Metropolitan Transport Research Unit

The Cost-Benefit Analysis of a Third Runway at Heathrow – an Independent Assessment commissioned by WWF-UK

Part Two
Demand Forecasts

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1 Introduction

MTRU has been engaged by WWF-UK to undertake the following tasks in relation to the Cost-Benefit Analysis (CBA) published as an annex to the Government consultation *Adding capacity at Heathrow airport*[i]. These relate to the impact on the Net Present Value (NPV) and Benefit to Cost Ratio (BCR) of the proposals which would arise from using different but reasonable assumptions about the inputs to the analysis. The changed inputs are summarised below.

NEW INPUTS

- Oil price to reflect current price of over $100 a barrel (instead of the UK Government assumption of $65 today falling to $53 by 2012 and remaining at that price indefinitely)

- Taxation revenues, for example from Air Passenger Duty (or its replacement), treated as neutral in the appraisal

- Substitution of corporate air travel by improvements to electronic communications, in particular strong promotion of video conferencing

- Transfer of short distance flights to rail, both in UK and for nearby EU destinations such as Paris and Brussels

- The cost of carbon raised above the average figure used by Government, in particular the test used until 2007 of doubling the central estimate.

The different inputs would be tested individually and, where appropriate, incrementally. As far as possible all would be tested together for a final assessment.

It should be noted that some of these tests require information additional to that in the spreadsheets supplied by the Department for Transport . This data may require more detailed modelling, and where it is not available, a best estimate has been undertaken using what is available.

In fact, the elements can be divided between those which may affect the cost benefit appraisal, without any change in overall demand (Group 1), and those which slow down the predicted major growth in air travel (Group 2). The latter will effectively remove the benefits which are currently included in the cost benefit appraisal. This is because these benefits stem from increased capacity "releasing" future forecast demand which is suppressed by not expanding airports to cater for it. In the absence of suppressed demand, there is little or no benefit from adding capacity.

This Part 2 Report deals with the Group 2 changes to overall demand.

2 Approach for this study

The appraisal of Heathrow options has been undertaken by DfT using costs and benefits up to 2080. The benefits are derived from releasing demand to travel by air which would in future years be restrained by a lack of runway capacity. Future year money values are reduced (discounted) at a rate of 3.5% per year for the first 30 years and 3% thereafter.

Judging sensitivity using DfT spreadsheets

The available spreadsheets used by DfT to assess the NPV (entitled SCAB) do not contain an air passenger demand model which allows easy calculation of the impact of different oil prices. This model has been run for other scenarios and some of the assumptions behind it have been published. It is run in conjunction with a model which allocates demand between airports. This is entitled NAPALM (or NAPAM) and has not been released for public use.

The normal aviation appraisal process can thus be described as: Aviation Demand Model, then NAPALM, then SCAB.

For this study, it is possible to divide the tests into two groups. The first can be undertaken using the SCAB spreadsheets alone (the final stage above). This includes carbon price and removing taxation effects. These recalculations should be consistent with Government figures and were set out in the Part 1 Report. This report considers the potential impact of policies or events which would slow down demand, using DfT published figures and MTRU estimated reduction factors.

Baseline with and without Stansted expansion

The second group of policy changes involves making simplifying assumptions to adjust demand forecasts and their impact on the benefits. This also allows some comparisons with the sensitivity tests in the Government's latest aviation forecasting report.[ii]

The desired baseline for the study was no additional runway at either Stansted or Heathrow. The original spreadsheets supplied had analysed Heathrow with an additional runway at Stansted. It was clear that benefits would be higher for Heathrow if Stansted did not have an additional runway. Following our request, the DfT has supplied a version without the Stansted capacity and this has been used for some of the estimates in this report. However, the overall demand calculations are not dependent on assumptions about Stansted capacity.

The next section sets out the results for the Group 2 effects, based on the supplied DfT spreadsheets[iii] and the other published information.

3 Group 2: changes to overall demand

There are two basic issues in estimating the economic changes from changes in the demand for air travel. The first is the calculation of reductions in demand and the second is how this impacts the benefits.

