



Airports Commission:

Heathrow Airport Extended Northern Runway:
Business Case and Sustainability Assessment

November 2014

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Introduction

Business Case and Sustainability Assessment – Heathrow Airport Extended Northern Runway

In its *Appraisal Framework*, the Commission set out its intention to construct a Business Case and Sustainability Assessment for each of the shortlisted schemes.

Business Case

The Business Case provides an integrated assessment of the overall case for the Heathrow Airport Extended Northern 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.

The results presented within the various cases represent the Commission's present judgement on the basis of the available evidence. This consultation seeks comment on these judgements, and the Commission will review them in light of responses received. As such these results may change between this Consultation Document and the Commission's final report.

Sustainability Assessment

The Sustainability Assessment *provides information about the performance of the Heathrow Airport Extended Northern 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.*

The Commission’s intention is that should Government decide to use the recommendations in its Final Report as the basis for a future National Policy Statement, the information and analysis in the Sustainability Assessment would provide a useful foundation for the production of the associated Appraisal of Sustainability.

Judgements of performance within the Sustainability Assessment presented here reflect the Commission’s present judgement on the information currently available. This consultation seeks comment on these judgements, and the Commission will review them in light of responses received. As such these impact level judgements may change between this consultation document and the Commission’s final report.

The Sustainability Assessment is not intended to be a means of defining a total scheme impact (for example, through the process of summing predicted impacts). Neither does poor performance in one area or a number of areas imply that a scheme is not suitable for progression.

Commission’s approach to forecasting: passenger demand and carbon

The future development of the airline industry is inherently difficult to predict, particularly over a 60 year period. Therefore five possible scenarios of future demand have been constructed, building on the analysis presented in the *Interim Report*:

Assessment of need	Future demand is primarily determined by central projections published by sources such as the Office for Budget Responsibility, OECD and IMF.
Global growth	Higher <i>global growth</i> in demand for air travel in the future, coupled with lower airline operating costs.
Relative decline of Europe	Higher relative growth of passenger demand in emerging economies in future and a strengthened position of Far and Middle Eastern aviation hubs and airlines.

Low-cost is king	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.
Global fragmentation	Economies adopting protectionist policies, with a decline in passenger demand from all world regions, coupled with higher operating costs.

These scenarios are reflected in the Commission's passenger demand forecasts, and are used to inform the assessments undertaken in this consultation. None of these scenarios should be considered a 'central case'. Rather, by considering each scheme in relation to a range of potential futures, the Commission aims to test the robustness of its analysis, and ultimately its final recommendations to Government.

In line with the approach taken in the *Interim Report*, the Commission has also prepared two sets of forecasts for each scenario based on different approaches to handling carbon emissions from aviation; 'carbon-capped' and 'carbon-traded'. Both sets of forecasts assume that the total number of emissions are set with reference to stabilisation targets aiming for a global temperature increase of equal, or close to two degrees C and aims to ensure that a four degrees C global temperature increase is reached only with very low probability (less than 1%), but are characterised by the following key differences:

- The Commission's 'carbon-capped' forecasts model the levels of aviation demand expected in a world where carbon dioxide emissions from flights departing UK airports are limited to 37.5 MtCO₂e – the level recommended by the CCC¹ as a planning assumption to achieve reductions across the whole UK economy of 80% over 1990 levels by 2050. These forecasts increase the costs of carbon to ensure demand for aviation in the UK is reduced to stay within this planning assumption and as such assume no trading of aviation emissions either within the UK economy or internationally (for example, such as under an EU Emissions Trading Scheme or any international global agreement to tackle these emissions).
- By contrast the Commission's 'carbon-traded' forecasts model the levels of aviation demand in a future where carbon emissions from flights departing UK airports are traded at the European level until 2030 and then traded as part of a liberal global carbon market. In contrast to the carbon-capped forecast these do not constrain emissions to a pre-determined level, rather reflect the demand response to DECC's² carbon values for appraisal.

1 Committee on Climate Change.

2 Department for Energy and Climate Change.

The Commission has only considered aviation demand in a world without action to manage and reduce carbon dioxide emissions from aviation in one sensitivity test, explained in the report “Transport Economic Efficiency”.

As with the Commission’s scenarios, the objective is not to identify a single ‘correct’ forecast, but rather to understand the varying effects on aviation demand of constraining and pricing carbon emissions. In effect the two worlds set out above represent a range of possible ways in which aviation in the UK may contribute to achieving stabilisation of the global climate.

At one end of the range the capped approach sees that happen within the UK economy. This takes a static view of what the relative effort between sectors should be, assuming no flexibility or interactivity to promote economic efficiency or reflect society’s changing views of the value of aviation relative to other sectors. It is set with reference to the 37.5 MtCO₂e planning assumption the CCC recommends as a proxy until such time as a long-term global climate agreement is reached. This planning assumption has been developed with a view of what the relative effort of sectors should be, based on what we know now – and thus reflects the CCC’s concern that should aviation grow to 37.5 MtCO₂e, the implied near 85% reduction in the CO₂e emissions of other sectors may be at the limit of what is feasible. As the CCC notes it is a limit that should be kept under review, to allow for policy changes and new information about technology and abatement in different sectors.

The other end of the range assumes action to tackle emissions from this international industry seeks the most globally economic efficient approach without reference to national boundaries or other concerns that characterise current international negotiations. The future will almost certainly lie between these two points, for example the agreement to inclusion of aviation emissions in the EU emissions trading system, but also the adverse international reactions to its full implementation illustrate this dynamic.

Part 1: Business Case

1. Strategic Case

Introduction

1.1 The Airports Commission's Strategic Case comprises **(1)** a summary of how the scheme satisfies the Commission's *assessment of need* in terms of the (potential) capacity, connectivity and benefits of competition provided, and its impacts on passenger experience and the freight sector; and **(2)** a description of the wider economic, social and environmental impacts with reference to existing spatial and economic strategies.³ This corresponds to the Strategic Case described by the Commission in the *Appraisal Framework*:

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.

1.2 As such, the Strategic Case provides the Commission's overall **Strategic Fit** assessments, as outlined in the table below.

Table 1.1: Airports Commission's Strategic Fit assessments

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 <i>assessment of need</i>	Q1: Does the option provide additional capacity that facilitates connectivity in line with the <i>assessment of need</i> ? What kind of connectivity may the option provide?	Demand for aviation is inherently uncertain so it is important to get the sense of the range of outcomes	Part 1: A set of global aviation scenarios testing a range of potential connectivity outcomes

³ The details of the Commission's wider economic, social and environmental assessments are discussed in the Welfare Impacts section of the Economic Case.

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
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 for socio-economic and spatial development?	Providing extra capacity may interfere with previously established plans for affected constituencies 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

1.3 The Commission’s assessment of strategic fit draws particularly from the following documents:

- Strategic Fit: Forecasts
- Strategic Fit: Expanding Airport Capacity – Competition and Connectivity
- Strategic Fit: Fit with Wider Spatial and Socio-Economic Development Strategies

1.4 The case also draws on a variety of other modules, including **Economy, Local Economy Impacts, Surface Access, Operational Efficiency** and a number of environmental modules. Findings arising from other modules regarding the financing and delivery of the scheme are also relevant to the case, but are chiefly captured through their impacts on **Delivery**.

1.5 The Commission’s **Strategic Case** does not precisely follow the HM Treasury Green Book format, but it at the same time replicates much of the function of the strategic case implied by the Green Book, in that it identifies how each of the

short-listed proposals for airport expansion fit with the *assessment of need* set out in the Commission's *Interim Report* and with national, regional and local policies, strategies and plans, thus providing a starting point for any Government-led strategic case assessments which might be prepared following the Commission's Final Report in the summer of 2015.⁴

Part 1: Strategic fit with the Commission's *assessment of need*: strengths and weaknesses

1.6 It should be noted that the analysis of the two Heathrow options is very similar, as the strategic impacts are broadly comparable. The specific forecast outputs, such as for numbers of passengers and destinations, vary to some degree due to the different capacity limits for the two schemes.

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?

1.7 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 Extended Northern Runway would facilitate the potential future connectivity outcomes for UK aviation – at the expanded airport, in the London airport system and UK-wide airport network.

1.8 Heathrow Airport is currently operating at very close to its maximum capacity, accommodating more than 470,000 air transport movements (ATMs) in seven of the last ten years. This is more than 98% of its maximum annual capacity of 480,000 ATMs, 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 72 million in 2013. Heathrow has sufficient terminal capacity to accommodate a maximum of 95 million passengers, and the Commission's forecasts show that without 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.

1.9 As passenger numbers grow, Heathrow 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

4 <https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government>

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.

- 1.10** 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 these indicate there would be significant increases in frequency on the thickest and most profitable routes. This pattern is seen at Heathrow across the full range of the Commission's scenarios, including both carbon-traded and carbon-capped forecasts.
- 1.11** 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, makes Heathrow a less attractive option for these passengers.
- 1.12** The high level of runway utilisation at the airport leaves almost no scope in the timetable to recover from any unforeseen incident. The airport operator 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 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.
- 1.13** The capacity and connectivity outcomes of expansion at Heathrow Airport (as for all 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

- 1.14** 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 Extended Northern Runway would increase ATM capacity from 480,000 currently to 700,000, enabling passenger numbers to reach 126-142 million passengers by 2050, across the Commission's five scenarios. This compares to plans for Istanbul's new airport,⁵ which is being designed to accommodate up to 150 million passengers.

- 1.15** High levels of unmet demand for travel from Heathrow would see traffic movements increase rapidly once an Extended Northern Runway comes into operation. By 2040, the airport is forecast to be operating at or near its capacity of 700,000 ATMs across all scenarios, and in four of the Commission scenarios it is operating at 685,000 or more ATMs by 2030. The exception to this is the *global fragmentation* scenario, in which a lower economic growth rate and higher oil prices hold down the level of increase in global aviation demand. Even in this scenario, however, the airport is forecast to accommodate 625,000 ATMs, utilising almost 90% of available capacity, by 2030.
- 1.16** Increasing demand at the expanded airport would 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 across most scenarios as a result. The corollary to this is generally continuing growth in overall destinations at the London level, as demand spills over from Heathrow to other airports.
- 1.17** The passenger forecasts prepared by Heathrow Hub Ltd (HHL) are towards the lower end of the Commission's carbon-traded forecast range in 2030, rising to the mid-range by 2040, although passenger demand does not achieve the levels predicted in the *global growth* or *low-cost is king* scenarios at any point. Heathrow Hub Ltd forecast that the 700,000 ATM limit at an expanded airport would be reached in or around 2040.
- 1.18** Passenger numbers and destinations at Heathrow with an Extended Northern Runway across the Commission's five forecast scenarios are summarised in the table below.

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

Table 1.1: Heathrow Airport Extended Northern Runway option, terminal passengers and destinations, Airports Commission's carbon-traded forecasts

Scenario (Carbon-traded)	Passengers per annum (m)				Destinations			
	2011	2030	2040	2050	2011	2030	2040	2050
Assessment of need	70	116	127	131	179	196	196	183
Global growth		123	131	142		199	189	174
Relative decline of Europe		116	123	131		222	221	221
Low-cost is king		119	130	141		224	226	217
Global fragmentation		104	119	126		186	198	188
<i>Heathrow Hub Ltd forecast</i>		<i>106</i>	<i>122</i>	<i>130</i>				

Source: Airports Commission analysis.

1.19 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 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 marginally lower in 2050 than in 2011, it should be noted that this is still some 30 destinations more than in the baseline, as without expansion the airport's route network is forecast to shrink significantly.

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

1.21 The other scenario in which Heathrow's route network becomes more focused on short-haul routes is *relative decline of Europe*. In this scenario, there is a significant reduction in the share of international transfer passengers in total passenger numbers as Heathrow's role as a hub diminishes. The result is that

the long-haul route network stays broadly static over time, 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 these scenarios, the majority of routes are long-haul by 2050.

- 1.22** Without specific measures to incentivise the establishment of new services, the number of domestic destinations into 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 by 2050.
- 1.23** At the national level, an Extended Northern Runway at Heathrow would facilitate growth in overall capacity and in the scale of the overall UK route network, with 18-43 million more seats and 55-168 billion more seat-kms across scenarios in 2050 compared to the baseline. This would include noticeable increases in capacity to emerging markets⁶ (4-8 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* scenario, with growth in the *low-cost is king* scenario, which also sees strong global economic growth, only marginally lower. The smallest differences are found in the *relative decline of Europe* scenario as the UK network is less dependent on the availability of hub capacity.
- 1.24** All the carbon-traded expansion scenarios entail increases in carbon emissions from aviation above 37.5 MtCO₂e (the Climate Change Committee's recommended planning assumption to ensure the UK can meet any future emissions reduction commitments). This is set out in the table below.

Table 1.2: Heathrow Airport Extended Northern Runway option, Airports Commission's carbon-traded forecasts of UK aviation emissions in 2050 (MtCO₂e)

CCC advice	S0 assessment of need	S1 global growth	S2 relative decline of Europe	S3 low-cost is king	S4 global fragmentation
37.5	42.6	50.9	43.4	50.2	40.2

Source: Airports Commission analysis.

⁶ Destinations defined as 'newly industrialised countries' or 'less developed countries' in the DfT forecasting model.

1.25 The highest levels of carbon emissions are associated with the *low-cost is king* and *global growth* scenarios, both of which would see UK aviation emissions in 2050 in excess of 50 MtCO₂e. 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

1.26 In the Commission’s carbon-capped forecasts, emissions from aviation are constrained to approximately 37.5 MtCO₂e 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 would still see significant growth in passenger numbers, with ATM capacity reached by 2040 across all scenarios. Under any scenario, the additional capacity provided by an Extended Northern Runway at Heathrow would enable the airport to grow significantly larger in passenger numbers than any current airport.

1.27 As with the carbon-traded scenarios, increasing passenger numbers at Heathrow 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.

1.28 The table below shows numbers of passengers and destinations at Heathrow with an Extended Northern Runway in place across all five forecast scenarios.

Table 1.3: Heathrow Airport Extended Northern Runway option, terminal passengers and destinations Airports Commission’s carbon-capped forecasts

Scenario (Carbon-capped)	Passengers per annum (m)				Destinations			
	2011	2030	2040	2050	2011	2030	2040	2050
Assessment of need	70	110	124	129	179	192	198	193
Global growth		110	126	131		192	197	188
Relative decline of Europe		111	120	127		220	221	220
Low-cost is king		116	125	131		220	227	217
Global fragmentation		111	124	127		193	201	188

Source: Airports Commission analysis.

- 1.29** It is noticeable that in the *assessment of need* and *global growth* scenarios the number of destinations served from Heathrow in 2050 is higher in the carbon-capped than in the carbon-traded scenarios. This reflects the fact that the lower levels of demand at Heathrow in these scenarios do not drive the same degree of concentration on the thickest routes. In the other scenarios, the number of destinations is broadly similar to the carbon-traded equivalent in both 2040 and 2050, though more limited growth in destinations is seen in the early years after expansion.
- 1.30** Lower demand growth overall due to the cap on emissions is seen across all scenarios. As a result, the overall number of destinations in the London system is broadly comparable to the baseline in 2030, and lower in 2040, across all scenarios. In the later part of the forecast period, as a significant degree of excess demand moves from Heathrow to other London airports, some growth in destinations compared to the baseline is seen.
- 1.31** An important point in respect of the carbon-capped forecasts for an Extended Northern 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, in most scenarios it supports an overall increase in long-haul connectivity, with national long-haul capacity 1-8 million seats higher in 2050 than in the baseline and long-haul seat-kms 11-61 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 MtCO₂e.
 - 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.
- 1.32** 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.
- 1.33** As with the carbon-traded scenarios, the number of domestic destinations into London airports are forecast to see limited change. The number of domestic passengers into the London 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 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.

- 1.34** All of the carbon-capped scenarios keep carbon emissions from aviation at 37.5 MtCO₂e in 2050, consistent with the Climate Change Committee's advice.

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

Passengers

- 1.35** 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 Factor⁷ (SPF) of 44m²/DHP, higher than other comparable large European hubs. This provides for sufficient room to accommodate the current passenger numbers. Heathrow's terminals also provide passengers with a relatively large number of different leisure outlets for dining and shopping.
- 1.36** 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 from the west of England must either change at Paddington or Hayes and Harlington, and those from the north, 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

⁷ The gross terminal floor area per design hour passenger, i.e. a standardised measure of the typical space available to passengers in a given airport.

slow average speeds in peak hours. Additional road widening and other changes will reduce congestion on some key routes. Capitalising on its location close to a number of major motorways, Heathrow 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.

- 1.37** Recent CAA survey results estimated that 87% of passengers at Heathrow were positive about their airport experience.⁸ Heathrow is currently rated by passengers within the top 10 airports in the world, and Terminal 5 has been voted 'Best Airport Terminal' for three years in a row.⁹
- 1.38** 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 2030.¹⁰ The current terminals have capacity for 80 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.
- 1.39** There are a number of planned surface access infrastructure improvements from which Heathrow passengers will benefit by 2030. In rail, 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 connectivity to the north and midlands via an Old Oak Common interchange with Crossrail and Heathrow Express services to the airport.
- 1.40** 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 upon the construction of

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

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

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

an Extended Northern 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.

- 1.41** With or without expansion, the airport operator 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. When 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.
- 1.42** 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

- 1.43** Heathrow Airport currently plays a vital role in the UK’s air freight market, handling 1.42 million metric tonnes of freight during 2013. 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.
- 1.44** Expansion at Heathrow is likely to be highly beneficial to the air freight sector. 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. 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.

- 1.45** With many freight handling and forwarding companies already having a presence on or near the Heathrow site, the industry would be well placed to respond quickly to a growth in freight capacity there. Heathrow'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.
- 1.46** The proposal does not specify additional freight capacity within the expanded airport boundary. Any such development would therefore have to be located outside of the currently proposed limits.

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

- 1.47** Extending Heathrow's northern runway would increase the airport's capacity to 700,000 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 potentially enter the high yield Heathrow 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 Airports Commission's five scenarios.
- 1.48** Based on the analysis of the London airport system and key drivers of airline behaviour, the Commission has identified three different feasible airline responses to expansion of Heathrow Airport.

- **Airline response 1: Hub carrier growth at Heathrow, point-to-point growth at Gatwick**

The most likely airline response across all scenarios explored by the Commission is for the current hub carrier to expand its operations at Heathrow. The additional capacity when Heathrow expands would enable the hub airline and its partners to grow capacity at Heathrow, 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, taking

advantage of available high yield slots. In this airline response low-cost carriers would remain focused at Gatwick and the other London airports.

- **Airline response 2: Two hub operations at Heathrow, point-to-point growth at Gatwick**

Another potential airline response, although less likely than the one described above, would be for a competing network carrier to develop a hub operation at Heathrow besides the current hub carrier and its partners, benefiting from the strength of the London OD market. This response would only arise under those scenarios that are relatively optimistic for the global route networks (*assessment of need, global growth*). Even in such scenarios, the move into Heathrow 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 due to a reduction of scarcity rents resulting from expansion. In comparison to the expansion of the hub carrier in airline response 1, the two smaller hubs would most likely generate a route network smaller in size, but the benefits of competition in terms of potentially lower fare levels could be larger due to enhanced competition between the two hub carriers. Gatwick 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, Heathrow remains the network hub**

This is the future in which 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 to Heathrow expansion would be that of a low-cost carrier entering Heathrow 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 with its network of short-haul feeder traffic. While such airline responses 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 would potentially incur a bigger drop than in the case in which one hub carrier dominated capacity at Heathrow.

- 1.49** The different airline responses will have varying impacts on connectivity, competition impacts 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 and to a limited extent from Gatwick, 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.
- 1.50** The Heathrow scheme's strengths lie 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.¹¹ The scheme's connectivity benefits are likely to be largest if Heathrow'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. On the other hand, the benefits of competition in case of the dominant hub carrier expanding are likely to be limited. The benefits of competition would potentially be larger when the hub carrier and its partners were exposed to competition, either from another hub carrier that would decide to establish a second hub at Heathrow or from a new, low-cost entrant.¹² 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.

11 HHL's submission to the Airport's Commission stresses the importance of expanding hub capacity at Heathrow in order to achieve greatest benefits of connectivity.

12 HHL's submission stresses that some low-cost carriers have increasingly demonstrated their ability and willingness to fly from major hub airports.

Part 2: Wider economic, social and environmental impacts: Opportunities and threats

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

Local assessments

Growth of employment

- 1.51** Expansion at Heathrow is forecast to support significant growth in local employment. The additional direct, indirect and induced jobs created would total, across the full range of Commission scenarios, between 47,400 and 96,200 in 2030, rising to between 54,800 and 92,900 in 2050.
- 1.52** 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.
- 1.53** Heathrow has been defined in the London Plan as an Opportunity Area, and local authority plans also note the benefits that Heathrow provides as a driver and catalyst of economic activity. For example, 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.
- 1.54** Any new direct jobs created as a result of the 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.
- 1.55** 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.

Pressure on housing demand and infrastructure

- 1.56** The additional employment supported by Heathrow's expansion would lead to a significant requirement for additional housing. The Commission's analysis indicates this would total between 22,900 and 60,600 houses by 2030 within the local authorities assessed as part of the local economy assessment. This additional housing and population growth would also require substantial supporting infrastructure including schools and health care facilities.
- 1.57** Delivering new housing of this scale will present challenges for local authorities, many of whom already struggle to meet housing targets. This is mitigated to some degree however by the timescales for delivery and the broad area (some 14 authorities) over which the requirement is spread. Labour market flexibility and strong surface access links may enable this area to be extended further. The land take associated with the additional housing demand may require some de-designation of areas of the Green Belt, although the London Plan's encouragement of high density housing and brownfield redevelopment may reduce this.
- 1.58** Overall, the Commission's analysis is that the delivery of the necessary 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 benefits of expansion.
- 1.59** The extension of the current northern runway at Heathrow would likely require the loss of residential and commercial properties, particularly around the parish of Colnbrook with Poyle. 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 in respect of its proposed northwest runway to pay for compensation to residents. For those remaining, yet impacted by the airport, it proposes to pay for noise insulation. Similar measures could potentially be put in place if the Extended Northern Runway was taken forward.

Environment and land

- 1.60** 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 an Extended Northern Runway.

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.'

- 1.61** Increased environmental impacts as a result of an Extended Northern Runway would be felt in a number of areas. Construction would entail a loss of some 580ha of the Green Belt land, as well as wider, non-Green Belt land take. The Commission forecasts a significant increase in the airport's noise impact as result of the proposal's focus on minimising the numbers of additional households affected by the resultant expansion. Increasing numbers of passenger and air traffic movements would increase impacts on air quality.
- 1.62** Some mitigation of increased noise impacts is possible. Advances in aircraft technology, steeper approaches and for this particular proposal novel curved approaches and extensive mixed-mode operations over the day may reduce the eventual noise profile. These latter two proposals require further analysis. However, even with technological advances and standard respite periods, the operation of the Extended Northern Runway would by 2030 be expected to impact more people than at present (although there would be some improvements to night noise compared to the current situation).
- 1.63** The impacts of expansion on local air quality, where EU limits are forecast to be exceeded at a number of sites even without expansion, are important, as they would be expected to make it harder to address this issue. 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.
- 1.64** The expansion will entail the loss of some green spaces and communities. However, the promoter has proposed mitigation strategies and identified locations in the region for their deployment.

Regional and wider impacts

Regional

- 1.65** 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 where a need is identified is acknowledged as a key enabler of economic growth.

- 1.66** Expansion of Heathrow airport could support further opportunities for growth 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.
- 1.67** The importance of Heathrow to the regional economy is recognised in plans published by several regional Local Enterprise Partnerships. 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.
- 1.68** 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.
- 1.69** Domestic flight connections to Heathrow are recognised by some authorities throughout the UK as being of strategic importance to the international connectivity of their regions. Expansion at Heathrow 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.

London

- 1.70** London plays a particular role in contributing to the national economy. 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.

- 1.71** Expansion of Heathrow airport could provide an opportunity for London and its surrounding region to play to its strategic strength as a global city in the years ahead, supporting economic growth. Expansion at Heathrow could also provide an opportunity for London to continue to benefit from a network of international airports serving different markets and geographical catchment areas, although it may result in increased concentration of long-haul services at a single location. Expansion at Heathrow 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's substantial long-haul route network, potentially enabling the provision of new links to emerging market destinations. Conversely, expansion at Heathrow may not offer the same scope for growth in low-cost aviation, unless Heathrow's business model and costs of operation are able to attract low-cost carriers.
- 1.72** Expansion at Heathrow 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 London Plan 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.
- 1.73** 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 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.

2. Economic case

Introduction

- 2.1** The Airports Commission's *Appraisal Framework* sets out the purpose of the economic case as “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).”
- 2.2** The document sets out a summary of the analysis, methods and initial views of the Airports Commission on the economic case for airport expansion in the form of a Heathrow Airport Extended Northern Runway. In constructing this case the Commission has been mindful of the need to ensure a fair and comparable assessment of all short-listed schemes. It has used methods for assessment from standard appraisal guidance such as the HM Treasury Green Book and the Department for Transport's (DfT) WebTAG and supplemented these analyses with more novel approaches, both quantitative and qualitative, to better understand and account for the potential impacts of airport expansion.
- 2.3** In its *Interim Report* the Commission concluded there was a need for one net additional runway in the South East by 2030. The analysis behind this assessment included studying connectivity, airline operating models, demand forecasting and estimating the economic impacts of having a capacity constraint in place. The economic analysis led the Commission to conclude that the cost to the economy of having a capacity constrained system compared to a completely capacity unconstrained system were as follows in Table 2.1:

Table 2.1:

Impact	Cost of a capacity constraint (Present Values 2021-2080 in 2013 prices) ¹³
Direct transport economic efficiency cost	£15-18bn
Delay costs	£5.1bn
Wider economic costs	£30-45bn

Source: Airports Commission analysis.

