Aviation carbon emissions, a new runway and the Airports Commission

An AirportWatch Briefing.
January 2015

The key issue is whether a building new runway in the South East can be compatible with the UK's carbon targets. This briefing shows it probably cannot – and sets out why.

The briefing takes the form of questions and answers, so dividing the issue into sections, for clarity.

Summary

- Each Heathrow runway now causes emissions from departing flights of around 9.5 $MtCO_2$(million tonnes of CO2) per year.
- A new Heathrow runway could be expected to produce a comparable (slightly lower) figure, once in full use, and before any new generation of aircraft etc. – i.e. about 9 $MtCO_2$ per year.
- The Gatwick runway now causes emissions from departing flights of around 4 $MtCO_2$ per year.
- A 2nd Gatwick runway could be expected to produce a comparablefigure, once in full use, and before any new generation of aircraft etc. – i.e. about 4 $MtCO_2$ per year. But maybe more like Heathrow's figure, if more long haul flights were added over coming decades. ie. about 8 MtCO2 per year.
- Heathrow with a 3rd runway, once it had built up to being relatively full, might emit a total of around27 $MtCO_2$ per year (3 x 9 $MtCO_2$).
- Gatwick with a second runway, once it had built up business, might emit a total of between 8 $MtCO_2$and 16 $MtCO_2$. With 2 runways it would be the size of Heathrow now.
- All the other UK airports, excluding Heathrow and Gatwick, currently emit in total, around 10.5 $MtCO_2$ per year.The UK's regional airports have aspirations to grow very substantially. They might double their passenger numbers by 2050, unless a new runway in the South East sucks potential trade away from them. These airports together may grow, and attract more long haul flights. Their emissions may be 20 MtCO2 by 2050, or higher.
- **Very approximately, a 3 runway Heathrow + 1 runway Gatwick + growth at regional airports, could cause UK aviation emissions to be 27 + 8 + 20 $MtCO_2$ per year = 51 $MtCO_2$.Or more.**
- **Very approximately, a 2 runway Gatwick + 2 runway Heathrow + growth at regional airports, could cause UK aviation emissions to be 18 + 8-16 + 20 $MtCO_2$ = 46-54 $MtCO_2$.Or more.**
- If there were 20% more carbon efficiencies (CO2 per passenger kilometre), over time, reducing those figures, they would be:
- …. for a 3rd Heathrow runway, 51 $MtCO_2$ – 20% = **41 $MtCO_2$ total UK aviation emissions**. Or more.
- …. for a 2nd Gatwick runway, 46-50 $MtCO_2$ – 20% = **35-43 $MtCO_2$total UK aviation emissions.** Or more.

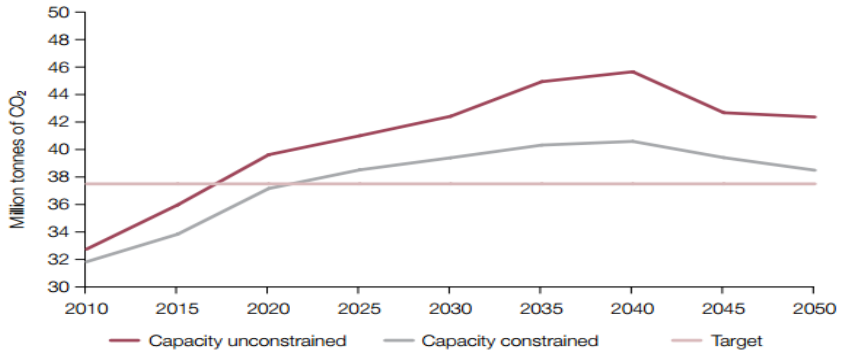
Rough estimates of carbon emissions from UK aviation by around 2050

$MtCO_2$	Heathrow	Gatwick	Other UK airports	Total	Total with 20% more carbon efficiencies	Total with 35% more carbon efficiencies
Emissions from UK aviation with a 3rd Heathrow runway (one Gatwick runway)	27 (3 x 9)	4	20 (or more)	**At least 51 MtCO2**	51 minus 20% = **41 MtCO2**	51 minus 35% = **33 $MtCO_2$**
Emissions from UK aviation with a 2nd Gatwick runway (2 Heathrow runways)	18 (2 x 9)	8-16 (higher if larger % long haul)	20 (or more)	**At least 46 – 54 MtCO2**	46 - 54 minus 20% = **35-43 $MtCO_2$**	46 - 54 minus 35% = **30-35 $MtCO_2$**

These figures do not include the carbon emissions from the running of the airports themselves, or the surface access travel of passengers and employees to and from airports. Jacobs' estimates are that these are 3 -10% of the emissions from air travel (though that is not explicitly stated). The energy from construction of the runway and buildings is not included.

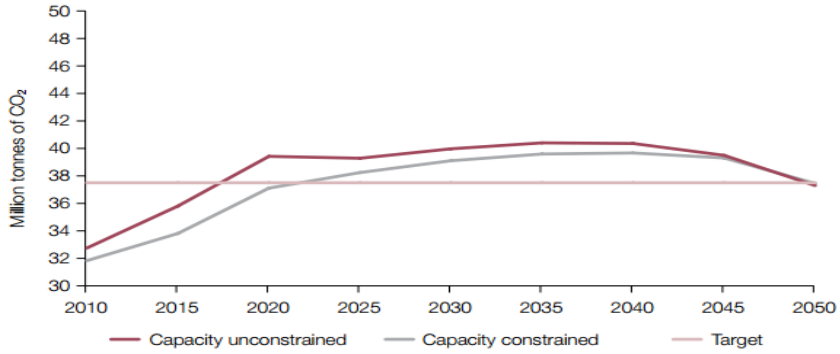
The Airports Commission's own figures show in most of their scenarios that UK aviation carbon emissions go substantially over the 37.5 MtCO2 cap, even without a new runway.

