commission is satisfied in light of the evidence base that it is reasonable to conclude that there would be a good likelihood of any Appropriate Assessment determining that the project would not adversely affect the integrity of any designated site. However, the Commission does recognise that further work will be required to demonstrate this in relation to the birds using the reservoirs to the west of Heathrow and the ongoing management of any mitigation or avoidance measures

Commission Assessment

- 8.12** All of the schemes would have negative impacts on the biodiversity of the surrounding area. The Heathrow Airport Northwest Runway scheme has a potential impact on Pennyroyal, birdstrike control issues and a challenging programme of watercourse diversions including culverting. Therefore, against the objective **to protect and maintain natural habitats and biodiversity** the Commission considers the scheme to have an **ADVERSE** impact. The additional green space included in the scheme design could be tailored to provide compensatory space to balance these negative impacts, and has the potential to move towards **NEUTRAL**.
- 8.13** The schemes would all have impacts on some local statutory and non-statutory designated sites and SSSIs⁶⁵ but the type of impact and biodiversity effect would be different. The Gatwick Second Runway scheme would result in the loss of irreplaceable ancient woodland but would also deculvert rivers, returning them to a more natural state. The loss of habitats for Pennyroyal associated with the Heathrow Airport Northwest Runway scheme at Heathrow would not be experienced under a Heathrow Airport Extended Northern Runway scheme, but the Extended Runway in particular could bring further local bird populations in range of departing planes.
- 8.14** The comparison of the Heathrow Airport Northwest Runway and Gatwick Airport Second Runway scheme is a matter of balancing the different impacts. Heathrow Airport Northwest Runway scheme has the potential impact on Pennyroyal, birdstrike control issues and a challenging programme of watercourse diversions including culverting, to be weighed against Gatwick Airport Second Runway's scheme loss of irreplaceable ancient woodland and a smaller-scale but still significant river diversion scheme. The impacts of the two Heathrow schemes are similar in character but differ in severity – for example the Heathrow Airport Northwest Runway scheme is further from the reservoirs, which could help limit birdstrike risk, and involves less extensive culverting of rivers.

65 Site of Special Scientific Interest

9. Assessment: Water and Flood Risk

Updates to Evidence Base

- 9.1** Several respondents requested further detailed analysis of impacts of associated mitigation measures. These will be required for whichever scheme is taken forward as part of the planning process but given the stage of design would not be possible or appropriate to undertake them now. This is discussed in the Risks and Mitigations section below. No further technical analysis has been undertaken for Water and Flood Risk as a result of the consultation responses.

Approach and Outcomes

Approach and Baseline Conditions

- 9.2** As with other appraisal sections, the Commission developed a do minimum assessment of the water conditions around Heathrow and compared it to the implications for water conditions if the scheme were built. The water quantity and quality conditions around Heathrow are already heavily impacted by the current airport and the associated development, and a baseline do minimum level of growth at the airport sees these effects compounded.
- 9.3** Affinity Water concluded⁶⁶ that there is a water resource deficit in the Water Resource Zone (WRZ4) that supplies Heathrow and the Water Framework Directive Classification of water bodies within the Heathrow Study Area found that existing ecological and hydromorphological quality was limited. The current overall ecological quality and hydromorphological status of the water bodies around Heathrow are set out below.

66 In their Water Resource Management Plan

Table 9.1: Water Framework Directive classifications of water bodies within the Heathrow Airport Northwest Runway (LHR NWR) Study Area

Type	Number	Current Overall Ecological Quality	Hydromorphological Status
Watercourses	2	Good Potential	Heavily Modified Water Bodies
	4	Moderate Potential	Heavily Modified Water Bodies
	1	Moderate Status	Not Designated
	1	Poor Potential	Heavily Modified Water Bodies
Lakes/Reservoirs	2	Moderate Potential	Artificial
	3	Poor Potential	Artificial
Groundwater	1	Good Quantitative Quality	N/A

Source: Airports Commission analysis and Jacobs

- 9.4** With respect to flood risk the baseline picture is more mixed. The Commission considered fluvial (river and stream), surface water, groundwater, reservoir and water services flood risk. The groundwater and surface water baseline showed that these areas should be considered of potential concern, whereas the other flood risks, while they exist, are either moderate in impact or already managed by ongoing monitoring and control (for instance reservoirs).

Water Quantity

- 9.5** The scheme will increase the demand for potable water resources in a region that is already under water stress. The baseline (i.e. without any scheme development taking place) total annual water consumption in the Water Resource Zone (WRZ4), including an allowance for climate change, would increase by 13% by 2026 and 32% by 2050 from the 2013 level. In the do something scenario, with no mitigating actions, there is an increase in water consumption in 2026 of 0.34Mm³ (15%) and 1.64Mm³ (71%) in 2050 compared to the current situation.

Water Quality

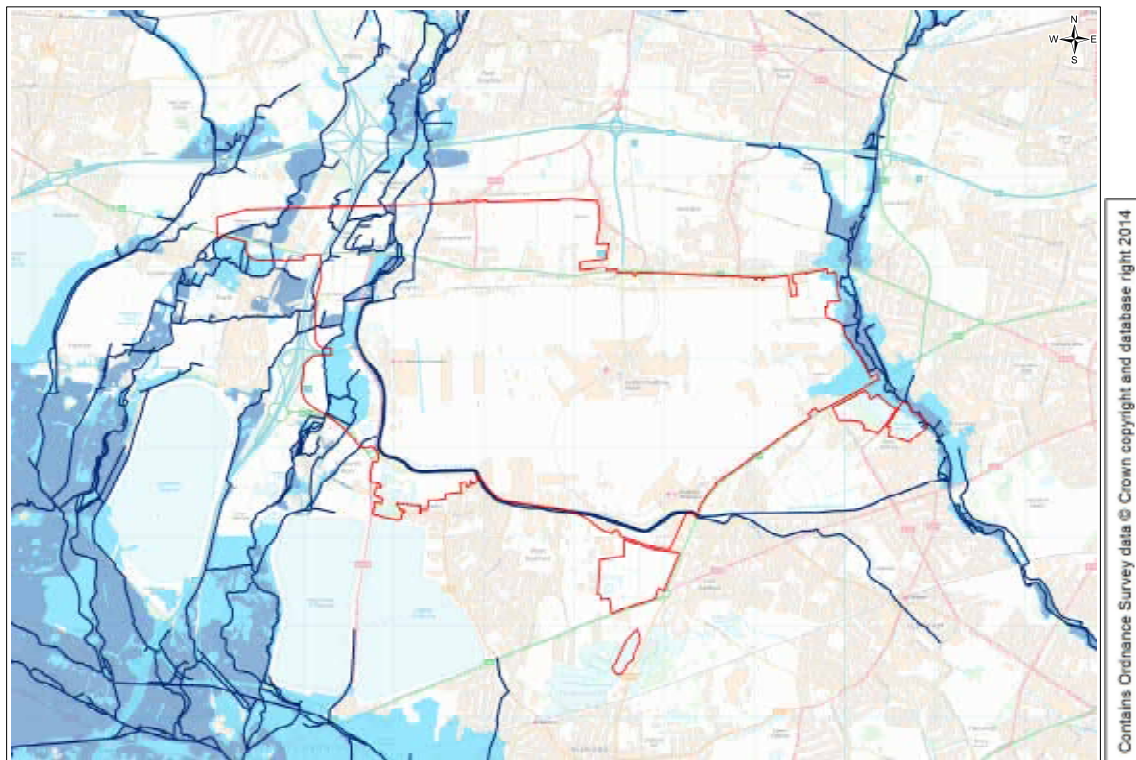
- 9.6** The water quality in water bodies around the airport would be impacted both by the increase in scale of the airport and associated draining, cleaning, storage etc. in the operations of the airport in general but also particularly by diverting sections of the Colne Brook, the Duke of Northumberland's River and the River Colne, by the creation of a new channel (the 'River Colne Spur'), and by placing watercourses in culvert beneath the new runway. These developments would reduce total channel length significantly and without mitigation could fundamentally alter sediment

processes in the existing waterways, with concurrent ecological implications. Without mitigation this could compromise the ability to meet water quality standards set out in the Water Framework Directive (WFD). It is important to note however that the overarching aim of the WFD is to achieve at least Good Ecological Status/Potential in all water bodies by 2027 and it is acknowledged in the River Basin Management Plans that with or without expansion this would be an ambitious and significant challenge given current conditions around Heathrow. These changes would also reduce the availability of natural waterscape, which can be a factor in people's wellbeing.

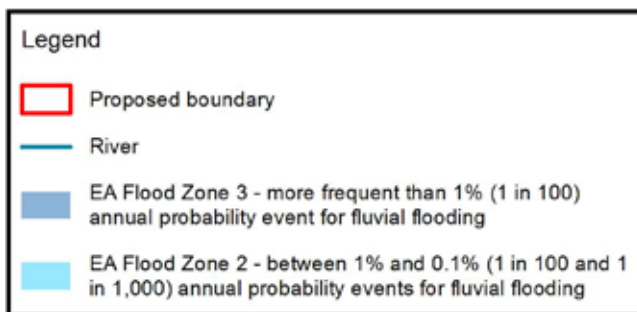
Flood Risk

- 9.7** A key consideration with respect to the scheme is the co-ordination between the culverting, diversion and creation of a new channel (the 'River Colne Spur'), along with loss of flood storage in the Colne Brook, Wraysbury River and River Colne floodplains. The impacts of these developments on flood risk, both at Heathrow and downstream, are difficult to quantify accurately because of the complexity of the development, but are significant. Even with mitigations these actions are likely to have residual adverse effects on flood risk, and this could have negative impacts on people who live in these areas. These would need to be managed on an ongoing basis.
- 9.8** The scheme also includes a culverted major watercourse near the M25 tunnel and at a higher elevation. HAL identified this as a possible flood risk in their submission and proposed mitigation measures in terms of flood storage areas and best practice channel design that are at an appropriate level of detail for this stage of the project. However, these suggested design mitigations would also need to be supported by regular and frequent inspections and monitoring.

Figure 9.1: Environment Agency Indicative Flood Map showing Scheme Boundary (red line)



Source: Airports Commission and Jacobs analysis using Environment Agency and Ordnance Survey data



Risks and Mitigations

9.9 Several well-developed mitigation strategies, both in terms of their design and plans for ongoing monitoring, have been suggested by HAL, and best practice mitigation strategies are available, which could reduce the impacts on water quality, quantity and flood risk. For instance HAL proposes schemes such as greywater recycling and rainwater harvesting to mitigate the quantity impacts (although the proposed levels of reduction appear optimistic). The detail of these proposals are set out in the Water and Flood Risk technical reports. The unmitigated water quality impacts could be limited by ongoing operational management of, for instance surface water runoff, and would need to be part of any water management scheme developed by the promoter. The planning process will give HAL the opportunity to work with

subject matter experts at the Environment Agency (the body with strategic responsibility for flood risk) to ensure their plans reflect best practice.

- 9.10** The Commission's assessment is based on the current level of design of the airport masterplans and assumptions about the operations of the airport. As can be seen from the above the water effects are complex and will be impacted by the detailed design and operations decided upon later in the development process. Although climate change was taken into account in the assessment, how climate change will actually impact the situation is not certain and various bodies (such as Thames Water) will need to be involved in developing plans. The overall scale and direction of the unmitigated impacts would be unlikely to change substantially but mitigation plans could have substantial positive impacts if well design and operated.
- 9.11** As the design process continues the final detailed impacts of the scheme on the water conditions will become clear, as will the way the scheme will be operated and the mitigations required. This detail will be developed as part of the planning process. The Environment Agency will be involved in reviewing the impact of the application on water conditions to ensure all relevant requirements would be met including the WFD.

Commission Assessment

- 9.12** The scheme will have impacts on water supply, high groundwater levels in the Thames Gravels and control of contaminated run-off as well as proposed remodelling of watercourses in the Colne Valley. However, this takes place against a baseline where waterscape around Heathrow is already, and will continue to be, heavily impacted by the airport and associated development. The water quantity impacts are substantive, but set against a backdrop of water stress that is an issue for the wider region, rather than something that would be materially impacted by the scheme growth. The Commission considers that the scheme itself has an **ADVERSE** impact on the Commission's Water and Flood Risk Objective **to protect the quality of surface and ground waters, use water resources efficiently and minimise flood risk**. We consider it unlikely that the impact of the scheme could become entirely **NEUTRAL** but specific areas could achieve this and all areas could have the adverse impacts limited by good design and ongoing best-practice operational mitigations.

- 9.13** There is very little to differentiate the two Heathrow schemes, with the more complicated Northwest Runway watercourse diversion counterbalanced in scale by the wider extent of culverting in the Heathrow Airport Extended Northern Runway scheme. The water quantity impacts, and the current baseline conditions, are also very similar.
- 9.14** Gatwick has clear advantages in terms of water supply to any expansion of Heathrow. All three schemes raise off-site flood risk issues, but those at Gatwick are perhaps less challenging as the watercourse remodelling programme is less extensive and includes removing the River Mole from its present culvert, and groundwater levels are not a complicating factor. The Heathrow Airport Northwest Runway scheme would need to be carefully designed in detail, and even more exactly managed, with the support of the relevant agencies, to limit the water impacts of the scheme.

10. Assessment: Community

Updates to Evidence Base

- 10.1** The Commission received a number of comments on the impact that the scheme would have on Community, which in general provided useful qualitative views from residents about how the outcomes noted below would impact on particular facilities or very local areas, and the knock-on effects (for instance anti-social behaviour). Respondents also cited the need, in their view, for an Equalities Impact Assessment (EqIA) and a Health Impact Assessment (HIA) to understand the full impacts on local communities. The health impacts have been collated into the Health Impacts Annex at the end of the *Sustainability Assessment* and the Equalities Impacts into an *Equalities Impacts Report*.

Approach and Outcomes

- 10.2** The proposed expansion would largely impact villages to the north and west of the current airport- Hamondsworth, Longford and Sipson would be directly affected by land take for the airport itself, and possibly Harlington due to a road diversion. The Colnbrook and Poyle ward of Slough, situated to the west, would also be affected.
- 10.3** Permanent land take would affect some 783 residential properties in Harmondsworth, Longford and Sipson. Further housing loss would be required as a result of surface access works. The unmitigated high-end estimate for this surface access housing loss is set out in the *Place: Assessment* report at 289 properties, but HAL have reported that they are confident this number can be substantially reduced through detailed design and mitigation, which the Commission considers is a reasonable expectation. Other properties will become much closer to the revised airport boundary. 48ha of recreation and open space (including Harmondsworth Moor) would be lost, as would 49ha of employment land. Access to good quality services and supportive and cohesive community networks are very important for people's wellbeing, and reduce the likelihood of depression and chronic illness⁶⁷. The unmitigated impacts of the scheme on people's wellbeing would be extensive (the proposed mitigations are discussed in the Risks and Mitigations section).

67 See the *Quality of Life: Health and Equalities Assessment Review*

- 10.4** Because of the scale of physical impacts on the community immediately north of the airport, and the timescale over which land clearance, preparation and construction would take place, the effects on the community need to be judged on two levels. At the very local level it is difficult to see any existing community cohesion being maintained in the villages most directly affected, unless entire communities and their facilities could be moved en masse at the same time. For those households not in the land take, the prospect of a shrinking local community may encourage them to move, particularly if compensation is suitable. Where these households go has implications for where community facilities should be built. For example, the success of a relocated Harmondsworth Primary School assumes that Harmondsworth residents will be relocated nearby.
- 10.5** Work on the impacts of schemes on road freight, carried out in light of consultation responses, has indicated a number of roads in the vicinity of the Heathrow site which may see a noticeable increase in goods vehicle traffic following expansion. Some of the areas affected are residential, so there may be an amenity impact for affected communities. Elsewhere there could be additional impacts from increased local congestion. Southern Rail Access may have severance implications for residents of Stanwell, depending on the details to be worked up. In addition, works to put the M25 in a tunnel will reduce traffic flows on it for a period, potentially leading to increased congestion on local roads in Poyle, Stanwell Moor and Stanwell.
- 10.6** The Commission conducted a high level equalities analysis, based on the current community profile and the impacts that have been identified so far. This analysis suggested that the unmitigated loss of certain types of community facilities may differentially⁶⁸ impact several groups of people with protected characteristics, including older people, those with disabilities and those who are pregnant or recent mothers, if no alternative facilities were provided. How much these impacts can be mitigated will be dependent on the detail of what and where alternative facilities would be provided.
- 10.7** There could also be differential impacts due to the operations of the schemes, through increases in pollutant concentrations that could affect older and younger people, or people with pre-existing conditions more strongly, or noise impacts that will have particular impacts on children. However, these impacts would vary considerably based on more detailed operational plans, such as final flightpath designs or the particular air quality mitigations developed. As such more analysis

68 Differential impacts are those that affect a group of people who have a protected characteristic specifically because of that characteristic, for instance the demolition of a Christian Church would have a differential impact on those Christians who worship there

later in detailed design would be required to determine whether this possible differential impact would in fact occur.

- 10.8** The scheme could also have disproportionate impacts⁶⁹ on some protected groups. The population in the Heathrow Villages ward, and more widely around the airport, is more ethnically diverse than the population on average, with a higher proportion of Black, Asian and Minority Ethnic (BAME) residents (50%) than the average across England (14.5%). There is also a higher share of Hindus, Muslims and Sikhs than nationally. The people close to the scheme would experience negative impacts through noise and/or loss of facilities, for example, but could also experience positive impacts through the new employment the schemes provide.
- 10.9** There could be a positive impact on social inclusion, as new direct and indirect jobs due to expansion could support increased employment in local areas with relatively high levels of deprivation and/or underemployment. If the scheme is taken forward for further development and planning permissions are sought, more detailed identification and consideration of equalities impacts will need to be undertaken. More information on equalities is available in the *Equalities Impacts Report*.
- 10.10** Only a more detailed screening, undertaken when more detailed design and mitigation measures are known, would confirm the preliminary information provided above and in the *Equalities Impacts Report*.

