Scenario: 1	Maximum capacity		

ASSESSMENT SUMMARY

		Impact relative to current situation				
Criterion	**Constituency**	**++ve**	**+ve**	**Neutral**	**-ve**	**--ve**
Strategic fit						
Economy	Airport					
	Airlines					
	Passengers					
	Connectivity					
	Employment					
	Public accounts					
Surface access	Road access capacity					
	Rail capacity					
	Journey time					
Environment	Noise					
	Air quality					
	Climate change					
People	Employment					
	Housing & demolition					
	Vulnerable groups					
	Quality of life					
	Social impacts					
Costs	Capital					
	Operating					
	Surface access					
Operational	Resilience					
	Efficiency (delay)					
	Reliability					
	Passenger experience					
	Safety					
	Scalability					
	Airspace					
Delivery	Timescales					
	Technical & operational risk					
	Planning risk					

ASSESSMENT RESULTS

Summary	This package provides significant benefits in terms of additional capacity at Heathrow (potentially up to 15%, but more likely in the region of 8-12%). However, this package has potential resilience impacts. It also has very significant public acceptability impacts, to the point where the planning application involved in raising the cap at Heathrow must be considered a lengthy and risky process (which may make this more appropriate to consider as a medium term option, where it could be set in the context of a broader long-term strategy).
Strategic fit	Compared to the core package, the maximum capacity package would substantially increase the ability of Heathrow to meet current and future demand over the short to medium term, by allowing existing and new airlines to increase frequencies and introduce new routes, reducing travel times and fares for passengers (including increased competition). The number of flights that could be added (between three and nine per hour) will influence the extent to which capacity will be able to respond to demand. The introduction of mixed mode will also allow for a significant improvement in resilience and reliability, although the benefits in reduced delays lessen as the capacity cap is increased (i.e. 540k ATM sees significantly lower resilience benefits compared with 500k ATM). This would support the maintenance and growth of the UK as an aviation hub. However, increased numbers of flights will, compared to the core package, result in increases in noise.
Economy	Net NPV of between **£4.2B** and **£4.6B NPV** (2014-2030) compared to the status quo[1], an increase in NPV of between £1.6B and £1.9B compared to the core package. The Maximum capacity package would increase the number of flights at Heathrow by between three and nine hour on average, enabling airlines to provide additional routes, additional frequencies and allowing more airlines to provide services at Heathrow, including highly valuable night services. It would also deliver higher standards of reliability and reduced delays, and would provide lower operating costs for airlines, lower travel times and delays for passengers, and increased connectivity and choice for passengers, both for international and domestic destinations (including connectivity from regional airports to international destinations). This package is likely to be consistent with any future medium and longer term options that support increasing airport capacity. This will contribute towards wider economic benefits by supporting growth in trade, tourism and investment.
Surface Transport	Significant increases in passengers using Heathrow are likely to put some pressure on surface access, which will be partially ameliorated by Crossrail and the Piccadilly line upgrade.
Environment	Air quality and carbon benefits are significantly less than the core package. Quantitative analysis indicates NO_x **savings** of approximately **5,860 in the 500k scenario** through to an **increase of 3,800 tonnes** of NO_x at Heathrow. Carbon savings ranging from **5.69M** tonnes to **2.44M** tonnes of CO_2 over the period 2014 to 2030, with central scenario traded carbon cost savings of approximately **£126.9M NPV to £49.0M NPV** (compared £147.9 NPV for the core). Noise cost benefits have not been quantified. The overall noise impact is significantly worse than the core package. Although (based on anticipated fleet mix changes), ERCD Report 0705 suggested that 540,000 ATMs in mixed mode would by 2030, compared to 2002, see the 57dB Leq contour **reduce by approx 35.5km^2** (28%) and the number of people in that contour **reduce by 76,700**, the overall benefit is considered to be highly negative, because the increase in movements will lead to an increase in noise in the short term, and the proposal to remove the night flights cap will be very negatively received by the public**.**
People	There are a series of trade-offs in impacts on people, from enhanced employment opportunities, through to reduced quality of life where noise impacts are key. At Heathrow, additional night flights and loss of respite are the major impacts, but growth in aviation will provide additional opportunities. Maximising capacity elsewhere is likely to affect other communities currently less conditioned to noise impacts.
Cost	Costs are expected to be low, beyond those incurred by the core package, although increased capacity caps are likely to require some additional infrastructure works at Heathrow to accommodate greater numbers of queuing and parked aircraft. Any package that increases ATM caps at the major airports, or requires extension to the night flights regime, will incur additional planning costs, and this should be considered in addition to capital expenditure on infrastructure. The 2007 Impact Assessment carried out to assess the impacts of three different options for increasing Heathrow's capacity estimated that the cost of implementing mixed mode within the 480,000 planning cap would be circa **£600 million** in 2006 values, adjusted for inflation bias. The Q5 capital investment package (2008- 2013, now Q5+1 to 2014) has delivered £4.79B capital expenditure to date, and in the course of the development of Eastern

[1] The 'status quo' means current operations using a baseline of 2008 data.