Figure 5.4 Departing CO_2 forecasts without a carbon cap (carbon traded)



5.20 **Figure 5.5** shows the effect of increasing carbon prices to achieve the carbon cap, without making any additional or operational adjustments. The 37.5$MtCO_2$ target would be exceeded before it is achieved in 2050.

Figure 5.5 Departing CO_2 forecasts with carbon capped



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

Airports Commission: Interim Report. Appendix 3: Technical Appendix. December 2013 Pages 71 & 72

These figures show that, unless blind faith and optimism are used in planning future UK runway capacity, the UK cannot add a new runway in the South East, as well as allowing its regional airports to expand, and expect to stay within its aviation carbon ceiling of 37.5 MtCO_2 per year.

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Part 1. The legal position and a cap on carbon emissions

1. Are there legal carbon targets that UK aviation has to meet?

No, not exactly. It is messy as far as aviation is concerned. The UK Climate Change Act 2008[1]says that international aviation has to be taken into account[2]but there is nothing legally binding.

What the Act does require is for international aviation and shipping emissions be taken into account whensetting carbon budgets.[3]

However,international aviation and shipping have not been included in the first four carbon budgets, covering the period 2008 – 2027. The Department of Energy and Climate Change ('DECC')is still to decide whether international aviation will be included in the fifth carbon budget, 2028 – 2032.[4]

2. What is the level of aviation emissions recommended by the Committee on Climate Change (CCC) for 2050?

The Committee on Climate Change (CCC), the Government's advisers on climate change, recommended in December 2009[5] that total emissions from aviation in the UK (domestic and international) should be no higher in 2050 than they were in 2005. That level was 37.5 MtCO_2. The full CCC report explains their recommendation.[6]

The CCC estimated that between 2009 and 2050, the aviation industry might become about 35% more fuel efficient in "carbon intensity." With larger planes, some biofuel, more efficient routing and other changes, the CCC estimated that all this would allow around 55% more flights (ATMs – Air Transport Movements) by 2050 compared to 2005– and about 60% more passengers.

The Airports Commission's Interim Report (Dec 2013) suggested these figures should be 33% more flights (ATMs) and 66% more passengers.[7]

3. Why has that 37.5 MtCO_2 level been set by the CCC?

When in 2008/2009 Heathrow Airport and the Government were trying hard to get backing for a third Heathrow runway, the Government made the commitment that UK aviation emissions would be no higher in 2050 than they were in 2005.[8] Forecasts of air traffic demand showed carbon emissions would be very much higher if growth was not controlled. The figure for emissions in 2005 was also useful, as it fitted within the period 2004 – 2006 that was the baseline for the European ETS (Emissions Trading System).

4. Might future governments decide to ignore the 37.5 $MtCO_2$ limit for UK aviation emissions?

There is always the possibility that a future government could renege on environmental legislation if business interests complain it damages the economy. However, with the atmospheric level of CO_2 rising rapidly each year[9] and ever growing global concern, it could be difficult politically for any government to change course.

Part 2. Current UK aviation emissions

5. How much carbon does UK aviation emit at the moment, compared to the 37.5 $MtCO_2$ level?

Carbon emissions from UK international aviation[10]were about15.7 $MtCO_2$ in 1990 (with 1.4 Mt CO_2 from domestic flights[11]) making a total of 17.1 $MtCO_2$. Figures for more recent years are shown below.

$MtCO_2$	**1990**	**2005**	**2006**	**2010**	**2011**	**2012**
International	15.7	35.3	35.9	31.6	33.2	32.3
Domestic	1.4	2.2	2.5	1.8	1.7	1.7
Total	**17.1**	**37.5**	**38.4**	**33.4**	**35.0**	**34.0**

These show that by 2005, the carbon emissions from UK aviation had grown to 37.5 $MtCO_2$, which is about double their level in 1990. **(**All the figures are just for departing flights, as that is the internationally recognised method of apportioning emissions from flights).

6. How much of that total UK aviation carbon is emitted by Heathrow; how much by Gatwick; and how much by all other, including regional, airports?

During 2005, domestic flights to and from Heathrow plus international departures from Heathrow generated a total of 17.1 million tonnes of CO_2.[12]

Heathrow's carbon emissions, at 17.1 $MtCO_2$ in 2005, made up around 45% of total UK aviation emissions for that year.

The Department for Transport ('DfT')[13]estimates that in 2010 Heathrow flights emitted 18.8 $MtCO_2$, 56% of the UK aviation total of 33.4$MtCO_2$. By contrast, 2010 flights from Gatwick (smaller airport, one runway; mainly short haul flights) emitted 3.9 Mt CO_2, which was 12% of the UK aviation total.

Put simply, CO2 emissions in 2010and 2050 forecasts (DfT 2013 data) with no new runways

MtCO2	**2010**	**2050**
Heathrow	18.8	18.2
Gatwick	3.9	4.3
Stansted	1.1	1.9
Manchester	2.2	5.3
Birmingham	0.8	4.6
Luton	0.7	0.9
Edinburgh	0.6	1
Bristol	0.4	1
Glasgow	0.5	0.8
London City	0.2	0.5
With all the other airports		
Total	**33.2**	**47**

Part 3. Forecast aviation emissions and assumptions on future carbon efficiency

7. How much carbon is expected to be emitted by a new runway at Heathrow, or a new runway at Gatwick?

Put very simply, probably somewhere between an extra 3 -9 MtCO2 per year. That depends the extent of improvement in carbon efficiency, and the mix of destinations.