Risks and Mitigations

- 10.11** The central tenet of HAL's proposed mitigation is compensation, with compensation being offered at 25% above un-blighted market value, plus legal fees and stamp duty costs. This is significantly above the legal minimum and also exceeds the Government's current offer for HS2. Initially this was offered for those homes which would need to be compulsorily purchased as they were within the new airport footprint. HAL has now extended this offer to homes within a compensation zone it has designed⁷⁰ which would make it available for approximately 3,750 homeowners.
- 10.12** For those houses not covered by the property compensation scheme described above, on the basis of HAL's proposed mitigation package, compensation would be provided in the form of noise insulation, or HAL would provide support in relocating.

69 Disproportionate impacts are those that have a proportionately greater effect on groups of people with a protected characteristic than the population in general. For instance if a group of houses that need to be demolished happen to house a greater number of Christians than the population at large this would be an example of a disproportionate impact.

70 HAL has set out the scope and shape of this scheme on its website here: <http://your.heathrow.com/newpropertycompensation/> and covers Poyle, Colnbrook, Brands Hill, Harmondsworth, Sipson, Harlington and Cranford Cross (Longford was already covered under the previous scheme).

The promoter also plans to extend its current community investment programme and undertake re-provision of community services such as Harmondsworth Community Hall and Primary School.

- 10.13** There would need to be sufficient facilities available to support those displaced, and to mitigate the knock-on effects on communities elsewhere where applicable. HAL is confident that this can be done, but the Commission notes that this would need to be ensured and that this approach is more about rebuilding communities than maintaining existing cohesion. If the scheme is taken forward for further development, more detailed design would need to be undertaken of the proposed mitigations and would need to take into account the impacts on the community. The proposed Community Engagement Board could play an important role in ensuring that mitigations are designed to reflect the needs and priorities of local communities, and this is discussed further in the *Final Report*.
- 10.14** Even allowing for mitigation, any forced moves would be stressful and unwelcome for many and a number of consultation responses emphasised the need to ensure people could move to an 'equivalent' property. The compensation packages would significantly offset some of the community impacts, but as a number of consultation responses noted, compensation cannot be equated with full mitigation.

Commission Assessment

- 10.15** The final impacts on community cohesion around the sites are difficult to judge because a lot of the impacts will be dependent on the detail of the possible mitigations and compensation – will people's journey times to the new compensatory facilities be longer than to the previous facilities, for instance. Given the scale of the land take north of the airport the Commission considers that in terms of the objective **to manage and reduce the effects of housing loss on local communities** un-mitigated impacts would be **HIGHLY ADVERSE**. The extensive mitigation plan proposed by the promoter could significantly offset some of the community impacts, but as a number of consultation responses noted, compensation cannot be equated with full mitigation and as such the impact would still be **ADVERSE**. In terms of the objective **to reduce or avoid disproportionate impacts on any social group**, at this stage, with the information currently available it would not be appropriate to make final judgements on the particular impacts. It is, however, anticipated that negative impacts would be susceptible to mitigation.

- 10.16** All of the three schemes would result in a loss of homes in the local community, but the impact of the Heathrow Airport Northwest Runway scheme would be much larger compared to the other schemes. The housing loss associated with surface access may well reduce but focussing only on the houses inside the boundary the Heathrow Airport Northwest Runway scheme dwarfs the impact of the others, at 783 houses, compared to 242 at Heathrow Airport Extended Northern Runway and 168 at Gatwick Airport Second Runway. Both schemes at Heathrow seek to limit their impacts (Heathrow Airport Extended Northern Runway through keeping its footprint constrained, and Heathrow Airport Northwest Runway through providing extensive mitigation and compensation) but overall on this module the Heathrow Airport Northwest Runway scheme performs most poorly of all three schemes, even taking into account the extensive mitigations proposed.
- 10.17** All of the schemes also show possible differential and disproportionate impacts on groups of people with protected characteristics. Some of these impacts are common across the schemes, for instance the particular effect of pollutant changes on older people or children, but others are scheme specific, for instance the relocation of a Hindu temple at the Gatwick Airport Second Runway scheme, or the relocation of Harmondsworth Primary School under the Heathrow Airport Northwest Runway scheme. Determining a difference in impact between the schemes with respect to the Commission's objective to reduce disproportionate impacts on any social group would not be reasonable at this stage of design, but the Commission notes that for all three schemes there would be a mix of positive and negative impacts and it is anticipated that the negative impacts would be susceptible to mitigation.

Sustainability Assessment – Operational Impacts

11. Assessment: Noise

Updates to Evidence Base

- 11.1** As a result of consultation the Commission undertook several new pieces of work:
- An analysis of the impact of displaced thresholds on the scheme's noise footprint
 - A sensitivity test on how the introduction of new aircraft can affect noise
 - The preparation of further detail on the mitigation and compensation possibilities for noise, in particular night flights, insulation, and how communities can engage in noise management, through a noise authority or community planning organisations
 - A report on the health related impacts of noise: *Aircraft Noise Effects on Health*
 - Further noise modelling in respect of the Heathrow Airport Extended Runway scheme. The modelling merges the offset approaches routes used for the Heathrow Airport Northwest Runway 'minimise total people affected' scenario with the runway configuration of the Heathrow ENR scheme. The noise effects of these new flightpaths are assessed below with the full set of results found in the *Noise: Local Assessment Addendum – Heathrow Airport Extended Northern Runway Offset Route and SEL Contours*.

Approach and Outcomes

Approach

- 11.2** One of the key findings of the Commission's 2013 *Discussion Paper on Aviation Noise* was that people respond to noise in different ways. Response to noise is subjective, and likely to be affected not only by the magnitude of the sound but also its duration, regularity, and the time of day at which it occurs. The responses to our consultation have continued to highlight that. Our analysis has also highlighted how susceptible noise is to change including changes in assumptions about how an

airport is operated, so the approach below focuses on unmitigated impacts, then discusses possible sensitivities and mitigations.

11.3 In order to help people understand the likely unmitigated noise impacts of the three expansion options, the Commission has assessed noise impacts in a range of different ways. The full set of measurements can be found in our supporting annexes. In this document, we present noise impacts in the following ways:

- day noise ($L_{Aeq\ 16h}$ 07:00-23:00) and night noise ($L_{Aeq\ 8h}$ 23:00-07:00), decibel levels, looking particularly at the 57 decibel level (which in the Government's Aviation Policy Framework marks the approximate onset of significant community annoyance), and the lower 54 decibel levels;
- the European 24 hour L_{den} measure, which puts more weight on noise that occurs in the evening (19:00-23:00) or the night (23:00-07:00) than the daytime (07:00-19:00);
- N contours, which capture the population affected by various frequencies of overflight at day or night (with a 70 decibel threshold for the day, and a 60 decibel threshold for the night).

11.4 The Commission's demand forecasts have been used as the basis for measuring future noise impacts. For each scheme, the *assessment of need* carbon-capped forecast has been assessed as a rough 'lower end' case, and a 'top end' case has also been assessed to understand the implications of scenarios showing higher levels of demand. For the Heathrow Airport Northwest Runway scheme, the *low-cost is king* carbon-traded forecast comprises the high end traffic scenario, which results in more and larger planes and higher noise impacts. This section first considers the lower end case, then compares these outputs with those from the upper end.

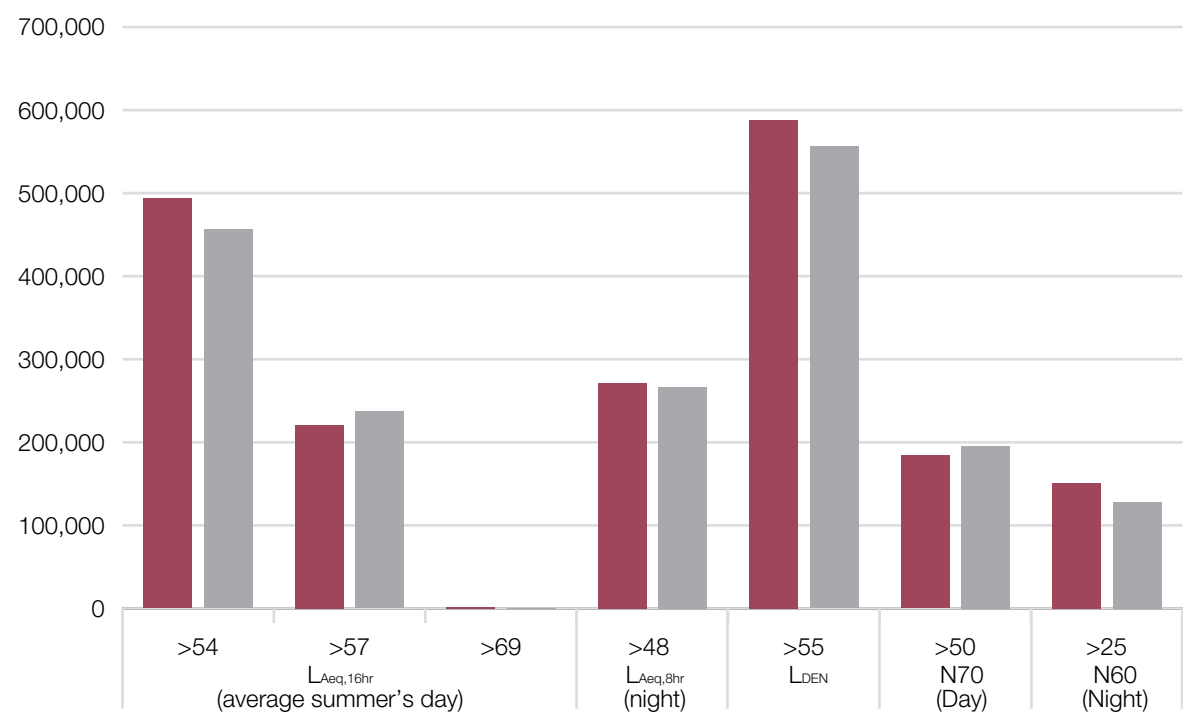
11.5 The Commission's modelling has been undertaken by the noise forecasting unit (ERDC) at the CAA using their ANCON model. The Commission's assumptions on the number and types of aircraft using the airport, the forecast population changes in overflown areas, the rate at which aircraft ascend and descend and other important inputs to the model are all set out in report *Noise: Local Assessment*. The assumptions input into the noise model can be expected to impact the noise results for a scheme, at various levels. This can be seen by comparing the results from scheme promoters and the Commission's modelling in the accompanying technical reports. A range of noise impact results can therefore be created, depending on which particular view of future and associated assumptions are input into the model.

- 11.6** The indicative flight path designs used for noise modelling should not be taken as showing where future flight paths would in practice be located. Creating and agreeing airspace plans for any new runways would require significant development and public consultation, which the Commission has not undertaken; and careful consideration of mitigation options, as well as the impacts of new technology, could lead to significant changes to the indicative designs.
- 11.7** In the case of Heathrow Airport Northwest Runway, the airport's three runways could be operated in a variety of ways. For example, different runways could be in operation at different times in the day to allow respite for residents living nearby, and all of HAL's proposals incorporate runway alternation to provide respite, with this being supplemented by flight-path based alternation in one. The Commission has undertaken some analysis of how respite and other landing and departure scenarios can affect the noise impacts of the airport, summarised below in the section on mitigations, and also discusses further possible mitigations in the *Final Report*.

Changes between the do minimum (2 runway) and do something (3 runway) scenarios in 2030

- 11.8** Figure 11.1 below illustrates the differences between the Heathrow Airport Northwest Runway 2030 do minimum and do something forecasts in the lower end, carbon-capped scenario. (Note that in 2030 the airport would not be operating at full capacity – though the impacts of full capacity operation are considered in the 2040 and 2050 descriptions below.) In the do something scenario, higher numbers of people are forecast to fall within the 57dB day noise contour, and to experience 50 or more 70dB overflights in a day than the do minimum situation. In contrast, however, fewer people are forecast to fall into the 54dB day noise contour, the 48 dB night noise contour, the 55_{Lden} 24-hour contour and to experience 25 or more 60dB overflights during the night.

Figure 11.1: LHR NWR, do minimum (2R) v expansion (3R), 2030, low end forecast (*assessment of need, carbon-capped*)



Source: Airports Commission analysis

11.9 The explanation for this somewhat uneven spread of noise impacts is that in the Commission’s modelling the airport’s noise contours are profoundly affected by the operation of a third runway and the flight paths that operate to and from it. The new noise contours impact areas with different population densities from those affected by two runway operations. For example, as Figures 11.2 and 11.3 demonstrate, when a third runway is operational the landing and departure corridors to the east of the airport diverge to a greater extent, leading to a three pronged noise contour as opposed to a single elongated protrusion. In this manner, a third runway could be seen to worsen noise impacts in some areas of west London, but improve the situation in others. In general terms, the noise impacts can be seen to shift further west.

Figure 11.2: 2030 do minimum (two runway) L_{den} 16hr contours, low end forecast, (assessment of need, carbon-capped)

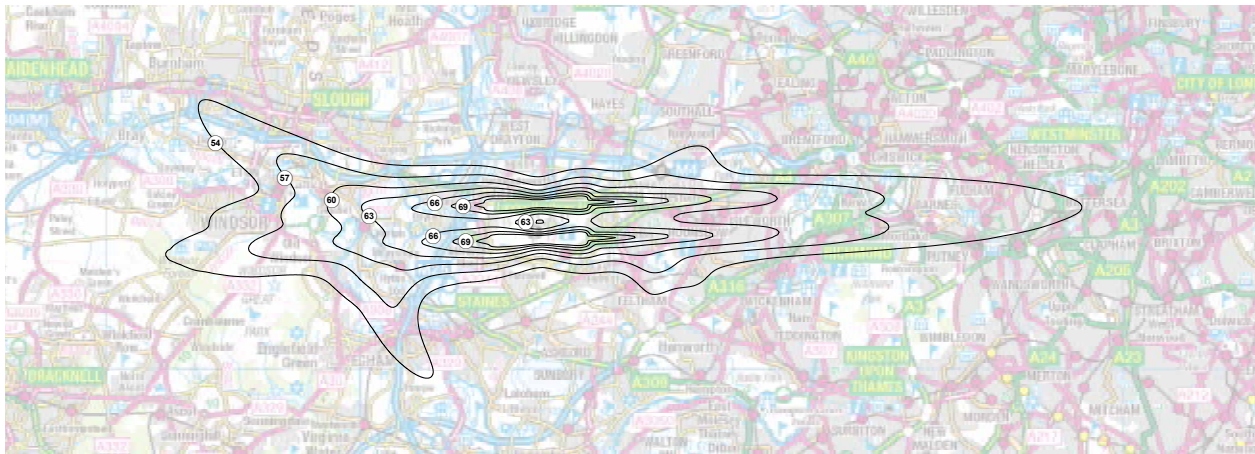
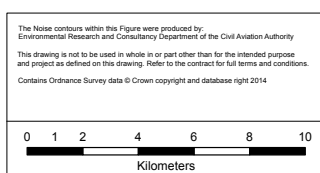


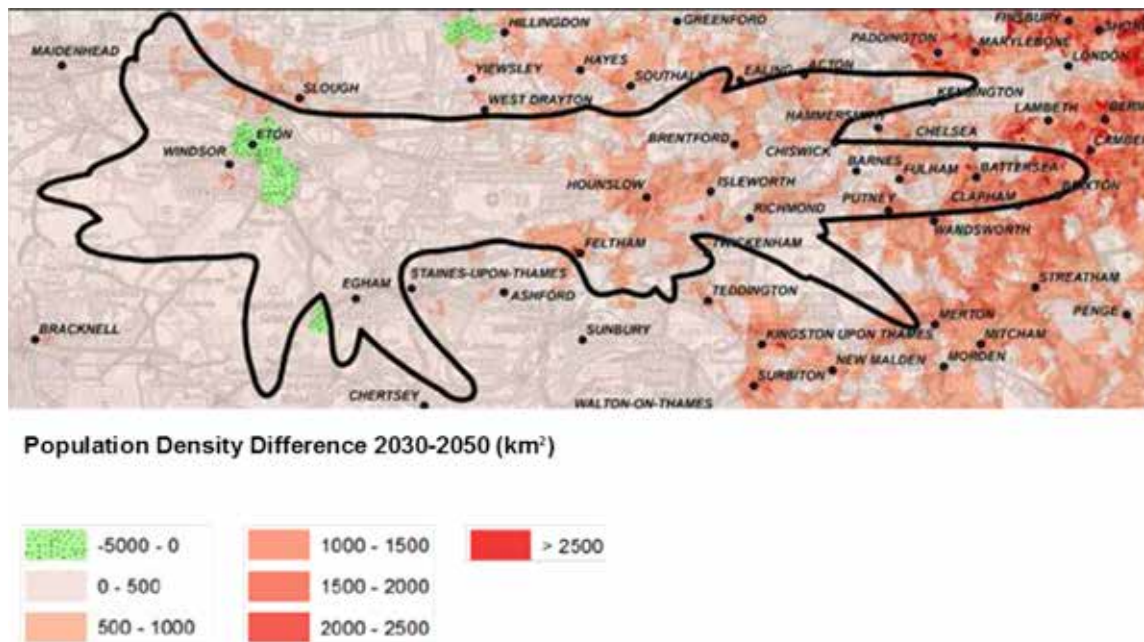
Figure 11.3: 2030 do something (three runway) L_{den} 16hr contours, low end forecast, (assessment of need, carbon-capped)



Source: Jacobs, CAA and Airports Commission Analysis

11.10 As can be seen in the Figure 11.4, the new contour has moved away from some of the most densely populated areas of London in future forecasts.