	Campus (T2a and T2B, T3 integrated Baggage, and related apron and runway projects a large volume of the infrastructure works indicated for mixed mode in the 2006/7 Impact Assessment will have been completed, so additional capital costs are not considered to be significant, although further works on taxiways, aprons and stands will be required.
Operational Viability	Implementing mixed mode at 540k ATM may present some risks that may mean it cannot deliver substantial benefits in terms of resilience. A safety case will be needed to implement full mixed mode at Heathrow.
Delivery	There are substantial delivery risks around obtaining planning permission for increased capacity caps at Heathrow and mixed mode operations, and airspace redesign needed to allow for mixed mode and reduced separation between SIDs.

Scenario: 1	Maximum capacity		

ECONOMIC IMPACTS

Impact on Industry (summary commentary) The primary impact of the maximum capacity package on the aviation industry will be at Heathrow. This would see additional flights at Heathrow, increasing airline services, including frequencies, routes and airline operators at the airport, and also additional night flights. In addition, airlines and passengers will experience higher savings of time (and operating costs), because the introduction of mixed mode would add to resilience beyond that of operational freedoms. Compared to "the status quo" this package will reduce costs for airlines and passengers, and increase utility for airlines and passengers by delivering net economic benefits by 2030 for the aviation sector and its users, including the value of the remaining core package. Economic benefits from maximum capacity from 500k to 540k are ***higher*** than the core package.	
Airports	Compared to the core package, Heathrow will have potentially increased passengers, and associated revenue, of approximately 3M, 5M, 6M or 9M additional passengers in each of the 500k, 515k, 520k and 540k ATM cap scenarios respectively, assuming current passenger to movement ratios. It is likely that this increase in capacity will reduce demand at Gatwick Airport in the short term, as a few services are shifted to Heathrow, but over the longer term capacity constraints at both airports will see Gatwick's capacity reutilised for other services. The degree of impact on Gatwick is related to the extent to which capacity cap is increased.
Airlines	Airlines will have access to 20000, 35000, 40000 or 60000 additional slots per year at Heathrow respectively in the 500k, 515k, 520k and 540k ATM cap scenarios. Operational and resilience improvement measures will deliver quantifiable airline cost savings (2014 to 2030) at Heathrow of: • between **£1,527M** and **£1,364M NPV** due to reduced delays (higher efficiency) • **£201M NPV** due to reduced cancellations (higher resilience). They will also deliver potential savings of order **£80M NPV** in reduced block-time buffers at Heathrow as flight delays reduce and flight times become more predictable. Efficiency measures will deliver delay reduction benefits at other airports during busy times, especially Gatwick. Compared to the core package, the maximum capacity package will deliver increased airline benefits by between **£1.36B** and **£1.55B NPV** (2014 to 2030) for a total of between **£2.88B** and **£3.07B NPV**.
Passengers	Passengers will have additional capacity, destinations and frequencies available from Heathrow due to the 20000, 35000, 40000 or 60000 additional slots at Heathrow respectively in the 500k, 515k, 520k and 540k ATM cap scenarios. Operational and resilience improvement measures will deliver quantifiable passenger cost savings (2014 to 2030) at Heathrow of between **£680M** and **£594M NPV** due to reduced delays (with lower benefits for higher capacity cap packages). The core package measures will also deliver benefits at other busy airports, principally Gatwick. The net difference between the maximum capacity scenarios and the core scenario for passenger benefits ranges from **£578M** and **£721M NPV**, for the range of 500k-540k (a total net benefit to passengers of between £**1.16B and £1.3B NPV**)
DfT WebTAG Impacts (summary commentary) ▪ Economic Surplus Producers: Compared to the core package, between **£1.4B** and **£1.5B** NPV in benefits due to increased ability to respond to demand, greater resilience and reduced operating costs. ▪ Economic Surplus Passengers: Compared to the core package, between **£0.6B** and **£0.7B** NPV in benefis due to reduced travel times and fares, and increased utility from passengers who would not otherwise have travelled. ▪ Time Savings From Delay Reduction: **£680M, £620M or £594**M NPV in the scenarios as passenger benefits above ▪ Public Accounts: Highly likely to be positive, as increased capacity and demand should result in higher APD revenue ▪ Wider Impacts And Regeneration: (See National Economic Impacts, Local & Regional Economic Impacts); ▪ Surface Access Impacts: (See below Domestic connectivity).	
User benefits	Increased choice of direct flights, routes, frequencies and airlines, with reduced delays and cancellations because of the introduction of mixed mode and reduction/elimination of caps on night flights.
Externalities (e.g. noise & CO_2)	Savings are less than available from the core package alone. Based on CO_2 savings from the 500k to 540k ATM caps over the period 2014 to 2030, there are central scenario traded carbon cost[2] savings of approximately **£126.9M NPV to £49.0M NPV** (compared £147.9 NPV for the core). Noise cost benefits have not been quantified. Respite will be lost in the mixed mode scenario at Heathrow, although total noise exposure would be expected to reduce by around

