Aviation and Climate Change Policy in the UK

A report for AirportWatch

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Photo: Phil Weedon

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Note: The views and policy suggestions contained in this paper are entirely those of the author and should not be taken to represent the position of AirportWatch or its member groups.

Summary

Context
In March 2011 the Government published a Scoping Document as the first step in its process to develop a new aviation policy. The Scoping Document rejects the previous government's *Future of Air Transport* White Paper as out of step with climate change policy, and lays considerable stress on the need to develop a 'genuinely sustainable framework' for UK aviation.

Recent History
The White Paper (2003) supported three new runways and expansion at 30 airports around the UK, leading to a doubling of CO_2 emissions from UK aviation between 2000 and 2050. Many commentators considered this an unsustainable proposition from the outset, and with the passing of the Climate Change Act in 2008 the problem was brought into sharp focus: aviation emissions were being allowed to increase while the overall economy was required to achieve an 80% cut in greenhouse gas (GHG) emissions on 1990 levels by 2050.

Following analysis by the Committee on Climate Change (CCC), the Government attempted to square the circle by setting a target for aviation emissions to be no higher in 2050 than in 2005, and asked the CCC to report on how this could be achieved. The resulting report made it clear that the expansion envisaged in the White Paper would have to be scaled back significantly. Given likely improvements in aircraft efficiency, the CCC advised that passenger numbers in 2050 should be limited to 370 million, whereas the White Paper supported growth up to 570 million in 2050. Neither refusing permission for new runways or applying a carbon price to aviation (or even the two policies combined) will be sufficient to reduce passenger numbers to the level required to meet the target.

Non-CO_2 impacts of aviation
Furthermore, recent advances in the science of aviation's non-CO_2 impacts support current Government practice of using a precautionary multiplier for aviation emissions of 2, on the basis of 100-year Global Warming Potential. The science is likely to be sufficiently robust to include these effects within the UK's carbon budgets within a decade, and this will require the aviation target to be tightened if other sectors are not to be required to make unrealistic reductions.

Prospects for reducing emissions
There is a range of projections of the rate at which aircraft fleets will improve overall efficiency. The industry's estimate, set out in the Sustainable Aviation Roadmap, uses highly optimistic assumptions that result in an annual rate of improvement that is twice that assumed by the Department for Transport, and 2.5 times higher than that of the CCC. At least one industry group acknowledges that the CCC is right to recommend a more cautious estimate as the basis for airports policy.

Although biofuels hold the potential to reduce the carbon intensity of aviation, there are serious concerns around whether their use can be scaled up in a way that is sustainable and affordable. Overall, for the purpose of planning airport capacity, the Government should accept the CCC's 'likely' estimate that biofuels will make a 5% contribution to reducing aviation CO_2 emissions in 2050 (which equates to 2.5% of its overall climate impact).

The alternatives

Rail already offers an alternative to many UK flights, and an extended and co-ordinated high-speed rail network, both in the UK and Europe, could extend the substitution potential in coming decades. Videoconferencing will play an increasingly valuable role in a carbon-constrained world, and already progressive businesses are making substantial savings by substituting virtual meetings for air travel – leaving them far more resilient to shocks to the air transport system such as the recent volcanic ash cloud. The Government has published a Tourism Strategy, with an explicit goal of increasing the number of domestic holidays taken by UK residents, in recognition of the benefits this brings the UK economy.

Airports policy should be determined in conjunction with related policies and alternatives to air travel fully considered.

Policy recommendations

The over-riding aim for a sustainable aviation policy should be to ensure the sector makes a fair contribution towards meeting the UK's overall climate change targets, especially the legal requirement for an 80% reduction in GHG emissions from 1990 levels by 2050. This will require confirmation of the 2050 Target, as well as robust mechanisms to ensure the sector is on track to meet it, and a mechanism to review its stringency in light of developments in climate change policy or the science of aviation's non-CO_2 impacts.

Since the UK airport system, in terms of planning permissions granted, is *already today* close to the maximum number of passengers compatible with achieving the 2050 Target, the Government must urgently clarify that the White Paper no longer affords a basis to support expansion of any airport, and should only release additional capacity when the industry has demonstrated that efficiency improvements mean that it can be 'afforded' in terms of emissions.