Figure 11.4: 2030 vs 2050 difference in population densities around Heathrow Airport, shown against noise study area⁷¹



Source: Airports Commission and Jacobs, using CACI Ltd. population data

Changes between the do minimum (2 runway) and do something (3 runway) scenarios in 2040 and 2050

11.11 Similar patterns can be seen when comparing the differences between the 2040 and 2050 carbon-capped do nothing and do something scenarios. In both cases, the contour patterns of the two runway and three runway airports remain broadly as set out above, and this in turn drives similar patterns in the numbers of affected people. In both 2040 and 2050 a three runway Heathrow is predicted to cause more noise impacts than a two runway Heathrow during the day, but would be a better neighbour at night. This is because the Commission's modelling above supposes that the restrictions on night flights currently in place at Heathrow are preserved (between 23:30 and 6:00), and therefore the model assumes no marked increase in traffic in this period, but continues to capture the onset of quieter planes entering most airlines' fleets, as well as optimised flight paths. The possibilities for restricting night flights discussed later in this section and in the *Final Report* could well change these results.

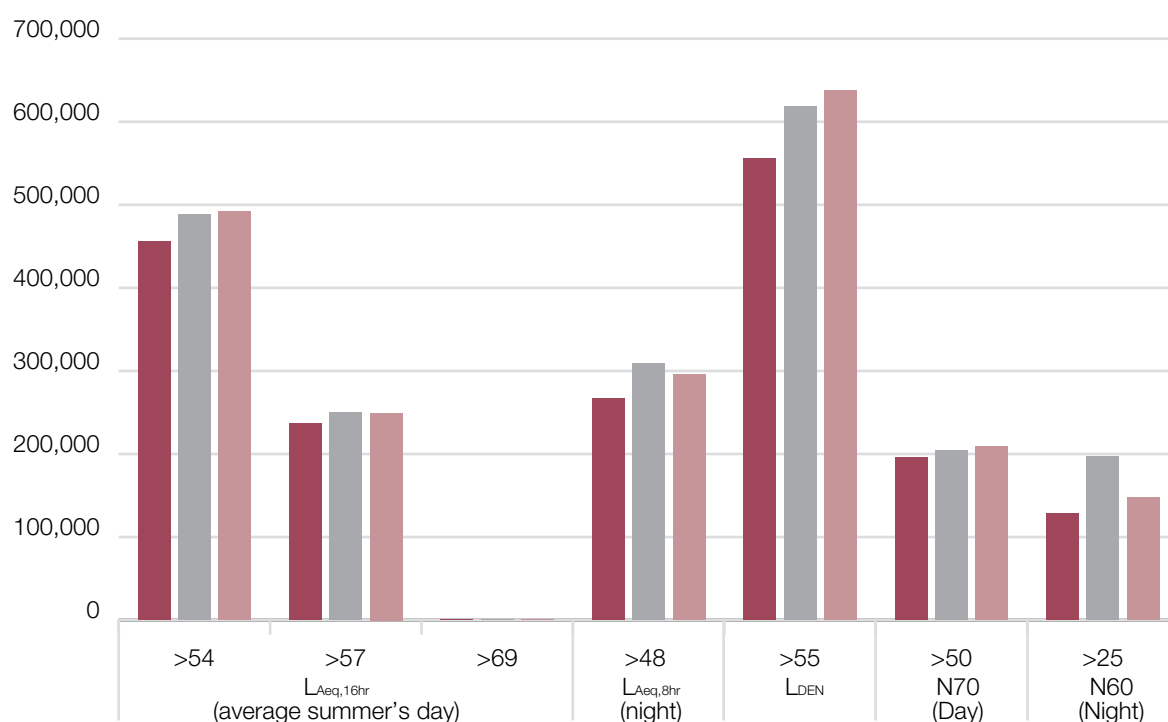
⁷¹ The "study area" shows the largest possible extent of the 54dB contour taking into account the current extent of the contour and the Commission's analysis of AoN CC (year 2040) to provide context

11.12 In the day, by 2040, the reduction in people within the 54dB contour from the do minimum scenario that was seen in 2030 has changed to an increase in affected population. At night the reductions in the number of people experiencing overflight at significant levels continue, with reductions in the N60 metric particularly noticeable.

Change over time in do something: 2030, 2040 and 2050

11.13 From 2030 to 2040 the Commission's modelling sees traffic at the airport increasing, from 652,000 ATMs to 740,000 ATMs. Traffic remains at broadly this level until 2050. In most interpretations, this trend of growth between 2030 and 2040 corresponds with a growth in the noise profile of the airport, as Figure 11.5 shows. However, the growth in affected populations is relatively slight (given the forecast increase in the numbers of planes from 2030-2040), as the impact of new traffic is somewhat counter-balanced by the expected improvements in airplane technology over the same period.

Figure 11.5: LHR NWR, do something in 2030, 2040 and 2050, low end forecast (assessment of need, carbon-capped)



Source: Airports Commission analysis

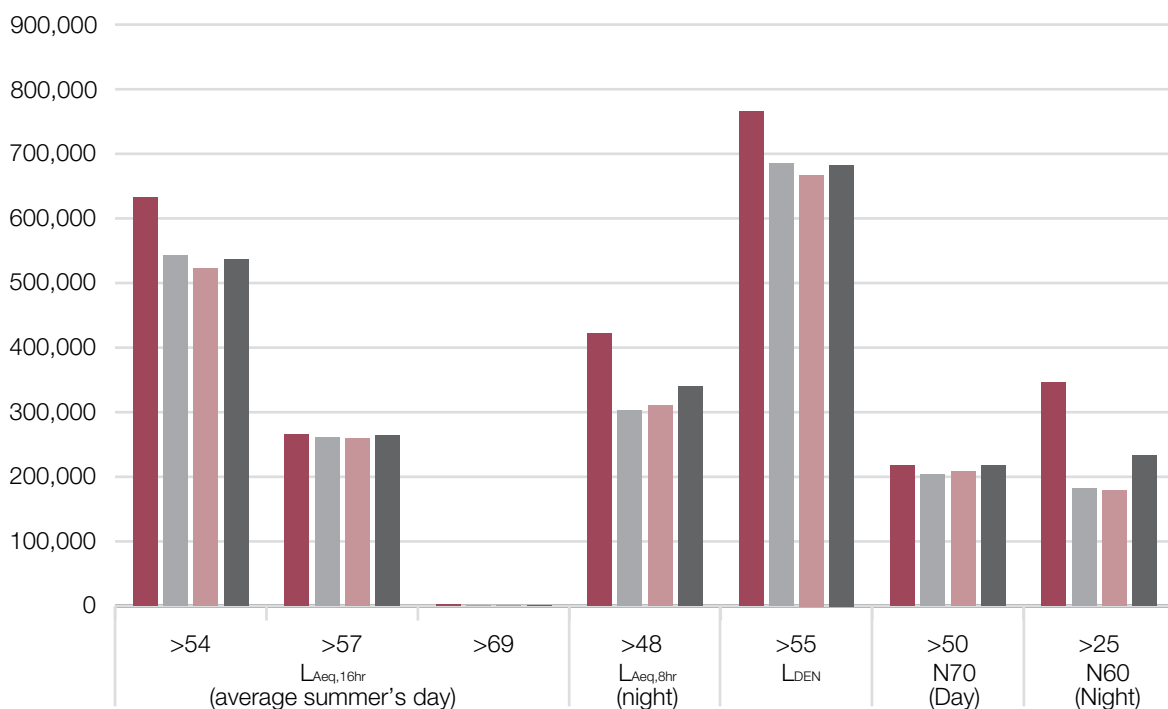
11.14 The night noise statistics (48dB and N60) buck the trend of a steady increase in noise from 2030 to 2050, for the reasons set out above. Although in 2050 night noise would still be predicted to be marginally worse than in 2030.

Comparison of carbon-capped and carbon-traded scenarios

11.15 Figure 11.5 can be compared with Figure 11.6, which displays the results of the Commission's carbon-traded do something forecasts, for the highest growth scenario, *low-cost is king*. In this scenario more traffic is forecast throughout the assessment period, and this manifests itself most fully in the 2030 assessment (in the 2040 and 2050 assessments the airport is effectively full and cannot accommodate any higher levels of traffic). In addition there are fewer price constraints in place on the use of more polluting planes, so more large aircraft are forecast to form part of HAL fleet mix.

11.16 The daytime noise impacts displayed in the 54dB, 57dB and 55L_{den} contours are markedly higher in the 2030 carbon-traded assessment than the carbon-capped assessment, with approximately 100,000 more people affected in the 54dB and 55L_{den} contours. And the 2030 reduction of noise impacts compared to current day operations is much less marked.

Figure 11.6: LHR NWR, current day scenario versus do something in 2030, 2040 and 2050, high end forecast (*low-cost is king*, carbon-traded)



Source: Airports Commission analysis

New Technology – Impact of fleet mix sensitivities

11.17 The Commission’s assessment has been based on an expected fleet mix that the Commission has developed. The Commission has tested the impact of these assumptions on noise results by reducing the percentage of (Airbus) A350s in the mix (which stakeholders have noted they believe are overestimated), reducing the number of “Generation 1” aircraft (those just coming into use) and the impact of increasing or reducing the amount of quieter “Generation 2” aircraft (those not yet in production, with no known manufacturer noise profile) in the fleetmix in 2040 and beyond. The impacts are summarised below – and gives an indication of how the noise contours could be impacted.

Table 11.1: Results of fleet mix sensitivity analysis

Sensitivity test in 2040 fleet mix	Impact on number of people in 2040 57db Contour
Correct A350 over-estimation	-2%
Generation 2 not present in 2040	+3%
5% fewer Generation 1 in mix	+2%
20% fewer Generation 1 in mix	+8%

Source: Airports Commission analysis

11.18 The scheme promoter predicts that Heathrow will attract a higher proportion of quieter aircraft than the Commission’s fleet model assumes. A sensitivity was run using HAL fleet mix, and the results showed a significant difference to the results above. They are set out in the *Noise: Local Assessment Compendium of ANCON Modelling Results* report. These are based on quite substantial amendments to the fleet mix the Commission has modelled so far.

National noise assessment

11.19 If the Heathrow Airport Northwest Runway scheme were to be developed, the national daytime noise situation would be largely similar to the do minimum scenarios across the assessment period. This is because in the daytime the forecast increase in population exposed at a developed Heathrow Airport Northwest Runway site would be broadly offset by reductions in exposed populations at other airports, where traffic would not grow as sharply as in a do minimum scenario. In 2030 Heathrow Airport Northwest Runway expansion has a positive impact compared to a do minimum scenario, due to a decrease in population exposure at a number of airports.

11.20 For nighttime noise, the large reductions provided by the scheme are sufficient to have a marked effect on the national situation, with 26,000, 68,000 and 125,000 fewer people predicted to be exposed nationally in 2030, 2040 and 2050 respectively (48dB). Restricting night flights further would intensify this downward trend.

Risks and Mitigations

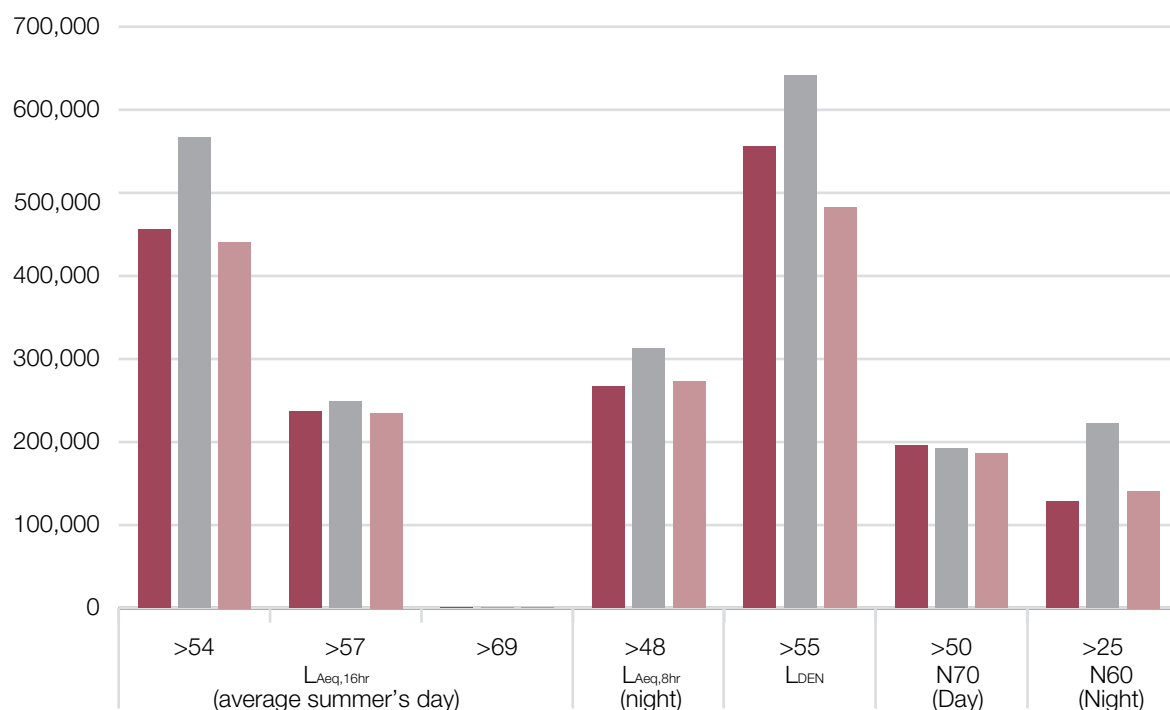
11.21 These figures cannot and do not capture the full noise impacts of an expanded Heathrow. For example, it is well understood that people who live beyond an airport's noise contours can often be irritated and upset by the overflight of planes. An expanded Heathrow would lead to more planes overflying the capital. The Commission's assessment is also based, by necessity, on a set of assumptions. If these assumptions change then the impact shown will change as well. Key stakeholders, such as NATS, as well as the airport, can amend their operations to change the type of noise impacts experienced by the community, mitigation measures could be put in place, and communities could also be provided with compensation to take into account the impacts that cannot be fully mitigated. These issues are considered below.

Flightpaths

11.22 For the Heathrow Airport Northwest Runway scheme, HAL provided the Commission with potential flight paths that demonstrate how the airport could be operated to achieve different noise outcomes, namely: to minimise the numbers of new people affected by noise; and to maximise the levels of predictable respite for residents near the airport (all operating models proposed also deliver respite through alternation). These flight path scenarios have also been modelled.

11.23 In Figure 11.7 the results of these two alternative operating strategies are compared with the strategy to minimise the total numbers of people affected by noise, discussed above. Whereas flight paths designed to minimise newly affected populations show substantial increases in the total number of affected people across most metrics, an operating strategy designed to provide predictable respite to residents near the airport shows numbers comparable to, and in some cases better than, the flight paths designed to minimise total numbers affected.

Figure 11.7: Heathrow Airport Northwest Runway, alternative operation strategies, 2030, low end forecast (assessment of need, carbon-capped)



Source: Airports Commission analysis

11.24 Whilst this may seem slightly counter-intuitive (the minimising total strategy, in the Commission's modelling, actually affects higher numbers of people than the option providing predictable respite) this analysis broadly tallies with the scheme promoter's own work, which also sees techniques to prevent new populations receiving significant noise impacts producing higher total numbers of affected populations, and sees the respite and minimising total strategies producing broadly comparable results.

Night Flights

11.25 Nighttime flights and arrivals are very unpopular with local residents on account of the noise disturbance at a particularly unwelcome hour. The resulting sleep disturbance can have health and other impacts such as lost productivity the next day for people who have suffered from lack of sleep. A number of consultation responses called for greater restriction or a ban on night flights whilst other responses highlighted the economic value of such flights and argued for their continuation.

11.26 At Heathrow under current arrangements a quota system limits the number of flights that use Heathrow and the noise levels the aircraft create, during the ‘core’ night period from 23:30 to 06:00. In practice there are an average of 16 arrivals per night between 04:30 and 06:00 from long haul destinations and no departures. Having considered all of the arguments and the evidence presented to it, the Commission recommends that following construction of a third runway at Heathrow there should be a ban on all scheduled night flights between 23:30 and 06:00. This is explained in more detail in the *Final Report*. Whilst the Commission has considered the potential noise benefits of such a ban, it should be noted that the effects of a ban are not included in the quantitative analysis above.

Respite

11.27 The Commission notes the importance of periods of respite from being overflowed for the local community, and the emphasis placed on it by the promoter. However, the effect of such respite is only demonstrated in the noise modelling by virtue of its effect on the average, which is sometimes relatively insignificant. Also, respite can be delivered in different ways, over different hours or days, short or longer periods etc. The particular respite options should be developed with the local community, to ensure it meets their needs. How communities can be assured of predictable respite that meets their needs is discussed in detail in the *Final Report*.

Other operational mitigations

11.28 The scheme promoter has predicted a steeper glide path of 3.5 degree descent in future decades of the airport’s operation. The Commission sees this as a realistic assumption by 2050 for any of the schemes, and so has considered the potential effect on future noise levels in this assessment year only. The modelling demonstrates that any such change to glide path may improve the noise situation at the airport in 2050 from between 5 and 10% across the full range of metrics. Of course, this mitigation is not an option only for the Heathrow Airport Northwest Runway scheme, but could be applied to any of the three short-listed options.

11.29 The position of the new runway further west offers some potential for approaching aircraft during westerly operations and less busy periods, to maintain a higher altitude for longer over the highly populated areas of London resulting in a slight reduction in noise. The opposite is true during busy periods and easterly operations, where aircraft landing on the new runway approach the airport over communities to the west at a lower altitude than currently, resulting in a slight increase in noise.

- 11.30** Future improvements in air traffic management could further reduce the need for repetitive overflight of populations some distance removed from the airport.

Insulation

- 11.31** The scheme promoter has proposed a home insulation scheme that offers households closest to the airport full costs of their noise insulation covered by the airport and up to £3,000 in noise insulation would be offered to homes further away from the airport. In total, Heathrow estimates that over 160,000 homes could be eligible for insulation, at a cost of up to £700 million⁷². The Commission has set out recommendations for how an appropriate package of support should be agreed and delivered in its *Final Report*.

Voluntary Purchase scheme

- 11.32** The Commission has noted HAL's proposals to offer to voluntarily purchase up to 3,750 homes, including in Poyle, Colnbrook, Brands Hill, Harmondsworth, Sipson, Harlington and Cranford Cross for their full unblighted market value plus 25%. This offer could enable residents in these areas to choose to move to a less noise affected area if they wished to do so.