[2] https://www.gov.uk/carbon-valuation

	30% by 2030.
Connectivity to domestic markets (summary commentary) Allowing an additional three to nine flights an hour overall should result in a proportion of those flights being used to increase frequencies to existing domestic airports or introduction of services to such airports, increasing connectivity between Heathrow and domestic markets.	
International connectivity (interline vs. point-to-point; market access)	An increase in the capacity declaration at Heathrow should result in additional flights to existing destinations and the introduction of some new destinations, enhancing connectivity and also allowing for more airlines to provide greater competition at Heathrow (particularly from airlines that do not consider services to other UK airports as being commercially viable)
Domestic connectivity (surface transport & domestic aviation)	Impacts are expected to be negligible
National Economic Impacts (summary) Compared to the core package, the Maximum capacity packages will result in significantly higher benefits in terms of airlines being able to offer a wider range of services, including new direct routes, additional frequencies and additional airline market entry, enhancing competition and reducing air fares. In addition, the reduced delays expected from implementation of mixed mode will enhance the overall quality of service at Heathrow Airport, increasing the attractiveness of the UK for inbound investment and tourism. This is likely to have a highly positive overall economic impact by allowing some demand to be met by increased airport capacity, and by allowing Heathrow and airlines based at Heathrow to capture a moderately higher proportion of interlining air traffic in Europe because of increased services and increased service quality (although the higher the capacity declaration, the lower the improvement in service quality).	
Local & Regional Economic Impacts (summary) • Support to trade: An increase in flights at Heathrow, including reduction or removal of the cap on night flights would significantly support increased trade, investment and inbound tourism, by enabling the airport and airlines to meet currently constrained demand. Additional destinations, frequencies and airlines are likely to service Heathrow, enhancing London and UK wide connectivity. • Creation of new industries: At higher levels of increased flight caps, the resulting reduction in price and time costs of air travel will help to support the creation of new industries with high dependency on air travel costs as an input or to supply or access customers. • Land Impact: Negligible impact, although a high increase in the capacity cap is likely to increase demand for construction of hotels, logistics facilities and other support related functions or industries in the vicinity of Heathrow Airport. • Direct Employment: Highly positive impact on employment at Heathrow and with airlines and companies supporting airline operations at Heathrow. • Indirect Employment: Highly positive impact on employment in logistics, trade, tourism and related service industries due to lower air fare and cargo prices and increased ability to meet demand. • Induced Employment: Likely to be positive multiplier impacts on employment due to increased trade, tourism and investment. • Catalytic Employment: Likely to be positive multiplier impacts on employment due to increased trade, tourism and investment. • Agglomeration Impacts: Likely to be positive impacts on agglomeration in the Thames Valley/M4/Heathrow corridor as increased airline services support businesses that are located to gain the benefits of air connectivity. Modest positive impacts for agglomeration for London, as increased services support connectivity for London, with reduced travel times, fares and improved service quality (due to reduced delays). • Residual Value: Not relevant.	

ENVIRONMENT

Noise

The overall impact is significantly worse than the core package, and results in a highly negative incremental noise impact. This package includes measures which will generate additional noise associated with 20000, 35000, 40000 and 60,000 additional movements at Heathrow each year. Based on anticipated fleet mix changes, ERCD Report 0705[3] suggested that 540,000 ATMs in mixed mode would by 2030, compared to 2002, see the 57dB Leq contour **reduce by approx. 35.5km^2** (28%) and the number of people in that contour **reduce by 76,700** (compared to 115,600 in segregated mode). The overall benefit is considered to be highly negative, because although the increase in movements will lead to a relatively small increase in noise in the short term, assuming limited immediate improvement in fleet mix, and ongoing improvements in the use of quieter aircraft, the proposal to remove the night flights cap will be very negatively received by the public. The recent first phase of the consultation on night flights received significant response from the public seeking a reduction or ending of night activity. The introduction of mixed mode is also seen as strongly negative as people will be affected differently with some experiencing significant increases. Modernisation of the fleet is not expected to change this outcome.