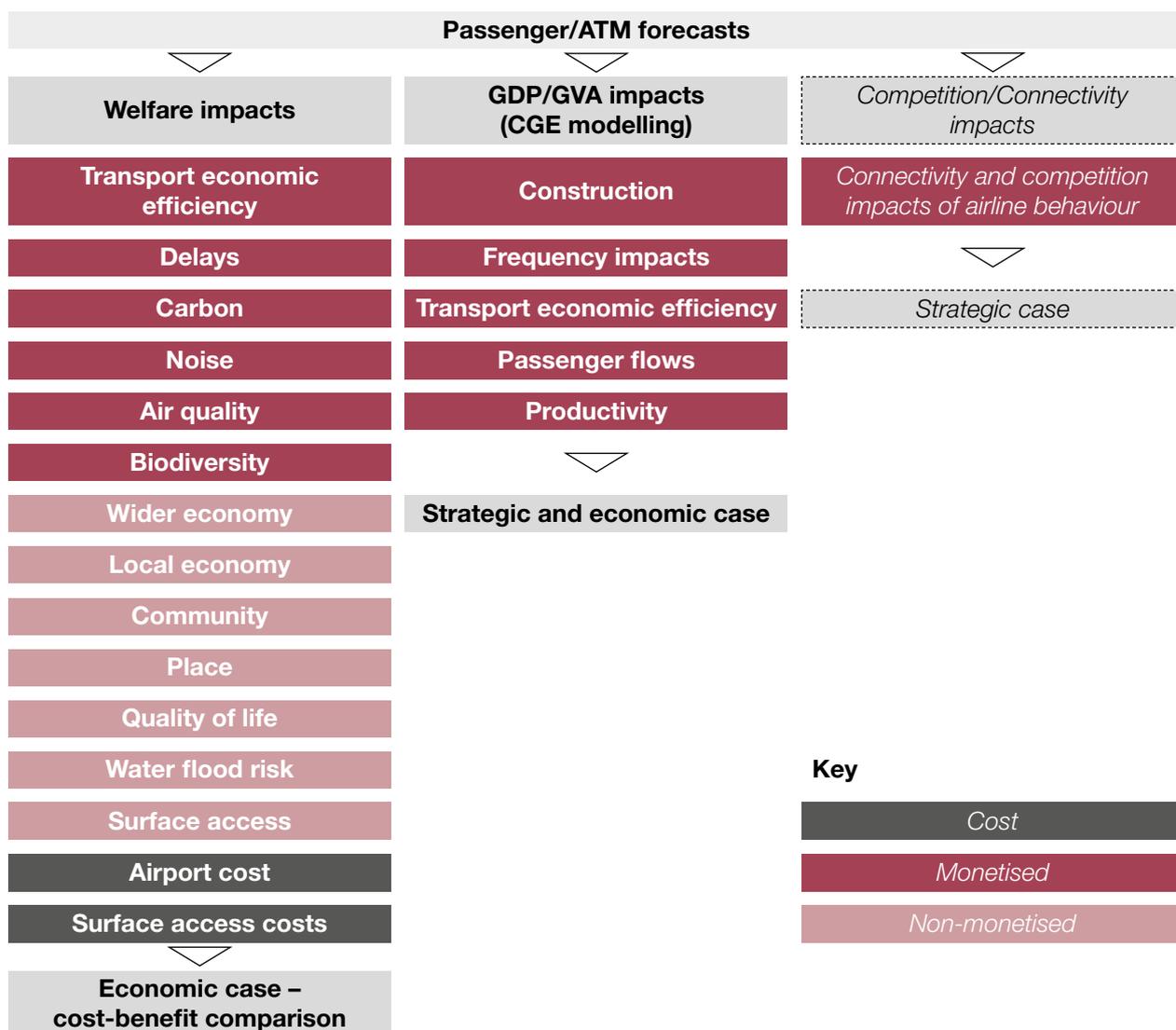
¹³ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/266670/airports-commission-interim-report-appendix-3.pdf

- 2.4** The analysis undertaken in phase two of the Commission's work is scheme specific and considers the benefits and dis-benefits associated with each scheme, as set out in the Airports Commission's *Appraisal Framework*.¹⁴
- 2.5** There are many ways to weigh up the pros and cons of airport expansion ranging from the commercial assessment for an investor to the broader societal impact assessment that would normally be expected to accompany a government spending decision.
- 2.6** Although the Commission is not defining relative contributions it is likely that a large proportion of the total scheme cost will be privately funded, though some elements of the proposal, notably the associated improvements to road and rail access to the airport, could require the investment of public funds. The commercial merits of the scheme are considered under the financial and commercial case. The varied nature of the sources of funding raise questions about the suitability of established government appraisal methods which normally deal with schemes where the majority of funding is public.
- 2.7** In order to undertake an economic assessment, the Commission have approached the appraisal from both a microeconomic and macroeconomic perspective. This dual approach draws on some methods used by Government but also considers a wider perspective, giving the Commission a richer picture of the possible impacts. We have also noted in Figure 2.1 how airline responses to an increase in capacity may impact upon competition and connectivity which the Commission is considering under the strategic case,¹⁵ alongside a range of wider impacts including on connectivity, passenger experience and spatial development. Figure 2.1 depicts the approaches and assessments underlying each.

14 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/300223/airports-commission-appraisal-framework.pdf

15 SEO Economics have undertaken work on competition/connectivity impacts on the Airport Commission's behalf. The Commission remain interested in this subject and plan to undertake further work in the future.

Figure 2.1: Economic appraisal framework



2.8 The microeconomic approach on the left hand side includes many areas which would normally be included in a government appraisal of such a scheme, where the cost and benefits are weighed against each other. The Commission’s analysis here is largely consistent with guidance broadly outlined in DfT’s WebTAG¹⁶ and the HM Treasury Green Book¹⁷ and incorporates a large number of inputs, drawn from across the *Appraisal Framework*, to build a picture of the scheme’s welfare impacts. Some of these impacts are also covered in the strategic case, such as surface access and local economy.

2.9 The macroeconomic approach in the centre of this diagram is more innovative, using a Spatial Computable General Equilibrium (S-CGE) model, which allows a

16 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/275125/webtag-tag-unit-a1-1-cost-benefit-analysis.pdf

17 <https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government>

better understanding of the impact on the whole economy in terms of changes in Gross Domestic Product (GDP) or Gross Value Added (GVA) as a result of the scheme. This approach is novel and there are a number of uncertainties over the causation and scale of these impacts. Therefore, the results should not be treated as definitive, but rather as providing an indication of the ways in which investment in enhancing aviation capacity and connectivity can support economic growth. The GDP impact figures do not include any dis-benefits associated with impacts upon the environment and wider society.

2.10 The welfare and GDP approaches provide different perspectives on the potential impacts of airport expansion, as does the competition/connectivity work outlined in the strategic case, and one should not be considered additional to the other, rather they should be viewed at this point as complementary methods for understanding the impacts.

2.11 In respect of the economic case, each scheme has been assessed against the same 'do minimum' set of demand forecasts, which establishes what would happen if no new long-term capacity infrastructure is developed, under five demand scenarios. The 'do minimum' option was developed using the Commission's version of the DfT aviation forecasting model, which was extensively updated by the Commission in phase one in response to comments to its Demand Forecasting discussion paper.¹⁸ The latest forecasts underpinning the appraisal can be found in the "Strategic Fit: Forecasts" report.

2.12 A scenario based approach is taken to assess the scheme. The future development of the airline industry is inherently difficult to predict, particularly over a 60 year period. Therefore five possible scenarios of future demand have been constructed, building on the analysis presented in the *Interim Report*. Details of these scenarios, and different approach to handling carbon emissions, can be found in the introduction to the business case.

2.13 The forecast outputs are described in the strategic case, for both carbon-capped and traded systems, and are set out in detail in the document, "Strategic Fit: Forecasts". These also form the basis for this economic appraisal. The rest of the economic case summarises results for each relevant area of the scheme assessment. All the outputs here have been drawn from the analysis produced by the Airport Commission and its advisors and further detail can be found in the technical reports.

18 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/73143/aviation-demand-forecasting.pdf

2.14 Table 2.2 below summarises which appraisal results have been calculated. This shows which assessments will be monetised in this case and which are analysed on a qualitative and quantitative, but non monetised, basis.

Table 2.2: Appraisal results presented in the economic case

Appraisal results	Assessment of Need		Global Growth		Relative Decline of Europe		Low-cost is King		Global Fragmentation	
	CT	CC	CT	CC	CT	CC	CT	CC	CT	CC
Carbon-traded (CT)/capped (CC)	CT	CC	CT	CC	CT	CC	CT	CC	CT	CC
Monetised										
Transport economic efficiency	Y		Y		Y		Y		Y	
Delays	Y		Y		Y		Y		Y	
Noise		Y	Y ¹⁹ (LHR)				Y (LGW)			
Air quality		Y								
Carbon emissions		Y		Y		Y		Y		Y
Biodiversity		Y								
Scheme and surface access cost	Y	Y	Y (LHR)				Y (LGW)			Y
Non-monetised										
Wider economic impacts										
Surface access										
Quality of life										
Community										
Place										
Local economy										
Water and flood risk										

2.15 It has not been possible to assess the transport economic efficiency or wider economic impacts under a carbon-capped forecast. This is because carbon prices are much higher in the scheme option than the 'do minimum' meaning the carbon policy component of the appraisal dominates the capacity appraisal. This is particularly problematic as appropriate carbon policies have not been investigated in detail. For example, carbon emissions have been forecast assuming that the same technology is in use, whereas in reality, it might be expected that the higher carbon prices associated with greater capacity could incentivise technological

¹⁹ Noise disbenefits under these scenarios have not been monetised, but a full quantified noise assessment has been carried out to understand the differential impact compared to the *assessment of need* carbon-capped case.

developments and uptake which enhance the carbon efficiency of aircrafts. This risks implying greater dis-benefits attached to cutting carbon than may be realistic.

- 2.16** To test the sensitivity of its economic analysis to more stringent measures to control carbon emissions, the Commission has tested the impact of DECC's high carbon price on its calculations of transport economic efficiency benefits, as opposed to the central carbon price used as the basis for its carbon-traded scenarios.
- 2.17** What is also clear from the carbon-traded forecasts is that the carbon emitted by the sector in 2050 is above the CCC's planning assumption in both the baseline and 'do something' options for all scenarios. In the the upper end scenarios, (*global growth* and *low-cost is king*) baseline emissions are more than 9 MtCO₂e higher than the planning assumption and around 13 MtCO₂e higher with runway expansion. If this was to be incorporated within the UK economy's target of reducing overall emissions by 80% relative to 1990 levels, it would require the remainder of the economy to accommodate it by making further reductions of a similar amount. However, the Commission notes the CCC's advice that there is "limited confidence" in the feasibility of this. Although reductions are relatively small compared to the total reductions required (an addition of around 13 MtCO₂e to an existing reduction of over 600 MtCO₂e), they imply cuts in CO₂e emissions of 85% or more.
- 2.18** The Commission intends to carry out further work to complete a fuller economic assessment of the case where UK aviation emissions are constrained to the CCC planning assumption of 37.5 MtCO₂e for its final report in summer 2015.

Welfare Impacts

- 2.19** All the following impacts have been monetised using methods detailed in the *Appraisal Framework*. The majority of these are consistent with a standard DfT WebTAG and HM Treasury Green Book approach, though some, such as the delay assessment, follow new approaches developed by the Airports Commission.
- 2.20** All appraisal results in this section are presented in Present Value (PV) terms in 2014 prices over a 60 year appraisal period, starting from an opening of Heathrow's Extended Northern Runway in 2026.
- 2.21** Non-monetised impacts are considered qualitatively and quantitatively and these are included in the overall weighing up of cost and benefits. As with the monetised impacts, these broadly follow the DfT WebTAG and HM Treasury Green Book approach, with some exceptions, such as the assessment of wider economic impacts, which is drawn from the Commission's macroeconomic S-CGE work.

Some monetised results on wider impacts are included in this document but given the nature of this analysis they have not been incorporated into the overall welfare cost-benefit comparisons.

Monetised impacts

Direct impacts – Transport Economic Efficiency

- 2.22** Many of the costs and benefits attached to airport capacity expansion fall directly on airports, airlines, passengers and the public finances. Quantifying such impacts is important as part of the complete economic appraisal. The table below sets out the estimated transport economic efficiency impacts (including impacts on Government revenues) from an extended northern runway, allowing capacity at the airport to increase to 700,000 air traffic movements a year.
- 2.23** Airport expansion allows passengers to access the air network more conveniently and / or at lower cost. The expansion lowers the shadow cost²⁰ for airports that are constrained without the addition of extra capacity; to the extent the airline market is competitive (and airports are appropriately regulated if necessary), this will lead to a reduction in fares. 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 – so being more likely to be able to travel at their preferred time – and access to a greater range of destinations without having to transfer.
- 2.24** The lower fares enjoyed by passengers are largely a direct transfer from airlines to passengers. If reductions in shadow costs did not translate into reductions in fares – but instead into a more pleasant travelling environment – then the producer surplus dis-benefit would be lower than reported in Table 2.3 below. Partially offsetting this, airlines may receive ‘new’ shadow cost revenue (that is, scarcity rents) attached to greater demand if the airport becomes capacity constrained again even after capacity has been added. There will also be the possibility for airlines to increase passenger volumes as new capacity becomes available.

20 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.

Table 2.3: Passenger, producer and government impacts, present value (£ billion, 2014 prices)²¹

	Assessment of need	Global growth	Relative decline of Europe	Low-cost is king	Global fragmentation
Passenger benefits excluding I to I ²¹	41.3	109.2	49.0	118.1	35.2
Producer shadow cost impact	(31.6)	(88.5)	(38.3)	(94.9)	(32.0)
Government revenue impact	1.5	6.8	1.9	7.2	1.6
Total excluding I to I	11.3	27.6	12.6	30.4	4.9
Passenger benefits to I to I	5.1	8.0	3.1	6.3	4.5
Total including I to I	16.4	35.6	15.7	36.7	9.4

Source: Airports Commission analysis.

2.25 Passenger benefits are heavily driven by passenger demand forecasts. *Low-cost is king* and *global growth*, with the highest levels of forecast demand, have the greatest benefit associated with adding capacity. These scenarios also see the highest levels of carbon emissions from aviation, in both the ‘do minimum’ and ‘do something’ forecasts.

2.26 Table 2.4 below splits passenger benefits into UK origin, foreign origin and I to I transfers. WebTAG recommends both UK and foreign origin passengers be included in the appraisal, though the costs and benefits should be identified separately.

2.27 Currently WebTAG recommends I to I transfer passengers should be excluded. This raises a difficulty in this context, 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. So, to ensure consistency across the appraisal, benefits to such passengers have been considered.

²¹ All values are shown in 2014 market prices, and, in the case of discounted and present values, are discounted to 2014.

²² International to international interliners i.e. passengers who are transferring via a UK airport with their origin and destination outside the UK.

Table 2.4: Passenger benefits split by passenger type, present value (£ billion, 2014 prices)

	Total	UK	Foreign	I to I
Assessment of need	46.5	28.9	12.4	5.1
Global growth	117.3	76	33.2	8.0
Relative decline of Europe	52.1	33.5	15.4	3.1
Low-cost is king	124.4	82.9	35.2	6.3
Global fragmentation	39.8	24.8	10.4	4.5

Source: Airports Commission analysis.

2.28 As noted above, it has not been possible to assess these benefits for the Commission's carbon-capped forecasts. Therefore, a sensitivity test has been carried out on the *assessment of need* scenario using the DECC high carbon price to assess the potential impact of raising carbon prices. This sees passenger benefits decrease by 12% due to lower levels of demand growth, but Government revenues rise from £1.5 billion to £6.4 billion. The result is that net benefits are increased by 16% from £16.4 billion to £19.1 billion. The overall effect of higher carbon prices will however vary according to the degree to which reductions in demand growth are offset by higher Government revenues, and in some cases the impact on the economic case may be negative.

2.29 The Commission has also reviewed the strategic capacity and connectivity benefits of an Extended Northern Runway at Heathrow in both its carbon-traded and capped cases, drawing upon the demand forecasting results set out in "Strategic Fit: Forecasts". This is discussed in the Strategic Case.

Delay impacts

2.30 The delay impacts capture the benefits to airlines, passengers and the environment of a reduction in delays at UK airports as a result of a Heathrow Airport Extended Northern Runway scheme.

2.31 The methodology used has been formulated using the UK CAA Runway Resilience Study²³ and a study on the European airline delay cost reference values²⁴ conducted by the University of Westminster. This is applied to the Commission's passenger forecasts across our five demand scenarios (see Table 2.5) for the carbon-traded system.

2.32 The benefits of reduced delays from the scheme range from £0.6 billion to £1.5 billion, depending on the demand scenario under consideration. Under the

23 UK CAA Runway Resilience Study (2008).

24 European airline delay cost reference values Final Report (Version 3.2) (2011).

global growth scenario, benefits experienced by airlines account for 65% of the total benefits.

Table 2.5: Total benefits from reduced delays, across scenarios, present value (£ billion, 2014 prices)

	Total benefits	Total benefits (exc. foreign)
Assessment of need	0.61	0.56
Global growth	0.62	0.59
Relative decline of Europe	1.48	1.20
Low-cost is king	1.00	0.83
Global fragmentation	1.47	1.18

Source: Airports Commission analysis.

2.33 The benefits of reduced delays are highest under the *relative decline of Europe* scenario since delay benefits are driven by a combination of delay time savings and the number of passengers or ATMs that these savings accrue to. When compared to the ‘do minimum’, delay time savings are higher when the additional capacity remains spare longer and so delays do not start to build up. This is the reason benefits from reduced delays are lowest for the *global growth* scenario where a large number of passengers leads to the additional capacity filling up quickly, causing delays to occur earlier than in other scenarios. It is likely that there will be further additional benefits related to having a more resilient airport system which are not captured in the monetised numbers above.

Noise

2.34 The noise impacts of the Heathrow Airport Extended Northern Runway have been considered at a national and local level based on the *assessment of need* carbon-capped scenario, alongside sensitivities to consider other demand scenarios.

2.35 A wide range of noise metrics have been considered, details of which are available in the ‘Noise: Local Assessment report’,²⁵ in 2030, 2040 and 2050. The local appraisal is based on detailed contour maps modelled using the UK Civil Aircraft Noise Contour model (ANCON). On a national level, 13 UK airports were modelled, the short listed airports by ERCD and the other 11 modelled by Bickerdike Allen using the widely available Federal Aviation Administration (FAA) Integrated Noise Model (INM).

2.36 The noise impacts are monetised at a local level using noise contour and population estimates to consider Annoyance, Sleep Disturbance, Acute Myocardial Infraction

25 Noise: Local Assessment (2014).

(AMI) and Hypertension on Quality Adjusted Life Years (QALYs).²⁶ The calculations for these are based on guidelines found in the WHO Environmental Burden of Disease as well as the ERCD report 1209,²⁷ with an adjustment to make the measure consistent with the *Appraisal Framework*. Essentially this approach values noise impacts by estimating the number of years of life lost or spent with a disability and multiplying these by well-established value for each QALY lost to provide the total monetised noise impact.

- 2.37** The analysis suggests that the scheme creates noise dis-benefits valued at £7.5 billion (PV, 2014 prices) using the mid range require using *assessment of need* carbon-capped forecast.
- 2.38** These monetised carbon-capped impacts are likely to represent a lower bound dis-benefit. Carbon-traded noise impacts have not been monetised, but a noise analysis under the *global growth* carbon-traded forecast, representing a high end forecast for the Heathrow Extended Northern Runway scheme, has been carried out. The size of the additional population affected by noise compared to the “do minimum”²⁸ in this forecast across a number of key metrics²⁹ is between 1.1 and 1.3 times higher than for the *assessment of need* carbon-capped forecast in 2030 and 2050.

Air quality

- 2.39** This module assesses the scheme’s impact on air quality levels nationally and locally. Within the assessment, the impacts of the pollutants NO_x, PM₁₀ and PM_{2.5} are considered, though for monetisation purposes only NO_x and PM₁₀ are costed since PM_{2.5} is a subset of PM₁₀. The total UK impacts have been monetised using DEFRA values.³⁰ 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. This includes following HM Treasury Green Book guidance to uplift 2010 pollutant prices by 2%. A deviation from this was made to follow the WebTAG price adjustment, which uplifts 2010 prices by the rise in gross domestic product (GDP) and household income. Also, the cost placed on a tonne of PM₁₀ is dependent on the area within

26 Quality Adjusted Life years are a measure of years spent in perfect health, free of disability or disease.

27 There are limitations and uncertainties associated with such monetisation, for further detail of these and the methodology used please refer to 5. Noise: Local Assessment, ERCD Report 1209: “Proposed methodology for estimating the cost of sleep disturbance from aircraft noise” (2013) and the WHO Environmental Burden of Disease guidelines.

28 These figures may represent an over-estimate as the baseline for the *global growth* carbon-traded forecast would in practice be higher than the baseline used from the *assessment of need* carbon-capped forecast.

29 54dBL_{Aeq}, 57dBL_{Aeq}, 55dBL_{den}, and N70 >50.

30 DEFRA – Department for Environment, Food and Rural Affairs.

the UK the pollutant is being emitted within and the source of the pollutant. Results of the *assessment of need* scenario are shown in Table 2.6 below.

Table 2.6: Values of monetised air quality impacts, present value (£ million, 2014 prices)

	Monetised value over 60 year appraisal period
NO _x	341.5
PM ₁₀	107.9
Total emissions dis-benefits	449.4

Source: Airports Commission analysis.

2.40 These impacts are small compared to other monetised elements of the economic case reflecting the limited impact of airport expansion on air quality at national level. They do not, however, take account of changes in the risk of exceeding regulated limit values at local level, which are covered in the Sustainability Assessment.

2.41 The values presented above are based on a carbon-capped forecast (carbon-traded values have not been calculated). The carbon-capped figures above are likely to represent a lower bound to the air quality dis-benefit due to the higher number of passengers and journeys to the airport under a carbon-traded system.

Carbon

2.42 The carbon emissions from increased ATMs have not been monetised in this economic analysis. This is because it is assumed that aviation is part of an aviation emissions trading scheme, meaning that there is no need to monetise carbon emissions in such scenarios as the scheme does not increase overall emissions – this is set out in WebTAG Unit A3.³¹

2.43 Carbon impacts of surface access, airport operations and construction and associated infrastructure are set out in tables 2.7 and 2.8 below.

Table 2.7: Carbon assessment for Heathrow Airport Extended Northern Runway, change in MtCO₂

Area of Emissions	Additional MtCO ₂ over 60 year appraisal period
Passenger surface access	4.9
Airport operations energy & fuel use	1.8
Construction of airport facilities & surface access infrastructure	10.1
Total	16.8

Source: Airports Commission analysis.

31 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/313826/webtag-a3-environmental-impact-appraisal-may2014.pdf

Table 2.8: Value of monetised carbon findings for Heathrow Airport Extended Northern Runway, present value (£ million, 2014 prices)

Area of Emissions	Additional dis-benefits over 60 year appraisal period
Passenger surface access	306.5
Airport operations energy & fuel use	108.3
Construction of airport facilities & surface access infrastructure	229.5
Total dis-benefit	644.3

Source: Airports Commission analysis.

2.44 The carbon impacts are the second largest monetised dis-benefits for the scheme, after noise. However, the carbon-capped figures above represent a lower bound of the dis-benefit due to the higher number of passengers and journeys to the airport under a carbon-traded system.

Biodiversity

2.45 This module aims to assess the impact on the biodiversity of area surrounding the airport, paying particular attention to protected habitats and species. As such, sites of interest were identified within various distances of the site according to the species in question and assessments made of the likely extent of impact.

2.46 The Heathrow Extended Northern Runway proposal involves direct land take impacts to varying degrees on five local designated sites, three of which are non-statutory (East Poyle Meadows SNCI, Lower Colne SMINC and Greenham's Fishing Pond SINC), two statutory (Arthur Jacob LNR and Management Unit 1 (Poyle Meadow) of Staines Moor SSSI). The outline cost for provision of compensatory mitigation habitat is estimated to be between £4.3 million and £8.5 million (based on the use of management agreement or land purchase options respectively³²).

2.47 The loss of nearly 60ha of woodland, nearly 40ha of grassland and 371ha of agricultural land are the main impacts on eco-systems services. The overall value of ecosystem services loss is estimated to be between £5.6 million and £16.4 million over the 60 year assessment period. These impacts are small compared to other monetised elements of the economic case.

³² These are indicative habitat off setting costs are adapted from the Defra 2011 '*Costing Potential Actions to Offset the Impact of Development on Biodiversity*' and do not cover construction costs for the river diversions or other capital works.

Non-monetised impacts

Wider economic impacts

- 2.48** In its *Interim Report*, the Commission found the costs to the economy of a capacity constraint could be between £30 billion and £45 billion (PV 2013 prices 2021-2080). This analysis produced clear evidence that these effects are significant and potentially large driven by impacts on trade, Foreign Direct Investment (FDI) and tourism effects.³³
- 2.49** These findings were supported by findings from a literature review undertaken by Steer Davis Gleave for the Commission. Trade in services, industries with the highest propensity to fly, were found to be of significant economic value to the UK. For example, the financial sector makes up around 28% of UK service exports and 23% of total global financial exports.³⁴ Trade in many goods, particular high-tech sectors such as pharmaceuticals and high-tech machinery, are highly dependent air freight which accounted for 31% of the UK's total non-EU imports and 46% of the UK's total non-EU exports in value terms in 2011.³⁵
- 2.50** The literature review also found aviation has an important role in attracting FDI. Strauss-Kahn and Vives (2009), for example, found that the probability of firms in the US relocating to a particular location increased by 90% if there is large airport nearby or 40% if there is a small airport. In addition, tourist spending, which is also significant, was worth £19 billion to the UK economy in 2012, with over 80% arriving by air. The value of outbound tourism from the UK was £32 billion in 2012, which negatively affected the overall UK trade balance.³⁶
- 2.51** Further work has been undertaken by the Commission to consider the possible size of some of the possible wider economic impacts alongside its S-CGE modelling programme. The only impact listed in this work potentially affecting the wider economy from a WebTAG perspective is related to productivity, which feeds only through from trade in the modelling, amounting to between £4.6billion – £7.1billion.³⁷ However, results have not been incorporated into the welfare cost-benefit analysis since they exclude other likely wider economic impacts such as FDI and tourism and are not calculated using techniques from a standard WebTAG

33 <https://www.gov.uk/government/publications/airports-commission-interim-report>

34 BIS (Feb 2012) "UK trade performance across markets and sectors".

35 HMRC analysis.

36 ONS IPS 2012.

37 These numbers are in present value terms, 60 year appraisal in 2014 prices.

appraisal.³⁸ The developing nature of this analytical approach means that these results are subject to significantly more uncertainty than those generated through the more established WebTAG approach.

2.52 On the basis of analysis done as part of the *Interim Report* and the size and scale of the results from the S-CGE work, the wider economic impacts are expected to have a strongly positive impact on the economic case. The impact would be largest under the *global growth* and *low-cost is king* scenarios, and smallest under the *global fragmentation scenario*.

Local economy

2.53 The Heathrow Extended Northern Runway scheme 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.

2.54 Depending on the scenario, the estimated additional jobs ranges between 47,400-96,200 jobs in 2030, and 54,800-92,900 jobs in 2050.³⁹ The upper end of the figure represents the *global growth* scenario, while *global fragmentation* represents the lower end of the range. The direct jobs related to the airport are anticipated to remain relatively low skilled, as in the 'do minimum'. The additional jobs are summarised in Table 2.9 below.

Table 2.9: Additional jobs for Heathrow Airport Extended Northern Runway

Year	Assessment	Number of jobs
2030	<i>Additional jobs (compared to baseline)</i>	47,400-96,200
	<i>Jobs (total)</i>	238,000-333,200
2050	<i>Additional jobs</i>	54,800-92,900
	<i>Jobs (total)</i>	197,100-314,000

Source: Airports Commission analysis.

2.55 An alternative approach to assessing the number of jobs created comes from the S-CGE model, with an estimated 163,300 net jobs created under the *assessment of need* scenario by 2050. This figure is the net impact of the scheme, so takes into account any displacement effects, but it is still larger than the Commission's estimates as it includes the catalytic impacts of the scheme. These effects arise

38 Our current approach currently only considers the productivity impacts associated with additional trade, not FDI or Tourism as found in the previous literature, and other wider economic impact such as those from increased competition. We have also used an Equivalent Variation technique to convert the GDP figures into welfare units, which not consistent with a normal WebTAG appraisal.