What are the benefits?

In the case of air travel, new runways do not allow aircraft to travel faster, or save a great deal of time, as is the case with other transport infrastructure. Instead, the benefit is assumed to be the release of demand for air travel which would otherwise not be possible. To assess its value, a “shadow price” is created, based on how much it would cost to deter people from flying. If the demand does not occur, there is little value in building more capacity. Thus the benefits disappear if the forecast growth is lower than anticipated.

This makes the Heathrow runway proposal very different from other transport schemes. It is uniquely dependent upon a forecast for air travel that is predicted not to take place unless the runway capacity is enlarged.

What influences demand for air travel?

To predict demand, the DfT have made assumptions about the cost of fuel, airlines’ non-fuel costs, growth in people’s incomes and growth in the economy. The relationships between changes in fares and changes in demand are expressed using elasticities of demand for different types of air traveller. Thus, for any given increase in fares, leisure travel will be more sensitive than business travel. In fact, business travel is assumed to not be at all sensitive to price (zero elasticity).

It should be noted that there are several different relationships at work within any overall elasticity. For example, some leisure travellers may decide that a fares increase based on an oil price rise will cause them to choose a destination which is closer and thus cheaper because it needs less fuel. The number of aircraft movements would be unchanged in this case. On the other hand, some travellers may choose not to travel at all, or choose a different leisure trip with no air travel required. The sensitivity of holiday travel to places outside the UK has another important variable: the total cost of the trip including the non-travel elements. Longer distance holiday flights would be a higher proportion of total cost and thus some are more sensitive to air fare changes.

A further important factor is the exchange rate, with the pound having had a decade of relative strength. This particular factor has not been included in the DfT forecasts[iv].

Within business travel, price is also having an impact. In this case, the number of premium seats sold may decrease, particularly for short to medium flights, for example most in the EU. This has been documented already by British Airways[v], who recorded a fall from 60% business travellers in premium class in 1990 to around 20% by 2004. Thus there should be a different (lower) sensitivity among these business passengers than those who have already traded down to economy seats or no frills airlines. In the case of long hauls, downgrading may not be seen as an option and the reaction may be to seek less frequent travel.

All this complexity has been reflected in the studies which seek to establish firm elasticities for use in an aviation demand model. In the case of UK business users, it has not been possible to establish a significant relationship and this is usually set at zero. Leisure travel is currently assumed to have an elasticity of one (i.e. a 10% increase in price causes a 10% fall in travel). Charter flights are also assumed to be inelastic at 0.4 and domestic flights very inelastic at 0.3. The average for all UK flights is 0.44 and for all flights 0.56 [vi].

The important underlying price assumptions are:

- As income rises (with GDP), air travel increases (high elasticity)
- GDP grows at 2-2.5% (although this is clearly an overestimate[vii])
- Market "maturity" effect[viii], slowing down growth as people fly more (about an 18% reduction by 2030)
- Aircraft become much more efficient (30%) over the next 30 years and then stay constant
- Airlines' non-fuel costs fall significantly by 2020 (25-30%) and then stay constant.

Impact of changes to oil price

While total spending on aircraft fares is not provided in the published data, there are typical fare costs for Europe and the Far East in the DfT forecast report, showing the proportion of fuel cost and taxes, plus non-fuel operating costs[ix]. This includes aircraft becoming more efficient.

The data shows that by 2030, fuel costs for leisure flights will be about 28% of a European flight and 31% of a Far East flight. Of course, for premium fares, the fuel proportion is very much lower. These higher fares are, however, a very low proportion of all sales, between 3% and 15%.

Applying a correction of 10% for the premium seats, fuel costs (excluding any carbon tax) would be 26-27% of total fare costs for flights overall. Thus a doubling of fuel costs would result in a 26-27% increase in fares and a 12 to 15% reduction in demand (26-27% X 0.44 to 0.56). It should be noted this is applied to the unconstrained demand forecast used by DfT, which is a more than doubling of the current level of 241 million passengers per annum (mppa). This would result in a reduction from 490mppa in 2030 to 417mppa.