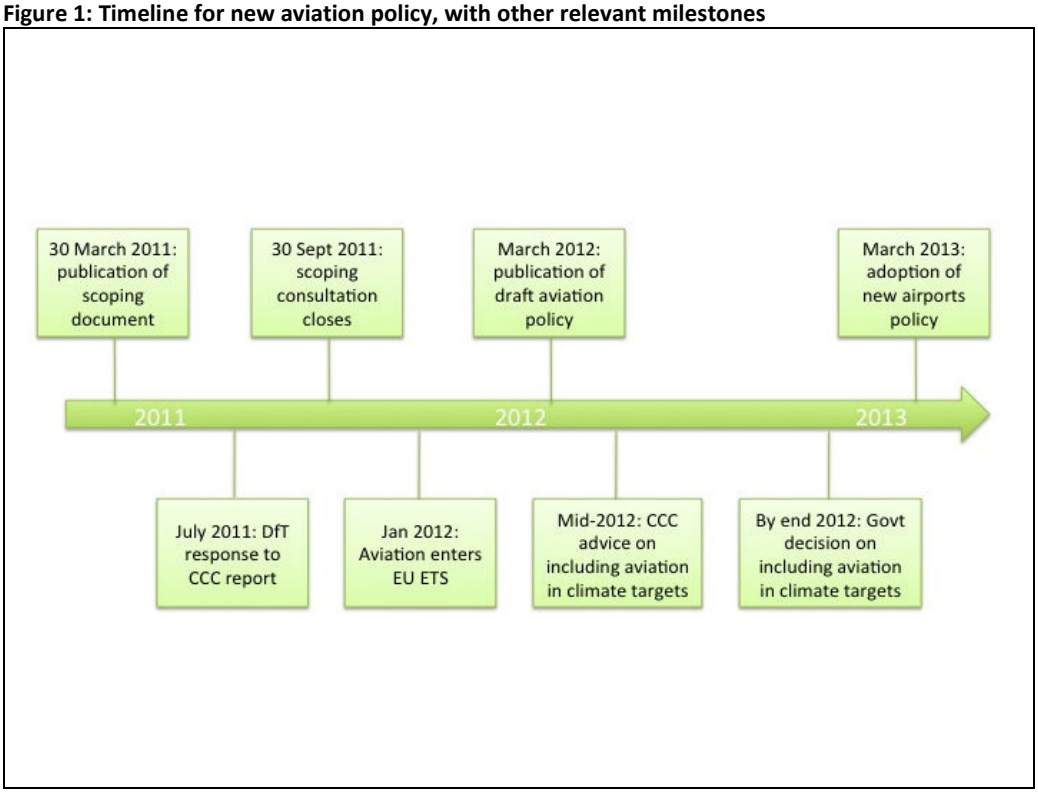
Government should ensure that aviation taxation recoups as far as possible the revenue lost via fuel tax and VAT exemptions, and develop a package of measures to support alternatives such as rail travel, domestic holidays and virtual meetings.

It should seek to strengthen the terms of aviation's inclusion in the EU ETS during any general review of the ETS. Any increase in auctioning revenues should be directed to climate change projects in the developing world, as part of the effort to negotiate a multilateral global deal coverall all international aviation emissions.

Chapter 1. The context

On 30 March 2011, the Department for Transport (DfT) initiated the process to develop a new policy for UK aviation, with the publication of a scoping document called 'Developing a sustainable framework for UK aviation'. The scoping document is a six-month consultation on the general principles that should underpin UK aviation policy. The DfT intends to consider responses to this consultation and publish a draft policy for further consultation in March 2012, with a view to adopting the new policy in March 2013.

Figure 1: Timeline for new aviation policy, with other relevant milestones



The new aviation policy will replace the previous government's *Future of Air Transport* White Paper (2003), which provided for three new runways, the expansion of over 30 UK airports, an increase in passenger numbers from 180 mppa[1] to 470 mppa, and a doubling of greenhouse gas emissions – all between 2000 and 2030.