Traditionally Heathrow has a large number of long haul destinations, and Gatwick does not. It is not unreasonable to believe Gatwick might have a much larger proportion of long haul, if it had a 2nd runway and effectively became about the size of Heathrow now. So assumptions that the emissions from a Gatwick runway would be much smaller than those from a Heathrow runway may be unreliable.

The DfT forecasts in January 2013[14] anticipate that CO_2emissions in 2050 from Heathrow, if a third runway was ***not***built, would be 18.2 $MtCO_2$ - i.e. very similar to today (about 18.8 $MtCO_2$ – or about 9.4 $MtCO_2$ per runway); the reason for the slight reduction is due to use of larger planes and some fuel efficiencies. If a third Heathrow runway was built, research by AEF and WWF expected it to add 8.2 Mt CO_2[15] per year, bringing the total of a three-runway Heathrow to 26.4 $MtCO_2$ annually. This means that Heathrow with a third runway would take up over 70% of the total CO_2 available to UK aviationunder a carbon cap of 37.5 $MtCO_2$. AEF also anticipate that a 2nd Gatwick runway could have a higher proportion of long haul flights than now, and so would have CO2 emissions higher than the current level.

Just considering the current level of emissions per runway, emissions with a new runway would be:

(MtCO2)	**2050**
Heathrow 2 runways	19
Heathrow 3 runways	27
Gatwick 1 runway	4
Gatwick 2 runways	8 to 16

8. How much fuel efficiency improvement is expected by the aviation industry, out towards 2050?

Jacobs, the consultants employed by the Airports Commission, argue that the total emissions from a three-runway Heathrow would be lower than just 50% more than the current level. Anticipating large gains in carbon efficiency over the next 35 years, Jacobs anticipate carbon emissions in 2050 might be 20.5 $MtCO_2$ per year for Heathrow with the north-west runway.[16] [And 19.9 $MtCO_2$ with the Heathrow Hub runway[17], and 5.3 $MtCO_2$ for a 2 runway Gatwick[18].] This appears to be anticipating over 20% gains in carbon efficiency (though it is not clearly explained).

Jacobs does not clearly specify what percentage improvement it is considering, but it appears to be using a figure somewhere between 20% and 35%. The figures from Jacobs are optimistic about the impact of new technology and improved operational practices. They admit that both these factors will take time to kick in – but believe that by 2050 they should have a considerable impact. They may not have as much effect earlier than 2040. Jacobs expects Heathrow's CO_2 emissions to be 23.2 $MtCO_2$ in 2030, 23.7 $MtCO_2$ in 2040, then falling to 20.5$MtCO_2$ by 2050.[19]

Estimates of carbon emissions from UK aviation by around 2050

$MtCO_2$	**Heathrow**	**Gatwick**	**Other UK airports**	**Total**	**Total with 20% more carbon efficiencies**	**Total with 35% more carbon efficiencies**
Emissions from UK aviation with a 3rd Heathrow runway (one Gatwick runway)	27 (3 x 9)	4	20 (or more)	**At least 51 MtCO2**	51 minus 20% = **41 MtCO2**	51 minus 20% = **33 $MtCO_2$**
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These figures do not include the carbon emissions from the running of the airports themselves, or the surface access travel of passengers and employees to and from airports. Jacobs' estimates are that these are 3 -10% of the emissions from air travel (though that is not explicitly stated). The energy from construction of the runway and buildings is not included.

The figures illustrate that without large, and partly hypothetical, improvements in carbon efficiency of air travel in the next four decades, the carbon emissions from a new runway in the South East rise markedly – and are likely to pass the 37.5 MtCO2 cap. There is no certainty of what carbon efficiencies will be achieved, in practice.

The CCC[20] anticipated efficiencies in carbon intensity of perhaps 35%. There are varying expectations of the use of biofuels over coming decades, with ever reducing figures. Papers by Jacobs for the Airports Commission contain projections of the efficiency of the new generation of aircraft (A350, Boeing 787 etc) compared to older models[21], and some speculation about the efficiency of aircraft designs as yet unbuilt or undeveloped. Again, the percentage efficiency is largely a matter of speculation, but between 20% and 35% per seat kilometre would be a reasonable range. Jacobs makes the assumption that biofuels are to be assessed as being zero carbon, which is a serious inaccuracy. As mentioned above, there is no reason to believe Gatwick might not, in time, develop a much higher proportion of long haul flights. The CCC and the Airports Commission interim report presume that by 2050 long-haul flights carry 26% ofpassengers and are 12% of ATMs.[22]

9. Will UK aviation CO_2 emissions rise in coming decades, before falling back to the target by 2050?

The growth in flights will happen faster than the anticipated efficiency gains, especially if these depend on new designs of aircraft that are not even on the drawing board. Overall, emissions will therefore rise.

It will take a long time for the hoped for carbon efficiencies of 20% – 35% or so to take effect (through new ways of managing airspace, new generations of aircraft and perhaps new fuels). In the meantime,aviation emissions will continue to increase.

The Technical Appendix of the Airports Commission interim report[23] contains the graphs below, which show clearly that aviation emissions rise before (perhaps) coming back down to the necessary 37.5MtCO2 cap level.

The Commission used "carbon capped" and "carbon traded" (more of that later) scenarios, and in both it is clear how much total aviation emissions exceed the cap. The problem is particularly with the "carbon traded" scenario. These also show the cap is exceeded, even without a new runway ("capacity constrained"), and far more with a runway ("capacity unconstrained.")