The current DfT assumption for the oil price in 2030 is $53 per barrel, well below half of today's $130 (May 2008). It should be noted that a higher oil price will also mean lower economic growth, which is not taken into account in the above adjustment. In the short term it is clear that the GDP assumptions used by DfT are too high by at least 0.5%. DfT itself estimates that a 0.25% reduction in annual GDP growth would result in 8% fewer passengers in 2030. This would reduce the 417mppa to 384 million.

It should be noted that the DfT model forecast year was 2005. In fact, the annual rate of growth between then and 2007 has been very much slower than predicted, falling from 8% in 2005 to 2% in 2007[x]. The overall growth is entirely due to no frills airlines; others are showing passenger falls. During the same period, the oil price rose from about $60 to over $100 (mostly at the end of 2007) and APD doubled. Since many airlines had pre-bought their fuel it remains to be seen what the longer term impact on fares and demand will be.

Taking 2006 compared to 2005, fares went up 2%[xi], the first rise in a decade, and growth slowed from 8% to about 4%[xii].

The DfT has itself undertaken some sensitivity tests in its most recent report, but these are expressed in terms of changes to total benefits rather than demand. In February 2003 it produced a new modelling run (the model was then called SPASM) requested by environmental groups which applied a tax increase of £9.2billion, including fuel duty and VAT. This reduced demand by about 37% in 2030. The doubling of fuel costs from $53 a barrel would be equivalent to about £3.5-4billion (assuming 12.4billion litres of fuel). Reducing the SPASM 2003 impact in proportion would cause a reduction of 14-16%, broadly in line with that predicted above.

This preliminary analysis, and the two most recent annual CAA results, suggest that the oil price rise will have a significant impact on aviation demand.

Targeted market interventions: short haul and video conferencing

Short haul

The recent CAA figures for aviation demand also show that UK domestic flights have fallen by 1.4% between 2007 and 2006. The CAA explanation is the increase in air journey times through new security arrangements, combined with improvements to rail services. For the EU destinations served by Eurotunnel, as well as those in the UK, rail will be increasingly attractive.

In fact, taking January 2008 compared to January 2007, domestic air traffic has fallen by 6%.

While mode transfers should be included in an overall elasticity, the current DfT estimate for domestic flights seems particularly low (0.3). It is clear, particularly taking into account the latest passenger figures, that such travel is much more sensitive than this figure suggests. Domestic flights differ from international flights in their impact because they represent low passenger numbers, but are a relatively high proportion of aircraft movements (the key for runway capacity). By this measure they represent 35% of all UK take offs and landings, although this is lower for the six London area airports at 16%.

Given that a reduction in domestic passengers of 1.4% was achieved in 2007, it seems reasonable to assume that policies to encourage near distance transfers could achieve a significant impact. New high speed links to Amsterdam will reduce travel time by at least 30 minutes from London in 2008/9. Eurostar has very recently (November 2007) cut journey times to Paris and other destinations by 20 minutes. The European high speed network will expand by 50% to 4,750 miles by 2010 and thereafter will expand by about 350 miles a year[xiii].

Examples of what can happen are available from the French high speed rail network. The Paris to Brussels Thalys takes 1 hour 25 minutes for 186 miles and this has led to the dropping of all scheduled air services. Between Paris and Marseille (486 miles), the TGV has 69% of the air/rail market (2006), up from 22% before the high speed service was introduced (2001). London to Edinburgh is less than 400 miles. Table 1 below shows flows for 2007 between the most relevant EU destinations.

Table 1
Flows between near distance EU cities and London airports
Passengers in thousands per year, Source: CAA data[xiv]

	Paris	Brussels	Amsterdam
Heathrow	1,790	689	1,799
Gatwick	2	60	670
Luton	329	-	321
London City	117	47	262
Stansted	1	-	258
Total London area	**2,239**	**796**	**3,310**

Table 2 shows flows between all UK airports and the three nearest national markets.