39 This is a gross estimate, so does not take into account any negative employment effects in other areas as a result of the inflow to the airport's local economy. This approach is not fully webTAG compliant.

as a result of the wider benefits that air travel provides, improving connectivity and reducing costs through reduced travel times, a greater choice of destinations and more regular flights, as well as reduced country to country trade costs. This increase in available destinations also expands the potential markets for businesses, which benefit workers, intermediate goods and services. There may be increased competition across countries with the ability of firms to access new markets which would improve efficiency. These effects lead to an increase in employment in the economy, with the largest gains in the manufacturing and services sectors, which are trade intensive.

2.56 Growth of jobs and businesses associated with the airport has the potential to put pressure on housing in the local area. The Table 2.10 below demonstrates the range in the forecast of homes required as a result of airport expansion. Of the additional employees the number seeking residences in the local area is assumed to be consistent with the baseline, at 63%; a conservative assumption given the wider catchment area enabled by the surface access improvements planned.

Table 2.10: Additional homes needed for Heathrow Airport Extended Northern Runway

2030	Low	high
Additional homes (direct employees)	11,000	22,300
Additional homes (total employees)	22,900	60,600

Source: Airports Commission analysis.

2.57 The high end numbers are significant and could present delivery challenges, but there are many reasons why the additional housing required is unlikely to be as high as these figures, depending on the assumptions made about population growth, net migration, unemployment and out-commuting. In addition, this housing will typically be provided in a phased manner and across the entire assessment area⁴⁰ and the demands on an individual local authority are likely to be less substantial. Increased housing densities and renovation of brownfield land could be considered in meeting this need (which could result in additional costs). This additional housing will need to be supported by additional social infrastructure including schools and GP practices.

2.58 The local economic impacts are expected to have a positive impact on the overall economic case. This would be strongest in the *global growth* and *low-cost is king* scenarios, and have the smallest impact in the *global fragmentation* scenario.

⁴⁰ The assessment area consists of the local authorities of Hounslow, Hillingdon, Ealing, Slough, Spelthorne, Windsor and Maidenhead, Richmond upon Thames, Runnymede, Harrow, Bracknell Forest, Reading, West Berkshire, Wokingham and South Buckinghamshire.

Community

- 2.59** The objectives associated with the community assessment are to manage and reduce the effects of housing loss on local communities and to reduce or avoid disproportionate impacts on any social group.
- 2.60** The main impact on the local community would be felt in terms of lost housing, with 242 houses expected to be lost to enable the delivery of the Extended Northern Runway at Heathrow and associated infrastructure. In addition, access to a small number of community facilities would be more difficult, and noise impacts at a local primary school would be felt, both during and after construction. The provision of sound insulation and alternative local routes would need to mitigate these impacts, and compensation would be provided for housing loss.
- 2.61** The unmitigated community impacts would have a negative impact on the economic case. If appropriate and effective mitigation is provided, this impact could be neutral. This would not be expected to vary significantly across the demand scenarios.
- 2.62** A high level equalities screening identified potential disproportionate impacts on certain groups, but insufficient data was available to confirm this. A fuller assessment may be necessary as detailed plans are developed.

Place

- 2.63** The aim of the module is to assess the impacts of the Heathrow Airport Extended Northern Runway scheme upon land take, landscape, waste and heritage.
- 2.64** The land take of the airport itself would be approximately 335ha. This land is a mixture of commercial and industrial, and there are various sites in the local area where this activity could be moved to. A total of 242 residential properties lie within the airport footprint and are likely to need to be demolished. Additional land take for surface access improvements and flood storage area together come to an additional 330ha. An additional 165 residential properties lie close to the surface access routes and could also be lost depending on detailed route and construction design. Approximately 580ha of proposed the airport scheme would lie within designated Green Belt.
- 2.65** It is important to note that the site footprint is limited in part because, unlike other scheme designs, the promoters have not included areas of land within the airport boundary for commercial development. The AC consider that the expansion of the airport is likely to drive the need for more commercial development, and if this is not

within the airport boundary it will likely occur elsewhere in the vicinity. It is not clear what impact this would have on local landscape.

- 2.66** The assessment for landscape considered the potential changes to physical elements in the landscape along with visual perception. The impacts on views and landscape are likely to be more pronounced during the construction phase than operation but some areas would continue to experience moderate adverse effects during operation. The schemes impact on tranquillity is negative, but limited, given the background low level of tranquillity.
- 2.67** The waste assessment found the greater number of passengers would increase the production of waste by approximately 48,000 tonnes in the highest demand scenario, *global growth*. Heathrow Hub Limited have suggested continuing to use several existing facilities for recyclable waste. It would need to be determined if the additional quantities of waste is can be treated through existing facilities.
- 2.68** The heritage assessment assesses impacts on designated cultural heritage assets. Seven designated heritage assets have been identified within the land take area for the Extended Northern Runway which would be directly affected, with a further 30 within the Intermediate⁴¹ Study Area and 168 in the outer study area.
- 2.69** On the basis of this assessment, impacts on place are considered to have a small negative impact on the economic case. This is not be expected to vary significantly across demand forecast scenarios.

Quality of life

- 2.70** The Commission has published a study and literature review considering how airport expansion may affect quality of life. Analysis of this kind for major infrastructure scheme has not previously been undertaken.
- 2.71** 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). The project found there are both local and national quality of life impacts associated with airport development and, particularly at local level, there is a degree of ‘bundling’ of effects, in which positive and negative effects, whilst felt acutely by individuals, broadly balance out over a larger population.
- 2.72** For the Heathrow Airport Extended Northern Runway scheme the national impact on quality of life is likely to be positive, with negative impacts due to increased

41 Intermediate Study Area – 300m study area around the development footprint of each of the proposed options (Size suggested in HA208/07 for scoping studies).

carbon emissions more than offset by the net positive impact on jobs and increased connectivity for leisure. Locally, the main impacts would be expected to be from noise alone (which would be negative) and increased local employment (which would be positive), leading to a broadly neutral overall impact.

- 2.73** On this basis, the overall effect on the economic case is expected to be neutral. This would not vary significantly across forecast scenarios.

Water and flood risk

- 2.74** The Heathrow Extended Northern Runway scheme is estimated to create demand from the airport for an additional 14% of potable water per year by 2026 rising to 64% by 2050, compared to 2013, in an area which is already under water stress.
- 2.75** Approximately 10km of existing watercourse would be 'lost' with diversion of the Colne Brook and Poyle Channel. The creation of a new channel, 'the 'River Colne Spur' confluence is likely to have a significant residual impact. Over 12 km of water bodies would need to be culverted, running contrary to efforts by the Environment Agency to provide environmentally-friendly flood schemes. There could also be residual water quality impacts arising from polluted runoff. The scheme will include development in Medium to High risk flood zones which will lead to loss of floodplain storage and pose high flood risk.
- 2.76** Based on the assessment of the scheme's impact on the water environment, we consider the scheme to have a small adverse impact on the economic case, which could be reduced by good practice mitigation strategies. This would not vary significantly across demand scenarios.

Surface access

- 2.77** The surface access components of the scheme are based on three broad categories of surface transport project:
- those which are already committed and funded;
 - those which are likely to be required by 2030 to meet background demand regardless of airport expansion; and,
 - those which are required specifically to support the scheme.
- 2.78** The first category includes 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 including the Piccadilly Line and the M25. The second category includes Western Rail Access to Heathrow,

as well as further managed motorway projects on strategic links connecting to the airport. The costs of these projects have not been associated with the Heathrow Airport Northern Runway Extension scheme. Accordingly, the economic benefits of these projects have also not been associated with the scheme.

2.79 Of the schemes falling into the third category, some are further investments in road capacity required 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. Others relate to 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. These are not assumed to produce any economic benefits in their own right.

2.80 One further scheme, Southern Rail Access to Heathrow, has been included as a specific intervention to support the Heathrow Airport Northern Runway Extension scheme. This scheme would produce journey benefits for passengers travelling to the airport from a number of areas, most notably those parts of London whose proximity to Waterloo is substantially better than to Paddington or any of the Crossrail stations. These benefits, however, must be set 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.

2.81 While not forming part of the Commission's core appraisal of the scheme, the scheme promoter has also proposed an alternative surface transport strategy involving a hub station on the Great Western Main Line. The Commission has examined this proposal and its analysis has demonstrated some benefits, such as improved journey times for passengers travelling to Heathrow from the west, but also some dis-benefits, such as extended journey times for passengers travelling into central London from the west using the Great Western Main Line.

Scheme and surface access cost

2.82 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 are likely to be necessary, as well as the cost of the 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.

2.83 The Commission makes no judgement as to who should bear these costs and in its analysis recognises that historically these have been split between the public and private sectors. However, in its analysis the Commission considers the situation where the public sector funds the surface transport requirements and the private sector airport funds the remainder of costs on and off the airport site. The Commission also considers the case where the private sector airport funds all on and off airport costs.

Airport development

2.84 The Commission has estimated the capital costs associated with each 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. In addition, the Commission has included appropriate allowances for risk and a range of values for optimism bias.

2.85 The Airports Commission's view of the total costs of building the Heathrow Airport Extended Northern Runway scheme is £13.5 billion. This cost does not vary significantly between scenarios as in all cases the infrastructure is built before 2050. The design capacity of the proposed infrastructure is for 130 million passengers. Some Commission forecast scenarios see passenger numbers exceed this level by 2050, which would be likely to entail either some reduction in passenger experience due to higher crowding levels or investment in additional capacity. The PV costs of Airport Development are estimated at £9.7 billion (2014 prices). Details can be found in **Table 2.11**.

Surface access development

2.86 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. Surface transport costs which are required to support expansion specifically, however, have been included in the assessment of scheme cost., as shown in **Table 2.11**.

2.87 The total costs of delivering the scheme are set out in **Table 2.11** below for the four forecast scenarios considered in the Commission's commercial and financial analysis. As benefits are calculated on a present value basis, scheme costs have been converted into a present value to enable a consistent comparison.

Table 2.11: Scheme capital expenditure costs per scenario present values (£ billion, 2014 prices)⁴²

Scenario	AoN carbon-capped	AoN carbon-traded	Global growth carbon-traded	Global fragmentation carbon-capped
Scheme Capex (2014, Real)	13.5	13.5	13.5	13.5
Scheme Capex (2014, PV)	9.7	9.7	9.7	9.7
Surface Access Costs (2014, Real)	6.3	6.3	6.3	6.3
Surface Access Costs (2014, PV)	4.3	4.3	4.3	4.3
TOTAL (2014, Real)	19.8	19.8	19.8	19.8
TOTAL (2014, PV)	14.0	14.0	14.0	14.0

Source: Airports Commission analysis.

2.88 Scheme costs include 20% risk and 20% mitigated optimism bias. This represents one view of the Commission's central assessment of costs taking into account the level of development of the concept undergone to date but still reflecting a considerable amount of uncertainty that remains at this stage. The surface access costs include the cost of building, operating and maintaining the infrastructure but do not include any revenues. Surface access costs include an optimism bias allowance of 44% for road schemes and 66% for rail schemes.

Weighing up the cost and benefits

2.89 There are many ways to weigh up the pros and cons of airport expansion ranging from a commercial assessment for an investor to the broader societal impact that would normally accompany a government spending decision. The unique nature of the airports funding model in the UK means that many different approaches

⁴² Further details can be found later in the business case under the commercial and financial case. These figures present a range around just scenarios and treatment of carbon, for further sensitivity analysis and other possible ranges, please consult the cost and commercial case.

are relevant to this question. Although the Commission is not defining relative contributions, it seems likely that the majority of financing will be determined by the commercial decisions of investors, but also that some key elements of the proposal will require some investment of public funds.

2.90 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 investing public funds and the social costs and benefits. To that end the varied nature of the sources of funding raise questions about the suitability of established government appraisal methods which normally deal with schemes where the majority of funding is coming from the public purse.

2.91 Table 2.12 below summarises the Commission's monetised and non-monetised appraisal results.

Table 2.12: Heathrow Airport Extended Northern Runway costs and benefits, present values (£ billion, 2014 prices)

Appraisal results	Assessment of Need		Global Growth		Relative Decline of Europe		Low-cost is King		Global Fragmentation	
	CT	CC	CT	CC	CT	CC	CT	CC	CT	CC
Carbon-traded (CT)/capped (CC)	CT	CC	CT	CC	CT	CC	CT	CC	CT	CC
Monetised										
Transport economic efficiency	16.4		35.6		15.7		36.7		9.4	
Delays	0.6		0.6		1.5		1.0		1.5	
Noise		(7.5)								
Air quality		(0.4)								
Carbon emissions		(0.6)								
Biodiversity		(0.04) to (0.08)								
Scheme and surface access cost	(14.0)	(14.0)	(14.0)							(14.0)
Non-monetised										
Wider economic impacts										
Surface access										
Quality of life										
Community										
Place										
Local economy										
Water and flood risk										

- 2.92** 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.
- 2.93** Considering the scheme by comparing total costs to the overall benefits the analysis shows there is a strong case for a Heathrow Airport Extended Northern Runway under certain scenarios, with greater risks associated with others.
- 2.94** Taking the monetised benefits first, with scheme and surface access costs amounting to £14.0 billion in PV terms and with noise and other environmental dis-benefits totalling £8.5 billion,⁴³ under *low-cost is king* and *global growth* there is a clear positive net benefit associated with such a scheme, via the large transport economic efficiency benefits of up to £37 billion. The significant potential wider economic benefits would strengthen the case further. Conversely, however, it is important to note that these scenarios see carbon emissions significantly in excess of the CCC's planning assumption for aviation in 2050. Any action to address this would be likely to affect the scale of benefits achieved.
- 2.95** Passenger growth at the airport would drive significant increases in ATMs and destinations served at Heathrow. At the national level, the Heathrow Airport Extended Northern 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'. Further details of the connectivity impacts can be found in the strategic case.
- 2.96** Under the *assessment of need*, *relative decline of Europe* and *global fragmentation* scenarios the economic case is more marginal, largely due to lower passenger demand driving lower transport economic efficiency benefits. Transport economic efficiency impacts are lowest under the *global fragmentation* scenario, at £9.4 billion, meaning this scenario delivers the lowest benefits and the case for the Heathrow Airport Extended Northern Runway is weakest here. In these scenarios noise plays a significant role in the overall economic analysis. The case for this scheme may therefore be strongly affected by the extent to which these impacts can be mitigated.
- 2.97** Nonetheless, there are likely to be wider benefits which are not picked up in the welfare analysis. There will be benefits to passengers in terms of improved connectivity and access to new markets and destinations, reduced delays as

43 This dis-benefits figure is calculated for the *assessment of need* carbon-capped scenario. Looking at a wider range of scenarios would allow further analysis of the scale of dis-benefits to inform the assessment.

constraints are relieved across the system and possible further benefits from improved resilience. In addition the non-monetised positive impacts on the local economy and wider economy are likely to be significant, even under the *global fragmentation* scenario. Particularly under *global fragmentation* these impacts become important in determining the overall case for expansion.

- 2.98** The ratio of costs to benefits when looking specifically at public sector expenditure would depend on the level of contribution made. On the basis that the public sector might only contribute the costs of surface access, the benefits clearly outweigh those costs under any scenario, with the exception of *global fragmentation* where the case may be more marginal, but that is only one potential outcome. The overall cost to the public sector could be higher or lower.

GDP/GVA impacts

- 2.99** To understand the GDP impacts associated with the Heathrow third runway scheme PwC and the Airports Commission have developed an S-CGE model. This analysis is not a welfare analysis, but considers what the GDP impacts of the Heathrow Extended Northern Runway scheme could possibly produce. The S-CGE model developed for this phase of the Commission's work is a significant extension to the CGE model used to estimate the impacts in its *Interim Report*.⁴⁴ It should be noted that this is a relatively novel way to consider the impact of airport expansion, with only one recent example (Sydney) where it has been applied to airport infrastructure investment. The outputs should therefore be treated with some caution.
- 2.100** Given the scale of investment and possible economic impacts found in the Commission's previous work, airport expansion is expected to impact on the macro-economy. In light of this, the Commission have chosen to use a CGE model to gain better understanding of how these impacts transmit through the macro-economy to effect GDP via interactions between firms (domestic and international), households and Government (as opposed to direct impacts covered under a microeconomic assessment).

44 For its *Interim Report* the Airports Commission undertook work with PwC to estimate the cost associated with a capacity constrained airport system. PwC undertook some econometric analysis to evaluate the impact between seat capacity and GDP and found there to be bi-directional causality between the two variables. Using the elasticities from this econometric work a Total Factor Productivity change related to this elasticity was fed into the CGE model based on the reduced seat capacity in a constrained airport system. This year we have taken quite a different approach which produces spatial and sector level outputs and the impacts have been fed in to the model via five separate channel as listed above. The larger number of channels included leads to higher benefits, a richer analysis but with a higher level of uncertainty.

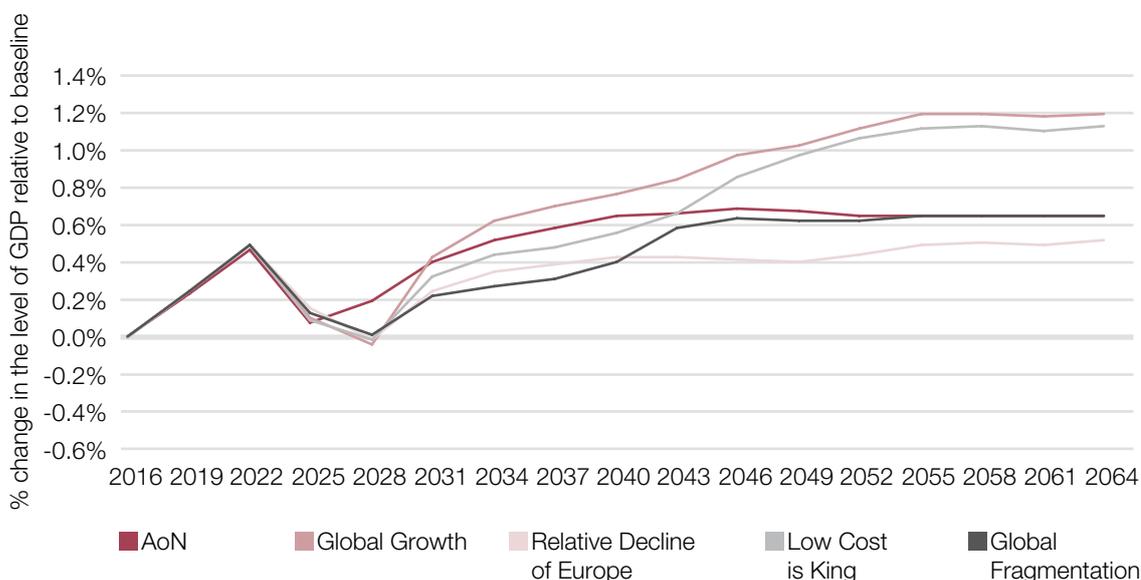
2.101 In order to estimate these impacts we have identified five channels where airport expansion could have such an impact:

- Changing **passenger flows** resulting in changes in the level of spend in the UK and overseas;
- **Productivity** impacts associated with changes in the level of trade (eg. companies becoming more efficient as a result of being better connected to international markets);
- **Frequency impacts** feeding through to Total Factor Productivity (TFP) across the economy and those sectors most closely linked to the aviation sector;
- Changes in the **Transport Economic Efficiency** (transfers of producer and consumer surplus) filtering through the economy via changes in household spending and airline revenue streams; and,
- The boost that infrastructure (airport and surface access) **construction** can boost the economy as economic resources are diverted to relatively more productive use.

2.102 The Commission’s analysis considers all five future scenarios in a carbon-traded world. The transmission mechanisms are numerous so our results provide only a summary of the main ones at play under the Heathrow Extended Northern Runway scheme across the five scenarios.

2.103 The profile of Heathrow northern runway extension GDP impact results across all scenarios is shown in **Figure 2.2** below.

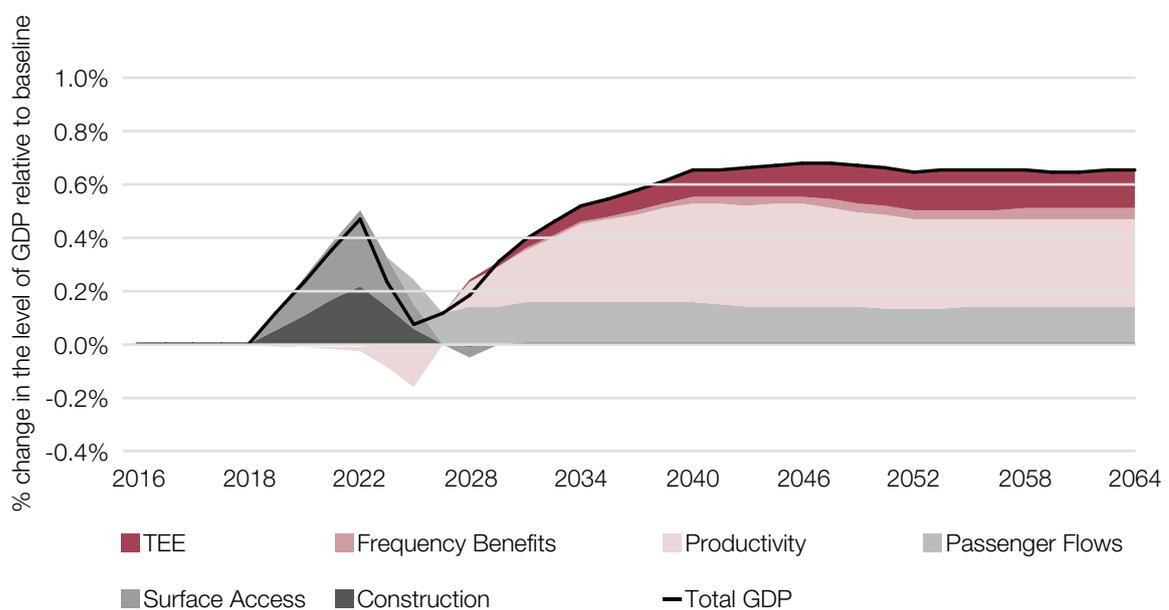
Figure 2.2: Overall GDP impacts for all scenarios



Source: Airports Commission analysis.

2.104 For the purpose of explanation we have focused on a description of how each channel feeds through to overall GDP under the *assessment of need* scenario. The reason for this is that the results show the *assessment of need* scenario provides a middle ground between two distinct groups of scenario results: at the upper end of the range *low-cost is king* and *global growth*; and at the lower end *relative decline of Europe* and *global fragmentation*. Figure 2.3 below provides a breakdown of results via the contribution made by each of the five channels highlighted above. Table 2.13 below covers a short explanation based on how the S-CGE model tracks these impacts through the economy to the modelled overall level of GDP generated.

Figure 2.3: GDP results in an *assessment of need* scenario on level of real GDP compared to the ‘do minimum’



Source: Airports Commission analysis.

Table 3.13: Assessment of need GDP impact description

	Impact
Phase 1 – construction phase	<ul style="list-style-type: none"> • Initially GDP impacts are driven by construction of both the airport and surface access infrastructure. This is driven by demand and supply side factors. <ul style="list-style-type: none"> – Demand side factors: where the economy orientates itself towards construction, having multiplier effects via procurement of materials and other inputs to the construction process; and – Supply side factors: More capital availability should stimulate workers’ productivity. It is also likely that wages in the sector will increase and unemployment decrease, putting a further upward pressure on GDP. • While the construction sector expands, other (relatively less productive) areas may contract. It is also worth noting that construction is largely funded by a reduction in consumption, and that during and just after this phase growth in GDP is negatively offset to a degree by small reductions in consumption from household’s restricting their consumption in anticipation of higher future returns. • Upon scheme opening in 2026, GDP impacts rise rapidly until the late 2030s. This is mainly driven by productivity impacts associated with increased trade (as businesses are better connected to and able to access international markets, and able to benefit from knowledge spillover). This is a supply-side boost to productivity and output potential. • Passenger flows also account for a sizeable proportion of the GDP impacts. This is driven by changes in the number of inbound and outbound passenger expenditure. Outbound tourists have a higher multiplier effect, due to supply chain impacts on products which are no longer consumed in the UK, than inbound tourists with a smaller multiplier, due to the relative productivity of the related spending in sectors such as accommodation and restaurants.

	Impact
Phase 2 – operating phase opening	<ul style="list-style-type: none"> • In the late 2030s both the transport economic efficiency⁴⁴ and frequency benefits start to become more significant: <ul style="list-style-type: none"> – The transport economic efficiency demand side benefits start to appear as airlines are unable to charge the level of scarcity rents as compared to the ‘do minimum’, with consumers being charged lower airfares than otherwise would have been the case. This makes businesses more efficient and provides non-business passengers with more available disposable income, which is spent elsewhere, having multiplier effects on the economy. The reduction in airline profits has a slight countering effect on this depressing GDP, which later reduce due to the expanded size of the sector via increased passenger numbers from high capacity; and – Frequency benefits also start to boost productivity as business passengers experience lower effective journey times as a result of new routes, more frequent flights and higher resilience of flight and airport operations.

2.105 The pattern of results and how they feed through the economy is broadly similar in the other scenarios but to a different scale and timing. 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 2.14 below. Construction economic impacts are not normally included since we would assume 100% displacement.⁴⁶ Though this unlikely to be so clear cut it is difficult to estimate an appropriate level, especially given factors such as the potential use of foreign labour or equipment and potential for outflows on the cost side.

Table 2.14: GDP impacts all scenarios, present value (£ billion, 2014 prices)

PV	Total impacts (exc. construction)
Assessment of need	131
Global growth	214
Relative decline of Europe	101
Low-cost is king	194
Global fragmentation	115

Source: Airports Commission analysis.

2.106 We have also undertaken a sector analysis to better understand how these impacts filter through the economy. Unsurprisingly the air passenger transport and freight

45 The final impact of the transport economic efficiency numbers does not include the impact of higher airport charges.

46 The impacts of construction can be found in the ‘Economy: Wider impacts assessment’ PwC paper.

sector is £2.1 billion (12%) larger when compared to the 'do minimum' in 2050. Likewise sectors with international linkages also benefit, with sectors such as manufacturing around 2% larger in 2050 compared to the do minimum. This is driven by the lower cost of transport making these sectors more competitive and therefore more productive.

- 2.107** The air freight industry will help facilitate some of the GDP growth, increasing the ability of UK businesses to supply more customers in more overseas markets, and in quicker time. Analysis of a Heathrow Extended Northern Runway suggests that the freight sector's contribution to GDP could be 3.7% higher than the 'do minimum' in 2050. Activity around Heathrow could increase as large and small freight operators increase their operations there, although other freight locations should also benefit, as an expanded Heathrow benefits the whole freight distribution network.
- 2.108** Further work is required to test and validate the approaches taken in some areas. For example, the analysis presented here provides the results for a carbon-traded world and the Commission may wish to consider further what the economic impacts are in a carbon-capped world, where demand may need to be to some degree lower. We would also be keen to review how the inputs (such as consumer and producer surplus) are channelled into the economy and investigate other possible mechanisms which may impact upon the results.
- 2.109** The overall scale of benefits therefore is uncertain at this stage. Nonetheless, the analysis does provide a clear indication that there may be substantial positive GDP/GVA effects from investment in aviation capacity and connectivity. The Commission has published as part of its consultation materials a detailed report by PwC setting out the approach taken and the results obtained, and the Commission would welcome responses on how this analysis may be developed further.
- 2.110** The analysis suggests that under all scenarios the GDP/GVA impact may be very substantial. The analysis also shows there are rapid increase GDP impacts upon scheme opening over the first decade. This is driven by the transport economic efficiency and passenger flow numbers. Growth remains on a steadier trajectory with additional gains from transport economic efficiency and frequency benefits thereafter.
- 2.111** The difference in the size of these impacts from the transport economic efficiency benefits are driven by the differences between a partial equilibrium analysis, as used in the welfare analysis, and a general equilibrium approach. The general equilibrium approach estimates the secondary economic impacts, dynamic interaction between

sectors, regional impacts and assumptions around imperfect competition, which differ from those calculated for a welfare appraisal.