Wider Community Compensation

- 11.33** The Commission has recommended that the airport should commit to deliver a world class package of compensation for local communities. In addition it recommends that Government should introduce a noise levy at major UK airports to ensure that airport users make a fuller contribution to compensate local communities. A levy should not impose undue or unfair costs at any airport.

Commission Assessment

- 11.34** In relation to the objective of ***minimising and where possible reducing noise impacts***, the Commission considers that the Heathrow Airport Northwest Runway scheme will have a **SIGNIFICANTLY ADVERSE** impact. At an expanded Heathrow daytime noise impacts are likely to materially rise in comparison with future do minimum scenarios, and this rise will incorporate tens of thousands of people. However, this rise is not uniform and some nighttime metrics show better performance than in the do minimum (this is before the suggested ban on flights before 06:00 is taken into account) in all assessment years.

72

<http://your.heathrow.com/heathrow-unveils-new-world-class-insulation-scheme/>

- 11.35** The performance of the Heathrow Airport Extended Northern Runway scheme is broadly comparable to the Heathrow Airport Northwest Runway scheme when similar flight paths are used, as the area of London, number and type of planes are broadly similar. However the Heathrow Airport Extended Northern Runway scheme concentrates the traffic approaching on the centreline of the current northern runway, and with two centrelines has more limited ability to provide respite via runway alternation, relying on flightpaths and deep landings to provide respite. This limits the respite available at peak times compared to the Heathrow Airport Northwest Runway scheme. However, the lower levels of overall traffic mean that in the quietest and furthest contours from the airport the Heathrow Airport Extended Northern Runway performs slightly better than the Heathrow Airport Northwest Runway.
- 11.36** In comparison across the metrics the second runway at Gatwick shows a higher relative impact. Broadly the population exposed to noise across all metrics is expected to double as there is limited scope for technology and improved operations to mitigate the increased volume of traffic. However, due to its relatively rural location and the relatively sparsely populated wider local area, expansion at Gatwick affects considerably fewer people than either of the two Heathrow schemes. In the *assessment of need* carbon-capped scenario, both Heathrow schemes on the $L_{Aeq} > 54$ metric affect approaching 500,000 people in 2030, whereas at Gatwick the number of people in this metric is less than 20,000.
- 11.37** There is potential for future improvements to compensation schemes, air-space management, flight path design, angle of approach and technology incentives to further mitigate the noise impacts at Heathrow. The Commission believes that further developments in this area have the potential to bring the noise impact assessment closer to **ADVERSE**. Also important would be the Commission's proposed ban on all scheduled night flights between 23:30 and 06:00 and an opportunity for communities in the area to meaningfully engage in the process of determining appropriate mitigations. The Commission discusses this further in the *Final Report*.

12. Assessment: Air Quality

Approach and Updates to Evidence Base

- 12.1** The Commission has considered air quality at a national and local level. The national level assessment quantifies total mass emissions and considers potential breaches of the UK national emissions ceilings. Mass emissions are used to calculate the environmental damage costs for emissions of different sources (as specified in the HM Treasury Green Book). The local level assessment considers ground-level pollutant concentrations; the number of properties and populations affected and the potential impacts on human health, sensitive ecosystems, and exceedances of the EU limit values and local air quality objectives.
- 12.2** At consultation the Commission had undertaken a mass emission assessment, analysing the expected increase in emissions given the increase in the scale of the airport and its increased operations and related surface access. These results were compared to UK-wide levels, the national emissions ceiling, and monetised allowing a full analysis of the national impact. The Commission also set out the broad scale of the local impacts by reviewing the current risks of local exceedances and comparing to the predicted emissions increase. However, the Commission had not completed detailed dispersion modelling, which combines this analysis of emissions increase with an analysis of from where (on or off the airport site) these are emitted and how these pollutants behave in the local atmosphere. This analysis provides a finer spatial resolution, to allow the Commission to see in detail how the pollutants impact on local sensitive receptors and sensitive ecological sites.
- 12.3** The Commission has now completed and consulted on this assessment and the analysis and the impact of the consultation are included in the analysis below. The *Air Quality Consultation Summary* report sets out in detail the Commission's consideration of the Air Quality consultation responses. In summary several respondents questioned the Commission's assumptions (for instance the use of the 2030 assessment year, the study area, or demand scenarios) and made specific technical points about the methods of modelling both the unmitigated impacts and the mitigations, particularly with respect to road traffic demand management. Other respondents focus on the legal structures around air quality, discussing the recent Supreme Court Ruling, the impacts on Pollution Climate Mapping (PCM) receptors above $40\mu\text{g}/\text{m}^3$ ⁷³ (the EU limit value) at Heathrow or the need to maintain good

73 Micrograms per cubic metres

standards of air quality at Gatwick, or the requirements of the Habitats Directive. Some responses focus more qualitatively on the impact of air quality changes on people's health and wellbeing, and the impacts on the landscape and biodiversity, as well as the process of consultation itself.

- 12.4** The Commission has made no changes to the technical information provided, but more information is provided in the Risks and Mitigations section, below, in terms of the Commission's views on the legal framework around air quality and how mitigations to the impacts can be assured.
- 12.5** In both cases the Commission has compared a future year's do minimum case, using current modelled forecasts, without expansion against the case where the development does take place in a high demand growth scenario (*global growth*, carbon-traded⁷⁴). This allows the change in emissions associated with the new development to be calculated against a plausible "worst case" scenario in terms of pollutant levels. The Commission has considered possible changes to emissions of nitrogen oxides (NO_x), particulate matter of 2.5 microns diameter (PM_{2.5}) and particulate matter of ten micron diameter (PM₁₀) and local concentrations of Nitrogen Dioxide (NO₂). Given the uncertainties around future background air quality levels, coupled with insufficient data on aircraft and surface access emission levels post 2030, the Commission has assessed the air quality impacts for 2030. This is discussed further in the *Air Quality Consultation Summary* report.
- 12.6** These concentrations include adjustments for expected improvements to vehicle emission technology up to Euro 6 standards⁷⁵, but not for further technological development, other potential government policy measures or scheme promoter mitigation measures to reduce local concentrations (beyond those already designed into the scheme through, for instance, taxiway design). As such it is very important to note that the numbers in the assessment section below represent unmitigated impacts. This is discussed further in the Risks and Mitigations section.

Outcomes

National assessment

- 12.7** Table 12.1 below sets out the projected mass emissions associated with the airport in 2030 in the do minimum case and in 2030 with expansion, including airport related road traffic emissions and no mitigation measures.

⁷⁴ All figures cited in this section relate to the *global growth* carbon-traded scenario unless stated otherwise

⁷⁵ European emission standards define the acceptable limits for exhaust emissions of new vehicles sold in EU member states. Euro 6 standards come into force from September 2015.

Table 12.1: Baseline (2030) NO_x, PM₁₀, PM_{2.5} and 2030 projected mass emissions by source, te/yr⁷⁶

Pollutant	NO _x			PM ₁₀			PM _{2.5}		
Emissions Source	DM	NWR	% change	DM	NWR	% change	DM	NWR	% change
Aircraft	5309.8	7606.7	43.3%	179.3	286.8	60.0%	179.3	286.8	60.0%
APU	284.7	398.2	39.9%	5.7	8.2	43.9%	5.7	8.1	42.1%
GSE	170	216.3	27.2%	11	13.7	24.5%	11	13.7	24.5%
Stationary sources (e.g. boilers)	85.8	100.6	17.2%	0	0	0%	0	0	0%
Road traffic – airport only	3,792.60	3,847.20	1.4%	563.2	569.4	1.1%	316	319.5	1.1%
Total	9,642.80	12,169.00	26.2%	759.1	878.1	15.7%	511.9	628.2	22.7%

Source: Airports Commission and Jacobs analysis

- 12.8** In 2030, the Heathrow Airport Northwest Runway (LHR NWR) scheme would increase emissions of NO_x from 9,643 te/yr (tonnes per year) to 12,169 te/yr, an increase of 2,526 te/yr (26.2%) above the do minimum. The increase is predominantly associated with the net change in aircraft emissions, and largely with non-ground operations (e.g. initial climb, climbout and approach). Emissions of PM₁₀ increase by 119 te/yr, from 759 te/yr to 878 te/yr (an increase of 15.7%) and emissions of PM_{2.5} increase by 116 te/yr, from 512 te/yr to 628 te/yr (an increase of 22.7%). Emissions of PM₁₀ and PM_{2.5} have been assumed to be equivalent from airport sources.
- 12.9** The primary source of increased NO_x emissions is aircraft engines, but these are generated at elevated heights during the take-off and landing cycle, significantly reducing their impact on local air quality at ground level. This results in emissions of NO_x from road transport around the airport in populated areas becoming a more significant factor for health impacts.
- 12.10** Emissions of PM_{2.5} and PM₁₀ are predicted to increase compared to the do minimum. The primary source of emissions of both types of particulate matter in these future years is emissions from brake and tyre wear and surface abrasion, where road transport is the most significant cause.
- 12.11** Based on the HM Treasury Green Book the national level damage costs of the increases in emissions of NO_x and PM₁₀ associated with the unmitigated Heathrow Airport Northwest Runway scheme *global growth* carbon-traded scenario over the 60 year appraisal period are calculated to be £94.2 million and £863.5million, respectively⁷⁷. The Impact Pathway values for 2030 for hospital admissions as

⁷⁶ Tonnes of emissions per year

⁷⁷ In lower demand scenarios, such as *assessment of need* carbon-traded as used in the Economic Case, these results would be lower.

calculated in line with WHO guidelines gives a maximum unmitigated impact central value of between £1.4 million and £5.2 million for NO₂ health effects.

12.12 The UK is subject to emission ceilings on its total emissions of a range of air quality pollutants including NO_x and PM_{2.5} through the 2001 National Emissions Ceiling Directive (NECD) and the Gothenburg Protocol, part of the Convention on Long-Range Transboundary Air Pollution (CLRTAP). The tighter emission ceilings for the NECD reflected below are currently under negotiation; for the purpose of this assessment, a 2030 NO_x ceiling in the range of 410 to 440kt, and a PM_{2.5} ceiling in the range of 44 to 50kt, has been assumed. The ceilings are to be met by 2030 and 2020 respectively.

Table 12.2: Annual Mass Emissions of Gothenburg Protocol pollutants and projections, kt/y

	NO _x kt	PM _{2.5} kt
NECD Targets (2030)	414	43.7
Gothenburg Protol Targets (2020)	711	57
National Atmospheric Emissions Inventory emissions pollutant projections for 2030 + airport expansion	588	51
Change due to Airport expansion in 2030	2.5	0.12
New total airport emissions as a percentage of national projection in 2030	0.61	0.26

Source: Airports Commission analysis

12.13 From the table above it is clear that although expansion results in increases in emissions these are small when viewed in the national context, making up a modest 0.61% of projected national NO_x emissions and 0.26% of projected national PM_{2.5} emissions. They do not materially alter the likelihood of delay of the UK exceeding the Gothenburg targets.

Local assessment

Baseline

12.14 As has been pointed out by a large number of consultation respondents, there are already exceedances of air quality objectives at locations near Heathrow, in absence of any future expansion. Air quality is measured at monitoring stations on an average annual and daily basis. For NO₂ the annual mean concentrations are below the air quality objective at background sites, but there have been consistently

recorded daily exceedances of NO₂ targets at the air quality monitoring station close to the northwest boundary of the airport (approximately 190m to the northwest of the existing northern main runway) and at other sites on or close to busy roads across the area studied (A4 Bath Road, A312, A316, A3044). Annual concentrations of PM₁₀ and PM_{2.5} are generally well below the objectives.

- 12.15** Hillingdon has declared an Air Quality Management Area (AQMA) for exceedances of the annual mean objective for NO₂. The AQMA boundary encompasses the southern part of the Borough, including Heathrow Airport. Whole Borough AQMAs have also been declared by the London Borough of Hounslow and Spelthorne Borough Council –for exceedances of the annual mean objective for NO₂.
- 12.16** There are several internationally and nationally-designated statutory conservation sites within, or immediately adjacent to, the wider study area used to assess air quality impacts. These include the South West London Waterbodies RAMSAR/ Special Protection Area (SPA) and Sites of Special Scientific Interest (SSSIs) such as those at the Staines Moor, Kingup meadows & Oldhouse Wood, and Langham Pond. A full list and the current background nitrogen deposition rates and NO_x concentrations are set out in the detailed Air Quality reports. Changes in air quality can have particular impacts on sensitive ecosystems through NO_x, NO₂ and the impact of deposits of nitrogen, directly related to concentrations of NO₂.

Concentrations at health based receptors

- 12.17** Health based receptors are sited in areas where members of the public are regularly present, so the data from them is important when considering the possible health impacts of air quality changes. The detailed Air Quality reports sets out the air quality impact on each particular impacted “receptor ID” without any mitigation. The maximum predicted annual mean NO₂ concentration with the Heathrow Airport Northwest Runway scheme is 34.7µg/m³ and occurs to the northeast of the airport; the incremental change above do minimum is 0.4µg/m³. The maximum predicted incremental change (10.8µg/m³) occurs to the northwest adjacent to the new runway, where the predicted concentration for the Heathrow Airport Northwest Runway scheme is 32.9µg/m³. There are no predicted exceedances of the air quality objective at any receptor location, in either the do minimum or Heathrow Airport Northwest Runway scenarios.
- 12.18** The numbers of properties and the associated population where annual mean NO₂ concentrations are predicted to improve, worsen, or remain unchanged, are summarised in Table 12.3 below. The analysis excludes properties that lie within the

scheme boundary or within 10m of any new road link as it is likely these houses will need to be demolished.

Table 12.3: Properties and Population, change in concentrations for LHR NWR scheme

Change in Concentration ($\mu\text{g}/\text{m}^3$)	Properties Affected			Estimated Population Affected		
	NO_2		PM_{10}	NO_2		PM_{10}
	Absolute NO_2 $<32\mu\text{g}/\text{m}^3$	Absolute NO_2 $>32\mu\text{g}/\text{m}^3$		Absolute NO_2 $<32\mu\text{g}/\text{m}^3$	Absolute NO_2 $>32\mu\text{g}/\text{m}^3$	
$>+12$	0	0	0	0	0	0
$+10 - +12$	0	7	0	0	18	0
$+8 - +10$	34	0	0	88	0	0
$+6 - +8$	72	1	0	186	3	0
$+4 - +6$	640	1	7	1,651	3	18
$+2 - +4$	2,386	3	45	6,153	8	116
$+0.05 - +2$	43,917	2	46,898	113,262	5	120,951
$+0.05 - -0.05$	19	0	160	49	0	413
$-0.05 - -2$	145	0	117	374	0	302
$-2 - -4$	0	0	0	0	0	0
$-4 - -6$	0	0	0	0	0	0
<-6	0	0	0	0	0	0

Source: Airports Commission and Jacobs analysis

12.19 More properties experience an increase than a decrease or no change. The average increase to annual mean NO_2 concentrations at affected properties is $0.9\mu\text{g}/\text{m}^3$. There are 14 “at risk” properties ($>32\mu\text{g}/\text{m}^3$) that would experience an increase in NO_2 concentrations. As a precautionary approach, a risk of exceedance has been taken to be any road link with a concentration of $>32\mu\text{g}/\text{m}^3$.

Exceedances of the EU limit values at local sites.

12.20 Table 12.4 sets out the Department for Environment, Food and Rural Affairs (Defra’s) PCM modelled road links with NO_2 concentrations for 2030 greater than $32\mu\text{g}/\text{m}^3$ and the incremental changes to annual mean NO_2 concentrations in 2030, associated with the Heathrow Airport Northwest Runway scheme at these locations.

Table 12.4: Predicted Annual Mean NO₂ Concentrations (µg/m³) in 2030 under LHR NWR scheme

Road Sector	EU Limit Value	Maximum PCM Predicted Concentration in Defra Zone	PCM Predicted Concentration for Road Sector	Predicted NWR Incremental Change	Total NO ₂ Concentration
Bath Road, A4 (junction A437 to west of Newbury Road)	40	48.6	47.4	1.3	48.7
A4 (junction of Fulham Palace Road to Earls Court Road)		48.6	37.4 – 44.9	0.5 – 0.6	38.0 – 45.4
A312		48.6	32.1 – 33.9	0.6 – 1.2	32.9 – 33.3
A40 Western Avenue (junction A406 to east of A219)		48.6	37.8 – 44.3	0.2 – 0.4	37.2 – 44.5
Junction of Kew Rd/ Gunnersbury Ave extending east along A4 to Chiswick Lane		48.6	33.7 – 33.9	0.6 – 3.7	34.5 – 37.4
M4 (Windmill Rd) extending west along Great West Road		48.6	33.3	n/a	33.3

Source: Airports Commission and Jacobs analysis

12.21 The PCM predicted concentration for road indicates the range across all individual links in the identified road sector. There are two key comparators when considering the change in NO₂ concentrations at the Heathrow Airport Northwest Runway scheme:

- 40µg/m³: This is the EU limit value, and the level which the government aims to achieve everywhere in the UK where members of the public are likely to be regularly present and are likely to be exposed.

- The maximum concentration in the Defra zone: the maximum predicted concentration by the PCM model in 2030 at any location within the Greater London agglomeration.

12.22 As can be seen above, the expansion does not shift any new receptors to beyond 40µg/m³. However, while there are three sectors where total NO₂ concentration at Heathrow could be above the EU limit value (Bath Road, A4, A40) only one of them (Bath Road) is higher than the predicted highest PCM sector in London (the Marylebone Road at 48.6µg/m³). This suggests that only one sector associated with the Heathrow Airport Northwest Runway scheme could delay compliance with the limit value in the Greater London Zone. The implications are discussed further in the Risks and Mitigations section.