Table 2
Flows between near distance EU countries and all UK airports
Passengers in thousands per year, Source: CAA data

	Belgium	Netherlands	Luxemburg	**Total**
From all UK airports	1,624	8,353	251	**10,228**

This market has also been subject to change over recent years, for example Heathrow passengers to Paris, Brussels and Amsterdam fell by 9%, 7% and 3% between 2007 and 2006.

It therefore seems reasonable to test the impact of an improving share of domestic long distance travel by rail, sufficient to reduce air travel by 1% per year up to 2030. The modest level reflects the fact that we have assumed this is independent from changes to domestic air fares. This would be accompanied by a similar reduction for near distance EU destinations including Paris, Brussels and Amsterdam.

Overall this would reduce air traffic movements by 9% by 2030. Applied to the unrestrained forecast this would cause a fall from 490mppa to 446 million.

Videoconferencing

A further sector where reductions are possible is in the field of substituting telecommunications for travel. Recent research for WWF-UK suggests[xv] that the UK's largest companies are seeking to reduce the amount they fly, and are in fact predicting a fall in air travel of 3% over the coming year. The assumption tested here – an annual reduction of 1% in business travel – could probably be achieved by a strong package to promote videoconferencing, for instance by offering tax incentives. This rate of reduction would result in just over 10 million fewer passenger trips per year by 2030 (4% reduction).

This is the area where there could be some double counting if effects are combined, because business travel would be influenced by improvements in rail services. This is taken into account in the final summary of the demand reduction factors. On the other hand, for the earlier calculations in relation to the oil price rise, business travel was assumed not be affected. In this case there is no double counting. In the context of suppressed demand, fewer business trips may be replaced by more leisure trips. This would not be a factor for scenarios where there is no suppressed demand.

However, the reduction in business travel may cause an above average reduction in economic benefits because business trips have a higher value than leisure trips, and at least some of the capacity released may be taken up by such leisure travel. This would have the effect of reducing the overall benefits from generated trips.

Summary of demand reductions

Table 3 below shows the impacts of the three demand reduction policies separately and in combination. This is estimated using standard elasticities and factoring DfT forecasts. Double counting has been reduced by applying the reductions sequentially, although this will not entirely eliminate it. On the other hand, under estimation may well occur due to the synergy between supporting policy or market instruments.

Table 3
Summary impacts of demand reduction factors in 2030

	Million passengers	% reduction
DfT base forecast (unconstrained)	490	
Oil price impact on fares	417	15%
Slower GDP growth + above	384	22%
Improved rail competition	446	9%
Enhanced videoconferencing package	480	4%
All above without GDP effect	364	26%
All above with GDP effect	352	30%

The current estimated passengers in 2030 without Stansted expansion, but with Heathrow 3rd runway, amount to 452 million. Thus about 38 million trips will be suppressed due to lack of capacity. The current estimated maximum practical capacity of UK airports is around 425 mppa in 2030.

If demand falls below capacity, the only suppression would be where demand is unevenly distributed. The combination of oil price rises, continuing the trend of rail competition, and the videoconferencing initiative would easily achieve this result. Under these circumstances there would seem no need to expand air runway capacity, although terminal improvements and investment to make surface access more sustainable may be justified. There may also be some reallocation of passengers between airports.

This is clearly shown in the forecasts of unconstrained demand and demand if extra runway capacity is not built. Figures are given in the SCAB spreadsheets for each airport and from 2000 to 2080. Some key dates and figures have been summarised in Tables 4 and 5 below to illustrate the important issue of constrained and unconstrained demand.

Table 4
Constrained and unconstrained passenger demand: no SE expansion
Millions per year

	2010	2030	2080
Unconstrained	274	496	1,404
Constrained	271	421	537
Airports at capacity		Heathrow, Luton, Stansted, Belfast City, Birmingham, Bristol, Norwich, Coventry	Aberdeen, Heathrow, Luton, Stansted, Gatwick, Edinburgh, Glasgow, Leeds/Bradford, Exeter, Liverpool, Manchester, Blackpool, Newcastle, Norwich, Southampton, Coventry

Source: SCAB spreadsheet s05a, worksheet Pax BASE
Note: there are marginal differences between these and the figures in the consultation document

There are several features of this analysis. The first is that the 2080 unconstrained figure is extremely high, amounting to 10 return flights a year for every person in the UK (assuming 70 million population). The cost of carbon in 2080 would be £8.8billion for the 537 million passengers.