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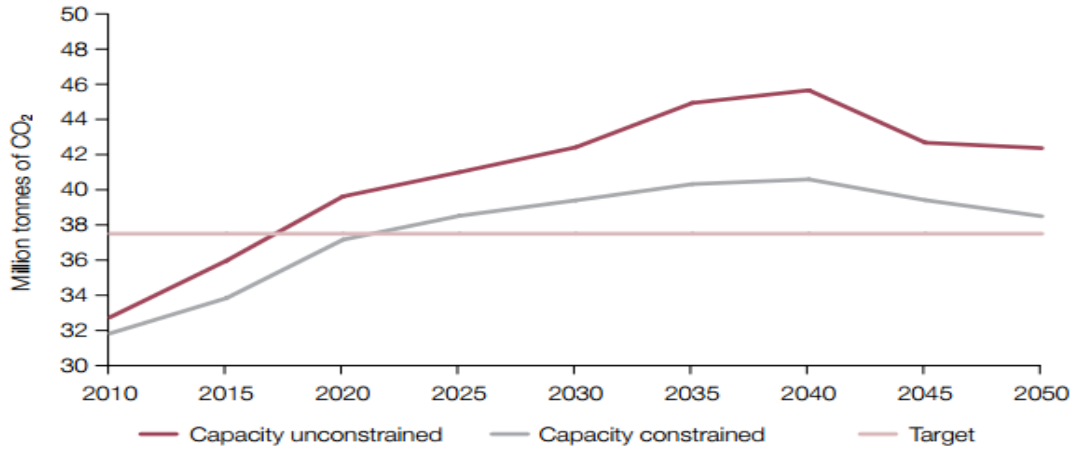

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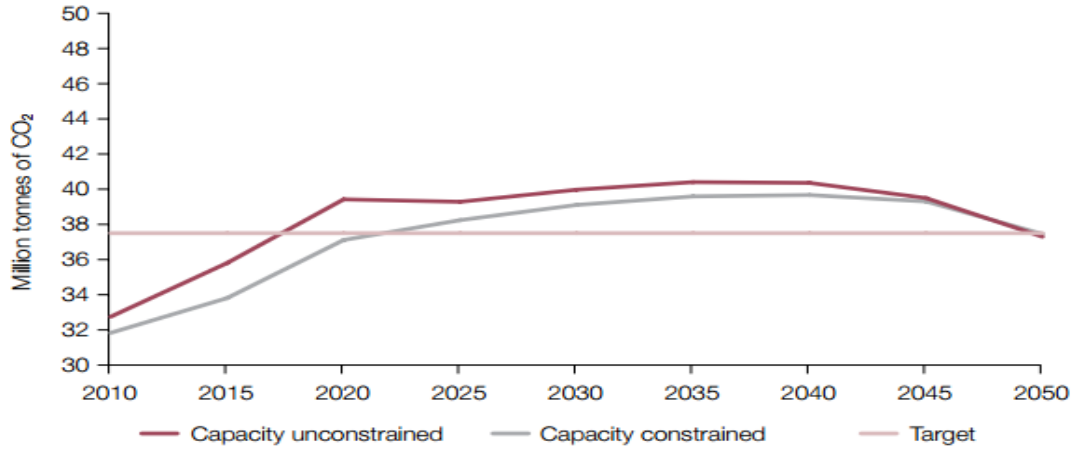

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Airports Commission: Interim Report. Appendix 3: Technical Appendix. December 2013 Pages 71 & 72

From Airports Commission Interim report. Technical appendix. Pages 71 ad 72

All the forecasts show aviation carbon emissions increasing up until 2040. The levels are around 39 – 40 Mt CO2 even with no new runway, and around 45 MtCO2 with a new runway.

The Commission's forecasts show emissions (hopefully) falling by 2050. This is not good news for the global climate. The cuts in CO2 emissions need to be made in the next decade or so; not between 2040 and 2050. What is important, in terms of reducing the increase of global CO_2, is to limit carbon emissions soon. It is the "amount of carbon under the curve" (i.e. all the carbon emitted and accumulated in the atmosphere) that matters.[24]

Part 4. Airports Commission "carbon-capped"and "carbon-traded" forecasts

10. Why does the Commission have "carbon-capped" and "carbon-traded" forecasts?

In order for the new runway to be profitable, and re-pay its shareholders, it will have to be used intensively. The costs of building the runway and other associated works are put at about £18.6 billion for a Heathrow north-west runway, and £9.3 billion for a Gatwick runway (with £13.5 billion for the Heathrow Hub option).

Carbon-capped. The Commission constructed its passenger and economic forecasts, for aviation staying roughly within the 37.5MtCO2 cap. However,as clearly the level of carbon emissions was forecast to rise far above the cap, the "carbon-capped' forecasts were produced, which showed how much demand would need to be reduced in order to meet the carbon cap. (The method was to progressively increase the assumed price of carbon and build it into the price of tickets, thereby reducing demand. But there are problems with raising the presumed price of carbon to the level necessary to cut demand for air travel).

Carbon-traded. The Commission's other option is to ignore the carbon cap, and produce "carbon-traded" forecasts instead. For these, it is presumed there will soon be an effective means of trading carbon, such as the EU Emissions Trading Scheme. In reality, there is no such scheme. The ETS only worked for one year, before being emasculated due to protests by airlines and governments. (It now only covers emissions within Europe). There is little prospect of an effective global scheme through ICAO for decades – if it ever happens at all. So there really is no mechanism by which the aviation carbon can realistically be traded.