Conclusions

- 2.112** Both the welfare impact and GDP/GVA results show that the Heathrow Airport Extended Northern Runway scheme has the potential to deliver net positive benefit across some scenarios but neutral and negative on others. The direct benefits listed under the welfare approach are potentially a net positive under *global growth* and *low-cost is king* scenarios, marginally net negative under *assessment of need* and *relative decline of Europe* scenarios and net negative under *global fragmentation*.
- 2.113** The major driver of this results is the schemes noise dis-benefit value. There are a range of noise values based on different monetisation approaches and the case above is the mid-range of these, so estimates on either side could also affect the overall assessment. When considering the likely net non-monetised impacts a further positive impact across all scenarios is estimated, driven largely by wider economic benefits and local economy benefits.
- 2.114** The GDP/GVA impacts tell a more positive story with impacts ranging from £101 billion in *relative decline of Europe* and £214 billion in *global growth* scenario. These impacts build up very quickly following the opening of the extended runway and are sustained consistently thereafter. This approach excludes environmental and other social impacts but accounts for how the benefits of airport expansion can transmit through to the wider economy. The approach is far more novel so results should be treated with some caution.

3. Financial and Commercial case

Introduction

- 3.1** In the Airports Commission *Appraisal Framework* the purpose of the financial case is to assess the overall cost and sources of funding for the scheme; and the purpose of the commercial case to assess the risks around commercial deliverability, including discussing options for public sector contribution. In conducting its assessment against this framework the Commission has also, where appropriate, applied the principles of HM Treasury Green Book.
- 3.2** The Green Book advises that the financial and commercial cases should demonstrate that the ‘preferred option’ results in a viable procurement and a well-structured fundable and affordable deal. However, HM Treasury Green Book is intended to develop an already identified preferred option and ensure the best value for money for the public spending required to deliver that option. The Airports Commission has not yet identified a preferred scheme, nor how that scheme should be delivered. Moreover, the Commission is assessing the business case for schemes which will ultimately largely involve delivery by the private owners of the relevant airports using privately raised financing.
- 3.3** The Commission has, as suggested by the Green Book, made an assessment of the overall cost requirements and of the financial and commercial risks associated with the Heathrow Airport Extended Northern Runway scheme. It has identified a number of significant financial implications for the scheme for ongoing consideration and assessment. This document discusses these implications, within the context of the objectives outlined below in Section 2. Given that they are closely linked and at an early stage of development, it considers the financial and commercial assessments together.
- 3.4** Although the Heathrow Airport Extended Northern Runway scheme has been developed and promoted by an independent commercial entity, Heathrow Hub Ltd, this assessment assumes that it would, if taken forward, be delivered by the current airport operator. This is in line with the scheme promoter’s expectations.
- 3.5** It is important to make clear that the assessment outlined here is an ongoing process and will be refined as the Commission’s work progresses and in light of the responses to the consultation.

Objectives

- 3.6** The Commission's objectives, set out within its *Appraisal Framework*, are to assess that the schemes are affordable and financeable, and to identify the conditions that would need to be in place credibly to provide a reasonable return on investment for infrastructure investors, including any public expenditure that may be required, taking into account the needs of airport users.
- 3.7** The objectives of this financial and commercial case are therefore to:
1. Assess the overall credibility of funding and financing the schemes and thus the affordability implications of the schemes to the consumer and the taxpayer.
 2. Identify the key risks for funding and financing and therefore delivering the schemes
 3. Identify options for mitigating these risks and the role for different parties in managing/supporting this.

Approach

- 3.8** To achieve these objectives, 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 charging and financing arrangements. These are summarised in Section 4 below, and more detail is provided in the cost and commercial viability reports.⁴⁷
- 3.9** Alongside this, the Commission has developed a risk framework that identifies the key risks associated with these factors. This framework is summarised in the table below, and a fuller description of the risks incorporated is found in the Literature Review. The Commission has then used this framework to assess the impact of these risks on the overall affordability and commercial deliverability for each scheme.

⁴⁷ The six cost and commercial viability reports are as follows:
 Cost and Commercial Viability: Literature Review (Literature Review);
 Cost and Commercial Viability: Financial Modelling Cost Inputs (Cost Input Report);
 Cost and Commercial Viability: Funding and Financing (Funding and Financing Report); and
 Cost and Commercial Viability: Cost and Revenue Identification Report. Note: There are three versions of this report, one for each Scheme Fromoter.

Table 3.1: 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 properly integrate 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 of the investment 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.
5. Investment	The Regulated Asset Base (RAB) model, currently used at Heathrow Airport and described in full in Section 4, 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 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 based model.
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 module 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 of the project.

Assessment of Heathrow Airport Extended Northern Runway scheme

Passenger demand forecasts and overall cost requirements

3.10 Table 3.2 below illustrates the passenger demand forecasts used by the Airports Commission and Heathrow Hub Limited (HHL). 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.

Table 3.2: Passenger Demand forecasts used by the Airports Commission and HHL

Scenario	Passengers per annum (m) Carbon-traded				Passengers per annum (m) Carbon-capped		
	2011	2030	2040	2050	2030	2040	2050
Assessment of need	70	116	127	131	110	124	129
Global growth		123	131	142	110	126	131
Relative decline of Europe		116	123	131	111	120	127
Low-cost is king		119	130	141	116	125	131
Global fragmentation		104	119	126	111	124	127
<i>Heathrow Hub Ltd forecast</i>		106	122	130			

Source: Airports Commission Analysis and HHL submission.

3.11 For the purposes of the financial and commercial assessment, a subset of these demand forecasts were taken to assess the costs associated with the scheme under different demand scenarios, and the implications of this demand scenario on the projected aero charges that would need to be paid to the airport. The four demand scenarios used for the Heathrow Airport Extended Northern Runway scheme reflect a range of passenger traffic that encompasses the lowest and highest demand forecasts and are as follows:

- *Assessment of need* – carbon-capped (AoN-CC)
- *Assessment of need* – carbon-traded (AoN-CT)
- *Global growth* – carbon-traded (GG-CT)
- *Global fragmentation* – carbon-capped (GF-CC)

3.12 HHL estimate an earlier rate of increase in passenger numbers from 2023. This reflects its suggestion that the runway extension will open that year and so earlier than the year (2026) forecast by the Commission.

3.13 The overall cost requirements for the Heathrow Airport Extended Northern 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 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.

3.14 There is a level of uncertainty to these projected costs because of the risks described in the risk framework (see Table 3.1). The Commission has reflected this uncertainty by adding a risk premium to its cost estimates. The Commission has also, in line with Green Book advice, added a further risk allowance – Optimism Bias – to reflect that a procuring entity'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. Two levels of Optimism Bias (OB) have been considered: full OB; and a mitigated OB where key factors contributing to the uncertainty are considered to have been managed to some extent. A summary of the risk premia and OB assumptions applied to the different cost categories is provided in the Cost and Revenue Identification Heathrow Airport Extended Northern Runway Report. HHL have assumed a range of risk premia varying between of 15 and 50% depending on the cost item. They have not made an allowance for optimism bias.

3.15 The total project costs vary depending on the demand scenario, sensitivities run and the risk premium and OB applied. Table 3.3 below summarises the range of projected cost requirements for Heathrow Airports Extended Northern Runway based on the four passenger demand scenarios used in this analysis.

Table 3.3: Heathrow Airport Extended Northern Runway – Airport Commission’s Cost Estimates (all costs in £ million (2014 prices) and with Risk and Mitigated Optimism Bias adjustments applied)

	AoN-CC	AoN-CT	GG-CT	GF-CC
Scheme Capex	13,539	13,539	13,539	13,539
Surface Access Costs ⁴⁷	6,282	6,282	6,282	6,282

	AoN-CC	AoN-CT	GG-CT	GF-CC
Core Capex	13,069	13,069	13,069	13,069
Asset Replacement	16,535	16,926	17,546	16,530
Opex	49,631	50,414	51,629	50,006

Source: Airports Commission analysis.

3.16 The Commission has assumed that, on the basis that the scheme would be implemented by the current asset owner, Heathrow Airport Ltd, if selected, that all capital core expenditure and asset replacement costs are identical to those assumed for the Heathrow Airport’s North West Runway scheme. The Commission has also opted to remove the cost of a multi-modal and passenger terminal ‘Heathrow Hub’ from their estimation of HHL’s proposals. This is because the Commission consider the Hub Site an additional feature to HHL’s proposals which could be applied to either Heathrow scheme. Full detail of how these costs were derived is provided in the Cost and Revenue Identification Heathrow Airport Extended Northern Runway Report.

48 Surface Access Costs include Capex, Asset Replacement and Opex costs.

3.17 The table below summarises HHL's projected cost estimates, inclusive of risk.

Table 3.4: HHL Cost Estimates

	HHL estimate (inclusive of risk) £m, real
Scheme Capex	10,121
Surface Access Costs	566 ⁴⁸
Core Capex	11,801 ⁴⁹
Asset Replacement Costs	9,440 ⁵⁰
Opex	44,525

Source: Heathrow Hub Ltd.

3.18 Differences between the Commission's estimates and HHL's largely reflect differing views on optimism bias.

3.19 The Commission has considered a range of surface access works that would be required if the runway scheme is implemented. Where HHL's proposal assumes that the 'Hub' is built, the Commission has based its estimates for surface access works on a revised plan without the Hub. This, and the fact that the Commission consider that HHL have underestimated the range of other surface access arrangements that would likely be required and the extent to which the airport may need to contribute to their cost, has led to the significant differences in surface access cost presented in the table above. The allocation of surface access costs would be a matter for negotiation between the scheme promotor and the government of the day. The analysis presented in this document does not include surface access costs, however the Commission has also run a sensitivity in which the full surface access costs fall to HAL, in order to understand the full range of potential impacts of these costs. The outputs of these sensitivities can be found in the Funding and Financing Report.

3.20 Figure 3.1 describes the profile of the estimated Scheme Capex requirements in real terms, based on the Commission's AoN-CC demand forecast. This scenario

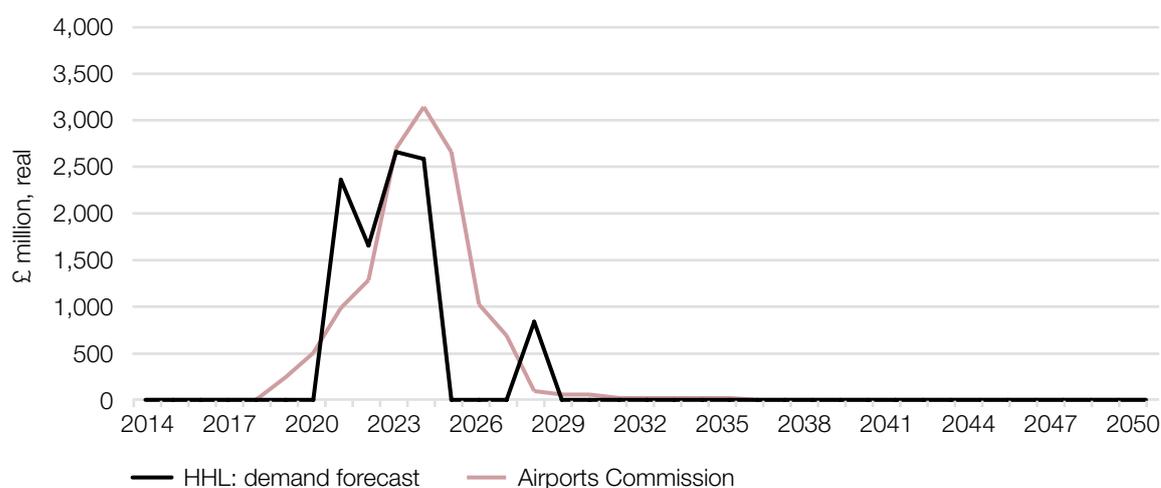
49 HHL's surface transport cost estimates were produced in the context of the development of the transport hub, which the Commission has not included in this analysis. As such HHL's estimate of £556m will not include significant elements of the surface access costs which the Commission considers necessary to enable delivery of the scheme without the transportation hub.

50 Note that HAL has included £43m of T5 landside road works which, in the Commission's analysis, have been included separately as surface transport costs.

51 Note that this figure, provided by HAL, excludes the five-year regulatory period between 2014 and 2018.

is towards the lower end of the Commission's demand forecasts. The Airport Commission forecasts that the majority of costs would 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. HHL's forecast assumes a shorter period for development, with land acquisition and site preparation works taking place in 2021, construction of a new terminal and runway in 2022 and the majority of the work taking place in 2023 and 2024. HHL's forecast also assumes a second satellite building is to be constructed in 2028.

Figure 3.1: Scheme Capex requirement under the AoN-CC demand scenario



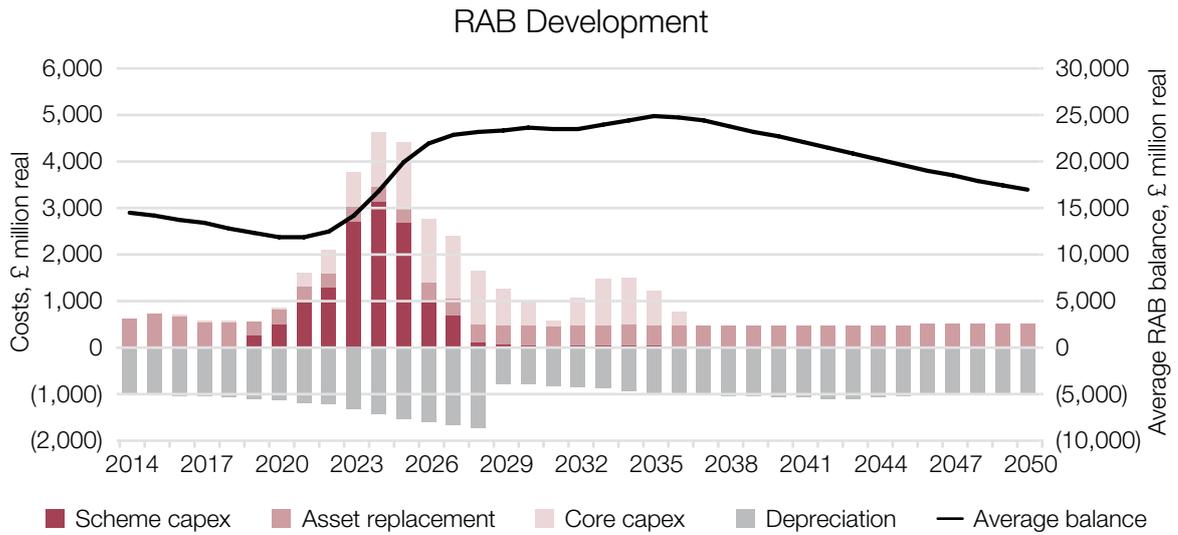
Financing arrangements

- 3.21** The Heathrow Airport Extended Northern Runway scheme assumes that the scheme will be sold to and subsequently financed by Heathrow Airport Limited (HAL). Heathrow Airport Limited 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 multiple bonds consisting 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 and Funding and Financing Report.
- 3.22** As an airport assumed as having substantial market power, Heathrow airport is subject to price controls by the Civil Aviation Authority. These are calculated on the basis of the airport's Regulatory Asset Base (or RAB – its core capex and core asset replacement costs). The return on this asset base (its 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.

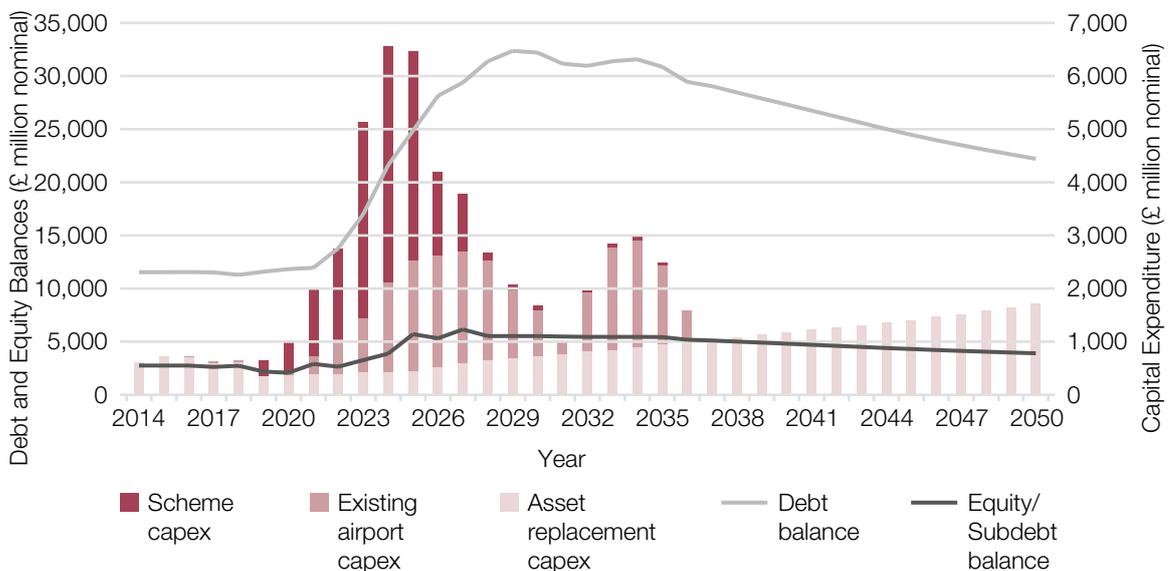
- 3.23** Heathrow Airport's current aero charge is c. £20 per passenger. Its total revenues are £2.5 billion (£1.5 billion from aero charges and £1 billion from non-aero revenues such as shops, restaurants and parking). Its total RAB is, as of 31 December 2013, c. £14.6 billion.
- 3.24** To determine the impact of the scheme on passenger aero charges, a number of approaches could be adopted. The Commission has assumed an extension of the existing RAB-based approach. This is consistent with HHL's proposal. It is assumed that assets are added to the asset base in the year in which the expenditure is incurred and that revenue will increase accordingly thereafter rather than at the next review period. This assumption sits between a scenario where the RAB only increases at each regulatory review period following expenditure and a scenario where the regulator allows a degree of pre-funding of a RAB before the necessary expenditure has actually taken place. The possibility of the latter is discussed in more detail below.
- 3.25** Figure 3.2 demonstrates the impact of the costs for the Heathrow Airport Extended Northern Runway scheme on the average RAB balance for the airport based on the Commission's AoN-CC scenario. The RAB balance increases significantly from 2021-2030 to a peak of £23.6 billion in 2030, owing to the high capital expenditure on major terminal and runway works; and then peaks again at £24.8 billion in 2035 following the final phases of development, which include car park and satellite works. The RAB balance then starts to decrease as a result of depreciation of capital assets and lower annual capital expenditure. The RAB balance is used not only to derive aero charges but also to determine one of the target ratios that the credit rating agencies expect to be met (the net debt to RAB ratio) and thus the airport's credit rating and its ability to access finance from the bond markets (see the Funding and Financing Report for further details).

Figure 3.2: Average RAB balance based on the AoN-CC demand scenario



3.26 Taking the profile for Scheme Capex, and coupling it with the airport’s Core Capex, Asset Replacement, Opex and Non-aero Revenues, the Commission has assessed one financing structure that it believes could plausibly meet the requirements to deliver the scheme. The approach adopted looks to finance the scheme capex through the issuance of bond financed debt where allowed to maintain HAL’s current A- credit rating.⁵² Where this is not possible, equity is injected. The build-up of debt and equity is illustrated for the AoN-CC demand scenario in Figure 3.3 and summarised for the four demand scenarios used in this analysis in the table below. This does not include surface access cost contributions that HAL may be required to make.

Figure 3.3: Heathrow Airport Extended Northern Runway Debt and Equity Balances vs. Capex for AoN-CC demand scenario



52 The details of the approach used to access this are found in Cost and Commercial Viability: Funding and Financing Report.

Table 3.5: Additional nominal debt and equity requirements for the delivery of the scheme under the demand forecast scenarios used in the analysis⁵³

Scenario	AoN-CC	AoN-CT	GG-CT	GF-CC
Additional debt requirement	£20.5bn	£23.4bn	£24.9bn	£21.3bn
Additional equity requirement	£3.5bn	£3.7bn	£5.1bn	£4.6bn

Source: Airports Commission analysis.

3.27 Across the four demand scenarios funding the scheme would require additional debt financing in the range £20.5-24.9 billion; and additional equity in the range £3.5-5.1 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 RAB value is smaller and therefore the net debt to RAB requirement has a greater restriction on the quantum of debt that can be drawn. In later stages, the increasing RAB value allows for the capital expenditure to be funded by a greater proportion of debt.

3.28 The costs of this additional financing as well as the ongoing costs of the airport 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 to passenger aeronautical charges across the Commission's four demand scenarios for Heathrow is an increase from c. £20 per passenger to an average of c. £27-29 per passenger, as summarised in the table below.

Table 3.6: Estimated passenger aero charges across the Commission's four demand scenarios

Scenario	AoN-CC	AoN-CT	Global Growth	Global Fragmentation
Charge peak	£29.43	£28.04	£28.05	£30.38
Weighted average (2019-2050) ⁵⁴	£27.95	£27.49	£27.32	£28.55
Weighted average (2014-2050) ⁵⁵	£27.17	£26.76	£26.64	£27.70

Source: Airports Commission analysis.

⁵³ Full details of how these have been calculated are found in Cost and Commercial Viability: Funding and Financing Report.

⁵⁴ Average aero charge weighted by forecast passenger volumes.

⁵⁵ Average aero charge weighted by forecast passenger volumes.

3.29 These projected aeronautical charges are higher than those estimated by Heathrow Hub Ltd, who predict charges could be kept to a peak charge per passenger of £22. These lower aero charges are likely to be driven largely by lower cost estimates predicted by HHL, but also by as different passenger demand profiles.

Application of risk framework

3.30 The table below applies the risk framework described in Section 3 to the overall cost and financing requirements for Heathrow Airport's Extended Northern Runway.

Risk	Description
Demand and revenue	Heathrow 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. £27-28 and a potential peak of £30 per passenger are significantly higher than current charges across the UK and there is likely to be a level of uncertainty associated with this very significant increase in aero charges in a context where Heathrow will be competing with other airport operators.
Cost and integration	For a project of such scale and complexity, with a potential forecast scheme capex of c. £13.5 billion, the impacts of the price of construction and operation being higher than forecast and of the different elements not integrating properly will have significant knock-on implications on the cost exposure of the airport and on the financing and contracting risks. HHL's cost projections are lower than the Commission's estimates, and if deliverable would reduce this level of exposure.

Risk	Description
Contracting	<p>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 will likely 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 likely be based on a form of risk share arrangement or target price arrangement rather than the traditional fixed price arrangement used for infrastructure projects. 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 Heathrow Airport Limited has experience in managing and delivery complex infrastructure projects, such as Terminal 2 and Terminal 5.</p>
Financing	<p>The RAB based approach under which Heathrow currently operates, and which HHL propose continues to be used should this scheme be implemented, 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. However, the scheme is likely to require an additional c. £3.5 billion in equity and c. £20.5 billion of debt (based on the AoN-CC scenario) and potentially up to c. £5.1 billion additional equity and c. £24.9 billion additional debt. This will put the Extended Northern Runway at the highest 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's Extended Northern Runway scheme peaks at around £7 billion, or around 15% 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 quantum of financing.</p>

Risk	Description
Investment	The major element of investment risk for Heathrow Airport's Extended Northern Runway is the extent to which an investment of this scale will be treated when determining the costs of capital, and therefore the returns on investment, under a RAB based model. The scale of investment means that to access sufficient liquidity HAL would likely need to issue bonds in a number of different currencies (its bond programme currently includes GBP, USA, EUR and CHF bonds) and the financing will have to command sufficient returns under any future regulatory framework to attract the required wide range of investors.
Regulatory and policy	Risks associated with changes to the wider regulatory and policy environment and their consequent impact on pricing will need to be assessed and managed by Heathrow Airport Limited.
Timing and delivery	The assessment made in this document assumes purchase, financing and delivery of the scheme by HAL. There may be risks associated with a transfer of ownership of the scheme from HHL to HAL. For an investment of this size then a key element may also be whether timing can be used to mitigate risk: HHL's proposals already allow for phased development, and completing the revenue generating elements such as the new runway as quickly as possible will ensure the RAB is built up, helping to control costs.

Assessment of implications for affordability and commercial deliverability

- 3.31** The risk framework identifies a number of risks associated with the Heathrow Airport Extended Northern Runway scheme around, cost and integration, contracting and financing and demand and revenue. Raising levels of additional financing of up to c. £5.1 billion equity and c. £24.9 billion debt would be challenging; and passenger aero charges of £27-28 on average and a potential peak of c. £30 are significantly higher than current charges across the UK and globally, based on our analysis.
- 3.32** The Airports Commission is considering options that may mitigate this level of challenge, identifying measures that could be implemented to support delivery of the scheme.
- 3.33** It may be appropriate to consider different funding structures for delivering the scheme. Measures could include: as mentioned above completing the revenue-generating elements of the scheme as early as possible, so ensuring the RAB is built up quickly, costs are controlled and aero charges are brought down; 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.

- 3.34** The role of the regulator is also key to creating an environment that promotes efficient investment and unlocks the airport's ability to raise finance whilst protecting the interests of consumers. Ultimately, the design of the future regulatory framework and the level of assurance it provides to potential investors will impact the price they place on the investment risk. The principle that risk should be allocated to those parties who can best manage it is one of a set of draft principles currently being considered by the Civil Aviation Authority in their consultation on the economic regulation of new runway capacity.⁵⁶ The CAA also include consideration of the principle that, subject to this being in the user's interests, capacity could be paid for both before and after the new runway opens – through a level of pre-funding, which could serve to reduce overall costs and smooth the impact of passenger aero charges. The regulatory approach has been flexed in the past to support the significant level of infrastructure associated with Heathrow's Terminal 5.
- 3.35** It is likely that Government will need to fund 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 above. There may be other options for public sector involvement that the Government of the day wishes to explore, for example a role in the delivery partnership, or in managing financing risks.
- 3.36** The Commission has not taken a view on any of these mitigating options; but is interested in consultation responses on their credibility, and on how they might be implemented.

Conclusions

- 3.37** As stated in the introduction, this is not the final assessment of the affordability or commercial deliverability of the schemes. It is an ongoing process that will need to be refined as work progresses. The case put here contains assumptions and gives ranges that reflect a number of different factors influencing overall cost, demand and affordability which the Commission will continue to consider. HHL has put forward its own estimates for projected costs and more detail of these is in the Cost Input Report.
- 3.38** The Commission is seeking views on the evidence and the risk framework presented here and in the supporting technical documents; and the credibility of the options for mitigating the identified risks.