These figures take the project appraisal into an area of prediction which is speculative in the extreme. However, benefits from these years are still allowed to flow into the cost benefit analysis.

The next table illustrates the impact of the third runway at Heathrow. The unconstrained forecasts are unaffected. The figures for 2030 and 2080 are significantly higher, showing the release of suppressed demand.

Table 5
Constrained and unconstrained passenger demand: with Heathrow 3rd runway, no Stansted 2nd runway
Millions per year

	2010	2030	2080
Unconstrained	274	496	1,404
Constrained	271	452	579
Airports at capacity		Heathrow, Belfast City, Southend, Bristol, Bournemouth, Stansted, Coventry, Doncaster/Sheffield	Aberdeen, Heathrow, Belfast City, Belfast Int., Birmingham, Southend, Bristol, Bournemouth, Luton, Stansted, Gatwick, Edinburgh, Glasgow, Leeds/Bradford, Exeter, Liverpool, Manchester, Blackpool, Newcastle, Norwich, Southampton, Coventry, Doncaster/Sheffield

Source: SCAB spreadsheet s05a, worksheet Pax BASE
Note: there are marginal differences between these and the figures in the consultation document

Reduced demand and impact on the economic analysis

Calculating the impact of the above on benefit to cost ratios is highly complex because of the assumption that demand is suppressed by a lack of runway capacity. In these circumstances, demand may, to differing extents, be released by reductions in demand elsewhere, especially those reductions which are not caused by higher prices. This released demand will have its own costs and benefits which differ from the original traffic. This complexity could be captured by the full suite of models, but is beyond the capability of the SCAB spreadsheets alone.

It is clear that it would also be possible to undertake a cost benefit analysis of a demand restraint package with no additional capacity, because it would create benefits by removing the shadow costs of the trips released. However, the only reliable way to undertake this would be using the national demand model in conjunction with NAPALM and to make assumptions about the costs of the alternatives.

This would also address the issue of where the suppressed demand would occur: the latest forecasts assume that this is predominantly in the South East.

It should be noted that, as well as external factors which reduce demand (such as an oil price rise), it would be possible to test the benefits of increasing aviation taxes such as APD or its replacement. This would tend first to reduce leisure trips and make room for higher value business trips.

It is strongly recommended that such a model run should be requested from DfT, and that its specification should be prepared after a technical discussion with them. This would also allow for a new approach to air/rail competition.

While the calculation of a full set of new BCRs for the demand reduction options is not possible without further model availability, the scale of demand reduction benefits can be estimated. However, this reduction will occur in a slightly odd way because of the assumption that if some demand is reduced, other suppressed air travel will take its place. For example, if demand were forecast to be 452 mppa the Heathrow benefits would be very similar in the DfT model. This is because capacity without Heathrow expansion is 421 mppa so expansion still releases 31mppa. If the forecast falls below 452 mppa, the benefits from the released demand will fall roughly in proportion to the amount by which it exceeds 421mppa. Thus a demand level of 446mppa would reduce user benefits by 6/31 = 19%. At a forecast demand of 421mppa there is no excess demand and user benefits fall to zero. The precise figure will depend on assumptions made about where the demand occurs and the capacity of the most convenient airport.

These will be accompanied by the environmental benefits of reduced noise and CO2 emissions. Once there is no more traffic to be released only the environmental benefits will remain. Without considering costs, the rail attractiveness package could produce benefits of several billion pounds and the videoconferencing package just under £800 million. These figures are produced simply by factoring the total discounted benefits given in the SCAB spreadsheets and are very approximate. Again, this estimate could be refined using the full suite of DfT models and a full economic appraisal. For example, if the time spent NOT travelling under the videoconferencing package were to be costed using to Government Value of Time figures, the benefits from this option could be significantly higher. There could also be environmental benefits from videoconferencing of around £230million, but this would depend on inclusion in a package which avoided the need for new capacity. Again this figure is produced by factoring the SCAB data.