Local air quality

The overall impact is less beneficial than the core package, dependent on scale of ATM capacity increase. Quantitative analysis indicates **savings** of approximately **5,860 in the 500k scenario** through to an **increase of 3,800 tonnes** of NO_x at Heathrow over the period 2014 to 2030[4], compared to the status quobased on 2008 operations and performance, extrapolated to 2030 taking into account fleet changes. Compared to the core package, this is delivered by:

- SIDs separation reduction (saving 165 tonnes per year) is available from 2016 until 2019 when it is subsumed into mixed mode
- reduced departure delays due to mixed mode: saving 630, 340 or 228 tonnes per year for the 500k, 515k and 520k ATM cap scenarios - there are no NOx savings on baseline indicated for 540k ATM
- increases in NOx emissions due to increased ATMs at LHR of between 320 and 800 tonnes per year[5]
- No savings have been ascribed to reduced engine taxi[6], despite the potential NOx and noise benefits, as the increase in ATMs within existing taxiway and apron space will restrict the opportunity for ground movement flexibility due to constrained taxiway availability.

Climate change

Carbon savings to 2030 are significantly reduced compared to the core package, which delivers 7.12Mt reduction. Quantitative analysis indicates savings of approximately **5.69M** tonnes, **4.47M** tonnes, **4.07M** tonnes or **2.44M** tonnes of

[3] Revised Future Aircraft Noise Exposure Estimates for Heathrow Airport http://www.caa.co.uk/application.aspx?catid=33&pagetype=65&appid=11&mode=detail&id=4979

[4] LeighFisher analysis has estimated delay and NOx benefits from a relationship to CO2, derived from estimates of fuel burn generated using the ground holding delay models developed in the CAA runway resilience study (http://www.caa.co.uk/docs/589/ICF_runway_resilience_final_report_16Feb09.pdf) augmented by emissions predictions generated using the ICAO Aircraft Engine Emissions Databank and the Eurocontrol BADA (Base of Aircraft DAta), http://www.eurocontrol.int/services/bada

[5] Increases in NOx and CO_2 associated with ATM growth have been calculated on a pro rata basis from per plane emissions derived from Heathrow (http://www.heathrowairport.com/static/Heathrow/Downloads/PDF/air-quality-strategy_LHR.pdf; http://www.heathrowairport.com/static/Heathrow/Downloads/PDF/LHR_Climate_brochure.pdf) and CAA data, 2008.

[6] Reduced engine taxi benefits for NOx and CO_2 have been calculated from reference to BMI trial results at Heathrow (http://www.heathrowairport.com/about-us/community-and-environment/sustainability/case-studies/taxiing-the-way-to-lower-emissions), the estimate of ground level Aircraft NOx at Heathrow (http://www.heathrowairport.com/static/Heathrow/Downloads/PDF/air-quality-strategy_LHR.pdf) and apportioned to 25,000 ATMs based on CAA activity data for 2008. Sustainable Aviation CO_2 roadmap identified that taxiway availability would constrain any benefits from RET, so the approach here is conservative.

[7] Carbon impact calculated from estimated fuel savings, using emission factor for Jet A1: http://www.ukconversionfactorscarbonsmart.co.uk/

CO_2 over the period 2014 to 2030[7], respectively in the 500k, 515k, 520k and 540k ATM cap scenarios compared to *the status quo* based on 2008 operations and performance, extrapolated to 2030 taking into account fleet changes.
The differences between the core package and this scenario are:
At Heathrow by:

- reduction in separation between SIDs[8]: starting in 2014 and saving 41000 tonnes per year until it is subsumed into mixed mode in 2019
- mixed mode[9]: delivering reduced delays resulting in 200,000, 140,000 or 120,000 tonnes per year in the 500k, 515k and 520k ATM cap scenarios respectively
- mixed mode[8]: reducing delays associated with the increase in proportion of A380s in the fleet mix of approximately 100000 tonnes per year from 2019.

- increases in emissions from additional ATMs of 71,800, 113,300 and 127,131 tonnes per year in the 500k, 515k and 520k ATM cap scenarios respectively.[10]

There are likely to be further, impacts on climate change as follows:

- reduced engine taxi procedures across main airports other than Heathrow could save 23,250 tonnes of CO_2 per year from 2016.

PEOPLE

Employment
This scenario is likely to create a positive impact for employment overall, as the ability to meet currently constrained demand, is likely to boost employment at Heathrow, airlines that are able to increase services and the businesses that support them. This is likely to have indirect positive effects on employment, due to increased tourism, trade (resulting in increased air cargo) and investment. The higher the capacity cap, the greater the positive impact on employment.