56 The Civil Aviation Authority's consultation can be found at: <https://www.caa.co.uk/docs/2888/CAP1221.pdf>

4. Management Case

Introduction

4.1 The Airports Commission's *Appraisal Framework* describes the Management Case thus:

Management Case – assessing the overall achievability of the proposal, including its engineering and operational viability, and the risks associated with this.

4.2 HM Treasury's guidance on using the “Green Book” five business case model indicates that the Management Case may address issues such as programme and project management methodology, contract management arrangements, contingency plans and plans for benefits realisation and risk management.

4.3 As the Airports Commission's process does not exactly align with that envisaged by the Green Book, in that it is intended to select a preferred option from a number of schemes rather than developing an already identified preferred option, the Management Case presented here does not precisely follow the Green Book format. However, it does replicate much of the function implied by the Green Book, in that it makes an assessment of the potential benefits realisation, risk management, contingency plans and structures that would enable robust management of delivery following the Commission's Final Report.

4.4 The key building blocks of the Management Case are:

- **Module 14: Operational Efficiency**
- **Module 15: Operational Risk**
- **Module 16: Delivery**

4.5 The Management Case also draws upon findings of reports undertaken in respect of **Module 4: Surface Transport**, though the outputs of that module are chiefly reflected in the Strategic, Economic and Financial Cases. Findings arising from other modules may also be relevant to the Management Case, but are chiefly captured through their impacts upon **Module 16: Delivery**.

4.6 The Management Case addresses the extent to which the scheme satisfies the objectives set out in **Modules 14, 15 and 16**. It can also, however, be seen as addressing three key questions in relation to the scheme:

4.7 The Commission has already begun the process of exploring these issues in a non-scheme-specific sense through **Discussion Paper 7: Delivery of New Runway Capacity**. The Management case has been structured around these three questions specifically in relation to the individual schemes.

Delivery of capacity

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?

4.8 Since the publication of the *Interim Report*, the Commission has further refined its understanding of various aspects of the Heathrow Northern Runway Extension proposal, informed by the Updated Scheme Designs submitted by the scheme promoter, as well as the appraisal reports prepared by the Commission's Secretariat and consultants. To determine whether the scheme's components still present a credible means of satisfying the Commission's *assessment of need*, the management case must assess:

- 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 upon 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

4.9 Heathrow Hub Ltd (HH) indicated in its Updated Scheme Design that it estimated that the Heathrow Northern Runway Extension scheme would allow the airport to accommodate 700,000 ATMs, an increase of 220,000 on the airport's current capacity in two-runway segregated-mode operations. Analysis carried out by the

Commission's consultants has confirmed that this is a realistic estimate of the capacity provided and consistent with maintaining or improving current levels of resilience at Heathrow.

- 4.10** The Commission's consultants have advised of a number of potential congestion "pinch points" that might emerge as the utilisation of the expanded airfield nears full capacity, which are, in the case of this scheme, exacerbated by a design which continues to hold Heathrow's operations within a small site, relative to international comparators. This is reflected to a degree by the lower assumed capacity for this scheme, compared to the Heathrow North West Runway proposal. The "pinch points" are not affected to undermine the airfield's ability to support 700,000 air traffic movements per year.
- 4.11** The Commission's analysis has indicated that the masterplan presented in the Updated Scheme Design is compatible with a full range of future fleet mix scenarios.
- 4.12** The proposal includes a phased introduction of terminal capacity, with new terminal facilities and the redevelopment of existing terminals being introduced as required by growth in demand. On the basis of the available evidence, 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 upon the present passenger experience.
- 4.13** The Heathrow Northern Runway Extension proposal is based upon a new and innovative concept which does not have direct precedent in the world of civil aviation (although partial comparators can be found for end-to-end runway configurations, for instance at Madrid). The Commission recognises that obtaining certification for a new concept of this nature may involve complicated and time-consuming processes. However, based on the information available at this time, the Commission believes that there is no reason why the proposed runway configuration could not be demonstrated to be safe and no reason to believe that the process of obtaining safety approvals would significantly delay the opening of new runway infrastructure.
- 4.14** The Commission has taken advice from the CAA regarding the safety of the other proposed airfield 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.

- 4.15** The scheme requires constructing the new runway over the M25 motorway. On the basis of the evidence available to date, 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.
- 4.16** The Commission's assessment is that considering the likely planning, legal and construction stages, the new runway might plausibly be delivered by 2026. As with any project of this scale, estimated delivery dates must be treated with a degree of caution at this stage in the process. 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 need to gain safety approvals for a novel runway concept. 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 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

- 4.17** The Commission has received advice from NATS regarding the airspace structures that would be required to support the Heathrow Northern Runway Extension proposal.
- 4.18** 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.
- 4.19** The scheme is not expected to have a negative impact upon the capacity of any other major commercial airport in the London airport system. Fast-time simulation will be used to verify this position. The Commission explored whether the Heathrow Northern Runway Extension proposal would be likely to have an impact upon the operation of RAF Northolt, but, on the basis of the latest available advice, believes that there would be no significant increase in the interactions between traffic using the two airfields.
- 4.20** The Commission has noted that recent trials of revised flight paths in the London system 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 establishment of an Independent Aviation Noise Authority may support this process.

Surface Transport

- 4.21** As part of its submission in the first phase of the Commission's work, the scheme promoter put forward a proposal for a new hub station on the Great Western Main Line. In its *Interim Report*, the Commission set out its intention to consider this proposition as a separate component which could be associated with either of the Heathrow schemes.
- 4.22** The scheme promoter's Updated Scheme Design provided more detail on the proposed "hub station" concept. The considerations relating to this station are explored in Surface Access: Heathrow Airport Hub Station Option. The core appraisal for the Heathrow Northern Runway Extension scheme has been carried out on the basis of an "on-site" surface access strategy, rather than the "hub station" concept.
- 4.23** The "on site" strategy sets out a range of surface transport improvements that would support the Heathrow Northern Runway Extension 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 will be enhanced by a rail link from the HS2 interchange at Old Oak Common.
- 4.24** The Commission's *Interim Report* recommended that Government launch a study into such a Southern Rail Access link to Heathrow. This study is ongoing and the Commission has not, therefore, had a detailed Southern Rail Access design available for consideration. The Commission has used information on the previously proposed Airtrack scheme for appraisal purposes, but notes that this may not reflect any finalised design. The Commission notes that with no design on the table, and considering the opposition to the previous Airtrack scheme, the delivery of this scheme must be considered to be subject to its own risks and uncertainties.
- 4.25** 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, particularly on the Piccadilly Line, which is expected to be reaching the limits of its capacity by 2030. 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 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.

- 4.26** The Commission's work has identified the potential for further issues regarding Great Western Main Line capacity in the period beyond 2040. The Commission expects that, even with likely incremental enhancements, sections of the line will have more demand than they can accommodate from that point onwards, 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 have been required. The Commission has not yet identified examples of the nature that such investments might take and intends to carry out more work on this over the coming months. However, based on discussions with expert transport bodies, the Commission's view at this time is that plausible solutions likely exist and, while expensive, are likely to be required regardless of decisions on airport expansion. 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.
- 4.27** 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.
- 4.28** The Commission's analysis has indicated that the road schemes identified by the promoter are likely to be sufficient to accommodate both background and airport demand. The Commission cannot, however, rule out the possibility that additional M4 widening may be needed under some scenarios, which would in itself be a major engineering project. It is possible that demand management measures could be employed by the airport operator to mitigate any increase in road vehicle demand and offset the need for motorway widening.

Other Challenges

4.29 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.

Key risks

Question 2: 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?

4.30 The Commission's **Module 16: Delivery** has enabled the identification of the key risks associated with the schemes under consideration. Some of these risks are common to all proposals, as they reflect general risks associated with airport expansion schemes. Some risks, however, are specific to the Heathrow proposals or to the specific Heathrow Northern Runway Extension proposal. The Commission has identified a number of such risks, of which the highlights are:

- **Local airspace design likely to be complicated:** Recent trials of airspace change in the London system have 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 proposals, the successful delivery of new capacity at Heathrow will depend upon the design and delivery of low-level airspace structures. The size of the noise affected population at Heathrow means that design issues are likely to be particularly contentious. The scheme promoter has put forward a number of proposals for mitigating the noise impacts of the scheme, which make use of advanced navigational technology to provide further respite for communities affected by noise.
- **Approvals required for novel runway concept:** There is no direct precedent for the "in-line" runway proposal that forms part of this scheme, although partial precedents can be found in diagonally-offset end-to-end runways, for instance at Madrid. On the basis of the available evidence, the Commission's view is that it should be possible to operate the proposed runway infrastructure in a safe manner. Confirming this finding, however, is likely to require significant work with both UK and international safety regulators. The processes involved are

protracted and would need to begin early in the implementation stage of the scheme.

- **Tensions regarding utilisation of rail links:** Tensions relating to the use of rail infrastructure to serve airport users, as opposed to commuters and other users of the network, are likely to emerge. These are likely to be seen as early as 2023, when the track access rights for the Heathrow Express service are due for renegotiation.
- **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. Further demand management measures such as road vehicle access charging might help mitigate this risk by promoting additional mode shift.
- **Local stakeholder support:** The Commission has noted opposition to airport expansion from local Government bodies and some community organisations in the vicinity of the Heathrow site although regional business groups are largely supportive.

4.31 All of the above risks, as well as the wider group of risks discussed in **Module 16: 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 is that most of the risks do not appear, in isolation, 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.

Transition

Question 3: 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?

4.32 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

Airport Infrastructure

- 4.33** The Updated Scheme Design submitted by Heathrow Hub Limited is based upon a novel and untested runway extension concept which would require substantial work ahead of certification. Aside from the runway extension, other elements of the scheme are based upon well known and understood international airport design standards and principles. Perhaps the most complicated construction 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.
- 4.34** The Commission expects that following a recommendation in the Final Report, the scheme promoter and/or airport operator 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.
- 4.35** The Commission notes the well-understood nature of the construction elements 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.

Airspace Design

- 4.36** UK airspace systems are already undergoing a period of substantial redesign as part of the Future Airspace Strategy and London Airspace Management Programme. Based on submissions from NATS, the Commission's view at this time is that the airspace design work for the Heathrow Northern Runway Extension proposal could be integrated into these programmes to ensure timely delivery.
- 4.37** The Commission notes the difficulties associated with recent trials of airspace design changes in the London system 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.

Surface Transport

- 4.38** 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 Northern Runway Extension proposal 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 likely need to be procured via a later Control Period settlement, most likely Control Period 6 (2019-2024).
- 4.39** Rail services are specified in franchise agreements, which exist 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).
- 4.40** On the basis of the evidence available at this point, the Commission's view is that the UK's processes for planning and delivering rail infrastructure and services are sufficient to allow high confidence that the improvements assumed to form part of the Heathrow Northern Runway Extension proposal could be delivered.
- 4.41** In respect of road infrastructure, the Commission has noted that the UK does not currently have a system parallel to that which exists for planning rail infrastructure, although the Highways Agency's direction of travel points towards an eventual closer alignment. The Commission notes that the Highways Agency is continuing to develop its strategic plans for the network and that the nature and scale of the improvements required to support the Heathrow Northern Runway Extension proposal is compatible with what might reasonably be delivered through current planning and delivery mechanisms.
- 4.42** The delivery of surface access improvements may require negotiations between Government and the Scheme Promoter regarding the allocation of costs. The Commission has tested a range of scenarios regarding the funding of surface transport infrastructure as part of its work on cost and commercial viability. The Commission recognises, however, that eventual decisions on such funding (including, potentially, the funding of schemes in the extended baseline) will be a matter for commercial negotiation between the Government and the airport operator and that the Commission cannot prejudge the outcomes of any such negotiations.

Conclusions

- 4.43** On the basis of the evidence available at this time, the Commission's view is that the updated design components of the Heathrow Northern Runway Extension proposal put forward by the promoter provide a credible option for the delivery of capacity in line with the Commission's *assessment of need*.
- 4.44** A number of risks and challenges exist, but these are not of an unusual nature or scale for a project of this type at the current level of the development. The Commission does not believe on the basis of its current evidence base that any of these risks are significant enough to undermine the viability of the scheme.
- 4.45** The transitional arrangements for the delivery of the scheme would be complicated and would require rapid action by the scheme promoter, airport operator 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.

Part 2: Sustainability Assessment

5. Purpose of Sustainability Assessment

Section 1: Purpose of Sustainability Assessment

- 5.1** UK National planning guidance describes the role and value of sustainability appraisal as:

*an opportunity to consider ways by which the plan can contribute to improvements in environmental, social and economic conditions, as well as a means of identifying and mitigating any potential adverse effects that the plan might otherwise have. By doing so, it can help make sure that the proposals in the plan are the most appropriate.*⁵⁷

- 5.2** The aim of the Commission's Sustainability Assessment, as set out in its *Appraisal Framework*, is to provide robust information about the performance of each proposal 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 these. The process also allows for the identification of opportunities to undertake social, economic and environmental enhancement.

⁵⁷ <http://planningguidance.planningportal.gov.uk/blog/guidance/strategic-environmental-assessment-and-sustainability-appraisal/strategic-environmental-assessment-and-sustainability-appraisal-and-how-does-it-relate-to-strategic-environmental-assessment/>

6. Appraisal Structure

Objectives

6.1 The Sustainability Assessment contains the objectives below, which each scheme is assessed against.

Module	Objectives	Pg
Economy impacts	To maximise economic benefits and support the competitiveness of the UK economy.	91
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 proposal.	95
Noise	To minimise and where possible reduce noise impacts.	102
Air quality	To improve air quality consistent with EU standards and local planning policy requirements.	114
Biodiversity	To protect and maintain natural habitats and biodiversity	122
Carbon	To minimise carbon emissions in airport construction and operation	125
Water and flood risk	To protect the quality of surface and ground waters, use water resources efficiently and minimise flood risk.	129
Place	To minimise impacts on existing landscape character and heritage assets.	131
Quality of life	To maintain and where possible improve the quality of life for local residents and the wider population.	134
Community	To manage and reduce the effects of housing loss on local communities. To reduce or avoid disproportionate impacts on any social group.	138

Approach

- 6.2** The Business Case preceding provides assessment of the scheme based on the Commission’s assessment of expected economic, commercial and connectivity benefits and/or dis-benefits, and the risks and opportunities to delivering these. Some environmental aspects can be monetised, and these are included in the Business Case along with other economic, connectivity and commercial factors.
- 6.3** Further to this work the Commission is undertaking a sustainability assessment to consider how the scheme, as well as delivering these monetised benefits, can contribute to social, environmental and economic conditions, or how any potentially adverse impacts can be mitigated.
- 6.4** The Commission uses a ‘do minimum’ assessment to develop the baseline, which assumes no airport expansion at the three short-listed sites. In the case of the Heathrow Airport Extended Northern Runway this do minimum case is based on Heathrow Airport’s most up to date Masterplan, which covers both what the airport is like now and agreed plans for how to develop the airport with only two runways. This Masterplan is published online.⁵⁸
- 6.5** 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:

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.

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.

58 <http://www.heathrowairport.com>

- 6.6** 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 the Commission has noted these below.
- 6.7** 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.
- 6.8** Performance against these levels (e.g., supportive, neutral, adverse) reflect the Commission’s present judgement on the information currently available. This consultation seeks comment on these judgements, and the Commission will review them in light of responses received. As such these impact level judgements may change between this consultation document and the Commission’s final report.
- 6.9** 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.

6.10 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. If respondents wish to understand the detailed methodologies used in these assessments please refer to the relevant consultancy reports and the Commission's *Appraisal Framework*.

7. Assessment: Economy impacts

- 7.1** The national economic value associated with any airport expansion is created in several ways, such as through the impacts of increased transport efficiency, the removal of the “cost” of delays currently experienced because of the constrained airport system in the South East and associated wider impacts on, for example, trade and productivity
- 7.2** GDP growth would be beneficial for people across the UK through increased employment opportunities, both in terms of the economic value of having a wage, but also the wellbeing impact associated with having a job (discussed further in the Quality of Life report and Sustainability Assessment section 15) and the diminution of community dis-benefits associated with large numbers of people in an area being unemployed.
- 7.3** The detail of these different transmission mechanisms, how they interrelate and how they should be considered is set out in the economic case, but a summary of the impacts in respect of transport economic efficiency, reduced delays, and GDP at a national level is shown below. These vary by scenario.

Transport Economic Efficiency impacts

- 7.4** The transport economic efficiency impacts attached to airport capacity options accrue directly to airports, airlines, passengers and the public finances.

Table 7.1: Passenger, producer and government impacts, present value (£ billion)⁵⁹

	Assessment of need	Global growth	Relative decline of Europe	Low-cost is king	Global fragmentation
Passenger benefits excluding I to I ⁶⁴	41.3	109.2	49.0	118.1	35.2
Producer shadow cost impact	(31.6)	(88.5)	(38.3)	(94.9)	(32.0)
Government revenue impact	1.5	6.8	1.9	7.2	1.6
<i>Total excluding I to I</i>	<i>11.3</i>	<i>27.6</i>	<i>12.6</i>	<i>30.4</i>	<i>4.9</i>
Passenger benefits to I to I	5.1	8.0	3.1	6.3	4.5
<i>Total including I to I</i>	16.4	35.6	15.7	36.7	9.4

Source: Airports Commission analysis.

7.5 The economic impacts of the transport economic efficiency benefits of the scheme vary by scenario as passenger benefits are heavily driven by passenger demand forecasts. *Low-cost is king* and *global growth*, with the highest levels of forecast demand, have the greatest benefit associated with adding capacity. However, under *global fragmentation* the impacts are much weaker. These figures are based on carbon-traded forecasts, the benefits would likely be lower under a more stringent carbon framework, this is an issue discussed in more detail in the economic case.

Delay impacts

7.6 The delay impacts capture the benefits to airlines, passengers and the environment of a reduction in delays at UK airports as a result of scheme development.

⁵⁹ All values are shown in 2014 market prices, and, in the case of discounted and present values, are discounted to 2014.

⁶⁰ International to international interliners i.e. passengers who are transferring via a UK airport with their origin and destination outside the UK.

Table 7.2: Total benefits from reduced delays, across scenarios, present value (£ billion)

	Total benefits	Total benefits (exc. foreign)
Assessment of need	0.61	0.56
Global growth	0.62	0.59
Relative decline of Europe	1.48	1.20
Low-cost is king	1.00	0.83
Global fragmentation	1.47	1.18

Source: Airports Commission analysis.

The benefits of reduced delays from the scheme range from £0.6 billion to £1.5 billion, depending on the demand scenario under consideration. Under the *global growth* scenario, benefits experienced by airlines account for 65% of the total benefits.

Wider impact: Macro-economic modelling

7.7 To understand the GDP impacts associated with the scheme the Airports Commission have also worked with our consultants to develop an S-CGE (Spatial Computable General Equilibrium) model. This analysis is not a typical welfare analysis, but considers the possible GDP impacts of the Heathrow Extended Northern Runway scheme. These impacts vary by scenario and are set out below.

Table 7.3: GDP impacts all scenarios, present value (£ billion, 2014 prices)

PV	Total impacts (exc. construction)
Assessment of need	131
Global growth	214
Relative decline of Europe	101
Low-cost is king	194
Global fragmentation	115

Source: Airports Commission analysis.

7.8 The modelling suggests, initially GDP impacts are driven by construction of both the airport and surface access infrastructure. From scheme opening in 2026 to the late 2030s GDP impacts rise rapidly, mainly driven by productivity impacts associated with improved trade links allowing firms to access larger markets and benefit from knowledge spillover. In the late 2030's both the transport economic efficiency and frequency benefits start to become more significant as airlines are unable to charge the level of scarcity rents as compared to the 'do minimum', with consumers being charged lower fares and having more available disposable income, they spend

this elsewhere having multiplier effects on the economy, but the reduction in airline profits has a slight countering effect on this.

- 7.9** The Commission's assessment of wider GDP impacts is drawn from the Commission's macroeconomic analysis above. The monetised results are included in this document and the economic case but given the novel nature of this analysis they have not been incorporated directly into the overall cost-benefit comparisons in the economic case.

Conclusion

- 7.10** Looking at the more conventional analysis of transport economic efficiency and delay impacts, under *low-cost is king* and *global growth*, the scheme clearly delivers a **HIGHLY SUPPORTIVE** impact against the Commission's objective to maximise economic benefits and support the competitiveness of the UK economy, with the possibility of this being **SUPPORTIVE** under the other scenarios.
- 7.11** In assessing the overall economic value of any expansion proposal, these national economic benefits need to be considered alongside other impacts, including environmental disbenefits and local economic impacts, such as job creation, and assessed against the costs of the scheme. This is done in the economic case.
- 7.12** While the overall scale of benefits is uncertain at this stage, the S-CGE analysis does provide a clear indication that there may be substantial positive GDP/GVA effects from investment in aviation capacity and connectivity, and as such would represent a **HIGHLY SUPPORTIVE** impact against the Commission's objective to maximise economic benefits and support the competitiveness of the UK economy. It should be noted that that S-CGE modelling is a relatively novel way to consider the impact of airport expansion. The outputs should therefore be read with some caution.

8. Assessment: Local economy impacts

- 8.1** The Heathrow Extended Northern Runway scheme 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.

Direct, Indirect, Induced and Catalytic Employment

The direct employment provided by an expanded airport is defined as those staff employed directly by the airport or the airlines and concessions based there, for instance baggage handlers or customer service staff in the terminals.

The indirect impacts provided by an expanded airport are those generated by the activities of the airport's supply chain. So an indirect job would be, for instance, a chef at a facility that cooks airport meals which are then sold to airlines.

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 mainly by airport staff.

Catalytic effects arise as a result of the benefits that air travel provides. These impacts include reduced travel times, a greater choice of destinations and more regular flights. It also includes the consumer benefit of reduced cost of leisure travel. The economic model the Commission uses attaches values to the impacts – for instance, each minute of travel time reduced for the potential future users of the airport – and adds these together to provide a total catalytic effect. 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.

- 8.2** To understand the impact the Heathrow Extended Northern Runway scheme we have considered three levels of assessment area: the most local area consists of the closest five local authorities (Hounslow, Hillingdon, Ealing, Slough and Spelthorne), the second tier consists of the 14 boroughs closest to the airport, and the third is the wider city region of London and the South-East.
- 8.3** The Commission uses the traffic forecasts from its *global growth* scenario to calculate the top range of impacts, and the traffic forecasts from its *global fragmentation* scenario to calculate the bottom range of impacts of the Heathrow Extended Northern Runway scheme.

Employment

- 8.4** Any development at Heathrow will deliver direct, indirect, induced and catalytic job growth.
- 8.5 **Direct job growth:**** The Commission's different scenarios drive different passenger forecasts, and therefore each scenario models different numbers of people directly employed on the airport site. In 2030 the Commission's modelling suggests that Heathrow could be employing 17,500-35,400 more people in 2030 than against a do minimum baseline (dependent on scenario⁶¹). The results in 2050 show a similar range (20,300-34,400). Currently the five boroughs most local to Heathrow (Hounslow, Ealing, Slough, Hillingdon and Spelthorne) contribute about half the staff to the direct on-airport employment at Heathrow (33,490 against a total of 73,430).
- 8.6** The jobs currently at Heathrow, and in the air transport industry generally, are relatively low skilled⁶², and several areas in the five boroughs around Heathrow have a lower than average level of skills within the population (for instance much of Hillingdon and its surrounding area has 1.1% or below of the population having Level 4 qualification). As such, there could be a relatively strong match between the new jobs which could be created and the current skills of the population.
- 8.7** The relatively high unemployment rate in areas such as Hillingdon (7.7%) and Ealing (9.9%), along with the possibility of the relatively strong match between the new jobs which could be created and the current skills of the population, and current trends for on airport direct employment, suggest that there is capacity for some of these new jobs to be filled by unemployed people from these areas.
- 8.8 **Indirect and Induced job growth:**** As with direct jobs the range of scenarios mean a range of possible indirect and induced job numbers in 2030 and 2050. At its highest in 2030 the scheme could create 21,900 new indirect jobs and 38,800 new induced jobs (to a do minimum baseline) but at its lowest these could be 10,800 and 19,100 respectively. In 2050 these totals increase substantially, with additional indirect jobs ranging from 12,800-21,700 and induced from 21,700-36,800. Some industries developing induced and indirect growth will value being close to the airport but in general there is a wider geographical location for these jobs to be sited than is the case for direct job growth. Similarly, given the relatively broader group of industries that these indirect and induced jobs would be created in, the range of skill and pay levels across the jobs could be wider.

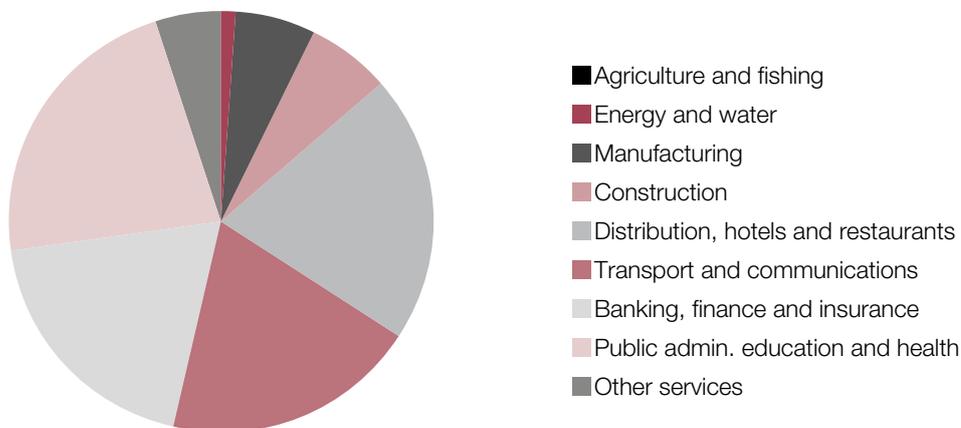
61 The Commission uses the *global growth* scenarios as the top of the range, and the *global fragmentation* scenario as the bottom throughout this assessment for Heathrow Extended Northern Runway.

62 From a study by Optimal Economics, more details provided in the Local Economy Assessment.

8.9 The employment impact in the very local community could therefore be less strongly positive than the sheer numbers suggest. Currently, despite businesses in Hillingdon providing 188,600 jobs (some of which could be reasonably classified as an indirect or induced impact of the airport⁶³), only 37% of the local jobs are taken by Hillingdon residents. There are already significant numbers of commuters into the borough and it is important to note that the travel to work area is likely to expand following the introduction of planned surface transport improvements. Similarly, some of the high-skilled jobs available in these industries would not have the same strong match with the skills base of people in the local area that exists for the direct jobs.

8.10 However, in the wider area the effect could be more positive, with a strong positive impact of these jobs in for instance the “Western Wedge” group of authorities. Over the last 35 years a sector reshuffle has been taking place, with manufacturing in the 14 local authorities declining and office based industries on the rise. This trend could continue, with the potential for the Heathrow area to move up the value chain due to an increase in land prices with business densities increasing near the airport. However, whether the trend will continue, or whether the economy in the area would develop differently, is very difficult to predict.

Figure 8.1: Heathrow percentage employment in Industrial Sectors 2013



Source: Airports Commission analysis.