4 Conclusions

This report has considered the sensitivity of current proposals to increase runway capacity at Heathrow to a number of different but reasonable assumptions in the economic and forecasting models.

The conclusion is that the Heathrow and national models would give very different and far less favourable results with relatively modest changes to the long term assumptions on which they are based. These changes include:

For predicted growth (this report)

- an oil price in 2030 which is in real terms no more than today, rather than assuming a level less than half the current market price
- a switch from flying to destinations within the UK and to nearby European destinations to rail, in line with recent trends, rather than a continuing increase
- a modest reduction in business travel due to an improved videoconferencing initiative

For economic assessment (see Part 1 report)

- tax revenue is not counted as a benefit but as neutral, on the grounds that money spent on goods or services other than air travel would generate the same amount
- if a reform reflecting this is not implemented for other transport schemes, a tax loss should be included in the Heathrow appraisal (air fares are zero rated for VAT)
- doubling the cost of greenhouse gas emissions would remove the justification for runway expansion (previously a standard sensitivity test, still valuing carbon at less than the Stern Review)

Overall, combining only two of the factors set out above can be enough to make Heathrow expansion significantly loss making in terms of public benefits. Reducing demand would remove the need for extra runway capacity.

During this study, other factors not included in the DfT analysis have been identified, in particular the impact of exchange rate changes, the slow down in economic growth worldwide, whether the level of air travel associated with EU migrant workers would continue to grow at the current rate, and the limits to the potential market from UK residents.

A further conclusion is that the recent consultation document failed to consider these factors properly as part of a risk analysis/sensitivity test and in particular did not make use of the most recent CAA analysis for the latest two years' data. This shows significant differences from the trends set out in the UK forecasting report (which is 2005 based) and the Heathrow consultation.

It is strongly recommended that a proper demand restraint package with more realistic oil price assumptions is tested using the complete set of DfT models.

References

[i] *Adding capacity at Heathrow airport,* Consultation document, DfT, 2007

[ii] *UK Air Passenger Demand and CO2 Forecasts,* November 2007, DfT

[iii] SCAB spreadsheets as supplied by DfT, filenames "SCAB26_PSDH2a", "SCAB26_PSDH4a" and "SCAB26_s05a"

[iv] See *UK Air Passenger Demand and CO2 Forecasts,* November 2007, DfT, Para 2.27

[v] See: *Changes In Demand For Air Travel,* Professor Alamdari, Head of Department of Air Transport, Cranfield University

[vi] See *UK Air Passenger Demand and CO2 Forecasts,* November 2007, DfT, Para 2.21

[vii] See *Regional economic outlook: Europe,* International Monetary Fund, April 2008, where short term growth rates are over .5% lower than the aviation forecasts http://www.imf.org/External/Pubs/FT/REO/2008/EUR/ENG/ereo0408.pdf

[viii] See *UK Air Passenger Demand and CO2 Forecasts,* November 2007, DfT, Annex B, Para 1.27 and Table B6

[ix] See *UK Air Passenger Demand and CO2 Forecasts,* November 2007, DfT, Annex B, Table B1

[x] See *Trends in UK air passenger traffic*, CAA, January 2008

[xi] HoC written answer, 21st April 2008

[xii] See *Trends in UK air passenger traffic***,** CAA, January 2008

[xiii] See *High-Speed Rail Give Short-Haul Air a Run for the Money in Europe***,** April 2007, Travel Industry Wire: http://www.travelindustrywire.com/article27223.html

[xiv] Annual CAA data, inter alia see: http://www.caa.co.uk/docs/80/airport_data/2007Annual/Table_12_1_Intl_Air_Pax_Route_Analysis_2007.pdf

[xv] *Travelling light: Why the UK's biggest businesses are seeking alternatives to flying*, WWF-UK, May 2008