Impacts on local Designated Sites

12.23 The Heathrow Airport Northwest Runway scheme would cause an increase in the concentration of nitrogen oxides at some Designated Habitats. A full list, and the levels of increase by site, are included in *Air Quality – Local Assessment – Detailed Emissions Inventory & Dispersion Modelling* but in summary include receptors in South West London Waterbodies RAMSAR/SPA and the Staines Moor SSSI, Wraysbury Reservoir, Fray's Farm Meadows, Langham Pond, Dumsey Meadow, Bushey Park & Home Park, Thorpe Park No. 1 Gravel Pit, Wraysbury No. 1 Gravel Pit, and Wraysbury & Hythe End Gravel Pit SSSIs (not all receptors in those locations show an increase).

12.24 However, the Heathrow Airport Northwest Runway scheme would not cause any new exceedances of the lower or upper bounds of the Critical Loads. These are the rates below which significant harmful effects to sensitive ecosystems are unlikely to occur. The greatest incremental change occurs at the Staines Moor SSSI (1.2 kgN⁷⁸/ha/yr) representing a 11.8% increase.

Risks and Mitigations

12.25 It is important to note that the above information is based on the unmitigated impact on air quality of the Heathrow Airport Northwest Runway scheme in a high demand scenario (*global growth* carbon-traded). Beyond some modelled changes to glide slopes, plane technology etc. which are factored in to the model as reasonable expectations for change between now and 2030, and the assumptions in the Commission's surface access dynamic modelling that is an input to this work. However, there are many more mitigation measures available, some of which have

78 Kilo tonnes of atmospheric nitrogen

been considered by the Commission's consultants and are set out in Table 12.5. Where the measure was already incorporated into the design, or where the impact could not be quantified the table shows the impact as "N/A".

Table 12.5: Possible air quality mitigation measures for LHR NWR scheme

Mitigation Measure	Commentary	Indicative Impact on PCM Exceedance
Achieving an increase in public transport access from 40% to >50%	The Promoter's Air Quality Assessment sets out a vision for high public transport access. Achieving this level of mode share would be challenging and would need ongoing concentrated effort by the operator and their partners, but the Commission considers that best practice operations could achieve this. The surface access modal share and traffic volumes assumed in this assessment have been built into the dynamic modelling. However, traffic movements on Bath Road are predicted to decrease with LHR NWR, due to the proposed rerouting of the A4/Colnbrook bypass and severance of the Bath Road crossing of M25. No reduction in emissions above do minimum can be quantified. Whilst a further reduction in surface access movements on Bath Road would be beneficial, this cannot be quantified.	N/A
The airport is designed to minimise the distances that aircraft taxi between stands and runways	The layout of the LHR NWR scheme has been incorporated into this assessment, and this mitigation measure has been fully accounted for in the modelling study.	N/A

Mitigation Measure	Commentary	Indicative Impact on PCM Exceedance
NO _x emissions charging	Although Heathrow Airport Ltd are consulting on a new NO _x emissions charging scheme, a current NO _x emissions charging scheme has been in operation at Heathrow Airport since 2004. There is no clear evidence that this measure has influenced airlines to select airframe/engine combinations with lower NO _x emissions when the other economic and environmental factors are also taken into consideration. The aircraft movements and fleet mix assumed for the LHR NWR Scheme have been based on the Airports Commission's <i>global growth</i> (carbon-traded) scenario, and it would not be appropriate to adjust this assumption within the assessment. If a 20% reduction in aircraft NOx emissions were assumed, based on future engine improvements, a reduction in concentrations could be achieved.	-0.8µg/m ³
Steeper Glide Slope	A steeper glide slope of 3.2 degrees has been assumed for the LHR NWR scheme. However, emissions during approach make very little contribution to ground-level concentrations (as the emissions are principally at altitude).	N/A
Airport Collaborative Decision Making (A-CDM)	Hold times used in the modelling are likely to have been under-predicted slightly; a sensitivity test has been carried out to consider a more realistic scenario. The results suggest that the underestimate of NO _x emissions associated with departure delay times in the model could be of the order of 29%, which would increase NO ₂ concentrations. The use of A-CDM to reduce average delay times by a similar margin could be expected to deliver benefits of the same magnitude, but the feasibility of such a reduction in delay times is highly uncertain.	N/A

Mitigation Measure	Commentary	Indicative Impact on PCM Exceedance
Fixed Electrical Ground Power FEGP and Preconditioned Air (PCA) for all future aircraft stands	<p>Uptake of greater FEGP use is sensitive to the cost incurred by airlines, and provision is no guarantee that it will be used. Should FEGP be made cost-advantageous to airlines over Auxiliary Power Unit (APU) by the Promoter, then greater uptake is likely.</p> <p>There are examples in Europe of international airport operators that enforce strict rules regarding the use of APU for commercial aircraft on both arrival and departure. A sensitivity test has been undertaken based on these rules, whereby APUs are only allowed to run for a maximum of two minutes on arrival and five minutes on departure. The results indicate an approximate 90% reduction in annual NO_x emissions from APUs could be achievable if stringent regulations on APU run times were introduced and enforced in 2030, at all stands.</p>	-0.6µg/m ³
Infrastructure for Ultra Low Emission Vehicles (ULEVs)	<p>It is not possible to forecast the uptake of ULEVs by airside operators or by visitors to the airport. A sensitivity test for the introduction of a higher proportion of non-road Ground Side Equipment (GSE) for the LHR NWR scheme has been based on an assumption that 80% of the diesel Non-Road Mobile Machinery (NRMM) is replaced with electric variants by 2030. The results suggest that the use of 80% electric NRMM within the GSE fleet could lead to reductions in total annual NO_x emissions of around 106te/yr, equivalent to an approximate 60% decrease.</p>	-0.25µg/m ³
Congestion Charging	<p>This would be an access charge that would be applied to a zone or zones as yet undefined around an airport scheme, with the purpose of supporting modal shift and managing traffic flows into and out of the airport and their impacts (e.g. air quality) rather than a congestion charge as applied in central London. As traffic on Bath Road is assumed to reduce with the LHR NWR scheme, further consideration to the benefits of a congestion (access) charge zone at this link has not been considered.</p>	N/A

Mitigation Measure	Commentary	Indicative Impact on PCM Exceedance
Encouraging airlines to shut down an engine during taxiing.	It is not clear to what extent shutting down one engine during taxiing could be implemented by the airlines. Based on U.S. studies, potentially a 25% reduction in NO _x emissions on taxi-out could be achieved.	-0.3µg/m ³
Ultra-Low Emissions Zone (ULEZ)	It is unclear what form a ULEZ would take. However, an indicative sensitivity test has been carried out assuming A) only Euro VI and Euro 6 vehicles are on Bath Road and B) in addition to (A) 30% of the light duty vehicles are zero emission.	A) -0.4µg/m ³ B) -1.6µg/m ³
TOTAL	Total potential reduction in the change in NO ₂ concentrations with LHR NWR at the Bath Road PCM exceedance area, assuming all the sensitivity tests are additive. A reduction of 0.1µg/m ³ is required to prevent the scheme from causing a delay to compliance with the annual mean NO ₂ EU limit value.	-2.4µg/m ³ to -3.6µg/m ³

Source: Airports Commission and Jacobs analysis

12.26 With the lowest end of the range of possible quantified mitigation results (-2.4µg/m³) the concentration at the Bath Road receptor would reduce from 48.7µg/m³ to 46.3 µg/m³, well under the Marylebone Road receptor at 48.6µg/m³. The mitigations shown above are by no means an exhaustive list and there may be more ambitious strategies available. They could encompass such things as rerouting roads or remodelling airport facilities but are likely to be costly and time consuming, and have not been considered by the Commission at this stage.

12.27 The pollutant levels at the Bath Road are part of a wider issue with air quality, particularly with respect to road traffic, in west London. The recent Supreme Court ruling ordered the Government to take action on air quality as soon as possible by producing an action plan by the end of the year. The Airports Commission considers it reasonable to anticipate there will be intervention within this plan to reduce the background traffic impacts and that airport expansion at Heathrow can be incorporated into this wider plan and not delay compliance. To take a precautionary approach however, the Commission recommends that the Government should consider introducing a congestion or access charge for road vehicles and that new runway capacity at Heathrow Airport should only be released

when it is clear that air quality at sites around the airport will not delay compliance with EU limits. This will require concerted effort from all parties, and active monitoring and scrutiny of detailed plans and mitigation measures as the scheme and mitigation designs are developed. This issue is discussed further in the *Final Report*.

12.28 As well as the possible impact of mitigation, several other key points to consider are noted below:

- The assessment above is based on a high-end traffic forecast (carbon-traded *global growth*) to give an indication of the unmitigated impact at the highest levels of demand forecasts. For the Commission's *assessment of need* scenario the demand forecasts are lower in 2030.
- The local roads changes associated with the scheme, as well as the detailed operational plans of the airport may change- while this would have limited impact on the total level of emissions it could strongly impact the local concentrations.
- The Commission has tested several scenarios with respect to technology and operational change such as in flight emissions and use of FEGP- however if technology and practice changes dramatically, perhaps as a result of wider government action, there could be implications for the air quality impacts.

Assessment

12.29 The impact on national levels of air quality, as measured by the Gothenburg targets and NECD levels, associated with the Heathrow Airport Northwest Runway scheme is relatively limited as a proportion of the total UK level. Concentration at health based receptors and at designated sites will increase (though it will not breach limit values at these receptors or critical loads at the designated sites).

12.30 The biggest impact is on exceedance of EU limit values along the A4, A40 and Bath Road. Bath Road in particular would, without mitigation, have levels higher than the predicted highest PCM sector in Greater London and could delay compliance with the limit value at the Greater London Zone level. The mitigations that the Commission has quantified could reduce this by $-2.4\mu\text{g}/\text{m}^3$ to $-3.6\mu\text{g}/\text{m}^3$ and more substantive measures, for example a wider government plan, could reduce this further, and support the UK's transition to meeting the limit value at all sites. This is discussed further in the *Final Report*.

12.31 The impacts at a local level, and with respect to exceedances at health based receptors and designated sites, are broadly comparable between the schemes,

with none breaching emissions values at health based receptors or breaching Critical Loads at designated sites. There are detailed differences, for instance the number of people or properties experiencing the $>32\mu\text{g}/\text{m}^3$ “at risk” level of NO_2 concentration varies between schemes, but in general none of the schemes breach these health and biodiversity based limits.

12.32 As such, against the Commission’s objective to improve air quality consistent with EU standards and local planning policy requirements the unmitigated impact of the Heathrow Northwest Runway scheme is **SIGNIFICANTLY ADVERSE**. Mitigations as above could limit this impact to **ADVERSE** if delivered with concerted effort from all parties including HAL but given the increases in pollutant concentrations at various health receptors and despite the fact that EU and local policy limits are not necessarily breached, the impact is unlikely to be able to reach a **NEUTRAL** level.

12.33 The Heathrow Airport Northwest Runway scheme performs more poorly than Gatwick with respect to EU limit values as Gatwick has no monitoring stations predicted to be in breach of EU limit values, but more strongly than Heathrow Airport Extended Northern Runway. The impacts between Heathrow schemes are broadly comparable at the A4 (junction of Fulham Palace Road to Earls Court Road) and A40 receptors but at the A4 Bath Road the exceedance under the Extended Northern Runway scheme is much higher and much more would need to be done to bring this receptor within compliance. This reflects the fact that the Extended Northern Runway extended runway will concentrate planes landing and taking off on the runway closest to the Bath Road, which combines a high degree of pollutants from planes with a high degree of pollutants from the road traffic. Under a Northwest Runway scheme while the Bath Road is still a hotspot for poor air quality, the effect is reduced as far fewer planes land or take off on the runway immediately adjacent to it. The Northwest Runway therefore performs better than the Extended Northern Runway scheme against this objective.

Assessment – Local economic and Quality of Life Impacts

13. Assessment: Local economy impacts

Updates to Evidence Base

- 13.1** In response to the comments made at consultation, the Commission has reviewed its Local Economy assessment. While there have been no significant changes in the analysis surrounding the local economy impacts, the Commission has worked with its Expert Advisor Panel Members to better set the analysis undertaken during consultation for the immediate area around the airport against the general trends in population increases and housing pressures in the wider London and South East region. This has included narrowing the ranges of results to look at a focal scenario (*assessment of need*) in order to clarify the conclusions of the assessment. An updated report, taking this into account, is available in *Local Economy: Impact Assessment Post Consultation Update*.

Approach and Outcomes

Development Context

- 13.2** Past trends in the South East region in general, and London in particular, suggest long-run trends of high population growth reaching up to 10.6 million by 2037. While this reflects the strength of the London economy and jobs market, significant areas of deprivation and high unemployment still remain. As the population grows, the availability and accessibility of new employment opportunities will be crucial in sustaining the economic success of the city and surrounding region.
- 13.3** Increasing housing supply in line with this population growth is also likely to be challenging. While housing densities in the capital have increased over time, they are still relatively low compared to other cities such as New York and Paris.

13.4 In addition, across London and the South East, the workforce is also being increasingly drawn from a larger area, aided by improvements in transport infrastructure. This trend is likely to continue as further enhancements to regional transport networks, such as Crossrail and Thameslink, come into operation. So, while the airport development is likely to create significant new direct, indirect and induced employment opportunities and may, as a result, generate demand for additional housing and social infrastructure, as detailed below, these impacts need to be considered in the context of broader background trends in the London and South East area.

Impacts from Airport Expansion

13.5 The development at the airport as a result of expansion will bring about both positive and negative impacts for the local community; in terms of changes to employment, local transport links, housing stock, social infrastructure and land use. The Commission has considered the direct, indirect and induced, and catalytic impacts of expansion on the local economy. For the expansion at Heathrow, the effects are most likely to be felt in the 14 local authorities⁷⁹ where most of the airport's current workforce come from, but especially in Hounslow, Hillingdon, Ealing, Slough and Spelthorne; where the employment links are strongest. However, as previously stated, given London's unique nature in terms of its size and developed transport network, the effects will need to be considered in the context of the wider London and South East area.

Impacts on Jobs

13.6 Following expansion, the table 13.1 below shows the additional number of direct employees at Heathrow as a result of the Heathrow Airport Northwest Runway scheme for the Commission's *assessment of need* carbon-traded demand scenario. These jobs are driven by the passenger forecast and associated passenger to employee ratio.

Table 13.1 Additional direct employees at Heathrow

Year	Additional direct jobs
2030	28,181
2050	29,023

Source: Airports Commission analysis

⁷⁹ These include Hounslow, Hillingdon, Ealing, Slough, Spelthorne, Windsor and Maidenhead, Richmond upon Thames, Runnymede, Harrow, Bracknell Forest, Reading, West Berkshire, Wokingham and South Buckinghamshire.

- 13.7** The direct employment provided by an expanded airport is defined as staff employed directly by the airport or the airlines and concessions based there, for instance baggage handlers or customer service staff in the terminals.
- 13.8** Expansion will also lead to additional jobs in the airport's supply chain: indirect jobs. This would include a chef at a facility that providing airline meals. Induced impacts are those generated by the spending of those employed directly or indirectly by the airport, for example, someone employed at a café frequented primarily by airport staff.
- 13.9** The following table presents the Commission's estimates of additional indirect and induced jobs in the assessment area for its *assessment of need* carbon-traded demand case:

Table 13.2: Additional indirect and induced employees around Heathrow

	Carbon-traded
2030	48,471
2050	49,339

Source: Airports Commission analysis

- 13.10** This number of jobs would represent a valuable employment opportunity that would attract and support the population growth in the local area. Indeed around Heathrow, the economically active population is forecast to expand by around 160,000 people⁸⁰ in the group of 14 authorities surrounding the airport. Therefore while some people might be attracted to the area to take up these jobs, there would also be those already forecast to be resident in the local area that would take up the new jobs generated.
- 13.11** Furthermore, catalytic effects arise as a result of the benefits of air travel on the wider economy. These impacts result from reduced travel times, a greater choice of destinations and more regular flights as well as reduced country to country trade costs. That helps expand the potential markets for businesses and improve efficiency, with impacts on intermediate goods and services. These effects lead to an increase in employment in the economy referred to as catalytic employment. The catalytic impacts could lead to, for instance, a business that is located in the South East of the UK travelling more easily to meet customers in Asia, and securing a new contract with them, then hiring new staff as their production grows. The

80 ONS/Nomisweb – see Local Economy Impacts Assessment: Post Consultation Update

Commission has forecast 190,000 more jobs in the whole of the UK as a result of the scheme.

- 13.12** The catalytic impact would be primarily concentrated in London and the South East, which already has strong labour market performance trends (e.g. Gross Value Added per head). Part of the reason for the strong catalytic impacts in this region is the effect of agglomeration. Agglomeration benefits arise as similar firms located close together benefit from productivity gains as a result of the spatial concentration. These effects can arise from shared supply chains (leading to greater competition and specialisation of suppliers) and economies of scale and scope. This implies that the productivity of individual firms will rise with the overall amount of activity in other nearby firms, or with the number of nearby workers or consumers. This can create a virtuous cycle, where agglomeration benefits support the performance of firms, which draws more firms to the area, which further increases agglomeration benefits.
- 13.13** Agglomeration benefits are already evident in London and the South East, which have several areas that have high employment, low unemployment and high resident and workplace salaries. This is particularly apparent in the area stretching west of London through to Oxfordshire and encompassing Thames Valley Berkshire and Enterprise M3 LEPs and could develop further elsewhere in the region. This is part of a long running trend which could be further supported by development at Heathrow. The area is important to London as a whole with the London Plan highlighting the Western Wedge as a key development area. The catalytic benefits of the airport would therefore be underpinned by the London Plan itself, which is focused on greater economic cohesion across the London area, although the plan opposes expansion at Heathrow for environmental reasons.

Housing and Infrastructure requirement

- 13.14** Growth of jobs associated with the airport has the potential to increase the need for additional housing in the local area. If it is assumed that 63%⁸¹ of additional direct employees were seeking new residences in the local area, demand would increase by 17,745 additional houses by 2030 in the Commission's *assessment of need* carbon-traded demand case, under the assumption of one worker per household. The associated housing demand for the indirect and induced additional workers would be 30,522 additional houses by 2030 in the *assessment of need* carbon-traded demand case⁸².