The Airports Commission's main consultation document[25] states:

"While all of the carbon-capped scenarios keep carbon emissions from aviation within the range 37.4-37.6 MtCO2e in 2050, i.e. consistent with the Climate Change Committee's (CCC) advice, all the carbon-traded expansion scenarios entail increases in carbon emissions from aviation above 37.5 MtCO2e. The highest levels of emissions are associated with the "low-cost is king" and "global growth" scenarios, which would see UK aviation emissions in 2050 of 49-51 MtCO2e." (Point 3.16. Page 40).

Much of the Commission's work is looking at these scenarios, which without as yet unimagined policies or mechanisms to limit air travel demand, will breach the carbon limit. (Possible options might be restricting the growth of regional airports; raising the cost of air travel to restrict demand – either in the south-east or across the country; restricting the use of the new runway; restricting higher carbon aircraft or destinations…. all difficult).

The Commission needs to find ways of restraining growth in demand for air travel to build into its economic analysis for the runway schemes. [This could be compared to the analogy of having deliberately opened the stable door, and let the horse out, a lot of effort has to be put into means to try and get the horse back again ... Better not to have opened the stable door in the first place ...]

The Airports Commission admits there is a gap in its evidence so far. It says, in the consultation document (page 26):

"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 37.5MtCO_2e for its final report in summer 2015."

This information will not be prepared in time to be part of the consultation (ends 3rd February 2015) and it is not clear how comprehensive it will be. It is likely to show that the net economic benefit would become negative, fatally undermining the Airports Commission's runway recommendation

Part 5. What would be the impact of a new south-east runway on regional airports?

11. Would a new runway at Heathrow or at Gatwick mean aviation growth at regional airports would have to be restricted?

Yes, it probably would.

There are aspirations for these airports to grow considerably over future years. The most recent DfT Aviation Forecasts, published in January 2013[26], show the scale of predicted expansion at all UK airports. The table below just looks at UKairports handling over 4 million passengers in 2005 - excluding Heathrow and Gatwick.

Passengers (millions)	**2005**	**2011**	**2030**	**2040**	**2050**
Manchester	22.1	18.8	22.1	39.0	55.2
Stansted	22.0	18.0	25.4	36.0	35.4
Luton	9.1	9.5	13.8	18.6	17.7
Edinburgh	8.4	9.4	10.5	16.8	20.5
Birmingham	9.3	8.6	11.8	28.2	38.3
Glasgow	8.8	6.9	6.9	9.7	12.2
Bristol	5.2	5.8	6.8	12.3	12.3
Liverpool	4.4	5.2	5.3	8.2	15.4
Newcastle	5.2	4.3	4.2	5.8	8.9
East Midlands	4.2	4.2	3.6	9.0	14.1
Belfast International	4.8	4.1	4.9	8.2	10.3
Total	**103.5**	**94.8**	**115.3**	**191.8**	**240.3**
				Up 185% on the 2005 level	Up 232% on the 2005 level

Data for 2011, 2030, 2040 and 2050 from DfT 2013 Aviation forecasts, Annex E.2.
Terminal passenger forecasts, central demand case, 2011-2050 (constrained). 2005 data from CAA[27].

These figures show that,**regardless of new runways in the South East**, the above– mostly regional – airports are predicted to increase their numbers of passengers by about 185% on their 2005 level by 2040, and by about 230% (i.e.to well over double their present level of throughput) by 2050.

These airports are unlikely to be keen to accept restricted growth, in order to allow a new runway in the South East to take a high proportion of the total UK aviation carbon allowance. Government policy is also to help the economic growth of the regions, and stifling the growth of regional airports will not assist with this.

Figures from the DfT 2013 forecasts (central demand) show the carbon emissions from just the 12 largest regional airports (excluding Heathrow and Gatwick) in 2010 were 7.5 $MtCO_2$[28]. Their level in 2050 was forecast to be 18.9 $MtCO_2$, which is an increase of 252% on 2010, reflecting an expectation of far more long haul routes being served by regional airports in the future.

The emissions for all UK airports, in 2010 were 33.2 $MtCO_2$, with those from Heathrow and Gatwick at a combined 22.7 $MtCO_2$, making up 68% of the UK total. The emissions from all other UK airports were 10.5 $MtCO_2$ in 2010, and were forecast to rise to 17.4 $MtCO_2$ in 2030 and 24.5 $MtCO_2$ in 2050.

The DfT figures do include reductions due to anticipated carbon efficiencies by 2040 and 2050.

Annex G.2 Page 173 from the DfT forecasts, December 2013.

Annex G.2

CO_2 emissions by UK airport, 2010, 2030, 2050 central demand, max use, (constrained)