Housing and demolitions
No housing demolitions will be required. The overall impact of 500,000 to 540,000 ATMs under mixed mode operations could see an initial increase in the number of people within the 57db Leq contour dependent upon the rapidity of fleet modernisation.

Mixed mode operations will impact more locations and more people, with limited respite.

Number of Houses	
New	*Demolished*
nil	nil

Vulnerable groups
Some impacts on vulnerable groups might anticipated from deployment of the maximum capacity package, as although noise impacts are anticipated to reduce over time, the widening of the noise footprint unless mitigated by fleet improvements may result in specific local impacts. Even so, an increase in ATMs even with noise event sound level reductions is likely to be perceived negatively in noise terms, if historic precedent is accepted.

Quality of life
This package will have a more significant negative effect on noise related quality of life than the core package. Prior to the introduction of mixed mode at Heathrow, impacts on quality of life will be the same as for the core package, in summary:

- application of operational freedoms will result in an increase in the number of de-alternated flights, compared to a baseline where this would be managed using conventional TEAM. The increase in de-alternated flights would range from approximately 15 per day in 2014 up to 26 per day in 2019 meaning that there will be a general reduction in respite after 07:00 hours
- use of a single runway for arrivals between 05:00 and 07:00 will result in an increase in arrivals between 05:00 and 06:00. However, alternation and respite would be guaranteed, from 05:00 to 07:00.

At Heathrow, application of mixed mode will remove respite. In addition, extra noise will be generated in each of the scenarios by the increased number of movements. Allowing the smoothing of the early morning schedule will result in more early morning arrivals before 06:00 and, compared to the core package, there will be no guaranteed respite.

Social impacts
No additional social impacts compared to those indicated under the above sections are anticipated.

---

8 LeighFisher analysis has estimated delay and NOx benefits from a relationship to CO_2, derived from estimates of fuel burn generated using the ground holding delay models developed in the CAA runway resilience study (http://www.caa.co.uk/docs/589/ICF_runway_resilience_final_report_16Feb09.pdf) augmented by emissions predictions generated using the ICAO Aircraft Engine Emissions Databank and the Eurocontrol BADA (Base of Aircraft DAta), http://www.eurocontrol.int/services/bada

9 LeighFisher analysis has estimated arrival delay and CO_2 emissions using the mixed mode models developed in the CAA runway resilience study (http://www.caa.co.uk/docs/589/ICF_runway_resilience_final_report_16Feb09.pdf) augmented by emissions predictions generated using the ICAO Aircraft Engine Emissions Databank and the Eurocontrol BADA (Base of Aircraft DAta), http://www.eurocontrol.int/services/bada

Scenario: 1	Maximum capacity		

COST

Capital

The 2007 Impact Assessment carried out to assess the impacts of three different options for increasing Heathrow's capacity estimated that the cost of implementing mixed mode within the 480,000 planning cap would be circa £600M in 2006 values, adjusted for inflation bias. The Q5 capital investment package (2008- 2013, now Q5+1 to 2014) has delivered £4.79B capital expenditure to date, and in the course of the development of Eastern Campus (T2a and T2B, T3 integrated Baggage, and related apron and runway projects a large volume of the infrastructure works indicated for mixed mode in the 2006/7 Impact Assessment will have been completed, so additional capital costs are not considered to be significant, although further works on taxiways, aprons and stands will be required.

Operating

Unknown at this stage, but not anticipated to be significant

Mitigation and compensation

Unknown at this stage.

Surface access

To be considered separately.

OPERATIONAL IMPACT

Resilience

At Heathrow, resilience measures (forming part of the Airport's Airfield Operational Efficiency Programme) are forecast to deliver savings in cancellations[11] of **£201M** NPV from 2014 to 2030. The 2008 runway resilience study showed that Heathrow is far more prone to large-scale cancellations than other airports, due to its operating very near to capacity. Resilience measures will likely have much more impact at Heathrow than at other airports. In addition to the measures identified within the core package, this scenario also delivers qualitative benefits from the more robust operations enabled by the capacity headroom generated by mixed mode will also contribute to an increase in resilience. Although this increase in resilience will diminish beyond 500k ATMs.