8.11 Catalytic effects: An alternative approach to assessing the number of jobs created comes from the S-CGE model, with an estimated 164,200 jobs created under the *assessment of need* scenario by 2050. This figure is larger than the estimates discussed above as it includes the catalytic impacts of the scheme. These effects

63 Hillingdon industry quotients demonstrate the top five industries (compared to the national average) include passenger air transport (67.81 times more concentrated), support activities for transportation (10.88), freight air transport & space transport (6.77). This demonstrates the strong knock on effect the airport has in terms of generating the need for airport support industries.

arise as a result of the wider benefits that air travel provides, improving connectivity and reducing costs through reduced travel times, a greater choice of destinations and more regular flights, as well as reduced country to country trade costs. This increase in available destinations also expands the potential markets for businesses, which benefit workers, intermediate goods and services. There may be increased competition across countries with the ability of firms to access new markets which would improve efficiency. These effects leads to an increase in employment in the economy, with the largest gains in the manufacturing and services sectors, which are trade intensive.

8.12 The catalytic impact would be concentrated in London and the South East, which already has strong labour market performance trends (e.g. GVA 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 increases agglomeration benefits.

8.13 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 inherently focused upon greater economic cohesion across the London area.

Housing & Social Infrastructure

8.14 Growth of jobs and businesses associated with the airport has the potential to put pressure on housing in the local area. The Commission's modelling suggests that in 2030 the range of additional households associated with the scheme (direct, indirect and induced) falls within the range of 22,900 and 60,600 (dependent on the scenario).

- 8.15** The additional housing at the upper end of this range – which equates to an average of some 400 homes per year in each of 14 local authorities – may be challenging to deliver, especially given that many local authorities struggle to meet current housing targets. However, the rate of provision of additional housing is not significantly out of line with many existing plans for the period to 2026 or with the rate of growth envisaged in the London Plan, although some further increase may be needed in some areas. In addition, the number of local authorities involved would also allow some flexibility in how new housing may be delivered across the area as a whole. It should also be noted that this is a worst case assessment for the number of additional homes required and there are many reasons why the additional housing required is unlikely to be as high as these figures. Different assumptions around passenger demand, population growth, net migration, access to employment for local people and commuting, for example, could all reduce the housing growth requirements.
- 8.16** The need for additional housing provision to house the increase in residents in the area around the airport will also need to be supported by the provision of additional social infrastructure such as schools, hospitals and leisure centres. The Commission's assessment suggests that provision of additional housing will need to be supported by the provision of up to 42 primary and five secondary schools across all 14 local authorities, two additional health centres (14 GPs) and two primary care centres per local authority to 2030.

Business Space

- 8.17** The businesses delivering the indirect and induced jobs growth discussed above will also need commercial premises. As above how closely these businesses need to locate to the airport is very dependent on the sector and nature of the business.
- 8.18** For those businesses less dependent on immediate geographical proximity to the airport it is likely that across the entire assessment area sufficient space for business expansion would not be a constraint on realising the benefits of the airport expansion. Similarly to housing, there is currently a general shortage of available premises for industrial and office space within the 14 boroughs of assessment 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. Given this local councils already have plans in place to make up this shortfall, and these plans would likely be flexible enough to support any further needs required by the airport.

8.19 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 in general is the large areas of surrounding green belt land, which restrict the potential for growth. For the Heathrow Airport Extended Northern Runway scheme in particular the site footprint is limited because the promoter has not included areas of land within the airport boundary for commercial development. The Commission consider that the expansion of the airport is likely to drive the need for more commercial development locally for those business that most value ease of access to the airport. If this space is not on in the airport boundary it could either limit the opportunities for these location-specific business to develop, or more likely, this development will occur elsewhere in the local vicinity. HH note that they believe the constraint is positive, encouraging for the area to move up the value chain through the attraction of highly productive business wanting to be near a potentially expanding global hub airport, with lower GVA businesses moving away from the airport to areas such as the Old Oak Common Opportunity Area.

Surface Access

8.20 As well as the benefits to airport users, surface transport improvements can provide benefits to non-airport users who are residents in the area, in the form of improved labour and market access. This will lead to some additional benefit to the individuals and potentially the local economy. 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 the situation in 2030 will be significantly more positive in terms of surface access than it is today. However, only a limited amount of this development is scheme specific: a very large proportion will be taken forward with or without any airport development.

8.21 In terms of scheme specific developments, 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 compared to today 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 there may be some conflict with commuting passengers for seats.

8.22 The Commission's analysis indicate that the proposal only marginally increases traffic on the Strategic Road Network in an already constrained system. Background demand is by far the majority of 2030 demand (with the exception of roads directly

serving the airport such as the M4 spur), but there may also be some very localised road impacts around the airport itself. However, detailed analysis has not yet been undertaken to estimate traffic flows on local surface roads around the airport.

- 8.23** Heathrow Hub Ltd believes there are further agglomeration and efficiency benefits of their proposed transport hub interchange (as opposed to the on-site surface access scheme analysed above). However, it is not within the Commission's remit to consider this.

Conclusion

- 8.24** Given the 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 the impact of the scheme on its objective to promote employment and economic growth in the local area and surrounding region as **HIGHLY SUPPORTIVE**. However, there are potential areas of constraint to delivering these benefits in the area very local to the airport, and if these risks are realised this could reduce the impact to **SUPPORTIVE**.
- 8.25** 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 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**. A contributing factor would be the impact on local roads, which the Commission does not currently have detailed modelling for. At this stage the Commission sees a conservative judgement of **NEUTRAL** as appropriate.
- 8.26** Both of these sets of impacts are combined with other relevant benefits and costs in the Commission's Financial and Commercial Case and Economic Case.

9. Assessment: Noise

The Commission's Approach to Assessing Noise Impacts

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.

In order to help people understand the likely 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 0700-2300) and night noise (L_{Aeq} 8h 2300-0700), 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 level;
- the European 24 hour L_{den} measure, which puts more weight on noise that occurs in the evening (1900-2300) or the night (2300-0700) than the daytime (0700-1900);
- N contours, which capture how many times in a day or night a population will be exposed to a very noisy aircraft flyover (with a 70 decibel threshold for the day, and a 60 decibel threshold for the night).

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 '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 Extended Northern Runway scheme, the *global growth* carbon-traded forecast comprises the high end traffic scenario, which results in more and larger planes and higher noise impacts. This chapter first considers the lower end case, then compares these outputs with those from the upper end.

The Commission's Approach to Assessing Noise Impacts (continued)

The Commission's modelling has been undertaken by the noise forecasting unit (ERDC) at the CAA. The Commission's assumptions on the types of aircraft using the airport, the population changes in overflowed 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 supporting annexes. 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.

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.

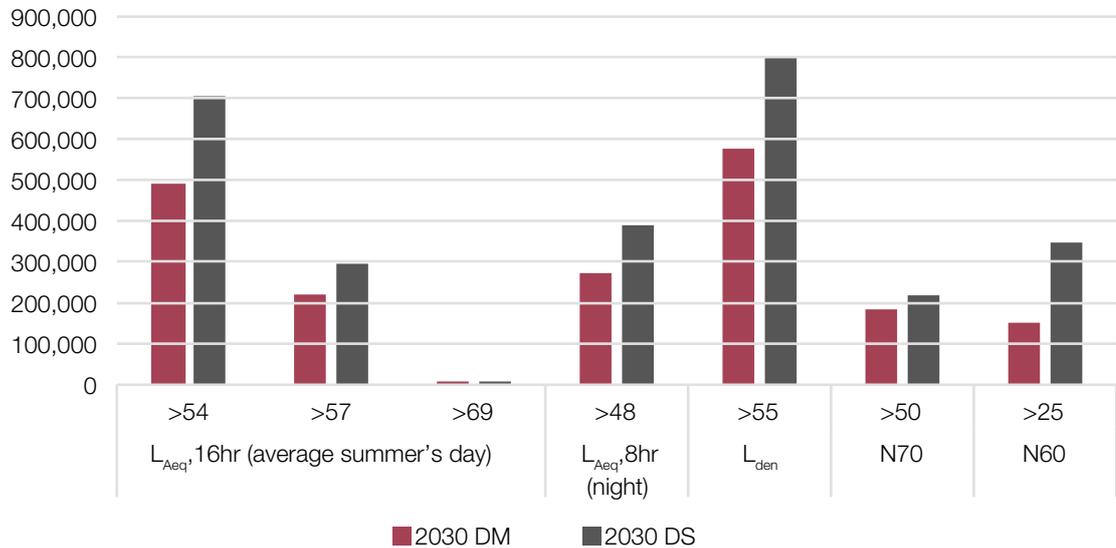
The Heathrow Airport Extended Northern Runway allows the airport to be operated in a variety of ways. For example, different runways could be in operation at different times in the day to allow respite for residents living nearby.

Changes between the do minimum (2 runway) and do something (3 runway) carbon-capped scenarios, 2030, 2040 and 2050

- 9.1** Figures 9.2 and 9.3 illustrate the differences between the Heathrow Airport Extended Northern Runway 2030 do minimum (Heathrow Airport without expansion) and do something (Heathrow Airport with an Extended Northern Runway) forecasts in the lower end, carbon-capped scenario. In the do something scenario, higher numbers of people are forecast to fall within the noise footprint of the airport, across every type of noise measurement. Both the $54L_{Aeq}$ and $55L_{den}$ show growth of over 25% in the do something scenario.

Figure 9.1: In 2030 higher numbers of people are forecast to fall within the noise footprint of the airport, across every type of noise measurement

Heathrow Airport Extended Northern Runway, do minimum (2R) versus expansion (extension), 2030, low end forecast (assessment of need, carbon-capped)

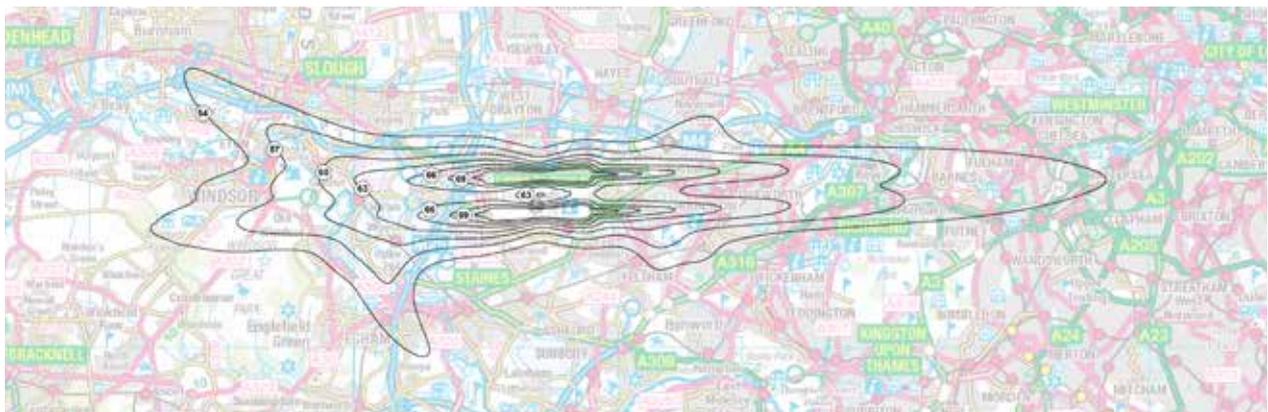


Source: Airports Commission analysis.

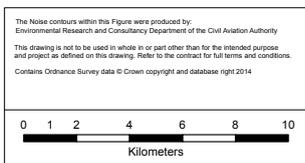
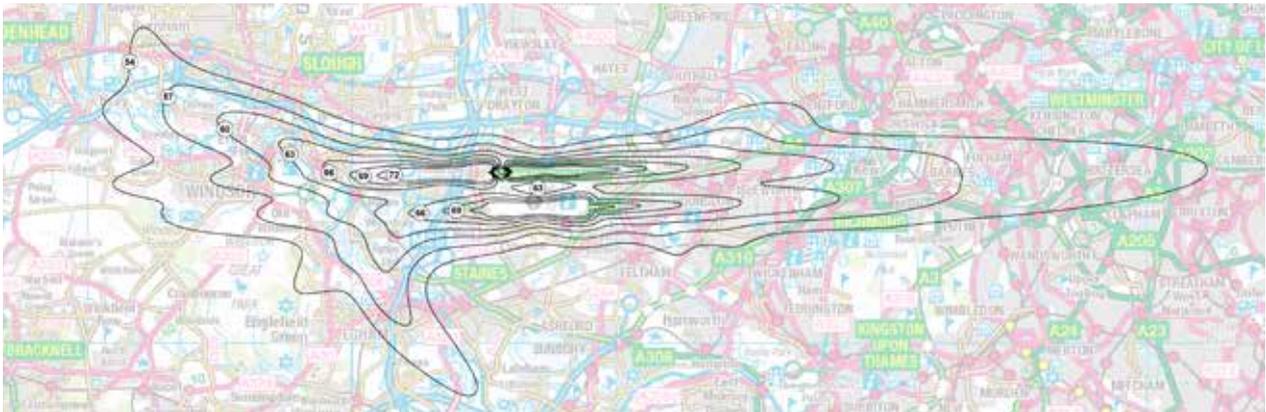
9.2 The noise contours produced in relation to the Heathrow Airport Extended Northern Runway scheme can help to explain this trend. Figures 9.2 and 9.3 demonstrate that, even though the flight paths assumed by the Commission cover many of the same areas as currently overflow, the airport’s noise contours elongate markedly to the west and to the east. In this manner, the increased operation at the airport can be seen to worsen noise impacts in some particularly densely populated areas to the east of the airport over more of west and south west London. In general terms, the noise impacts can be seen to shift further east.

Figure 9.2 and 9.3 The airport’s noise contours elongate markedly to the west and to the east

*2030 do minimum Heathrow Airport Extended Northern Runway scheme
 $L_{Aeq,16hr}$ contours, low end forecast (assessment of need, carbon-capped)*



2030 do something Heathrow Airport Extended Northern Runway scheme,
 L_{Aeq} , 16hr contours, low end forecast (assessment of need, carbon-capped)

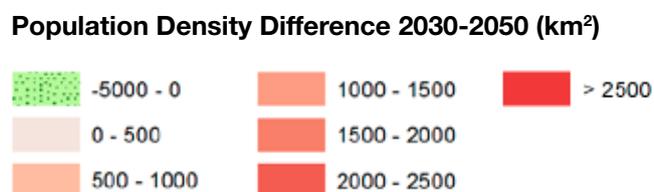
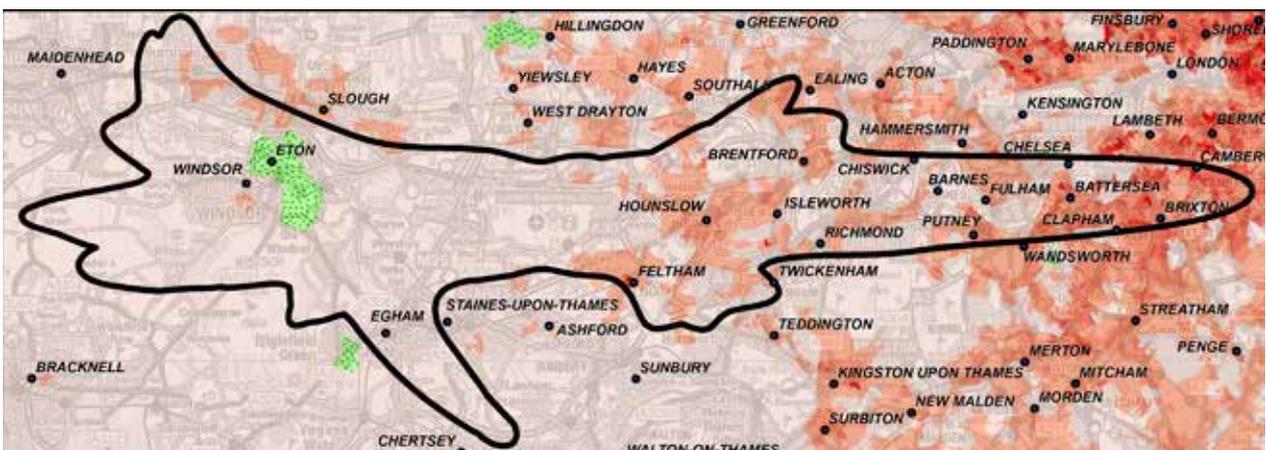


Source: Airports Commission analysis.

9.3 As can be seen in the Figure 9.4, the area of the contours produced by the Extended Northern Runway scheme extends further into the more densely populated areas of west and south west London where the population change is forecast to be the highest.

Figure 9.4: London's population is predicted to increase significantly in several areas under the 54db contour

2030 vs 2050 predicted changes to London population densities



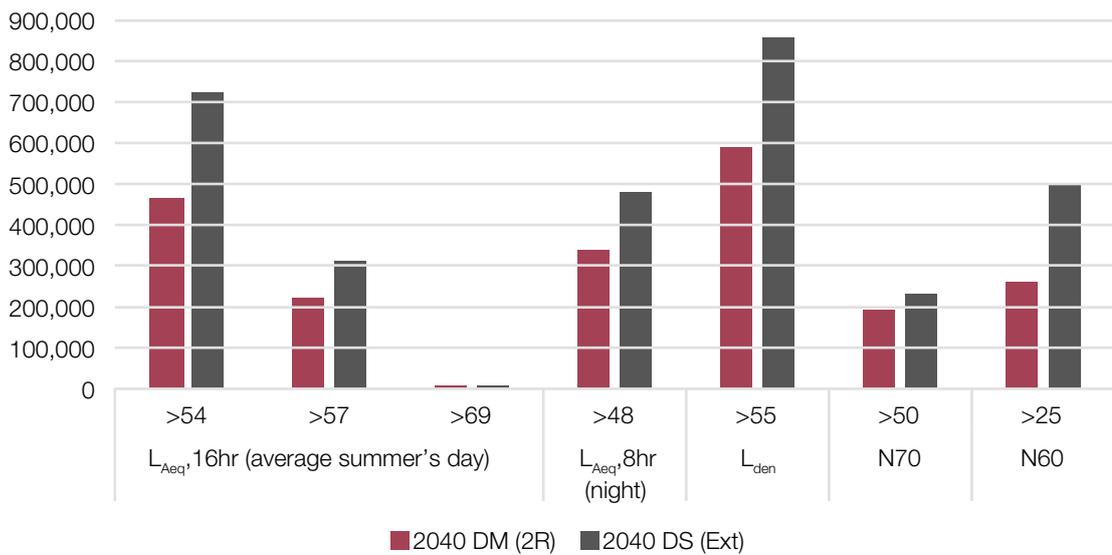
Source: Airports Commission analysis.

9.4 This elongation to the east is a product of the increased traffic operating off Heathrow’s newly extended northern runway. Assuming majority westerly operation (as currently), whilst at some periods of the day planes can be landed on the western half of the extended runway, at other times, and particularly as the airport fills with traffic in the period after 2030, only a portion of flights will be able to do so and therefore many will land in the eastern portion of the runway.

9.5 Similar patterns can be seen when comparing the differences between the 2040 and 2050 do nothing and do something scenarios. In both cases, the contour patterns of the do minimum and do something scenarios remains broadly as set out above, and this in turn drives similar patterns in the numbers of affected people.

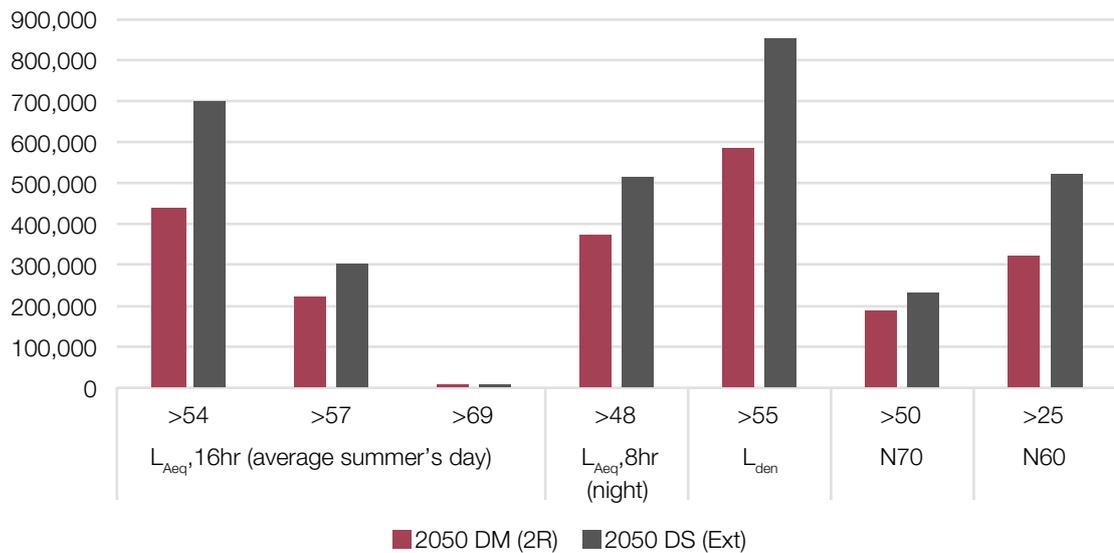
Figure 9.4 and 9.5: In 2040 and 2050, like 2030, higher numbers of people are forecast to fall within the noise footprint of the airport in the do something scenario, across every type of noise measurement

Heathrow Airport Extended Northern Runway, do minimum (2R) versus expansion (extension), 2040, low end forecast (*assessment of need*, carbon-capped)



Source: Airports Commission analysis.

Heathrow Airport Extended Northern Runway, do minimum (2R) versus expansion (extension), 2050, low end forecast (assessment of need, carbon-capped)

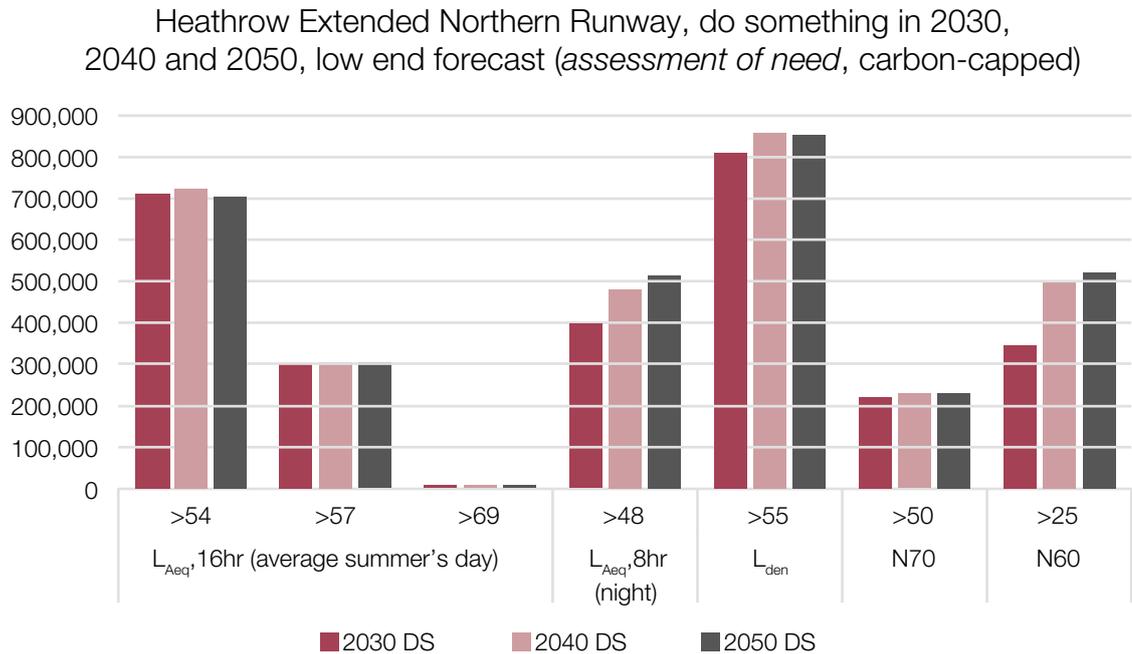


Source: Airports Commission analysis.

Changes from 2030 do something (extended northern runway) to 2050 do something (extended northern runway) carbon-capped

9.6 From 2030 to 2050 the Commission models traffic at the airport increasing, from 654,000 ATMs in 2030 to around 700,000 ATMs in both 2040 and 2050. In most interpretations, this growth and plateau in ATMs leads to a corresponding growth (to 2040) and decline (to 2050) in noise exposed populations, as Figure 9.6 shows. Aside from night metrics, any growth in affected populations between 2030 and 2050 is relatively slight, as the effect of new traffic is somewhat counter-balanced by the expected improvements in technology over the same period, which will see quieter planes entering most airlines' fleets.

Figure 9.6: Across most measures, the growth and plateau in ATMs leads to a corresponding growth (to 2040) and decline (to 2050) in noise exposed populations



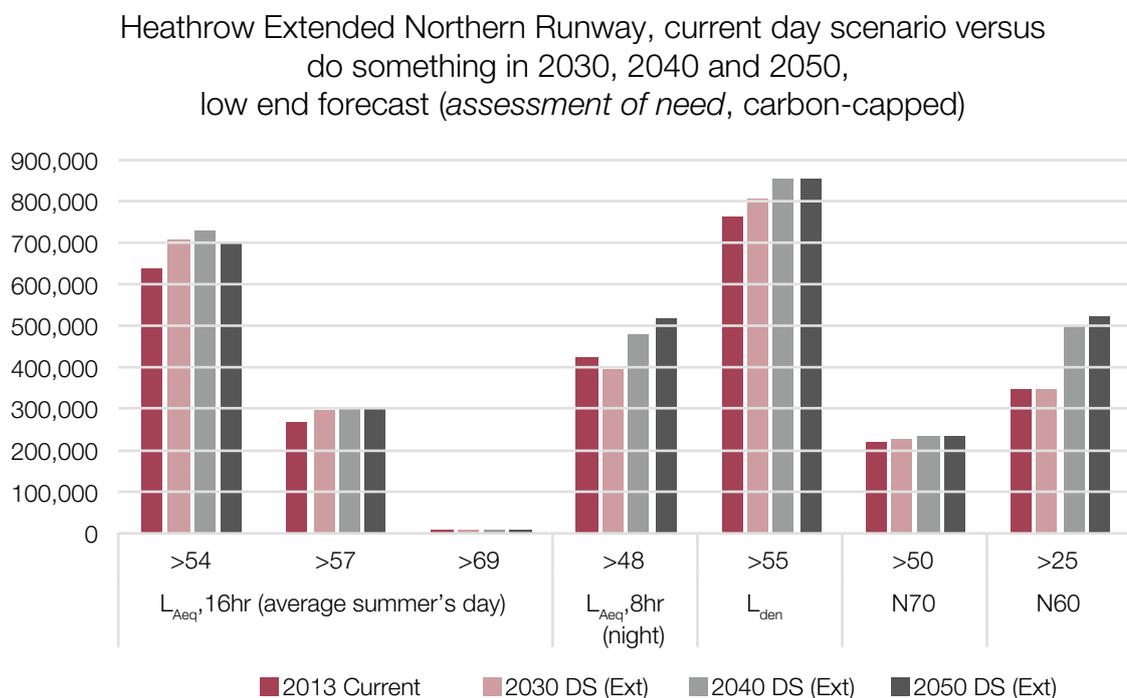
Source: Airports Commission analysis.