81 This is consistent with the current split at the airport

82 This uses the assumption of the movement of 63% of the additional indirect/induced number of workers to within the defined local area.

- 13.15** Following the consultation, the Commission felt it was important to highlight that the effects if 100% of workers were new to the area, in order to demonstrate that these could be accommodated. However, actual demand would be expected to be lower because unemployment levels and local labour market flexibility suggest that a proportion of new jobs would be taken up by pre-existing residents. Improvements to surface access, including Crossrail, and Southern Rail Access, could also enable a higher proportion of employees to commute from outside the 14 local authority area. Indeed, regardless of any additional surface access improvements, 61 local authorities are within a travel time of 60 minutes from Heathrow Airport, demonstrating the potential area from which employment could be attracted⁸³.
- 13.16** It is estimated that if current average housing densities in these areas continue, 6773m² of additional land per local authority would be required to meet the theoretical maximum additional housing demand from expansion. However, moving closer to average London housing densities could reduce this to 1,635m², indeed there is a strong case that with increasing housing density (redevelopment of brownfield land and refurbishing properties to house more people) then no additional land would be required.
- 13.17** Additional housing should be supported by the provision of additional social infrastructure such as schools, hospitals and leisure centres. The Commission's assessment suggests that the theoretical maximum housing demand would require 50 more primary schools and six more secondary schools across all 14 local authorities, two additional health centres (14 GPs) and two primary care centres per local authority by 2030.
- 13.18** While this increase in jobs in the wider UK economy and in the London and the South East in particular, as a result of the catalytic jobs is likely to increase demand for additional housing and associated infrastructure, the impacts will be small in comparison to the housing needs of the background growth in population.

Commercial Space

- 13.19** The businesses delivering the indirect and induced jobs growth will also need commercial premises. There is currently a general shortage of available premises for industrial and office space within the 14 boroughs around Heathrow and local plans already highlight that expansion of office and industry floor-space is necessary to cope with anticipated levels of employment demand by 2030. Local councils already have plans in place to make up this shortfall, and they should be flexible enough to support any further needs required by the airport. For those businesses

less dependent on proximity to the airport, sufficient space for business expansion exists across the entire assessment area for this not to be a constraint on airport expansion.

- 13.20** For businesses tightly tied to the airport, for instance catering businesses where very quick access is a high priority, there are possible constraints. A possible limitation around Heathrow is the large areas of surrounding Metropolitan Green Belt land, which restricts the potential for growth. Large areas of Hillingdon are within the Metropolitan Green Belt, including around the Heathrow Opportunity Area. The Metropolitan Green Belt and the developed nature of the borough means it may be a challenge to find suitable major development opportunities very local to the airport site in the longer term. HAL have mitigated this risk to an extent by the inclusion of large areas set aside for development, which would no longer be suitable for residential land due to the proximity of the runways, within their masterplan.

Surface Access

- 13.21** Several key developments in surface access, such as the Piccadilly Line improvement, Western Rail Access and Crossrail, will be transformative both for airport and non-airport users and surface access in 2030 will be significantly better in terms of surface access than it is today. Southern Rail Access provides better rail access to Heathrow from the south and will open up opportunities for employees and local residents. There will also be improved resilience as with an additional route from Heathrow into central London. However, the likely popularity of Southern Rail Access for commuters as well as for users of the airport could mean some conflict with commuting passengers for seats.
- 13.22** Improved surface access links are likely to expand the commuting area to the airport, and allow the workforce to come from a wider area. This is likely to increase the area available for the additional housing and social infrastructure provision for the additional employees in and around airports.

Risks and Mitigations

- 13.23** Like all economic analysis of this nature, the Commission's Local Economy Assessment is based on a set of assumptions.
- 13.24** A key input into much of this assessment is the demand forecasts. The number of additional jobs and the resultant need for housing and social infrastructure is driven by passenger demand under the various demand and carbon scenarios. However, the difference is not significant enough to change the Commission's assessment of the local economic effects. Further details are available in the *Local Economy*:

Impact Assessment Post Consultation Update report published alongside this document. If the demand is lower or higher than expected then the economic impacts will be affected. The Commission has also undertaken further sensitivities to test other key assumptions such as the productivity of workers in individual parts of the local economy assessment, details of which are available in the *Local Economy: Impact Assessment Post Consultation Update* published alongside this document.

- 13.25** As discussed in the *Final Report*, there are a number of ways in which negative impacts on the local economy can be mitigated and benefits enhanced. For example, HAL has proposed to commit more than £100 million through Community Infrastructure Levy payments or Section 106 agreements that would support sustainable development in the area. It should be for local and national government and the airport in consultation to determine the appropriate contribution that the airport should make to support local development. The Commission recommends that HAL should work with local authorities and schools to ensure local people are able to benefit from new employment opportunities, including through an enlarged apprenticeship scheme. It also recommends that the Government should consider establishing a dedicated body to enable an integrated approach across local authority boundaries to planning for wider residential and commercial growth that may be supported by airport expansion.

Assessment

- 13.26** Given the substantial net positive impact on local and wider regional employment set against challenging but achievable additional requirements for housing and other local services, the Commission judges that the impact of the scheme on its objective **to promote employment and economic growth in the local area and surrounding region** is **HIGHLY SUPPORTIVE**. As well as the direct economic benefits of employment there could also health and wellbeing benefits for those within the local community who secure a job, either taking them out of employment or a job that was paid more poorly or not in line with their skillset.
- 13.27** Given that the assessment is based on the surface access impacts of the scheme itself (rather than baseline improvements already scheduled for the area in general) the impact on the Commission's objective **to produce positive outcomes for local communities and the local economy from any surface access that may be required to support the proposal** would be either **SUPPORTIVE** or **NEUTRAL**. Southern Rail Access to Heathrow will have benefits for passengers and local communities more widely, increasing airport accessibility and significantly

reducing journey times to the airport. However, all surface access schemes have impacts in terms of land take and demolition of homes and community facilities. Gatwick's surface access package is geared towards reducing the impact of expansion upon existing networks while Heathrow's would do more to enhance certain communities access to the airport. Both of these sets of impacts would need to be considered with other relevant costs and benefits of the scheme. The Commission's Financial and Commercial Case and Economic Case sets these benefits in this context.

- 13.28** The benefits from Heathrow Airport Extended Northern Runway is slightly smaller due to the smaller number of passengers it is able to facilitate compared to Heathrow Airport Northwest Runway, but the scale and scope of the impact is similar.
- 13.29** All three schemes also lead to economic growth in London and South East in 2050, but the benefits from the Heathrow schemes are consistently higher than at Gatwick, and build up more quickly over time, as shown in the table below:

Table 13.3: Total Direct, Indirect and Induced Jobs, LGW 2R, LHR EHR, LHR NWR, *assessment of need*, carbon-traded

Total Direct, Indirect and Induced Jobs	LGW 2	LHR ENR	LHR NWR
2030	6,500	76,700	76,700
2050	32,100	65,600	78,400

Source: Airports Commission analysis

- 13.30** The Heathrow schemes would also be providing jobs in areas of relatively high unemployment, whereas due to the lower levels of unemployment in the local authority areas surrounding Gatwick it could be more difficult for the region to absorb any additional jobs. Given that Gatwick is expected to generate fewer jobs it would however require less additional housing and social infrastructure, which may help to limit its negative impacts on some of the more rural areas near the airport.

14. Assessment: Quality of Life

Updates to Evidence Base

- 14.1** Several consultation respondents noted that they believed the Quality of Life assessment would be improved by a consideration of health impacts. Health impacts are considered across several modules (for instance Noise and Air Quality) but for ease of reference have also been compiled into an annex. Those interested in health impacts should refer to this Annex A.
- 14.2** The Commission has also undertaken more analysis on the impacts of leisure connectivity on quality of life, which is available in *Quality of Life: Further Assessment* and taken into account in the analysis below.

Approach and Outcomes

- 14.3** This is the first time an integrated Quality of Life analysis has been undertaken with respect to airport development. The assessment considers both national and local impacts.
- 14.4** For both the national and local impacts the Commission reviewed the available literature on the impacts of airports on quality of life. It then undertook analysis of two datasets: the Annual Population Survey and Mappiness.
- 14.5** The Annual Population Survey is a combined statistical survey of households in Great Britain, which is conducted quarterly by the ONS. Since 2011 it has contained the four ONS measures of wellbeing and hence we have used waves 2011-2012 and 2012-2013 (the latest available wave) in our analysis. Airport Proximity and noise contour information was then added for all Census Output Codes (OA) within 5km of 17 UK airports. This was used to consider local and national impacts. Mappiness is an iPhone application that permits individuals to record their wellbeing scores via their phone. The data contain more than one million observations from tens of thousands of individuals in the UK, collected since August 2010. The Commission then merged the Mappiness data with the Department for Transport's noise contours for London Heathrow (LHR), London Gatwick (LGW), and Stansted (STN)⁸⁴ to link with the associated decibel level from the three airports to contribute information for the Local Assessment.

84 These were the only available Noise contours for the Mappiness data

14.6 Since the consultation documents were published the Commission has undertaken some new work on the impact of holidays and leisure on people's quality of life. The Commission conducted new statistical analysis and reviewed the existing literature on the subject. For this review the Commission analysed data from the Understanding Society Survey (and its precursor the British Household Panel Survey) which is an annual nationally representative panel survey which asks questions about a wide range of subjects, and the Taking Part Survey, which is an annual survey commissioned by the Department of Culture, Media and Sport specifically on arts, culture and sporting activities. In both cases, controlling for variables such as age and income, the self-reported quality of life and health indicators were compared to the answers to other questions about holidays and taking flights.

Assessment Areas

14.7 Locally the impacts of airport development have the potential to be very broad, with, for instance, the impacts of aircraft noise, loss of parks or other social and community amenities, as well as some positive impacts, such as the jobs provided on or very near the airport site, the local surface transport benefits, and of course ease of access to flights for business or leisure. The literature review has shown that there is a significant amount of evidence which links the majority of outcomes assessed in our *Appraisal Framework* to subjective wellbeing (with the exceptions of Biodiversity, Water and flood risk and, to an extent, Community).

14.8 Nationally the impacts will be felt in general through economic and connectivity benefits. Economic benefits will be through job creation (catalytic, induced and indirect) that can be felt over a wider area, as well as the benefits to business of greater connectivity. However, benefits of connectivity are not just for business, with more flights also being valuable for leisure purposes, most obviously holidays, and keeping in contact with friends and relatives abroad where planes are the only, or the most practical, travel option.

Locally

14.9 Our analysis suggests that locally:

- Living near an airport (5km) has no statistical impact on subjective wellbeing measures. It is not clear why this is the case. One possibility is that this may be because the positive effects (for instance availability of jobs and airport associated surface transport) and the negative impacts (noise, congestion, urbanisation etc.) cancel each other out, or perhaps that there simply is not a

strong relationship between being near an airport and these indicators. However, it is difficult using this analysis of this set of data to confirm what is driving the result.

- Being near an airport does not have a statistical effect on happiness in the moment, but is negatively associated with feeling relaxed: the negative effect of being near an airport is larger for people who are working or studying at that time.
- Being at an airport (and not working there) is positively associated in the analysis results with happiness and, at the same time, negatively associated with feeling relaxed: airports are associated with happiness and excitement, but are also stressful experiences. This is in line with findings in the literature review of the impacts of holidays, where people report a positive impact on mood when on a relaxing holiday abroad.
- Living in a daytime aircraft noise contour (over 55dB) is negatively associated with all subjective wellbeing measures: life satisfaction, sense of worthwhile, happiness, levels of anxiety and positive affect balance. There is a marginal negative effect on all five subjective wellbeing measures for every additional decibel from aircraft noise over the 55 dB threshold. The negative effect of day time aircraft noise was greater for people living in social housing⁸⁵. To provide a sense of scale, the negative effect of aircraft noise on peoples' sense of "worthwhile" is around half that associated with being a smoker, and less than a third that of being underemployed⁸⁶. The negative effect of aircraft noise on peoples' happiness is less than half that of being divorced and less than the negative effect associated with living in social housing⁸⁷.
- Living in a nighttime aircraft noise contour was not associated with any effect on subjective wellbeing in this statistical analysis
- Being in a high level aircraft noise contour was negatively associated with happiness and feeling relaxed at that time

14.10 These results obviously have limitations, which are set out in full in the *Quality of Life: Assessment* report and discussed in the Risks and Mitigations section below.

85 PwC's analysis also confirmed this result is not driven by the possibility that more social housing is located near to airports

86 Being underemployed can include those who are unemployed, involuntarily in part-time work (i.e. those who work part-time but wish to or could work full-time) and those who are overqualified or underutilised in their current positions

87 Airports Commission, Quality of Life: Assessment

Nationally

- 14.11** A consistent finding in the wellbeing literature is that employment is positively associated with a number of measures of subjective wellbeing, including life satisfaction. Although the wellbeing effect of the job will be internalised in wages to some degree, the available evidence suggests a residual effect of employment on wellbeing after controlling for income.
- 14.12** Our analysis found no statistical difference between jobs based in airports and those based outside airports on measures of happiness and relaxation. We make the assumption, therefore, that the value of employment estimated for the general population (which will include some people that work in airports) is applicable to jobs created as part of airport development.
- 14.13** There is also a benefit to people nationally (as well as locally) through the leisure impacts of increased connectivity, which could increase access to leisure holidays or visits to see family and friends by increasing the availability of flights to different places, reducing the cost of travel and improving the passenger experience. The general results of the Commission's statistical analysis across all of the datasets is that taking holidays and flights is associated with improvements in health and wellbeing. After controlling for the impacts of factors like income, health, age etc. people who take holidays and flights have higher life satisfaction and happiness, better levels of self-reported general health and better mental health. This correlation is present across all socio-demographic groups (e.g. age, income etc.). The only differential impact is that the positive association between having holidays and self-reported general health and depression is stronger for unemployed people than for employed people. The literature review found more specific results with respect to how long people feel the positive effects of a holiday, or how they feel when on holiday – but overall wherever quality of life outcomes were compared between going on holiday or not going on holiday, the impact of going on holiday was positive or at least neutral. The outcome from the earlier modelling that being in an airport is positively associated with happiness and excitement, seems to support this positive impact. The literature also revealed that holidays also have a positive impact on people's work productivity, as well as how they feel in their leisure time.
- 14.14** Overall, the possible areas of impact on people's quality of life, with respect to our *Appraisal Framework*, are set out below:

Table 14.1 Possible airport impact factors by geographical range and individual impact

Impact area	Possible Impact factors	Individual Impact
Local: within 5km	Local Economy Impacts (jobs)	POSITIVE
	Community	POSITIVE
	Noise	NEGATIVE
	Air Quality	NEGATIVE
	Biodiversity	NOT EVIDENCED
	Water and Flood Risk	NOT EVIDENCED
	Place	NEGATIVE
	Surface Access	POSITIVE
	Strategic Fit (connectivity)	POSITIVE
Local: outside 5km within flight path	All above	
	Noise	NEGATIVE
National	Economy Impacts	POSITIVE
	Carbon	NEGATIVE
	Strategic Fit (connectivity-business)	POSITIVE
	Strategic Fit (connectivity-leisure)	POSITIVE

Source: Airports Commission analysis

Risks and Mitigations

14.15 The methodological limitations of this analysis are set out in full in the *Quality of Life: Assessment* report. In particular the analysis published at consultation does not cover the impacts on children (as the Annual Population Survey is of people over the age of 18, and the Mappiness data is also from adults), although the analysis conducted since does include impacts on children (through the Understand Society survey which includes results for 11-16 year olds). Also, as noted above, this analysis has not been undertaken before with respect to airport development and the Mappiness data does not pick up health impacts. As such these results should be seen as providing a useful commentary on impacts to complement the analysis in the rest of the *Business Case and Sustainability Assessment*, rather than a full assessment. The Commission have considered a wide range of impacts on the quality of life of those impacted by the airport across many of its appraisal modules, for instance Noise, Place and Community.

14.16 Given the information above, one approach to mitigating some negative impacts on quality of life would be to:

- Increase the positive impacts of living near the airport (e.g. development of local job opportunities) and limit the negative impacts (e.g. loss of green space, impact of noise) to attempt to keep the “bundled effect” either neutral, or move it to positive
- Limit the number of people living in 55db plus noise contours
- Increase the positive national and local impact of job creation and connectivity for business and leisure

14.17 All three short-listed schemes have negative quality of life impacts on the local community and the promoters have set out mitigation measures of all three types above, which the Commission has considered and assessed. The quantitative impacts of these, where possible, are covered in the relevant *Sustainability Assessment* section (for instance Noise) or the Economic and Strategic Cases and in the *Final Report* itself.

14.18 For this scheme in particular, HAL has focused on providing extensive compensatory green space and support for local community groups and generous compensation scheme terms, all of which could help influence the effect of living near the airport. The Commission has also considered some specific operational mitigations that could reduce the noise impacts on communities.

Commission’s Assessment

14.19 With respect to the specific analysis discussed above Heathrow Airport Northwest Runway scheme demonstrates a broadly **NEUTRAL** impact overall with respect to the Commission’s objective **to maintain and where possible improve the quality of life for local residents and the wider population** with the positive benefits of employment and leisure potentially outweighed by negatives such as noise at an aggregate level, though impacts on particular individuals may well be different. This is also the case for the other two schemes. However, there are several other of the Commission’s assessment areas, such as Place, Community or Air Quality, which have the potential to affect people’s wellbeing. The relative performance of the different schemes with respect to these modules are set out in the relevant sections. However, adding these results into the Commission’s assessment of the schemes performance against its Quality of Life objective could risk “double counting” these impacts. As such the Commission has not distinguished different performance levels between the schemes on this particular objective.