	Total CO_2 ($mtCO_2$) in 2010	Share of 2010 Total CO_2	Total CO2 (mtCO2) in 2030	Share of 2030 Total CO2	Total CO2 (mtCO2) in 2050	Share of 2050 Total CO2
Heathrow	18.8	56.6%	21.4	49.3%	18.2	38.6%
Gatwick	3.9	11.8%	4.7	10.9%	4.3	9.0%
Stansted	1.1	3.4%	3.5	8.0%	1.9	4.0%
Manchester	2.2	6.7%	3.2	7.4%	5.3	11.2%
Birmingham	0.8	2.4%	1.7	3.8%	4.6	9.8%
Luton	0.7	2.1%	1.3	3.0%	0.9	2.0%
Edinburgh	0.6	1.7%	0.7	1.7%	1.0	2.2%
Bristol	0.4	1.2%	0.7	1.7%	1.0	2.1%
Glasgow	0.5	1.6%	0.7	1.5%	0.8	1.7%
London City	0.2	0.6%	0.5	1.1%	0.5	1.0%
Liverpool	0.3	1.0%	0.4	0.9%	0.9	1.9%
Leeds/Bradford	0.2	0.6%	0.4	0.8%	0.4	0.9%
Belfast International	0.2	0.7%	0.3	0.8%	0.5	1.2%
East Midlands	0.3	0.9%	0.3	0.8%	1.1	2.3%
Newcastle	0.3	1.0%	0.3	0.7%	0.5	1.2%
Southampton	0.1	0.4%	0.3	0.7%	0.4	0.8%
Aberdeen	0.2	0.5%	0.2	0.5%	0.2	0.5%
Prestwick	0.1	0.4%	0.2	0.4%	0.2	0.4%
Belfast City	0.1	0.3%	0.1	0.3%	0.2	0.4%
Humberside	0.0	0.0%	0.1	0.3%	0.3	0.7%
Southend	0.0	0.0%	0.1	0.3%	0.1	0.2%
Bournemouth	0.0	0.1%	0.1	0.2%	0.4	0.8%
Doncaster Sheffield	0.1	0.3%	0.1	0.2%	0.5	1.1%
Cardiff	0.1	0.3%	0.1	0.2%	0.4	0.8%
Exeter	0.0	0.1%	0.1	0.2%	0.2	0.4%
Inverness	0.0	0.1%	0.1	0.1%	0.0	0.1%
Newquay	0.0	0.0%	0.0	0.1%	0.1	0.1%
Norwich	0.0	0.1%	0.0	0.1%	0.3	0.5%
Blackpool	0.0	0.0%	0.0	0.0%	0.0	0.0%
Durham Tees Valley	0.0	0.1%	0.0	0.0%	0.1	0.1%
Ground (APU)	0.4	1.2%	0.5	1.2%	0.7	1.5%
Freight	0.8	2.4%	1.2	2.7%	0.9	2.0%
Residual	0.4	1.2%	0.1	0.2%	0.1	0.2%
Total	**33.2**		**43.5**		**47.0**	

Even with no new runway at Heathrow or Gatwick, UK aviation emissions are projected by the DfT(January 2013 forecasts) to rise to 43.5 $MtCO_2$ by 2030 and 47.0 $MtCO_2$ by 2050. The emissions from all airports other than Heathrow and Gatwick could be as high as 25 MtCO2 per year.

In more detail, the DfT states:

"The constrained passenger forecasts lead to a central prediction of CO_2 emissions from aircraft departing UK airports growing from 33.3 million tonnes of carbon dioxide ($MtCO_2$) in 2010 to 43.5 $MtCO_2$by 2030. The range around this forecast is 39.7 - 48.2 $MtCO_2$. By 2050, UK aviation CO_2 emissions are forecast to be 47.0 $MtCO_2$, with a range around the forecast of 34.7 – 52.1$MtCO_2$."[29]

If Heathrow and Gatwick, including a new runway at one of them, emit some 25 – 30 Mt CO2 per year, there is little scope for the regional airports. If the regional airports (or any airport other than Heathrow and Gatwick) collectively could be emitting 20 – 25 MtCO2, that is clearly well over 37.5 $MtCO_2$cap. It would therefore be likely that growth at regional airports would need to be restricted, especially if they include a higher proportion of long haul flights.

Part 6. Omission of non-CO2 impacts

12. Why have the non-CO_2 impacts of air travel not been included in the Airports Commission's analysis?

Aircraft contribute to climate change not only by their carbon emissions, but also by other effects of the gases from their fuel combustion high in the atmosphere. These are called non-CO2 impacts, and include nitrogen oxides and water vapour. The science about how much these increase the climate impact of air travel is complicated and details are still unclear. The impact may be to as much as double the CO2 itself.

The Commission said, in its discussion document on climate change (April 2013)[30]:

"4.19 The DfT has developed an approach to estimating non-CO_2 emissions from aviation. More recently, this methodology has not been used on the grounds of the scientific uncertainty around theeffect of these emissions. Similarly, in its recent advice on the inclusion of aviation and shipping in carbon budgets, the CCC (Committee on Climate Change) recommended that non-CO_2 emissions not covered by the Kyoto Protocol34 (including NO_X, contrails and AIC – aviation-induced cloudiness) should not be included in carbon budgets at present, but that options to reduce them will need to be developed over the coming years."

Though there remains some uncertainty, this does not seem to be sufficient justification for entirely ignoring the non-CO_2 effects, and just "pushing them off into the long grass". However, taking the non-CO_2 effects properly into account would mean a new runway in the South East could not be justified. And the Commission was set up, and given three years for its work, in order to recommend one. Politics.

13. When did the DfT and parts of the UK government stop taking non-CO_2 impacts of aviation into account?

Up till 2011, the DfT included a multiplier of 1.9 for the non-CO_2 effects of air travel.In the DfT's "UK Air Passenger Demand and CO_2 Forecasts", published in January 2009, a multiplier of 1.9 for "radiative forcing" was used.[31]

However, in the DfT Aviation Forecasts in August 2011[32], the multiplier is no longer used and in the DfT's January 2013 Aviation Forecasts there is not even a mention of radiative forcing.

However, the DEFRA/DECC carbon emission factors produced in 2012 and in 2013 both continue to use the 1.9 multiplier. The DECC/DEFRA document in July 2012 states[33]:

"191. On the other hand, consideration of the non-CO_2 climate change effects of aviation can be important in some cases, and there is currently no better way of taking these effects into account. A multiplier of 1.9 is recommended as a central estimate, based on the best available scientific evidence, as summarised in Table 35 below 48. If used, this factor would be applied to the emissions factors set out here."