- 9.7** For night noise, an increase in ATM numbers as well as a forecast increase in population are only partially countered by a predicted improvement in fleet performance, meaning there is a growth in numbers of people affected by noise in the night noise metrics during the assessment period. This is particularly pronounced in the areas closest to the city centre affected by a Heathrow Extended Northern Runway flight path.
- 9.8** The ATM forecasts assume that the current Quota Count system for managing noise between 23.30 and 06.00 will not change, although in some scenarios there are increases to the number of aircraft movements in the periods 23.00-23.30 and 06.00-07.00 (shoulder periods), which count towards the night-time noise metrics. These periods are used when there is either no time in the day to schedule flights or the destination/origin is considered to require an early morning slot.

Comparison of 2030, 2040 and 2050 do something carbon-capped scenarios with current day

9.9 As a point of contrast, it is useful not just to consider the scheme against future do minimum scenarios, but with the current noise situation in and around Heathrow, as shown by Figure 9.7. Across all metrics, the Heathrow Airport Extended Northern Runway scheme is forecast to impact more people in 2050 than Heathrow Airport does currently.

Figure 9.7: Across all metrics, the Heathrow Airport Extended Northern Runway scheme is forecast to impact more people in 2050 than Heathrow Airport does currently



Source: Airports Commission analysis.

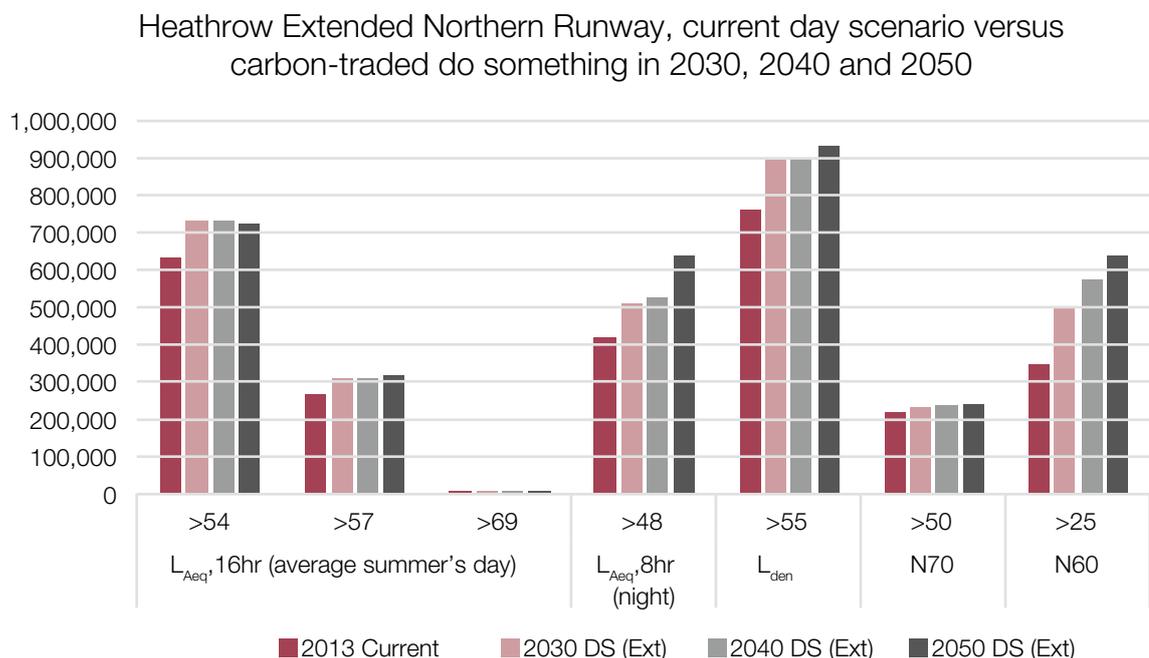
Comparison of carbon-capped and carbon-traded scenarios

9.10 Figure 9.7 can be compared with Figure 9.8, which displays the results of the Commission's carbon-traded do something forecasts. In this scenario more traffic is forecast where capacity allows, so 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 Heathrow's fleet mix.

9.11 The daytime noise impacts displayed in the 54dB, 57dB and 55 L_{den} contours are slightly higher in the 2030 carbon-traded assessment than the carbon-capped

assessment, with approximately 30,000 more people affected in the 54dB contour and 90,000 more people affected by the 55L_{den} contour. As can be seen the increase in 2030 noise impacts with the current day scenario is much more marked. Whereas in the carbon-capped scenario night noise was predicted to decline in 2030 compared to the current day, in the carbon-traded scenario the Commission's 2030 assessment places more than 100,000 people in the 48dB night contour than in the current day as many of the extra flights are expected to use the shoulder periods detailed in paragraph 9.8.

Figure 9.8: The increase in 2030 noise impacts with the current day scenario is much more marked in a high end forecast scenario



Source: Airports Commission analysis.

9.12 Another impact of more traffic through the existing centre line is that people living outside of this route could continue to experience no (or more limited) overflight. In effect, although the noise measure results show a large number of new people impacted many of these people would have been overflowed by the current Heathrow flight paths but would not have been in the contours as forecast in this assessment.

National noise assessment

9.13 If the Heathrow Airport Extended Northern Runway scheme were to be developed, the national situation would be higher in terms of noise impacts in all years than the do minimum case. This is because the forecast increase in exposed population at Heathrow would be higher than any reductions in exposed populations at other airports, where traffic would not grow as sharply as in a do minimum scenario.

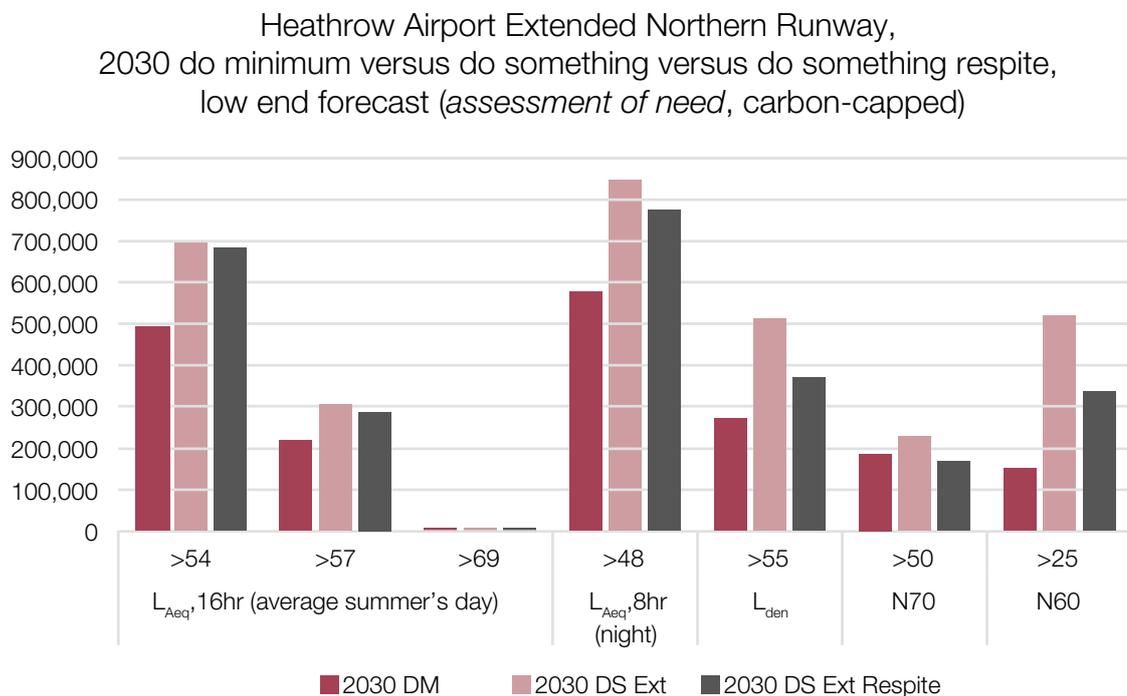
Limitations of the modelling, further potential mitigations and commentary on scheme promoter's noise assessments

- 9.14** Of course, these figures cannot and do not capture the full noise impacts of an expanded Heathrow. For instance, 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. And an expanded Heathrow would lead to more planes overflying the capital.
- 9.15** The Commission notes the importance the promoter places on offering the local community periods of respite from being overflown. The effect of such respite is only demonstrated in the noise modelling by virtue of its effect on the average. The Commission recognises the importance of such mitigation methods and is interested in views of how to take further account of them.
- 9.16** The scheme promoter has noted that the introduction of offset, curved and angled aircraft approach paths could effectively mitigate noise. These approaches have not been included in the Commission's analysis above, as the routes proposed by the scheme promoter were not sufficiently well-defined as to be incorporated into the Commission's analysis. Whilst there is some scope to take features of the flight paths designed for Heathrow Airport North West Runway scheme into account when considering noise impact of the Heathrow Extended Northern Runway scheme, this is limited due to the difference in concepts such as the location and set-up of runways. The Commission notes, however, that the optimisation of flight paths has the potential to improve the noise impacts of the Extended Northern Runway scheme, though this would require a deviation from the promoter's stated intention of limiting the numbers of people newly affected by noise.
- 9.17** In terms of respite, the Commission notes that at times of low traffic, or early in the assessment period before traffic numbers rise substantially, the Heathrow Airport Extended Northern Runway scheme may offer the opportunity to provide some predictable respite for residents close to the airport through runway alternation. When aircraft are landing from the east any landings on the extended runway, such as night flights, would be further west than current flights, and therefore quieter for people in central London as overflying aircraft would be higher than today. The scheme promoter's proposed model of operation would see traffic alternated between runways outside of the main morning and afternoon peaks.
- 9.18** As airport traffic grows, however, it is anticipated that peaks in the airport's schedule would become less apparent as it filled up and opportunities to provide predictable respite for residents on the final approach path (within 3-4 miles of the runway) would reduce substantially, as the duration of the non-peak periods would

be eroded. In the longer term, therefore, the Heathrow Extended Northern Runway scheme would have diminishing potential for runway alternation as traffic increased and the peak periods ate into the off-peak periods during which respite could be offered.

9.19 The Commission looked at the impacts of Heathrow Airport Extended Northern Runway respite option for 2030 before the airport is considered to be at full capacity. The results of this can be seen in Figure 9.9 below where the respite reduces the number of people under each contour level to varying degrees.

Figure 9.9: The increase in 2030 noise impacts with the respite scenario is smaller than the *assessment of need* carbon-capped scenario



9.20 The scheme promoter has stated that its scheme would obviate the need for night flights into and out of the airport within the night quota period (23.30-06.00). The Commission has not reached any view as to the merits of continuing or reducing night flights, but it considered that it was more appropriate for this analysis to model a conservative assumption in which night flights continue, following the current quota arrangement. This allows a consistent comparison between the two Heathrow schemes. In addition, if night flights were to be suspended, this mitigation could apply to any of the short-listed options.

9.21 The Commission notes that 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. Given the location of the extended runway further to the west than the north west runway, the effect is more pronounced in this scheme.

- 9.22** The noise modelling undertaken by the scheme promoter produced some different results to that undertaken by the Commission, for reasons explained in the underlying report, principally to do with differences in baseline population data and fleet mix.

Conclusion

- 9.23** In relation to the objective of minimising and where possible reducing noise impacts, the Commission considers that the Heathrow Airport Extended Northern Runway scheme will have a **SIGNIFICANTLY ADVERSE** impact. This is because the Commission's modelling shows that daytime and night time noise impacts will rise in comparison with future do minimum scenarios in 2030, 2040 and 2050, as well as in relation to current day impacts, and against some metrics these increases are over a hundred thousand people.
- 9.24** It is also important to compare the scheme's performance with benchmarks other than the Commission's do minimum scenarios: it is clear that in relation to comparator national or international airports the noise from Heathrow with an extended northern runway would affect a very large number of people, and some of these effects, such as for those living nearest to the airport, would have the potential to be severe.
- 9.25** The Commission notes the potential for optimised flight paths to reduce the total numbers of people affected by the Heathrow Airport Extended Northern Runway scheme. Additional mitigations, ranging from compensation packages to incentivising quieter fleets (many of which have been proposed by the airport operator itself), have the potential to further mitigate the noise impacts at Heathrow. The effect of such mitigations would however have to be extremely significant to reduce the scheme's noise impacts to **ADVERSE**.

10. Assessment: Air Quality

The Commission's Approach to Assessing Air Quality Impacts

To assess the air quality impacts associated with airport expansion, the Commission has compared a future year's 'do minimum' case (the harmful emissions produced by airports and their associated surface access without airport expansion) against a 'do something' case (the harmful emissions produced by airports and their associated surface access with expansion). This allows the change in emissions associated with the new development to be calculated.

The Commission has considered possible changes to emissions of nitrogen oxides (NO_x), particulate matter of 2.5 microns diameter ($\text{PM}_{2.5}$) and particulate matter of ten micron diameter (PM_{10}). These compounds have the potential to damage the health of humans and ecosystems. Potential damages associated with these changes at a national level are monetised based on environmental damage costs per ton emitted specified in the HM Treasury Green Book, and accounted for in the Commission's economic assessment, as set out in the preceding business case. This does not currently include the local effects of NO_2 .

The UK and its local authorities are obliged to limit concentrations of these three compounds at local and national levels, and the Commission's assessment describes the potential risks to future compliance. At the national level the assessment considers emissions associated with the airport schemes relative to total projected UK emissions, which are subject to national emissions ceilings set at international and European level. For local assessments the Commission considers two types of location: locations where Air Quality Objectives (AQOs) have been set by local authorities; and locations where EU limits are considered in the PCM model used by Defra for projections of air quality across the UK.

Predicting future air quality impacts of airport expansion is not a simple process. It requires modelling of vehicles (road, rail, aircraft) using the airport and related transport infrastructure, the emissions generated and then how those pollutants behave in the local atmosphere. Any modelling is very sensitive to the assumptions that underpin it such as likely pollution generated by engine, brake and tyre activity or the use of transport by both airport and other users, as well as the role of future technology including road vehicles. Many such assumptions can profoundly affect the results.

The Commission's Approach to Assessing Air Quality Impacts (continued)

At this stage in the assessment of the three options, the Commission has modelled the mass emissions associated with airport traffic (vehicle emissions within the airport perimeter) and road and rail traffic on journeys to and from the airport in its *assessment of need* carbon-capped Scenario to inform a risk based assessment. The Commission intends to test further the findings of this analysis with more detailed dispersion modelling to better understand the impacts of each option on local concentrations of air quality pollutants with a finer spatial resolution and address uncertainties. It is acknowledged that it would have been preferable to have available the outcome of this more detailed modelling exercise prior to consultation. Although a fuller picture may be provided by more detailed work, the high level modelling undertaken to date identifies the key challenges which the scheme faces in air quality terms and provides a sufficient evidential basis for consultees to express their views on the questions asked in the consultation document.

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 only undertaken quantitative assessments for the scheme's opening year (2026 for Heathrow Extended Northern Runway) and 2030, with qualitative assessment of potential impacts in 2040 and 2050 where appropriate.

10.1 Table 10.1 sets out the projected mass emissions associated with the airport in the 'do minimum' case, including airport-related road traffic emissions.

Table 10.1: Baseline NO_x, PM₁₀, PM_{2.5} annual projected mass emissions by source, t/y

Pollutant t/y	NO _x			PM ₁₀			PM _{2.5}		
	2030	2040	2050	2030	2040	2050	2030	2040	2050
Emissions Source	2030	2040	2050	2030	2040	2050	2030	2040	2050
Aircraft engine	10,168.80	9,544.20	7,924.70	27.9	27.8	26.2	27.9	27.8	26.2
Brake and tyre wear	-	-	-	51.8	41.8	26.7	36.2	29.2	18.7
APU	293.7	233	217.2	7.7	7.6	7.3	7.7	7.6	7.3
GSE	278.6	258	281.2	17.2	16	17.4	15	13.9	15.1
Road traffic – airport only	253.7	264.7	279.4	30	31.3	33	17.4	18.2	19.2
Total	10,994.80	10,299.90	8,702.50	134.5	124.4	110.5	104.2	96.7	86.5

Source: Jacobs.

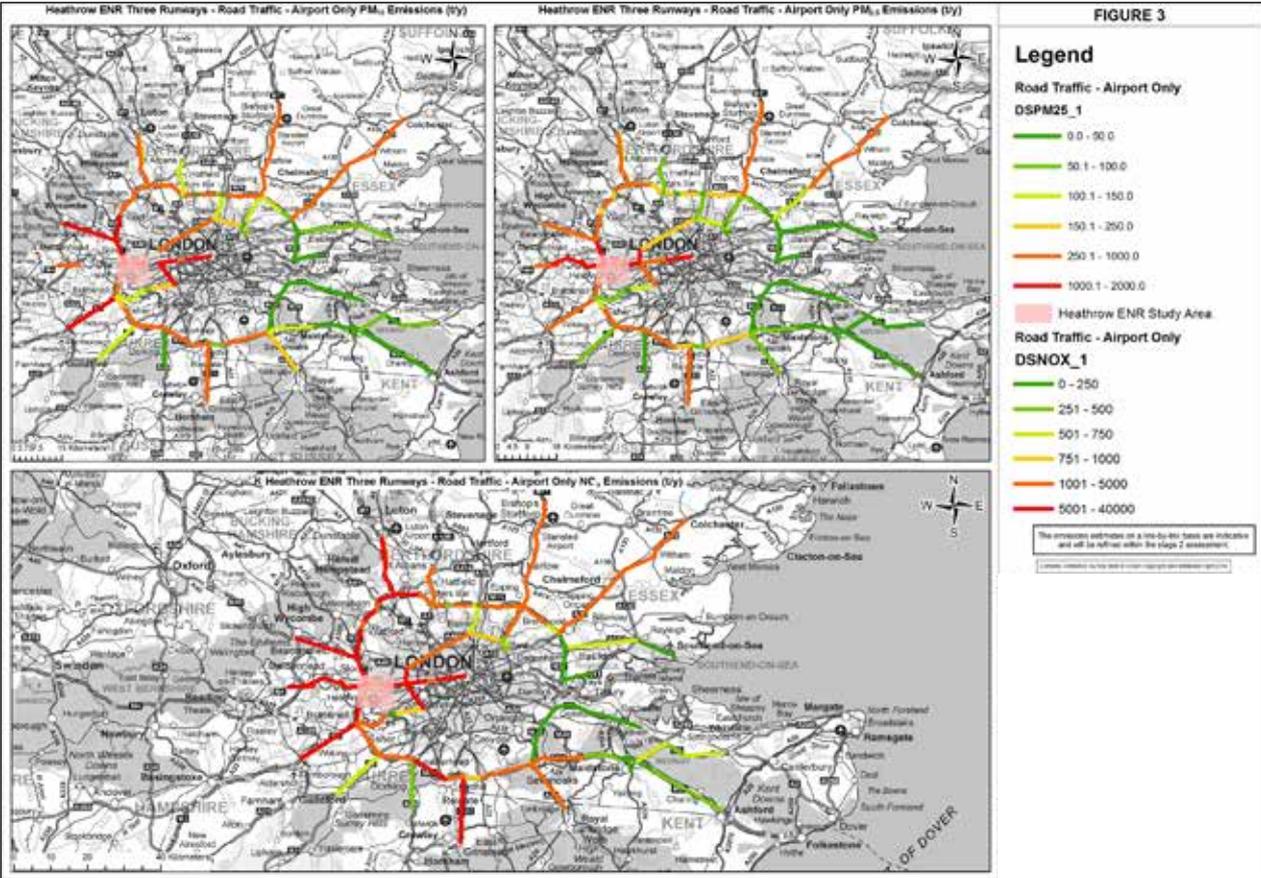
- 10.2** The Commission's assessment predicts that from scheme opening to 2050 emissions of NO_x are set to rise under a Heathrow Airport Extended Northern Runway Scheme if no mitigation is taken in all of its scenarios, though the modelled scenario is the *assessment of need* carbon-capped. The primary 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.
- 10.3** Emissions of PM_{2.5} and PM₁₀ are predicted to rise from 2026 to 2040, but by 2050 to have fallen below 2026 levels due to forecast changes in the Heathrow fleet mix. 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.⁶⁴
- 10.4** 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 Heathrow Extended Northern Runway Runway scheme over the 60 year appraisal period are calculated to be £341.5m and £107.9m, respectively.
- 10.5** The emissions also have the potential to adversely affect some protected ecosystems and other important environmental sites in the Heathrow area – these are identified below.

National Risk Assessment

- 10.6** Figure 10.1 demonstrates the extent of the Commission's modelling of surface access and also indicates the baseline emissions expectation for NO_x emissions in 2030.

64 For further details of these emissions in the UK see "Fine Particulate Matter (PM_{2.5}) in the United Kingdom", Air Quality Expert Group, DEFRA, http://uk-air.defra.gov.uk/library/reports?report_id=727

Figure 10.1: Map of study area and baseline emissions for 2030



10.7 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}. The UK expects to meet ceilings to be achieved by 2020 for these pollutants as set by the Gothenburg Protocol under the Convention on Long-Range Transboundary Air Pollution of the UN ECE. However tighter emission ceilings for 2030 have been proposed by the European Commission, specified as percentage reductions to be achieved by 2030 relative to emissions in 2005 as the base year. Hence this assessment also considers projected emissions from the airport scheme in terms of percentage contributions to projected total UK emissions in 2030, which are 589 kt of NO_x and 59 kt of PM_{2.5}.

Table 10.2: Annual Mass Emissions of Gothenburg Protocol pollutants and projections, kt/y

	NO _x	PM _{2.5}
Gothenburg Protocol 2020 Targets	711	57
NAEI emissions pollutant projections for 2030	589	59
Airport without expansion 2030	11	0.104
Change due to Airport expansion in 2030	2.6	0.07
New total airport emissions as a percentage of national projection in 2030	2.3	0.3

10.8 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 2.3% of projected national NO_x emissions and 0.3% of projected national PM_{2.5} emissions.

Local Risk Assessment

10.9 The legislated air quality targets are important for health impacts. For NO₂ there is a serious risk of exceedance associated with the baseline situation without any expansion. These risks are only likely to be exacerbated by the unmitigated emissions associated with the additional traffic caused by expansion. The PCM modelling would also suggest that expansion without mitigation would increase airport-related road transport emissions of NO_x by 25% in 2030% and by 35% in 2050.

10.10 The emissions of PM_{2.5} and PM₁₀ are not as significant a problem in these areas and the current levels are within the limit values. However, in general construction related activity and the creation of new elements such as tunnel entrances do have the potential to create localised problems that the Commission has not

modelled, but which need to be recognised and carefully controlled. There is, however, a substantially lower risk with these particulate pollutants than with NO₂ concentrations that airport expansion will be a contributory factor in causing limit values to be breached.

Impacts on Local Designated Sites

10.11 The air pollution associated with the Extended Northern Runway Scheme has the potential to increase existing impacts to designated sites in the area, specifically on Staines Moor and the Wraysbury Reservoir, both of which are near the airport boundary and busy junctions of the M25.

Potential mitigations and commentary on scheme promoter's air quality assessments

10.12 The promoter's impact assessment comprised a review of existing Air Quality Management Areas (AQMAs) and existing monitoring data and consequently comparisons with the Commission's consultants review are difficult.

10.13 The scheme promoter has suggested a series of suggested mitigation measures which offer the potential to mitigate air quality impacts and include:

- The embedded modal shift of passengers travelling by public transport is proposed to increase from 38% to 50%.
- Adjusting the proposed infrastructure layout to increase distance between source and receptors.
- The extended runway will move take-offs further away from the airport boundary.
- Development of take-off, landing and taxiing schedule to reduce emissions.
- Incentivising airlines to use cleaner aircraft through the use of landing charges.
- Providing fixed ground electrical points and preconditioned air.
- Provide low emission or electric airside support vehicles.

Conclusions

10.14 In the absence of effective mitigation, the Heathrow Airport Extended Northern Runway scheme will increase emissions of local air quality pollutants in 2025 and 2030 in a local area where there are current exceedances of legislative limits and future risks of these continuing without any airport expansion. There is also the risk

of these emissions potentially adversely affecting local designated sites and their associated ecosystems.

- 10.15** The strong influence of related and unrelated road transport to the air quality performance of any airport expansion scheme means that critical assumptions over matters outside the airport's control will determine the fundamental and underlying air quality performance of the local area. Currently the UK is breaching concentration limits in specific urban areas (including around Heathrow) and by the time of scheme opening, action at both a national and local level will have been considered to ensure these limits or any replacements or enhancements are respected. These include any changes in the road network including orbital and access routes to London. Such action would fundamentally alter the context in which the scheme's performance on this issue should be viewed, resulting in reduced emissions and potentially improved performance nationally from national level policy measures. The Commission will be developing a better understanding of these effects.
- 10.16** The emissions from the airport expansion are likely to add risk to that which already exists around future breaches. Action to tackle this existing risk will need to be taken across a wider area than just the airport but will be significantly enhanced if it is combined with action at the Airport. Additional mitigation at the airport would therefore be necessary to ensure that action to improve the background performance is not undone by additional emissions from the airport and so ensure that expansion is not adding to the problem. There is even the potential for very effective mitigation measures to improve performance beyond the level of additional emissions created by the scheme and further contribute to reducing the problem, although this would not in itself resolve the background issues.
- 10.17** The Commission notes that the promoter has produced several credible mitigation proposals to reduce the impact of both existing and future road access to the airport on local air quality. These would appear to offer the potential to reduce the airport's contribution to the problem significantly. These mitigations include financial incentives for the most modern and least polluting aircraft to use the airport and provide low emission or electric airside support vehicles.
- 10.18** Due to the increase in harmful emissions forecast to result from the Heathrow Extended Northern Runway scheme the Commission judges that without mitigation measures the scheme performance is **SIGNIFICANTLY ADVERSE** in relation to the objective of improving air quality consistent with EU standards and local planning policy requirements.

10.19 However, the Commission recognises that the scheme promoter has proposed a range of mitigations to improve air quality performance which the Commission's baseline modelling has not captured. As such, the Commission considers the potential for the air quality impacts of the scheme to become merely **ADVERSE** in comparison to the 'do minimum' case, but notes that this assessment is in the context of wider action to tackle the broader problem of road traffic emissions in the Heathrow area and that substantial and forceful measures may be required to bring about this result. The Commission will be carrying out further work to better quantify the local impacts and the extent to which mitigation will improve performance for example through dispersion modelling of emissions.

11. Assessment: Biodiversity

11.1 The Heathrow Airport Extended Northern Runway scheme involves direct land take impacts to varying degrees on five local designated sites, three of which are non-statutory (East Poyle Meadows SNCI, Lower Colne SMINC and Greenham’s Fishing Pond SINC), two statutory (Arthur Jacob LNR and Management Unit 1 (Poyle Meadow) of Staines Moor SSSI). The land take impact on designated sites, habitats and species will have high magnitude, medium to long-term duration and low reversibility⁶⁵. Given this, the Commission estimates that provision of alternative sites at a 2:1 ratio is required for land take impacts. This represents a total of 263.9ha or 282.5ha (including a 10% contingency for indirect impacts). Heathrow Hub Ltd. has assumed only 106.8ha of land take mitigation is required (largely due to different assumptions from the Commission on the extent of the area where biodiversity would be affected) with an additional 40ha as potential compensation for impacts to Lower Colne SMINC.

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

Table 11.1: Magnitude, Duration and Reversibility of non-land take impacts on Biodiversity, associated with the LHR-ENR scheme

Impact	Magnitude	Duration	Reversibility
Noise	Low	Short-term effect repeated over long-term period	High
Air quality	Low	Medium to 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.