Sustainability Assessment – National Impacts

15. Assessment: Economy impacts

Updates to Evidence Base

- 15.1** The updates to the evidence base on the economic and local economic impacts are set out in detail in the Economic Case, and are summarised below:
- A welfare approach to analysing the Wider Economic Impacts has been added
 - Further economic assessment has been developed to reflect the CCC planning assumption of constraining emissions to 37.5MtCO₂ by 2050.
 - The delay impacts assessment has been further refined and developed

Approach and Outcomes

- 15.2** The Commission considered all five scenarios described in the introduction to this document in its consultation documents, to give an indication of the range of results possible depending on the future demand patterns for air travel. In its *Final Report* and associated evidence base the Commission continues to use all five scenarios where appropriate as sensitives, but has focused its core narrative and analysis more firmly on the *assessment of need* scenario, which is based on central projections of key economic indicators. In addition, the Commission has continued to forecast demand based on different approaches to handling carbon emissions from aviation – carbon-traded and carbon-capped.
- 15.3** Unless stated otherwise, all the results presented are for the Commission's *assessment of need* carbon-traded demand scenario. All the economic analysis has also been conducted for a carbon-capped scenario, and reported at end of this section.

Transport Economic Efficiency impacts

- 15.4** The increased capacity available from expansion provides direct benefits to the passengers, airports and airlines as well as the government. These benefits have been captured in the transport economic efficiency impacts presented in Table 15.1 below for the Commission's *assessment of need* carbon-traded demand case:

Table 15.1: Passenger, producer and government impacts, present value, Heathrow Airport Northwest Runway scheme (PV £billion, 2014 prices)

Impacts on	Benefits
*These exclude I to I passengers	
Passengers* (lower shadow costs)	45.1
Passengers* (higher frequencies)	3.2
I to I passengers (lower shadow costs)	4.0
I to I passengers (higher frequencies)	2.4
Total passenger benefits (including I to I)	54.8
Government revenue	1.8
Producers	-38.4
Total transport economic efficiency impact	18.3

Source: Airports Commission analysis

- 15.5** The passenger benefits are heavily driven by the passenger demand forecasts. Alternative demand scenarios described in the Strategic Case provide a range of passenger benefits, with the highest benefit in the *global growth* carbon-traded scenario.

Delay impacts

- 15.6** Expansion at Heathrow provides benefits to passengers and airlines due a reduction in delays experienced during arrival and departure. These benefits are captured in the delay benefits, presented in table 15.2 below for the Commission's *assessment of need* carbon-traded demand scenario:

Table 15.2: Benefits from reduced delays to passengers and airlines, present value Heathrow Airport Northwest Runway scheme (PV £billion, 2014 prices)

Benefits to	Benefits
UK business passengers	0.2
UK leisure passengers	0.1
Foreign business passengers	0.2
Foreign leisure passengers	0.0
<i>Total passengers excluding I to I</i>	0.5
I to I passengers	0.1
<i>Total passengers including I to I</i>	0.6
Airlines	0.4
Carbon	0.0
Total benefits	1.0

Source: Airports Commission analysis

Wider economic impacts

15.7 In addition to the direct benefits to the users and providers of aviation, airport expansion also has impacts on the wider economy; from the increase in productivity through trade and agglomeration, increase in output in imperfectly competitive markets and the impact on government's tax revenue. These impacts are captured in the wider economic impacts presented in table 15.3 below for the Commission's *assessment of need* demand case:

Table 15.3: Wider economic impacts from Heathrow Airport Northwest Runway scheme, present value (£billion, 2014 prices)

Channel	Carbon-traded
Export	6.1
Import	1.3
Agglomeration	1.7
Increased output in imperfectly competitive markets	1.4
Tax wedge	1.1
Total	11.5

Source: Airports Commission analysis

Economic impacts incorporating the CCC planning assumption

15.8 The economic impacts of Heathrow Airport Northwest Runway scheme in a carbon-capped scenario have been presented in table 15.4 below:

Table 15.4: Summary of impacts on economy in carbon-capped scenario, Heathrow Airport Northwest Runway scheme present value (£billion, 2014 prices)

Benefits	Carbon-capped
Transport economic efficiency ⁸⁸	9.7
Delays	3.0
Wider economic impacts ⁸⁹	7.7
Total	20.5

Source: Airports Commission analysis

Risk and Mitigations

15.9 Like all economic analysis of this nature, the Commission's Economy Assessment is based on a set of assumptions. A key input into much of the Economy Assessment is the demand forecasts. If the demand is lower or higher than expected then the economic impacts will be affected. In order to deal with this risk, the Commission has considered the range of economic impacts under several possible demand scenarios as discussed in the introduction to this document. It has also undertaken further sensitivities to test other key assumptions in individual parts of the Economic Case, details of which are available in the technical reports published alongside this document.

15.10 The Commission has also considered several different approaches to value the economic impact of the scheme. For instance, it has taken a microeconomic and macroeconomic perspective in valuing the benefits of airport expansion. While the microeconomic perspective uses traditional welfare analysis, further cemented by the monetisation of wider economic impacts since the national consultation, the macroeconomic perspective uses a Spatial Computable General Equilibrium (S-CGE) model to assess the impacts on airport expansion on key macroeconomic variables, presented in the Strategic Case. The Commission has also considered the impacts of the scheme on the quality of life of people, providing a further wellbeing perspective.

⁸⁸ Indicates the demand reduction sensitivity results, where traditional carbon capped analysis was not possible.

⁸⁹ Indicates the demand reduction sensitivity results, where traditional carbon capped analysis was not possible.

- 15.11** There are several options available for how to secure some specific economic benefits that could be seen as particularly valuable. There is discussion in the *Final Report* about the possibilities for supporting regional airports to develop or consolidate connections into the capital and on to overseas markets, and working with the community to develop opportunities for local employment.

Commission's Assessment

- 15.12** Overall, against the Commission's objective to maximise economic benefits and support the competitiveness of the UK economy the scheme is at least **SUPPORTIVE**, with the potential to be **HIGHLY SUPPORTIVE**, in the *assessment of need* carbon-traded scenario. In a carbon capped world the impact is still positive and **SUPPORTIVE** to the Commission's objective, but the scale of the benefits is not as high. These benefits need to be considered in line with the costs and social and environmental disbenefits of the schemes, and this is set out in the Economic Case. The analysis set out here is in relation to a traditional welfare-focused approach to understanding the economic benefits. The broader GDP based approach is considered in the Strategic Case, calculated using a S-CGE model found there to be significant economic benefits associated with each scheme ranging from 0.75% impact on GDP for the Heathrow Airport Northwest Runway scheme to 0.5% in the Gatwick Airport Second Runway scheme in 2050.
- 15.13** In comparison to the other schemes the schemes at Heathrow are broadly similar in scale, with slightly lower passenger numbers at Heathrow Airport Extended Northern Runway scheme driving slightly lower scale of benefits. At Gatwick the scheme delivers lower transport economic efficiency benefits and wider economic impacts which largely outweigh the larger delay benefits. The benefits of a Heathrow Airport Northwest Runway scheme are compounded by the speed at which passengers fill up new capacity enabling the benefits of new capacity to be realised earlier; the continued development of the UK's short-haul routes with its well established trading partners and importantly increasing the number long-haul daily routes opening up new opportunities in markets around the world, boosting UK productivity; and better serving business passengers needs with more flight frequencies and a mix of lower fare and better quality services.

Table: 15.5 National economy benefits (£billions, 2014 prices, present value) – carbon-traded

	LHR ENR	LHR NWR	LGW 2R
TEE benefits	16.4	18.3	7.8
Delay Benefits	0.8	1.0	2.4
Wider Economic Impacts	10	11.5	8.1
Total national economic benefits	27.2	30.7	18.3

Source: Airports Commission analysis

Table 15.6: National economy benefits (£billions, 2014 prices, present value) – carbon constrained⁹⁰

	LHR ENR	LHR NWR	LGW 2R
TEE benefits	8.5	9.7	3.5
Delay Benefits	2.4	3	2.6
Wider Economic Impacts	6.6	7.7	5.5
Total national economic benefits	17.4	20.5	11.6

Source: Airports Commission analysis

90 Details of how the carbon-capped figures in this table have been developed are available in the Economic Case.

16. Assessment: Carbon

Updates to Evidence Base

- 16.1** Several respondents commented on the Commission’s carbon-capped demand analysis – this is covered further in the *Final Report* and the Strategic Case. The Commission developed some carbon analysis for a carbon-traded scenario, to add to the carbon-capped information provided at consultation.

Approach and Outcomes

- 16.2** The Commission has considered the carbon impact of the scheme across five areas:
- increased airport capacity leading to a net change in air travel;
 - departure and arrival route changes through altered flight operations;
 - airside ground movements and airport operations;
 - changes in non-aviation transport patterns brought about by a scheme’s surface access strategy;
 - construction of new facilities and surface access infrastructure.
- 16.3** The first four items reflect production of carbon on an ongoing basis, while the carbon associated with construction costs is a one off carbon “cost”.
- 16.4** The carbon assessment uses a carbon-capped scenario, with the exception of the specific carbon-traded sensitivity, which implies that increases in carbon production due to the scheme would need to be offset by reductions elsewhere to allow the UK to meet the CCC’s planning assumption of 37.5MtCO₂ (a carbon-traded scenario would imply increases due to the scheme would need to be accommodated within an overall carbon funding mechanism). This is discussed more in the *Final Report*.

Impact by Emissions Area

- 16.5** The impacts against these areas are shown in the table below, showing additional carbon output in addition to the calculated baseline.

Table 16.1: Carbon assessment findings for Heathrow Airport under the Heathrow Airport Northwest Runway scheme, change in MtCO₂

Area of Emissions	2030	2040	2050	Additional tCO ₂ over 60 year appraisal period	Total tCO ₂ over 60 year appraisal period
Air travel	3.1	4.5	3.9	236	1,313
<i>Ground movements component of the above</i>	<i>0.1</i>	<i>0.2</i>	<i>0.2</i>	<i>12.8</i>	<i>36.6</i>
Passenger surface access	0.06	0.1	0.1	5.7	32.7
Airport operations energy & fuel use	0.04	0.04	0.04	2.2	7.5
Total operational CO₂ emissions	3.2	4.7	4.0	244.6	1,353
Construction of airport facilities & SA infrastructure*	n/a	n/a	n/a	11.3	24.8

Source: Airports Commission analysis and Jacobs

* Construction emissions are calculated as tCO₂(e).

16.6 *Air Travel:* The largest factor by far is the carbon associated with an increase in flights at Heathrow Airport. The figure below sets out this increase, alongside a figure showing ATM increase at the airport. However, in either a carbon-capped or carbon-traded situation, these emissions will not be additional at the national or global level.

Figure 16.1: Air traffic movements (ATMs) during the period 2025-2050 at Heathrow Airport Northwest Runway

Figure 16.2: Carbon emissions from departing flights at Heathrow Airport Northwest Runway, with three runways, for 2026-2050 for the do minimum and do something scenarios

Figure 16.1

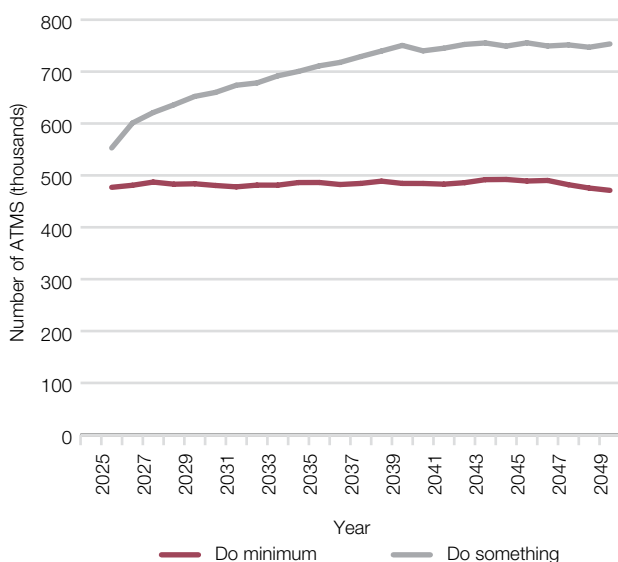
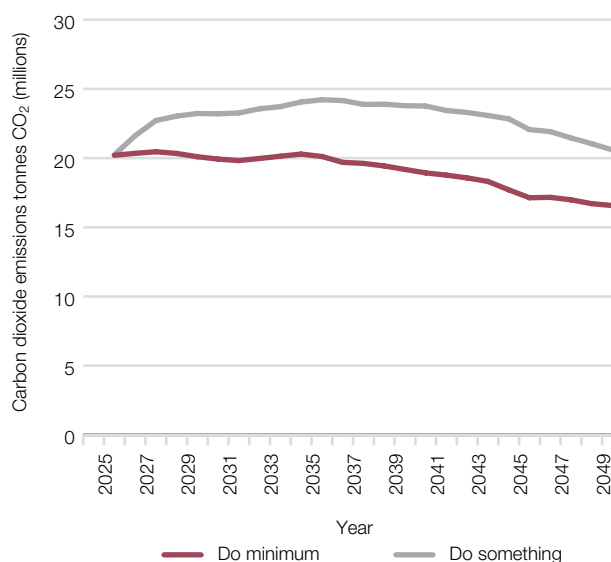


Figure 16.2



Source: Airports Commission and Jacobs analysis

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- 16.7** The figures show the increase in ATMs is higher than the increase in carbon (15.5% increase in ATMs compared to 11.7% decrease in carbon) for the do something. The difference reflects a predicted reduction in carbon per ATM across the assessment period due to a combination of aircraft fleet changes and alternative fuels. The reason that the carbon change moves below zero (i.e. reflects a decrease in carbon rather than a smaller increase) is that Heathrow becomes constrained. ATM numbers level off and each ATM delivers less and less carbon as the assessment period continues as technology improves.
- 16.8** Despite this positive trend in terms of carbon per ATM, it is important to remember that an expanded Heathrow under a Heathrow Airport Northwest Runway scheme would still be producing a high proportion, in fact a majority, of total UK carbon from aviation: in 2050 the carbon emissions from departing flights at Heathrow would represent 54.6% of the UK total.
- 16.9** The other impacts are much smaller in terms of scale but also show some quite high percentage increases compared to baseline.

- 16.10** *Ground Movements:* The differences in carbon associated with airside ground movements are driven by the same factors as those associated with the increased number of flights, with ATMs being the driving factor, but improvements in plane technology limit the impact of this. The emissions associated with airside ground movements increase rapidly, increasing by up to 60% from baseline by 2050.
- 16.11** *Passenger Surface Access:* Table 16.1 presents the emissions due to surface access at Heathrow Airport only. The combined total for all airports (e.g. including Gatwick, Stansted etc.) under the Heathrow Airport Northwest Runway scheme actually produces a decrease in total surface access emissions (-12.4% to baseline in 2050). This is due to the fact that under in the surface access model Heathrow has a higher public transport modal share than many other airports; passengers substituting into an expanded Heathrow will do so from airports where their surface transport emissions would have been higher.
- 16.12** *Airport Operations:* The emissions associated with airport operations are 35% higher than baseline by 2050. However, because grid electricity use is such a large part of the operational energy used (about two thirds⁹¹ of the 2026 carbon emissions), and the carbon emissions from this source are expected to decrease per kW of power with technology improvements, both the baseline and the scheme show lower levels of carbon produced in 2050 than in 2025.
- 16.13** *Construction:* The construction of new facilities and infrastructure has a one-off carbon impact over the construction period. This would likely be 11,260,690 tonnes, much of this occurring in 2026.

Carbon Traded Comparison

- 16.14** In a carbon-traded scenario the amount of CO₂ produced through airport operations over the appraisal period would be higher than the carbon capped scenarios. The total CO₂ emissions over the 60 year appraisal period would be 1458 MtCO₂, compared to 1353 MtCO₂ in the capped scenario above. However, the construction impacts would not change.

Risks and Mitigations

- 16.15** At this stage of design, route changes and flight operations have not been developed in sufficient detail to estimate emissions impacts and so are not assessed in the numbers above. More information is available in the carbon assessment report. The construction carbon emissions are based on the current

91 101,765 tCO₂ of a total of 157,788 tCO₂.

high level design, and as this moves forward it may change slightly. However, the *scale* of the carbon impact will likely be similar.

- 16.16** The impact of carbon due to new flights could be mitigated further by, for instance, increasing airport charges for older aircraft, or mandating “green slots” which require planes of a certain standard to take up the new capacity. Similarly operational improvements could lessen the impact of ground movements as could an increase in public transport use to the airport beyond that currently in our surface access assumptions. However, to assume further efficiencies, beyond those that would already be required to achieve the CCC’s carbon planning assumption, would be optimistic.

Commission Assessment

- 16.17** Given the large increase in carbon compared to baseline and the limited extent to which these can be minimised, the Commission has determined that the carbon impact of the scheme is **ADVERSE** with respect to the Commission’s objective ***to minimise carbon emissions in airport construction and operation***. The only reason this is not **HIGHLY ADVERSE** are some of the system wide surface transport impacts, which show a comparative carbon “saving” of developing at Heathrow as opposed to airports with higher surface access carbon impacts.
- 16.18** The comparative scales of different emission sources (aviation, ground movements, construction) do not vary between the schemes, with all of them showing aviation as the largest impact, for example. The Gatwick Airport Second Runway scheme shows lower aviation emissions, due to its higher proportion of short-haul flights with comparatively lower carbon emissions compared to Heathrow. Overall, the Gatwick Airport Second Runway scheme also has the lowest emissions from airport construction and operations (from energy and fuel use), less than half of the Heathrow schemes. This is because of the differing design requirements of the Heathrow schemes to the Gatwick scheme, given the expectation and requirements of their passengers and airlines and the complexity of the infrastructure needed. The Gatwick scheme also produces lower CO₂ emissions as a result of surface access to the airport over the full appraisal period than either of the Heathrow schemes.