Efficiency

At Heathrow, mixed mode coupled to the other measures are likely to deliver savings[12] in delays to airlines of **£1527M, £1413M or £1364M NPV** in the 500k, 515k and 520k ATM cap scenarios respectively due to reduced delays from 2014 to 2030 and savings in delays to passengers of **£680M, £620M or £594M NPV** in the 500k, 515k and 520k ATM cap scenarios from 2014 to 2030 compared to the *status quo* based on 2008 operations and performance, extrapolated to 2030 taking into account forecast fleet changes. In addition to the measures identified within the core package, this package also delivers benefits from:

- mixed mode[13]: £52M, £38M or £32M savings to airlines and £28M, £21M or £18M savings to passengers in reduced delays in each of the three scenarios, starting from 2019
- mixed mode[12]: £53M savings per year avoided delay costs to airlines and £26M per year avoided delay costs to passengers per year associated with the avoidance of arrival delays driven by the increase in A380s in the fleet mix. This benefit is realised from 2019 but is delivered prior to that by operational freedoms at the rate of £44M avoided costs to airlines per year and £20M avoided costs to passenger per year between 2014 and 2019.

Reliability

Based on reduced delay and enhanced resilience at Heathrow and associated airspace, operation to an optimised daily service plan and incentivisation of arrival punctuality, airlines will be able to reduce the buffers in Heathrow schedules[14], currently necessary to ensure reasonable punctuality against uncertain levels of delay. It is estimated that these savings in block-time buffers could amount to a reduced cost to airlines of **£78M NPV** from 2014 to 2030, although this is likely to reduce at higher ATM scenarios. Similar levels of buffer are not likely to be applied at other airports so this benefit is likely to be restricted to Heathrow.

Passenger Experience

In addition to the measures identified within the core package, this package also delivers benefits for the passenger

11 Derived from fuel savings information provided by Heathrow Airport.

12 Delays are derived from modelling and are then monetised using values derived from: Standard inputs for Eurocontrol cost benefit analyses, edition 5.0, December 2011.

13 LeighFisher analysis has estimated arrival delay using the mixed mode models developed in the CAA runway resilience study (http://www.caa.co.uk/docs/589/ICF_runway_resilience_final_report_16Feb09.pdf)

14 Based on the observations on the extension of short-haul block-times reported in the CAA runway resilience study (http://www.caa.co.uk/docs/589/ICF_runway_resilience_final_report_16Feb09.pdf)

experience through reduced airborne and ground holding at Heathrow due to mixed mode and local A-CDM.

Passengers are also likely to benefit from reduced travel times (due to the increase in frequencies and direct services) and reduced fares (due to increased choice of services and airlines) at Heathrow, with higher capacity declarations to have a positive impact upon this. Conversely, the higher the capacity declaration, the lower the expected benefits from reduced delays.

Safety
The implementation of mixed mode will likely require a safety case.

Scalability
The package is scalable at Heathrow, as is shown by the range of benefits from 500k to 540k. Economic benefits are maintained, but resilience and environmental benefits drop off as the scale increases.

Airspace
There is potentially a need for significant airspace redesign to enable mixed mode.

DELIVERY

Timescale
The measures would be delivered in phases starting in 2014 with the core package. Mixed mode could be delivered by 2019 subject to planning approvals.

Technical and operational risks
The principal technical and operational risks of this additional package are:

- safety cases for mixed mode at Heathrow

Planning risk
There is planning risk associated with:

- permission for increased capacity caps at Heathrow
- permission for mixed mode operations
- permission to apply operational freedoms, prior to the introduction of mixed mode
- permission for additional night flight operations
- airspace redesign for mixed mode.

Scenario: 1	Maximum capacity		

MEASURES INCLUDED IN THE PACKAGE INCREMENTAL TO THE CORE PACKAGE

Measure	Description	Template ref.
Mixed mode operations	Introduction of mixed mode operations for Heathrow runways. This would allow both runways to be used for both arrivals and departures as opposed to current operations where a single runway is currently used for arrivals and the other for departures. This measure has been proposed to increase capacity at Heathrow (which would necessitate additional planning condition to allow for more aircraft movements).	ApOP-HMM-1
Remove night flights cap at Heathrow, Gatwick and Stansted	This measure will see to the removal of the night flights cap at these airports so that there are no restrictions to the number of night movements during Heathrow's current operating hours (0500 – 2300).	NFlt-ERE-2
4 tracking of the Lee Valley Line	ASSESSMENT NOT INCLUDED IN THIS TEMPLATE.	
Reduce or lower the rate of APD	ASSESSMENT NOT INCLUDED IN THIS TEMPLATE.	