11.3 With good provision of alternative sites the biodiversity impacts above can be mitigated. 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

⁶⁵ Technical definitions of these terms are included in the relevant consultancy report.

River Colne Site of Metropolitan Importance), providing extra land does not entirely mitigate these impacts.

- 11.4** With respect to bird strike the Commission's assessment highlights that the main risk to biodiversity arises from the reservoirs west of Heathrow, where a large winter gull roost occurs and to which the extended runway would encroach significantly closer than current. Gulls may fly into their roosting sites at altitudes in excess of those quoted for aircraft, and may also soar above roost sites at similar heights. A full assessment of the heights at which gulls fly over the reservoirs and a modelling exercise to determine likely collision rates would need to be carried out if the scheme was to be progressed.

Ecosystem Services

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 of the environment focusing on these services and the functioning ecosystems which support them, rather than interpreting 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.

- 11.5** The proposed development may impact on the ecosystem services present through the loss of existing ecosystems (such as areas of arable land) and hydrological

change and pollution, but also through the promoters proposed mitigation of the creation of new assets (such as fens, marshes and swamp).

Table 11.2: Monetisation of ecosystem services impacts with respect to the LHR-ENR 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	21ha loss / 42ha gain	£1,009 to £8,112	£739 to £5,805	-£269 to – £2,307
Inland Wetlands	8ha loss / 17ha gain	£222 to £10,140	£173 to £7,908	-£49 to – £2,232
Grasslands	39ha loss / 78ha gain	£318 to £4,108	£248 to £3,203	-£70 to – £904
Woodland	57ha loss / 123ha gain	£25 to £10,828	£14 to £6,020	-£11 to – £4,809
Sub – Total				-£398 to – £10,24-5
Agricultural Land	371ha loss	£5,122 to £6,146	-	£5,122 to -£6,146
Total				-£5,521 to – £16,391

Source: Airports Commission analysis.

- 11.6** The Commission’s assessment finds a wide range of potential impacts on ecosystem service provision from land use. In some cases mitigations suggested by Heathrow Hub Ltd limit this impact in monetised terms but overall the impacts are adverse. Also, the mitigating measures would have to be produced as described, leading to well established and functioning ecosystems over time, in order to achieve the assessed level of ecosystem service compensation. A key impact in terms of ecosystem services is loss of agricultural land, for which mitigations are identified.
- 11.7** Given the wide range of possible negative impacts on ecosystem services and the negative impact on biodiversity (particularly on local designated sites) the Commission judges that in relation to the biodiversity objective to protect and maintain natural habitats and biodiversity the scheme has an **ADVERSE** impact. While the operational impact of birdstrike is considered elsewhere, the negative impacts on biodiversity of some of the solutions to the operational problem have the capacity to increase the impact on the biodiversity impact to **HIGHLY ADVERSE**.

12. Assessment: Carbon

12.1 The carbon impact of scheme development can be split into the below 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.

12.2 The first four items are produce carbon on an ongoing basis, while the carbon associated with construction costs is a one off carbon "cost".

12.3 Our carbon assessment below uses a carbon-capped scenario, which implies that in reaction to increases in carbon production due to the scheme would need to be offset by reductions elsewhere to allow the UK to maintain a carbon-cap of 37.5 megatons (a carbon-traded scenario would imply increases due to the scheme would need to be accommodated within an overall carbon funding mechanism).

12.4 At this stage of airport expansion proposals, route changes and flight operations are not developed in sufficient detail to estimate emissions impacts and so are not assessed below. More information on this is available in the carbon assessment report.

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

Table 12.1 – Carbon assessment findings for Heathrow Airport under the Extended Northern Runway proposal, change in tCO₂

Area of Emissions	2030	2040	2050	Additional tCO ₂ over 60 year appraisal period	Total tCO ₂ over 60 year appraisal period
Air travel	3.2	4.2	3.3	210	1,287
<i>Ground movements component</i>	0.1	0.2	0.2	11.2	35
Passenger surface access journeys	0.06	0.08	0.09	4.9	31.9
Airport operations energy & fuel use	0.04	0.03	0.03	1.8	7.1
Total operational CO₂ emissions	3.3	4.3	3.5	217.1	1,326
Construction of airport facilities & SA infrastructure*	n/a	n/a	n/a	10.1	23.6

* Construction emissions are calculated as tCO₂e.

As you can see, the largest factor by far is the carbon associated with an increase in flights. The figure below sets out this, alongside a figure showing ATM increase at the airport.

Figure 12.1⁶⁶

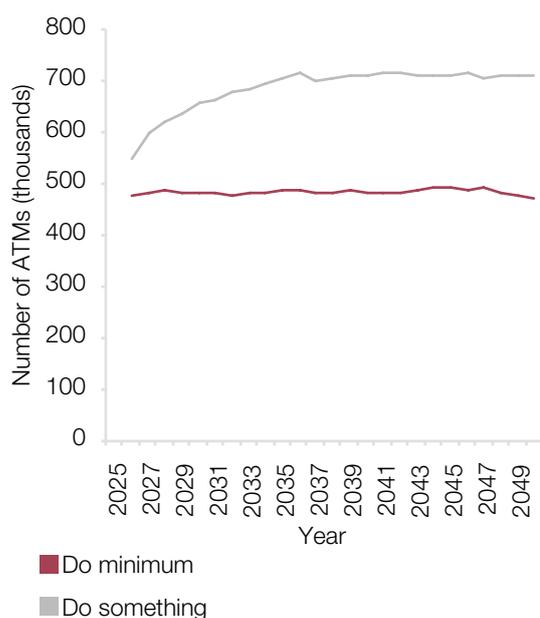
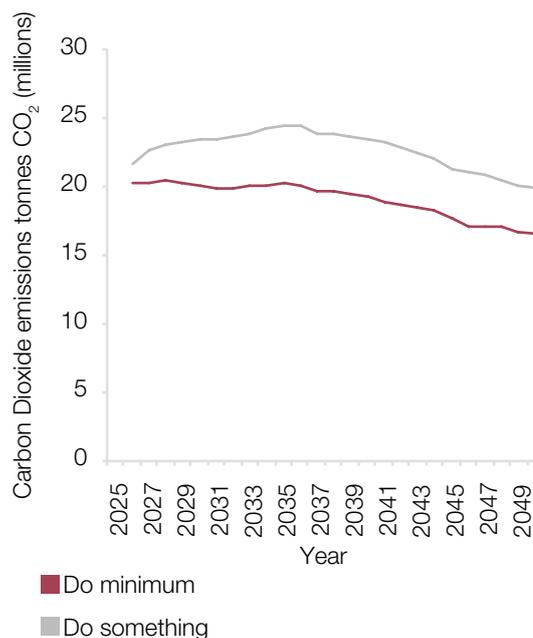


Figure 12.2⁶⁷



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12.6 As the figures show the increase in ATMs is higher than the increase in carbon (8.6% increase in ATMs compared to 14.7% 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. This impact could be mitigated further by, for instance, increasing airport charges for older aircraft, or mandated “green slots” which require planes of a certain standard to take up the new capacity.

12.7 Despite this positive trend in terms of carbon per ATM, it is important to remember that an expanded Heathrow under the Extended Northern 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 54.8% of the UK total.

12.8 The other impacts are much smaller in terms of scale but also show some quite high percentage increases compared to baseline.

66 Carbon emissions from departing flights at Heathrow Airport, with three runways, for 2025-2050 for the ‘do minimum’ and ‘do something’ scenarios.

67 Passenger numbers and air transport movements (ATMs) during the period 2025-2050 at Heathrow Airport Extended Northern Runway.

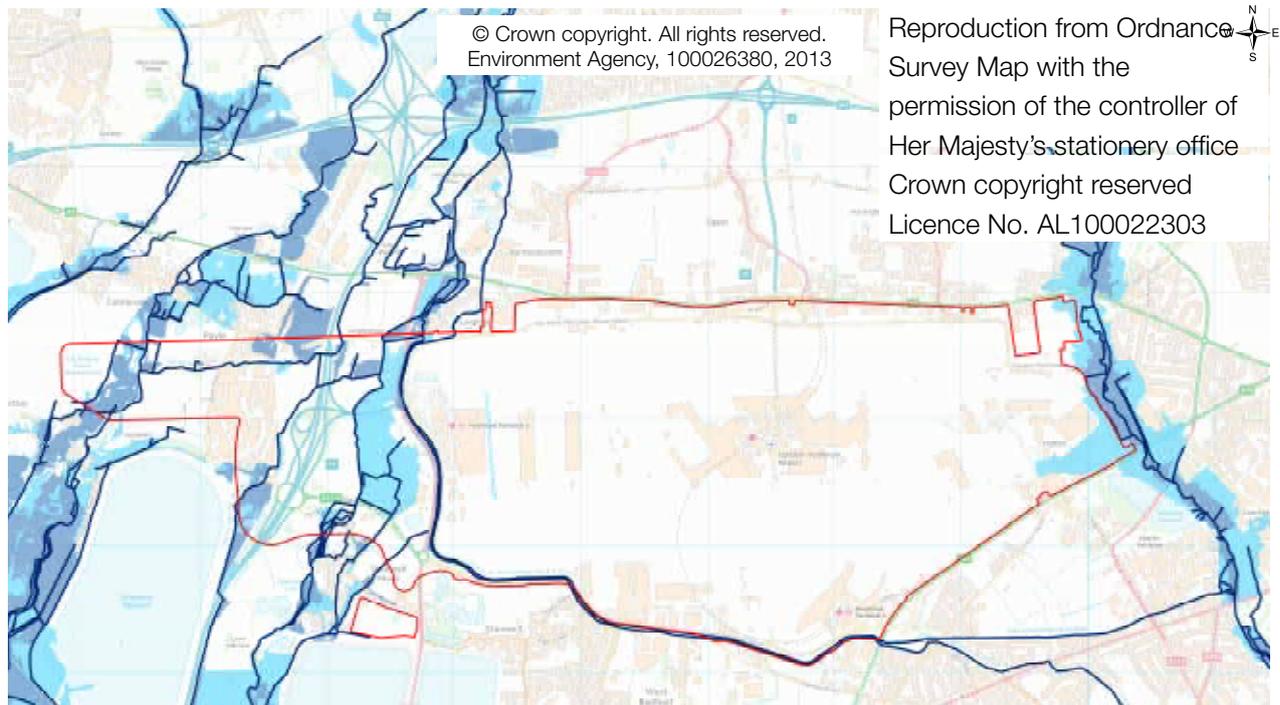
- 12.9** The differences in carbon associated with airside ground movements are driven by the same factors as those associated with the increased number of flights, with ATMs being the driving factor but improvements in plane technology limiting the impact of this. The emissions associated with airside ground movements increase rapidly, diverging by up to 50% from baseline by 2050.
- 12.10** The emissions associated with airport operations diverge widely from the baseline by 39.1% by 2050. It's important to note that total emissions actually decrease between 2026 and 2050 under the scheme, although the baseline reduces more significantly. This is due to the reduction in carbon emissions associated with grid electricity use, which makes up about 56%⁶⁸ of the 2026 carbon emissions. The emissions associated with gas and fuel use are expected to remain stable, so these increase with the increase in usage. Electricity use increases by approximately a third, due to the commensurate increase in passenger numbers in the 2026 to 2050 period, while gas use is modelled as significantly increasing due to the large increase in terminal area.
- 12.11** The above table 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 Extended Northern Runway proposal actually produces a significant decrease in total surface access emissions (-18.6% to baseline in 2050). This is due to the fact that under the base 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.
- 12.12** The construction of new facilities and infrastructure has a “one-off” carbon impact over the construction period. The Commission expect this to be 10,124,262 tonnes, much of this occurring in 2026.
- 12.13** 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 Commissions 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 and the fact that our assessment assumes a carbon-cap or trading scheme, both of which would limit the adverse impacts.

68 86,049tCO₂ of a total of 152,086tCO₂.

13. Assessment: Water and flood risk

- 13.1** The water conditions around Heathrow are already heavily impacted by the current airport and the associated development and housing surrounding it, and a baseline 'do minimum' level of growth at the airport would see these effects compounded.
- 13.2** In terms of water quantity, 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, including an allowance for the impact of climate change, would increase by 13% by 2026 and 32% by 2050 from the 2013 level. In the do something scenario there is an increase in water consumption of 0.32Mm³ (14%) by 2026, and 1.46Mm³ (64%) by 2050 when compared with 2013.
- 13.3** The water quality around the airport is susceptible to impacts from both the increase in scale of the airport but particularly from the culverting and realignment of the Colne Brooke, Poyle Channel, River Colne, Wraysbury River, Duke of Northumberland's River and Longford River. The Environment Agency policy (Fluvial Design Guide) is that no watercourse should be culverted unless there is an overriding need to do so, as, amongst other issues, the EA notes the ecology of the watercourse is likely to be degraded by culverting. An initial estimate suggests that there could be in excess of 12km of additional culverts associated with the scheme. These changes could compromise the ability of the watercourses concerned to meet water quality standards set out in the Water Framework Directive.
- 13.4** Along with the diverting and culverting noted above, the scheme will include development in medium to high risk flood zones that will cause loss of floodplain storage, and a significant increase in the impermeable surfaces in the area. In addition, development is in an area that could be impacted should there ever be a breach in nearby reservoirs. Due to the complexity and scale of these changes in the water environment, without effective long-term mitigation these impacts could cause a major increase in flood risk both in the local area and elsewhere. HH correctly identified these impacts in their submission but, given the stage in design, the assessment of flood risk is at a high level and more detailed information on both design and operational mitigations would be needed to determine if the impact could be more effectively mitigated.

Figure 13.1: Environment Agency Indicative Flood Map showing Scheme Boundary (red line)



Key to flood risk map:

Dark blue:	Flood Zone 3 – More frequent than 1% (1 in 100) annual probability event for fluvial flooding
Light blue:	Flood Zone 2 – Between 1% and 0.1% (1 in 100 and 1 in 1,000) annual probability events for fluvial flooding
No shading:	Flood Zone 1 – Less frequent than 0.1% (1 in 1,000) annual probability event for fluvial flooding.
Purple dotted line:	Flood defences (<i>none indicated on map</i>)

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

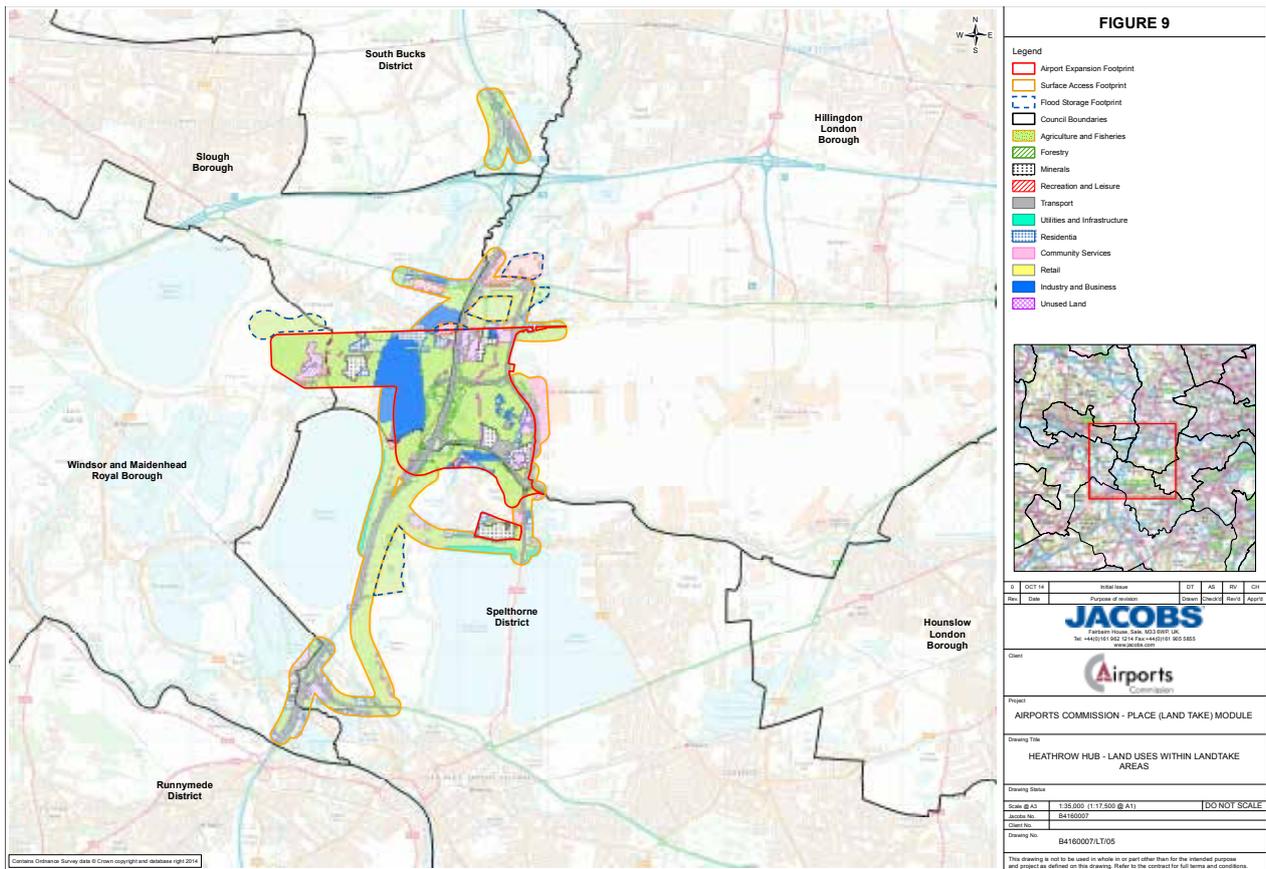
13.5 Several mitigation strategies have been suggested by the promoter, and further best practice mitigation strategies are available, which could reduce these impacts. However, it is not possible to quantify these impacts given the information available at the moment, as detailed design and operational plans would need to be in place to do so. Overall the Commission consider it unlikely that these impacts could be mitigated fully to make the development neutral with respect to our water objective.

13.6 As such, the Commission considers that the scheme has an **ADVERSE** impact on the Commission's 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 good practice mitigation strategies could move it towards this. These judgements are on top of a baseline scenario where waterscape is already, and will continue to be, heavily impacted by the airport and associated development.

14. Assessment: Place

- 14.1** The Commission's Place assessment takes information from several areas of appraisal: land take, landscape, waste and heritage impacts, to assess schemes against the Commission's place objective: To minimise impacts on existing landscape character and heritage assets.
- 14.2** The landscape around Heathrow is more mixed than might be expected, with developed urban areas existing alongside areas of high sensitivity, 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.
- 14.3** The landtake of the airport itself is mainly focused on the Poyle Industrial Estate and some agricultural land to the west of the airport, approximately 335ha. This land is a mixture of commercial and industrial, and there are various sites in the local area where this activity can be moved to. A total of 242 residential properties lie within the airport land take and are likely to need to be demolished. Additional land take for surface access improvements and flood storage area together come to up to 390ha. Further housing loss could be required as a result of surface access works depending on detailed route and construction design and potential mitigation options. Approximately 580ha of the proposed airport scheme would lie within designated Green Belt, and development would significantly change the land use in this area.

Figure 14.1: LHR-ENR land take by land type



Scale: 1:35,000 @ A3.

Source: Airports Commission analysis.

14.4 The landscape impacts are more mixed, with visibility impacts varying from negligible to moderately significant. Most areas that experience moderately adverse impacts experience them during construction of the scheme. For instance views in the Colne Valley Regional Park would be blocked by construction works. Only the Hillingdon Lower Colne Floodplain character area would continue to experience significant adverse impacts during operation, as loss of landscape features would be permanent.

14.5 The heritage impact of the scheme development is controlled to an extent by the constrained footprint of the airport. A total of seven designated heritage sites (all grade II listed buildings) have been identified within the Landtake Study Area, with a further 30 in the intermediate study area and 191 in the outer study area. Those sites located within the Landtake Study Area are at greatest risk from physical impacts (i.e. whole or partial removal of associated remains or fabric) during construction of the proposed option. In its submission, Heathrow Hub Ltd. has identified a lower number of sites requiring mitigation (eight total) than

the Commission but, of those for which they identified mitigation, the mitigations proposed are both feasible and practical.

- 14.6** It is important to note that the Heathrow Extended Northern Runway site footprint is limited in part because, unlike other scheme designs, they have not included areas of land within the airport boundary for commercial development. The Commission consider that the expansion of the airport is likely to drive the need for more commercial development, and if this is not within the airport boundary it will likely occur elsewhere in the vicinity. It is not clear what impact this would have on local landscape.
- 14.7** The Heathrow Extended Northern 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. Heathrow Hub Ltd suggest continuing to use several existing facilities for the treatment of recyclable waste. It would need to be determined if the additional quantities of waste can be treated through existing facilities. Heathrow Hub Ltd also suggest a new treatment facility for organic waste. Impacts of this site would be clearer once detailed requirements were known, but this information is currently not available.
- 14.8** The noise impacts of the scheme are discussed in detail in the noise section. With relation to Place we reviewed whether any of the schemes had an impact on areas of tranquillity. To the south and west of the airport, in particular, some of the scheme's flight paths may overfly some tranquil areas at high altitudes (at which noise from planes would be more limited). Further optimisation of flight paths may be able to mitigate these impacts.
- 14.9** The place impacts of the scheme development will be uniformly negative. The negative impacts are relatively contained, given the limited land take of the airport, precise location of the development with respect to views, and already low levels of tranquillity but are also, apart from waste, not very susceptible to mitigation. As such the Commission considers that the impact of the scheme on our Place objective to minimise impacts on existing landscape character and heritage assets is **ADVERSE**.
- 14.10** The Commission's scenarios have no substantive impact on the outcome of the Commission's Place assessment.

15. Assessment: Quality of life

- 15.1** This is the first time an integrated Quality of Life analysis has been undertaken with respect to airport development, and we would be interested in consultees' views on the examination that has been undertaken.
- 15.2** The impact of airport development on wellbeing is felt locally and nationally. Locally the impacts 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 Commission's 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).
- 15.3** 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 driven 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.

Locally

- 15.4** We undertook analysis of two datasets: 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 wellbeing questions 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. 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. We merged the Mappiness data with the Department for Transport's noise contours for London Heathrow (LHR), London Gatwick (LGW), and Stansted (STN)⁶⁹ to link with the associated decibel level from the three airports.

69 these were the only available noise contours for the Mappiness data.

15.5 Our analysis suggests that locally:

- *Living near an airport (5km)* has no statistical impact on subjective wellbeing measures – this may well be because of “bundling”: 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.
- *Being near an airport* does not have an 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* is positively associated with happiness and, at the same time, negatively associated with feeling relaxed: airports are associated with happiness and excitement, but are also stressful experiences.
- *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 55dB threshold. The negative effect of day time aircraft noise was greater for people living in social housing⁷⁰. 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 underemployed⁷¹. 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 housing.
- *Living in a night time aircraft noise contour* was not associated with any effect on subjective wellbeing.
- *Being in a high level aircraft noise contour* was negatively associated with happiness and feeling relaxed at that time.

15.6 These results obviously have limitations, which are set out in full in the Quality of Life Assessment report. Also, as noted above, this analysis has not been undertaken before with respect to airport development and so its suitability is to be determined as a measure. We would be interested in consultees’ views on this. As such these results should be seen as providing an interesting and useful commentary on impacts, rather than a full assessment.

70 The analysis also confirmed this result is not driven by the possibility that more social housing is located near to airports.

71 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.

Nationally

- 15.7** 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.
- 15.8** 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.
- 15.9** There is also a benefit to people nationally (as well as locally) through the leisure impacts of increased connectivity. The outcome that being in an airport is positively associated with happiness and excitement, seems to support this positive impact.
- 15.10** Overall, the possible areas of impact on people's Quality of Life, with respect to our *Appraisal Framework*, are set out below:

Table 15.1: Possible airport impact factors by geographical range and individual impact

Impact area	Possible Impact factors	Individual Impact
Local – within 5k	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 5k within flight path	All above	
	Noise	NEGATIVE
National	Economy impacts	POSITIVE
	Carbon	NEGATIVE
	Strategic Fit (connectivity)	POSITIVE

Source: Airports Commission analysis.

15.11 Given the information above, one approach to mitigating 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

15.12 All three short-listed schemes have negative impacts on some of these “bundled impacts” and the promoters have set out mitigation measures of all three types above. The quantitative impacts of these, where possible, are covered in the relevant Sustainability Assessment section (for instance Noise) or the Economic and Strategic Cases.

15.13 For this scheme in particular, the promoters have focussed on limiting the number of new people overflowed, keeping the footprint of land required as small as possible, to reduce impacts on the land used by the community, and to prioritise improving surface transport links, all of which could help influence the “bundled” effect of living near the airport. The promoter has also suggested some specific operational mitigations that could reduce the noise impact on communities. While the promoter has not provided a suggested approach to compensation for those affected by noise, such measures could nonetheless be put in place.

15.14 Nationally, the impact on Quality of Life, given the net positive impact on jobs, leisure connectivity benefits is **HIGHLY SUPPORTIVE**. Locally, we expect the impact with respect to noise alone to be **HIGHLY ADVERSE** without further mitigation and Local Economy alone to be **HIGHLY SUPPORTIVE**. However, these two impacts combined, along with all other impacts included locally, leads to an overall impact of **NEUTRAL**.

16. Assessment: Community

- 16.1** The proposed scheme would largely impact the Colnbrook and Poyle wards within the borough of Slough. Areas within the boroughs of Spelthorne and Windsor and Maidenhead would also be directly affected. Permanent land take would affect 242 residential properties, mostly in Poyle. Further housing loss could be required as a result of surface access works. 74ha of industrial and business land would be lost.
- 16.2** Heathrow Hub Ltd. has suggested several mitigations to the impact on the Community. For instance they suggest possible relocation for Poyle residents to north of Poyle or to the edge of Colnbrook; but much of this local area is designated as Green Belt, and is constrained by flood risk. In addition relocation here would impact local amenity and recreational facilities in the Colne Valley. For businesses the Commission considers that financial compensation and areas for relocation would need to be identified.
- 16.3** Even with the mitigations proposed there remains significant uncertainty for the residents of Poyle, some of whom may face the prospect of having both their home and job relocated. Relocating a significant number of households will present challenges, especially set against a background of increasing housing demand associated with airport expansion. For those remaining in Poyle, issues of severance will need to be considered further. For example there are currently two doctors' surgeries in Colnbrook and none in Poyle, so the loss of the Old Bath Road may impact on journey times for Poyle residents, especially the elderly. The same may apply in terms of Poyle residents accessing Colnbrook Village Hall. There is a possibility of increased congestion on local roads from non-local motorists avoiding the M25/M4 interchange.
- 16.4** The Commission has conducted a high level equalities screening, based on the current community profile and the impacts that have been identified so far. This high level analysis suggests that the loss of community facilities may disproportionately impact some of the groups, depending on the extent to which alternative and convenient facilities can be provided. Only a more detailed equalities screening would confirm this preliminary finding.

- 16.5** The Commission consider that without mitigation, the scheme's impact on its Community objective to manage and reduce the effects of housing loss on local communities would **ADVERSE**. With mitigation the impacts may be closer to **NEUTRAL**, but are probably still sufficiently severe as to remain **ADVERSE**.
- 16.6** The Commission does not consider enough information is available at present to make a judgement on whether the development would have a disproportionate impact on any social group.

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