17. Annex A: Health Impacts

Introduction

17.1 During consultation we received feedback from several stakeholders that a health appraisal module would be a positive addition to the evidence base of the Commission, and that a full Health Impact Assessment (HIA) should be undertaken. At consultation the evidence base did contain a substantial amount of information about the impact of the schemes on health, but they were considered across a wide variety of modules such as Noise, Community and Air Quality. As a result of consultation the Commission undertook a review of the health information provided at consultation and commissioned a *Quality of Life: Health and Equalities Assessment Review* to understand what, if any, further work could or should be done on the local health impacts of the scheme. The Commission has also produced a new report setting out the health impacts of noise specifically⁹². The Commission has concluded that, beyond the analysis discussed above, further detailed assessment work on the health impacts of the scheme, for reasons set out below, would not be appropriate at this stage, but we do recognise that showing the breadth of impacts in one place could help to make the analysis clearer, and that further work could be done later in the process to more fully understand and help mitigate the health impacts on communities. This annex has been developed to fulfil the following purposes:

- To provide a “map” to the rest of the appraisal – showing where and how issues with relevance to health are discussed
- To set out a short conclusion for the Heathrow Northwest Runway scheme of the health impacts discovered so far⁹³
- To set out what further analysis could be undertaken, and when in the process it would be appropriate to do so.

Health impacts across Appraisal Modules

Air Quality

17.2 Emissions of nitrogen oxides (NO₂), and particulate matter (PM_{2.5} and PM₁₀) have the potential to damage the health of humans – related to respiratory and

92 *Aircraft Noise Effects on Health*

93 The safety impacts of the scheme are covered in the Management Case

cardiovascular functions. Poor air quality can also reduce the subjective wellbeing of people experiencing it, this can be linked back to the health effects but also more subjective values to particular individuals, such as valuing clean air highly.

17.3 The Air Quality assessment sets out information on the total amount of increase of these emissions, but also the concentrations of them near sensitive receptors. Three particular pieces of information are key from a health perspective:

- The monetisation of air quality impacts – the damage costs are designed as estimates of the social cost of poorer air quality and include the health impacts
- Concentrations at health based receptors – these are sites specifically chosen to pick up on the health impacts on people, as they are where members of the public are regularly present
- The number of people for whom concentration of pollutants worsens.

Employment

17.4 Levels of employment and income have proven to be linked closely with people's mental and physical health and well-being, including through their living environment and their ability to access the services, facilities and products they need to live healthily. There is evidence to suggest that people who experience insecure employment are among those most likely to suffer poor health outcomes and earlier death, compared with the rest of the population, so an increase in the number of jobs could lessen the number of people in insecure employment and support better health outcomes. The Economic Case sets out the increase in employment associated with each scheme, and while they differ across different schemes, scenarios, years and methods of analysis all schemes show a positive impact on job creation by 2050, and so all would likely have a positive health and wellbeing effect for those who benefit from this impact. This has to be balanced against any negative wellbeing impacts, covered in the Place assessment, due to say, an increase in housing density in a rural area, required for any local population growth associated with these new jobs. The estimates vary significantly depending on which scenario for each scheme has been considered and also the assessment technique that has been used.

Noise

17.5 There have been extensive studies, and detailed guidance from the World Health Organization (WHO) and others, on the health impacts of Noise. Noise associated with airport expansion could impact people's health across a range of areas, such as sleep

deprivation, hearing damage, morbidity, coronary health, annoyance, changes in hospital recovery rates, and changes in wellbeing. These are set out in detail in *Aircraft Noise Effects on Health*.

- 17.6** To gain an overall understanding of the health impact of the scheme the *Local Noise Assessment* report includes monetisation of annoyance, sleep disturbance, Health-AMI and Health-Hypertension (strokes and dementia) associated with each of the schemes, consistent with the WHO's methodological guidance. These are set out impact by impact (e.g. annoyance, sleep disturbance) in the *Local Noise Assessment* report. The *Aircraft Noise Effects on Health* report sets out how the numbers of people in various decibel contours relate to possible health impacts for the local community and in particular impacts on children's learning. It also considers the impact of possible mitigation measures.
- 17.7** However, bare numbers do not accurately or fully describe people's reactions to increased noise. A particular issue for people's health is night noise, given the impact on people's sleep patterns. This is discussed in the Noise section of the *Sustainability Assessment* but also in the *Final Report*. Predictable respite has also been reported through consultation and by discussions with local people throughout the process, as key to their wellbeing. This again is discussed both in the Noise *Sustainability Assessment* section but also the *Final Report*.

Water Quantity, Quality and Flood Risk

- 17.8** Safe drinking water is very important to health, and all of the schemes proposed could have a negative impact on water quantity and quality. However, given the strict controls about drinking water the planning process will need to ensure any negative impacts on people's health from this route are mitigated. There could be, however, wider wellbeing impacts of the proposed changes to the waterscape. The Department of Health (2010) definition of wellbeing includes a sense of connection with the wider environment; including the natural water environment. Replacing existing natural waterscapes with hard engineering solutions could adversely affect the wellbeing of people in the community. Similarly, flooding can cause stress and anxiety as a result of damage to property and belongings, the threat of injury to oneself, friends or family, and isolation as a result of severed transport infrastructure.
- 17.9** The discussion of the impact of the area is focused on in Place, where waterscape is considered as part of the wider landscape. The water and flood risk section itself sets out that more detailed flood risk mitigation strategies, to reduce the possible impacts of downstream flooding in particular, will be needed.

Place

17.10 Being able to access suitable and attractive open/green space can lead to increased, physical activity, which is positive for health. Also, adverse impacts on landscape, waterscape and views could affect an individual's sense of connection with their natural and historical environment and ultimately impact people's well-being. The landscape, heritage and tranquillity sections of the Place assessment set out qualitatively the impact of the scheme on the area around the airport, for instance how views could change, or impacts on areas of recreation. Measuring the quantitative impact of these changes on people's health and wellbeing would not be possible, but the qualitative analysis of the changes can give an indication of the level of change.

Community

17.11 Access to good quality services and supportive and cohesive community networks are linked with health and wellbeing as they reduce the likelihood of depression and chronic illnesses. This access could be limited by removing the facilities that provide these support services, or removing the houses that form these communities, as part of the direct land take of the airport, but also through "severance" effects – where a physical barrier created by transport infrastructure runs through a community making it impossible or very inconvenient to access the services and support networks. There could also be additional impacts from increased local congestion.

17.12 The Community assessment sets out which communities will be most deeply impacted by the landtake of the airport and highlights key support services such as schools or community centres that may be lost or less accessible to those who wish to use them. It also sets out how the promoter intends to mitigate these impacts. This analysis could not quantitatively mapped to health impacts at this stage of design but gives an indication of the scale of the impacts on the relevant communities.

Quality of Life

17.13 Physical and psychological health are key factors contributing to quality of life and the quality of life report, conducted by PwC, specifically analyses the impact of aviation on subjective wellbeing.

17.14 No statistical impact was discovered for living near an airport, but there was a negative impact on wellbeing identified with living in noise contours. The report also highlights the positive wellbeing impacts of having a job, and being able to use the airport for leisure travel. These results are directly relevant to the psychological health of people in the local community.

Summary of Health Impacts of Heathrow Airport Northwest Runway

- 17.15** At Heathrow a key health and wellbeing impact would be the change in noise impacts both in the very local area and more widely across southwest London. Detailed modelling is set out in the Noise assessment but in summary the impacts without mitigation would be substantial. The mitigation measures discussed in the Noise *Sustainability Assessment* section and in the *Final Report* will be vital to limit the negative health impacts of the change in the noise environment. As pointed out in the *Aircraft Noise Effects on Health* report of particular health impact will be the possible mitigations from night time noise and measures to reduce the impact on schools.
- 17.16** The Heathrow proposals are not assessed as leading to any exceedances of NO₂ limits at any health-based receptor, and the number of residential properties entering the 'at risk' category as a result of expansion is small (fewer than 20). The scheme is however assessed as being at likely risk of increasing the predicted exceedance of annual mean NO₂ EU Limit Values in 2030 along the A4 sections of the Bath Road Colnbrook bypass. Local monitoring projections indicate that there is also a high risk of exceeding the mean NO₂ AQ objective by the M4 and in Hillingdon. This suggests that substantial mitigation would need to be undertaken for the scheme and these would need to be carefully designed and monitored and the health impacts taken into account. The mitigations available for the scheme are discussed in detail in the Air Quality section of the *Sustainability Assessment*.
- 17.17** People's wellbeing could be affected by changes in the landscape character and loss of historic sites due to the development at Heathrow. The scheme would have a significant adverse visual effect on the Hillingdon Lower Colne Floodplain character area due to the construction works and permanent loss of landscape features and historical sites. The new public green space proposed by the promoter could mitigate this to a certain extent (and may also be beneficial for health in terms of having access to space to exercise) but clearly some parts of the community would be negatively affected overall.
- 17.18** The health impacts of Community changes at Heathrow are difficult to determine in detail at this stage. There are no health facilities (e.g. doctors surgeries) directly lost as a result of the scheme but severance effects (where members of the community face a hard or impossible journey to the facilities due to change in infrastructure) could impact access to health facilities. The break-up of current communities and a loss of connection with the surrounding built environment could also impact people's wellbeing.

- 17.19** Positively, the Heathrow Airport Northwest Runway scheme is estimated to generate up to 190,000 additional jobs across the UK by 2050, which would likely have a positive health and wellbeing impact.

Possible Future Work

- 17.20** The sections above give an indication of how wide the possible health impacts of the developments are, but also some of the limitations in determining the precise impact at this stage of design. However, there is enough information to consider the Health Impact Assessment Screening Questions recommended by Department of Health:

1. *Will the proposal have a direct impact on health, mental health and wellbeing?*

YES – even with the best possible mitigation it is likely, to take one example, that more people will be affected by noise and that this will lead to consequent impacts on their health.

2. *Will the policy have an impact on social, economic and environmental living conditions that would indirectly affect health?*

YES – for example airport expansion may increase local job opportunities and hence provide positive wellbeing impacts of having employment.

3. *Will the proposal affect an individual's ability to improve their own health and wellbeing?*

YES – for example a reduction in useable green space could have a negative impact on people's likelihood to exercise, as set out in the Community assessment.

4. *Will there be a change in demand for or access to health and social care services?*

YES – the Local Economy section sets out the impacts of increased workforce in the area and how that will impact demand for, for example, GP services.

5. *Will the proposal have an impact on global health?*

NO

- 17.21** It seems clear, given the information set out above, that it would be appropriate to undertake a full Health Impact Assessment of the scheme. However, the stage at which this should be undertaken should be carefully considered. Below is a table setting out the framework suggested by the Department of Health to identify and prioritise health impacts and how the issues above can be mapped to the framework.

Table 17.1: Health impacts of Heathrow Airport Northwest Runway against the Department of Health's Health Impact Assessment Screening Questions

Health Impact Area	Will the health impacts affect the whole population or will there be differential impacts within the population?	Will the health impacts be difficult to remedy or have an irreversible impact?	Will the health impacts be medium to long term?	Are the health impacts likely to generate public concern?	Are the health impacts likely to generate cumulative and/ or synergistic impacts?	Combining the answers, on balance will the health impacts have an important positive or negative impact on health?
Airport development will increase Emissions of nitrogen oxides (NO ₂), and particulate matter (PM _{2.5} and PM ₁₀) which have the potential to damage the health of humans-related to respiratory and cardiovascular functions. Poor air quality can also reduce the subjective wellbeing of people experiencing it	Differential, but very dependant on wider govt. policies and actions not yet known	Unclear-scale and concentration of impacts very dependant on wider govt. policies and actions not yet known	Yes	Yes	Unclear	Negative
Noise associated with airport expansion could impact people's health across a range of areas, such as sleep deprivation, hearing damage, morbidity, coronary health, annoyance, changes in hospital recovery rates, and changes in wellbeing.	Differential – though not clear where specifically impacts will occur without final flightpaths, operational proposals and mitigation/ compensation package	Unclear – Impacts on some people are susceptible to full mitigation if flightpaths are changed, but other close to the airport will continue to experience impacts	Unclear-dependant on the long term operational plans of the airport	Yes	Unclear	Negative for most, but some may experience less overflight if flightpaths change
Increased levels of employment and income associated with airport expansion could improve people's mental and physical health and well-being, including through their living environment and their ability to access the services, facilities and products they need to live healthily.	Differential – although not clear at this stage how travel to work areas etc. could affect this	Positive impacts are associated with being in work at the time and so are not irreversible	Yes	No	Yes	Positive
Flooding can cause stress and anxiety as a result of damage to property and belongings, the threat of injury to oneself, friends or family, and isolation as a result of severed transport infrastructure	Differential – though not clear where specifically impacts will occur without detailed flood mitigation strategy	No	No	Yes	Unclear	Negative

Health Impact Area	Will the health impacts affect the whole population or will there be differential impacts within the population?	Will the health impacts be difficult to remedy or have an irreversible impact?	Will the health impacts be medium to long term?	Are the health impacts likely to generate public concern?	Are the health impacts likely to generate cumulative and/ or synergistic impacts?	Combining the answers, on balance will the health impacts have an important positive or negative impact on health?
Being able to access suitable and attractive open/green space can lead to increased physical activity, which is positive for health. Also, adverse impacts on landscape and views could affect an individual's sense of connection with their natural and historical environment and ultimately impact peoples well-being.	Differential – though not clear where specifically impacts will occur without finalised mitigation and compensation plan	Not clear without finalised mitigation and compensation plan – may only be problematic during building phase or may continue	Not clear without finalised mitigation and compensation plan	Yes	Unclear	Negative for some, but mitigations by promoter could improve access for some
Access to good quality services and supportive and cohesive community networks are linked with health and wellbeing as they reduce the likelihood of depression and chronic illnesses. This access could be limited by removing the facilities that provide these support services, or removing the houses that form these communities, as part of the direct land take of the airport, but also through “severance” effects	Differential – though not clear where specifically impacts will occur without finalised mitigation and compensation plan	Yes	Yes	Yes	Unclear	Negative
Physical and psychological health are key factors contributing to quality of life and the quality of life report, conducted by PwC, specifically analyses the impact of aviation on subjective wellbeing.	Differential – though the impacts of particular aspects cannot be determined	Dependant on the impact area	Some are, some are not	Some are, some are not	Unclear	Unclear

Source: Airports Commission analysis

17.22 As can be seen from the table, going beyond identification to prioritisation at this stage would be problematic. However, many of the areas that are currently uncertain will become clearer as detailed design is undertaken, and some work on quantifying the impacts has been undertaken where the information is available. Below are some key areas where further work could allow further stages of the HIA to be developed.

Air Quality

17.23 The air quality monetisation includes the impacts on health of the scheme, but further work could be undertaken on the distribution of these impacts on various socioeconomics groups and in relation to sensitive receptors, particularly to take into account forecast changes in demographics. Assessing the distribution of these impacts would need to be undertaken once scheme has been clearly defined and potential flight paths are established. There are also air pollution impacts of construction, which would need to be considered and mitigated once construction plans were developed.

Noise

17.24 The impacts of noise have been identified and quantified through monetisation in the noise assessment. However, these impacts are based on an indicative set of flightpath assumptions. The data used to monetise the impacts could also be translated to specific health indicators (such as increases in hospital visits) but it is important to note that these figures and the distribution of the impacts would be subject to change given future discussions on flightpaths and operations, and would provide only a sense of scale, which is apparent from the monetisation. The information included in the *Aircraft Noise Effects on Health* report is likewise built on a set of assumptions about both flightpaths and mitigation and compensation measures. Until these are available at a more detailed and firm stage of design the health impacts noted provide only a sense of scale, as per the monetisation. While this is sufficient for the Commission's purposes in comparing the impacts of different schemes, a full Health Impact Assessment would benefit from more information on distribution.

Employment

17.25 Given the wide variety of jobs that expansion could create and the broad national impacts, it would be difficult to ever determine fully the positive wellbeing impact of an increase in jobs. At the local level the Commission sets out how many direct and indirect jobs are created in the local study area but breaking these figures down further, say to borough level, would be spurious at this stage, until more information about the operations of the airport and detailed timetables for expansion are available to allow a better understanding of how the local economy could react.

Water Quantity, Quality and Flood Risk

17.26 The possible health impact of flood risk would not be possible to define at the present level of design. As noted in the Water assessment further detailed design and operational mitigations will be needed to ensure flooding risk is appropriately mitigated, and until this level of detail is available it would not be possible to estimate the health impacts. A review of the future detailed water strategy developed by the promoter during detailed design for health impacts could be appropriate, but for the Commission's purposes it is sufficient to understand that that the impact could reasonably be mitigated, as set out in the water section.

Place

17.27 With respect to the wellbeing impacts of changes to the landscape, a landscape/visual impact assessment would be a requirement of any environmental statement associated with a later planning application, with techniques such as photomontages used to give an indication of the impact. This would need detailed information about each aspect of the scheme design. Even at this stage quantitatively assessing the impact of Place on wellbeing would continue to be difficult given how subjective people's reactions are to their environment. However, much more could be understood about, for instance, the provision of replacement green space for enjoyment and exercise.

Community

17.28 The Environmental Assessment at the detailed planning stage could be used to pick up impacts due to change in demand for services. Impacts of this change on the local community could be assessed along with potential impacts on journey times to the new pre-schools and nurseries, to places of worship and other community services. These impacts of course would be very dependant on detail of local roads and relocation plans for any facilities, which aren't available at the moment. This could be combined with the assessments of congestion on local roads, already analysed by the commission to determine if there are severance issues, along with analysis of those congestion problems during construction as well as operation. It could also take into account whether any cultural groups could be socially excluded and so have their health particularly negatively impacted by the proposals. This is discussed in *Quality of Life – Health and Equalities Assessment – Review* and the Equalities Impacts Report. The Commission's discussions in the *Final Report* set out how appropriate mitigation or compensation for these impacts could be delivered in a way that suits the local community, once their details are understood.

Quality of Life

17.29 The Quality of Life assessment by the Commission is by its nature a high level view based on evidence from various spatial areas. While the impacts could be monetised comparing results from surveys across a wide spatial area (not just the area in question) to data specifically about the impacts on the local population could be spurious.

Local Concerns

17.30 In general to more fully understand the issues impacting the health of local communities it is important that they are engaged with, and a scoping exercise carried out to ensure that not only are the results of the statistical information available taken into account, but also the key concerns of local people. The Commission would recommend that the scoping exercise is undertaken at a similar time to the full HIA.

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