Table 35: Impacts of radiative forcing according to R. Sausen et al. (2005)

		RF [mW/m^2]							
Year	Study	CO_2	O_3	CH_4	H_2O	Direct Sulphate	Direct Soot	Contrails	Total (w/o) Cirrus
1992	IPCC (1999)	18.0	23.0	−14.0	1.5	−3.0	3.0	20.0	48.5
2000	IPCC (1999) scaled to 2000	25.0	28.9	−18.5	2.0	−4.0	4.0	33.9	71.3
2000	TRADEOFF	25.3	21.9	−10.4	2.0	−3.5	2.5	10.0	47.8

Notes: Estimates for scaling CO_2 emissions to account for Radiative Forcing impacts are not quoted directly in the table, but are derived as follows: IPCC (1999) = 48.5/18.0 = 2.69 ≈ 2.7; TRADEOFF = 47.8/25.3 = 1.89 ≈ 1.9

14. What would be the impact of including a multiplying factor for the climate impact of non-CO_2 aviation emissions?

If aviation's non-CO_2 emissions were to be taken into account, with a multiplier of 1.9, this would mean an approximate doubling of the climate impact of the purely CO_2 emissions from air travel. Therefore the amount of UK air travel would need to be reduced, in order to keep within the UK's aviation carbon cap.

Though including this multiplying effect may be technically difficult, it could have the effect of greatly lowering the limit for UK aviation carbon emissions. If a multiplier of x 1.9 was used, that would mean the 37.5 $MtCO_2$ limit would need to be approximately halved.

That would mean adding a new runway would be out of the question.

Part 7. Necessary carbon cuts by other sectors of the economy

15. If UK aviation is allowed to increase its carbon emissions above 37.5 $MtCO_2$ per year, how much more will other sectors have to cut their emissions, so that the UK does not breach its legal target?

The UK economy as a whole has a target, set out in the Climate Change Act 2008, of cutting emissions by 80% from their level in 1990 by 2050. Aviation was given a softer target, of keeping emissions to below their 2005 level by 2050. Air travel grew rapidly between 1990 and 2005, and during that time the sector's carbon emissions doubled.

Because the emissions from aviation have been allowed to grow, the target for carbon cuts by all other sectors of the UK economy and society has to be 85% - not merely 80%.

Lord Deben, Chairman of the CCC, wrote to Sir Howard Davies, Chairman of the Airports Commission in July 2013[34] to say:

"Our analysis has illustrated how the 80% target could be achieved through reducing aviation emissions to 2005 levels in 2050 and reducing emissions in other sectors by 85% on 1990 levels."

He continued:

"Reducing emissions in other sectors by 85% in 2050 on 1990 levels is at the limit of what is feasible, with limited confidence about the scope for going beyond this."

If the UK aviation sector was permitted to increase its carbon emissions above 37.5 $MtCO_2$, it might be necessary for other sectors to attempt to cut emissions by 2050 by more than 85%. That is not likely to be possible. Otherwise the UK fails on its climate commitments.

The Airports Commission acknowledges that UK aviation should keep its gross (not net) carbon emissions to the level of 2005 (ie. 37.5 MtCO2 e) and that if this is not done, there would be a need for "challenging reductions"[35] in other sectors of the economy.

That means, in plain English, many costs of unknown scale, and many problems for other sectors. Nevertheless, the Commission then ignores this, and continues work to assess other aspects of a new runway. The Commission even say they are contemplating the need for a second new runway, at some time around 2050.

Part 8. UK aviation expansion, a new runway - and the carbon cap

16. Can a new runway at Heathrow or at Gatwick fit within the UK aviation target of 37.5 $MtCO_2$?

Very probably not.

Even if by around 2050 there are 25% or so carbon efficiency gains, a new runway taking a lot of long haul flights (being used intensively, in order to pay back its investors) would be responsible for the emission of something of the order of 5 – 8 $MtCO_2$.

That figure would be higher if there was a high proportion of long haul flights. There seems little reason to presume, if Gatwick were to be permitted to build a second runway, that the airport would not soon become a hub, of a size comparable to Heathrow today, with many more long haul destinations.

The table in the answer to **Question 8** illustrates with approximate figures, the nature of the problem.

The graphs, by the Airports Commission itself, in the answer to **Question 9** also show how carbon emissions are expected to exceed the 37.5 MtCO2 cap, before perhaps falling back, conveniently, by 2050.

The Commission could have decided to look only at means of ensuring UK aviation emissions stay below the 37.5 MtCO2 level. However, they did not.

The aim of the Commission has been to work out whether a new runway would definitely be economically advantageous, both to the runway investors – and to the country. If the carbon figures did not fit, the Commission needed to find ways to make them fit. It had, after all, already decided that its recommendation would be for a new runway. So that is why the Commission works with "carbon capped" and "carbon traded" scenarios.

17. Can the UK stay within its aviation CO2 cap by 2050, if there is no new runway built?

Possibly, but perhaps with some difficulty.

The 2013 forecasts by the Department for Transportshow large increases in UK demand for air travel, regardless of whether a new runway is built in the South East. The number of passengers using UK airports was about 213 million in 2010, and 227 million in 2013.

Without a new south east runway, the DfT's 2013 low and central forecasts of number of passengers in 2050 are between 339 to 447 million (increases of about 60 – 113% compared to 2010).

Without a new south east runway, the DfT's low and central forecasts of number of passengers in 2040 are between 306 and 371 million (increases of about 46% and 77% compared to 2010).