Scenario: 1	Maximum capacity		

ASSUMPTIONS

Core package

Measure	Approach and assumptions
En route arrival management	Starts 2019. Assumes linear holding can absorb 2 to 3 minutes of stack holding. Modified stack holding is calculated from operational data by subtracting the linear hold from each flight's stack hold and averaging over summer and winter seasons to give an average reduction in stackholding. Assumes that there is no time saving because the queue is shifted upstream. Assumes that there is a saving in CO_2 emissions driven by the reduction in average stack holding time with the multiplier derived from the analysis underpinning the Helios airborne holding report (**reference:** Feasibility and options for reducing airborne holding for Heathrow arrival, Helios, 30 June 2012 produced under contract 1387 (Helios) service order number 20, commissioned jointly by CAA and NATS). Gives a lower bound of the CO_2saving because it omits the saving from the en route phase of flight arising because of s slower cruise speed, even though the flight is 2 to 3 minutes longer. Calculation is limited to Heathrow flights even though benefits likely to accrue at other airports during busy arrival periods. Assumed that this benefit is additive to mixed mode because it will be used to address residual stack holding in the mixed mode scenario. Simple scaling is possible for Gatwick based on the 2008 runway resilience report that shows airborne holding delays at LGW are 16% of those at LHR in summer and 7% in winter. Averaged this gives a yearly average of 14% - assumes that en route arrival management delivers 14% of the benefits at Gatwick that it delivers at Heathrow. Calculation limited to Heathrow and Gatwick even though benefits likely to accrue at other airports during busy arrival periods.
Time based separations	It is assumed that time based separation is of limited basis in the mixed mode environment because the effects of wind will be ameliorated by the additional spacing available from the use of two runways simultaneously for arrivals, interspersed with departures.
Single runway for early morning arrivals	Starts 2015 and runs to 2019 when it is subsumed into the removal of the night flight cap. Scenario 1 assumes that the demand profile from 05:00 to 06:59 is smoothed over those two hours; scenario 2 assumes that the demand profile from 05:00 to 07:59 is smoothed over those three hours. With the statistical models as currently established the modelling resolution is one hour – so it is not possible to look at the schedule in more detail. Single runway arrivals are assumed for 05:00 to 07:00.
Independent parallel approaches at Heathrow	Enables optimum mixed mode arrivals. A necessary precursor for mixed mode but does not deliver any benefits in its own right.
Reduction in separation between SIDs	Starts 2016 and runs to 2019 when it is subsumed into mixed mode. Assumed to be a necessary precursor to mixed mode. Its benefits are subsumed into those of mixed mode, which is set at 15% capacity increase for departures, corresponding to the maximum benefit available from the reduction in the separation between SIDs. The 2008 runway resilience report shows a very similar average ground holding delay at Gatwick compared to Heathrow. The total delays therefore scale according to traffic (assumed to be 2:1): assume departure benefits at Gatwick are 50% of those at Heathrow
Local A-CDM	Starts 2014. Assumes A-CDM and other process improvements deliver (source: Information provided by Heathrow Airport) the following at LHR: - reduction in departure holding of 1.5 minutes per flight (assumed also to apply at Gatwick and scales from Heathrow results on a 2:1 basis, as explained above) - avoidance of 200 cancellations per year. Assumed to be additive to mixed mode benefits.
Operational freedoms	Starts 2014 and runs to 2019 when it is overtaken by mixed mode. Assume that the availability of operational freedoms is used to overcome the negative capacity impact of increasing numbers of A380s (21 arrivals in 2014 (3%), 30 arrivals per day in 2016 (4.5%), 62 arrivals in 2030 (5.5%)) (Source: NATS). The Helios airborne holding report (**reference:** Feasibility and options for reducing airborne holding for Heathrow arrival, Helios, 30 June 2012 produced under contract 1387 (Helios) service order number 20, commissioned jointly by CAA and NATS) is used to compare the difference in delay using a 20 minute trigger for TEAM with the assumption that all A380s are landed on the departure runway (i.e. no negative impact on capacity). This difference is assumed to be the sole quantifiable benefit of operational freedoms based on the results of the recent trial. The negative impact on departures is calculated by adding the A380 arrivals to the departure runway loading taking account of the additional capacity gained through reduction in separation of SIDs

LVP	Information provided by Heathrow Airport suggests that improved LVP procedures could result in 600 fewer cancellations per year split at a ratio of 70:730 long haul:short haul. Assumed to be additive in the mixed mode environment
Block time reduction	The 2008 runway resilience study shows an increase in block time of short haul flights to LHR of up to 18 minutes over 20 years. It is assumed that increases in reliability/resilience will reverse this increase by 50% over a period of 10 years, starting in 2019. Eurocontrol standard figures for strategic delays are used to calculate the associated benefit of this. Assumed to be additive in the mixed mode environment.