Even if the industry achieved 35% greater fuel efficiency, per passenger kilometre, between now and 2050, that is likely to be out-weighted by the higher number of passengers. 35% may be an over-optimistic figure for fuel economy, as these savings are – with current knowledge – just theoretical.

Though there may be more fuel efficient planes, the length of journeys may be greater in future years – negating the fuel efficiency. Biofuels are unlikely to be available in significant quantities, or to be particularly low carbon.

With fuel efficiency gains of around 20% or so, which might be more realistic, it seems unlikely that UK aviation emissions – with a new south east runway – could stay under the 37.5 MtCO2 cap.

All the forecasts and estimates omit the non-CO_2 impacts of aviation. If these need to be included in future, effectively considerably lowering the 37.5 MtCO2 cap, it is highly unlikely that UK aviation – with a new runway – could meet the cap. [Even if a low multiplier for non-CO2 effects was used, such as – picking a figure at random – x 1.3, then the 37.5 MtCO2 would drop to 25 MtCO2.]

The industry would have considerable difficulty meeting the cap, even in the absence of a new, heavily used, runway.

18. If there was a new runway, and UK aviation emissions exceeded the 37.5 $MtCO_2$ cap, would it be necessary for the runway to be only partly used?

That does not seem likely.

The Airports Commission estimated, in its consultation document (November 2014[36]) that the construction of a second runway at Gatwick, together with a third terminal and all associated infrastructure, would cost up to £9.3 billion. It estimated that the Heathrow north-west runway scheme would cost c. £18.6 billion including construction of the new runway, a new terminal and all other required airport facilities. And they estimated that the Heathrow Hub scheme (extended northern runway) would cost c. £13.5 billion, including the runway extension, a new terminal and all other required airport facilities.

Those are huge sums to be repaid to investors. There are also substantial sums that the taxpayer would have to fund, particularly on road improvements – but also sums not yet quantified on items such as social infrastructure. The runway would need to earn as much money as possible, in order to repay all the investment.

It is possible theoretically that curbs could be put on the use of a runway, retrospectively. However, there would be considerable problems. Alternatively the price of air travel from that airport could be raised, to cut demand, but still make sufficient profit.

19. If the only way to keep UK aviation emissions below the 37.5 $MtCO_2$cap was to put the price of air travel up substantially, to limit demand for air travel, would a new runway then be profitable?

The carbon figures make it clear that adding a new runway in the South East would mean constraining the future growth of regional airports, to keep under the 37.5 $MtCO_2$ ceiling. (See point 11 above.) Or if regional airports were not to be constrained, there would have to be restrictions on the numbers of passengers in the South East.

Demand can most easily be reduced by increasing price. Some parts of the aviation market (such as low budget holiday travel) are particularly price sensitive. If the price of air tickets was raised, for example by a high price of carbon, and numbers of travellers fell, there are doubts that a new runway would then be economic.

The Airports Commission knows it has a real problem here. In its consultation document, November 2014[37], the Commission said:

"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$MtCO_2$e for its final report in summer 2015."

– i.e. they do not have the necessary information on whether a runway could be viable, with the necessary price of carbon in future.

The Commission is not going to provide more on this topic in time for their consultation (which closes on 3rd February 2015).

20. Would the best solution to the problem of UK aviation carbon emissions be not to build a runway?

Yes, that would be the simplest, cheapest and most effective solution.

If a new runway is permitted and built, it will be very difficult to restrict air travel demand to keep below the carbon cap of 37.5 MtCO2. There is a high risk of exceeding the cap, and contributing to the UK failing to meet its legally binding climate targets.

The easiest, cheapest and more effective way to keep UK aviation carbon emissions within their desirable range, is not to build a new runway.

Without a new runway in the South East, aviation in the UK can continue to grow at a reasonable level; the regional airports could grow as necessary; the North-South divide would not be amplified; and the imbalance between the South East and the rest of the UK for air travel could be somewhat rectified.

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[2]Domestic aviation (flights only within the UK) is fully included within the Climate Change Act and within carbon budgets.

[3]Section 10 (2) i of the Climate Change Act 2008.
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[13]DfT "UK aviation forecasts" January 2013. Page 90. Table 6.3
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/223839/aviation-forecasts.pdf

[14] ibid. Page 172. Annexe G.2

[15]"Implications of South East airport expansion for regional airports", Aviation Environment Federation & WWF, June 2014 - http://www.aef.org.uk/uploads/WWF-regional-airports-report2.pdf

[16]"Carbon Assessment", Jacobs. Page vi.
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/372450/8-carbon--assessment.pdf

[17] ibid. Page ix

[18] ibid Page iii

[19]Using the same assumptions for Gatwick, if Gatwick had two runways (based on the current level of carbon efficiency and current type of air traffic) it might be expected to emit about 2 x 3.9 = 7.8 $MtCO_2$ per year, at current rates. Presuming both runways are operating at 95% capacity, the emissions would be 95% of 7.8 $MtCO_2$, which is about 7.4 $MtCO_2$ per year. Jacobs does not give a figure for their estimate of emissions in 2050.

[20]"Carbon Assessment", JacobsPage 10
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[21]ibid. Pages 84 and 85

[22]Page 66. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/266670/airports-commission-interim-report-appendix-3.pdf
[23]Pages 71 and 72
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/266670/airports-commission-interim-report-appendix-3.pdf
[24] For an example of a chart showing the accumulated carbon, see Page 174, Figure 7.13 of the CCC Dec 2009 publication
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[34] Lord Deben letter to Sir Howard Davies. 3 July 2013
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[37] ibid. Page 26