Maximum capacity increments

Measure	Approach and assumptions
Raise the ATM cap	Assumes three levels of increase of the cap: 500000, 515000 and 520000. Assumes that the increases occur in 2019, coinciding with the onset of mixed mode
Mixed mode	Starts 2019. Assumes that mixed mode operations start in 2019 (five year lead time) and that they generate a 10% increase in capacity for arrivals, balancing the likely benefits generated, the amount of airspace change needed and the impact on other operations and airports. For departures, the capacity increase is assumed to be 15% - delivering the maximum generated by the reduced SID separation augmented by the freedom to use both runways simultaneously for departures. Mixed mode will also overcome the delays in the current operational scenario that would occur due to the increased proportion of A380s in the fleet mix without the penalty for departures assumed for operational freedoms. The overall benefits are calculated by taking the core package benefits for the years prior to the application of mixed mode and the mixed mode benefits thereafter. Benefits are calculated based on existing flights/passengers obtaining the full delay benefits and additional flights/passengers obtaining half those benefits.
Remove night flight caps at Heathrow, Gatwick and Stansted	Starts 2019. From a resilience perspective, it is assumed that removal of the night flight caps will result in a smoothing of the schedule, and associated increases as the ATM cap are increased over the period 05:00 to 08:00 (three hours) as assumed for the use of single runway for early morning arrivals in the core package.
General	All three components of the package 1 increment have to be considered together as they are not separable nor additive.

Scenario: 1	Maximum capacity		

Quantitative assessment for resilience and efficiency

Item	Costs	Annual benefits/savings		
		Low	Med.	High
En-route arrival management, from 2019 onwards	£6M (ref: NATS)	70ktonnes CO2 saving. Fuel cost saving: £15M	105ktonnes CO2 saving Fuel cost saving: £22M	135ktonnes CO2 Fuel cost saving: £29M
Time based separations: not applicable in this package as it starts in 2019 but will be overtaken by mixed mode	N/A	N/A	N/A	N/A
Early morning arrivals on single runway from 2016 to 2019	Small	55ktonnes CO2 saving Total aircraft operating cost saving:£8.5M Pax opportunity cost saving: £4.1M		83ktonnes CO2 saving Total aircraft operating cost saving:£13.6M Pax opportunity cost saving: £6.6M
Independent parallel approaches at LHR	TBD		51ktonnes CO2 saving Total aircraft operating cost saving:£9.0M Pax opportunity cost saving: £4.3M	
Reduction in separation between SIDs from 2016 to 2019	£500k (source: NATS)	34ktonnes CO2 saving 138 tonnes NOx savings Total aircraft operating cost saving:£14.7M Pax opportunity cost saving: £10.0M		47ktonnes CO2 saving 191 tonnes NOx savings Total aircraft operating cost saving:£20.1M Pax opportunity cost saving: £13.8M
Local A-CDM from 2014	Sunk		26ktonnes CO2 saving 106 tonnes NOx savings Total aircraft operating cost saving:£10.9M Pax opportunity cost saving: £7.4M. Avoided cancellations: £6.3M	
Operational freedoms to reduce impact of A380s (2014 to 2016)	Small cost and 15 additional de-alternated flights per day		68ktonnes CO2 saving Total aircraft operating cost saving:£44M Pax opportunity cost saving: £19M.	
Operational freedoms to reduce impact of A380s (2016 to 2019)	Small cost and 20 additional		93ktonnes CO2 saving Total aircraft operating cost	

	de-alternated flights per day		saving:£49M Pax opportunity cost saving: £21M.	
Improved LVP processes: triggers for application; and increased flow rates with MLS, from 2014			Avoided cancellations: £11M	

Quantitative assessment for resilience – maximum capacity increment

Item	Costs	Annual benefits/savings		
		Low	Med.	High
Revise the planning cap at Heathrow to 500000 ATMs per year, apply mixed mode and remove the night flights cap, starting in 2019	Small		20000 additional slots at Heathrow 203ktonnes CO2 saving and 738 tonnes NOx saving Airline delay cost saving of: £52M from general delay reduction and £53M from avoiding A380 associated delays Passenger cost saving: £28M from general delay reduction and £26Mm from avoiding A380 associated delays	
Revise the planning cap at Heathrow to 515000 ATMs per year, apply mixed mode and remove the night flights cap, starting in 2019	Small		35000 additional slots at Heathrow 144ktonnes CO2 saving and 441 tonnes NOx saving Airline delay cost saving of: £38M from general delay reduction and £53M from avoiding A380 associated delays Passenger cost saving: £21M from general delay reduction and £26Mm from avoiding A380 associated delays	
Revise the planning cap at Heathrow to 520000 ATMs per year, apply mixed mode and remove the night flights cap, starting in 2019	Small		40000 additional slots at Heathrow 118ktonnes CO2 saving and 334 tonnes NOx saving Airline delay cost saving of: £32M from	

			general delay reduction and £53M from avoiding A380 associated delays Passenger cost saving: £18M from general delay reduction and £26M from avoiding A380 associated delays	