Environmental campaigners and others have long condemned the White Paper's unsustainable 'predict and provide' approach, which simply allowed airports to expand in line with passenger demand – itself inflated by the tax breaks which make

1 Million passengers per annum

air travel artificially cheap.[2] This assessment has been shared by a growing number of politicians in recent years, as the scale and urgency of the threat posed by climate change becomes ever clearer. The Secretary of State's Foreword to the scoping document concurs with this view:

The previous government's 2003 White Paper, The Future of Air Transport, *is fundamentally out of date, because it fails to give sufficient weight to the challenge of climate change. In maintaining its support for new runways – in particular at Heathrow – in the face of the local environmental impacts and mounting evidence of aviation's growing contribution towards climate change, the previous government got the balance wrong. It failed to adapt its policies to the fact that climate change has become one of the gravest threats we face.*

The end of the White Paper regime marks a turning point in aviation policy: an important opportunity to build 'a genuinely sustainable framework' for UK aviation. This paper considers the emissions profile of UK aviation, its likely future evolution, and the climate change policy context with which it must be reconciled, and goes on to propose the essential elements of a genuinely sustainable framework.

2 The aviation industry pays no tax on kerosene and all aspects of its operations are zero-rated for VAT. Air Passenger Duty only goes a small way to compensate for these anomalies, meaning that the exemptions cost the Exchequer around £10 billion annually.

Chapter 2. Recent History: from the White Paper to today

The White Paper

The *Future of Air Transport* White Paper was published in December 2003 after a lengthy consultation process. The overwhelming majority of responses to that consultation were opposed to airport expansion (typically at a particular airport).[3] Nonetheless, the resulting White Paper supported expansion at over 30 UK airports, with new runways at Stansted, Heathrow, and either Glasgow or Edinburgh, with an option reserved for Gatwick. This unprecedented programme of expansion was predicted to result in an increase in passenger numbers from 180 mppa in 2000 to 470 mppa in 2030, and a doubling of UK aviation CO_2 emissions[4] over the same period, from around 30 $MtCO_2$[5] to over 60 $MtCO_2$.

The White Paper claimed to have rejected a 'predict and provide' model. 'Predict and provide' refers to a policy approach that was discredited for road transport in the 1990s, when it was proven that building new roads induced additional traffic. This meant that adding new road capacity could only ever provide a temporary relief for congestion, and was completely unsustainable in the long run. Despite the claim to the contrary, the White Paper all but embraced this approach: it predicted that passenger numbers would grow to 500 mppa in 2030, and provided capacity for 470 mppa – over 90% of the predicted growth.

The policy was immediately condemned as unsustainable – and not only by environmental groups. The House of Commons Environmental Audit Committee was highly critical of the White Paper, focusing in particular on the favoured tax status of aviation, and the difficulty of reconciling the growth in aviation emissions with the UK's climate change target – even as it then stood, as a 60% cut in from 1990 levels of emissions by 2050. It issued several reports into aviation, and had concluded already by 2006 that the White Paper was out of date:

We urge the Department to widen the terms of its current progress review of the 2003 Future of Aviation White Paper into a fundamental rethink of its airport expansion policy. […] The Department for Transport must work with the Department

3 See summary of public responses at http://collections.europarchive.org/tna/20080728103028/http://www.dft.gov.uk/about/strategy/whitepapers/air/responses/thefuturedevelopmentofairtra5692

4 Throughout this report 'UK aviation emissions' is used to mean 'emissions from flights departing from UK airports': this is virtually the same as emissions from fuel sold in the UK, and one or other is the usual basis for Government policy. Accounting for UK emissions on a 'consumption' basis, ie according to the nationality of the passenger, would increase emissions by around a third, since some two-thirds of passengers on flights to and from the UK are UK residents.

5 Million tonnes of carbon dioxide.

for Environment, Food and Rural Affairs to construct a new approach to aviation which constrains its future growth.[6]

AirportWatch also provided an alternative vision for airports policy: using the DfT's passenger forecasting models, former Treasury economist Brendon Sewill factored in a gradual correction of aviation taxation, so that by 2030 kerosene taxes were comparable to petrol or diesel taxes for private cars. The result was that passenger demand grew more slowly, at about the rate that technology advances could improve the efficiency of the aircraft fleet: emissions remained broadly stable, and there was no need for additional runways.[7]

The Government stuck to its guns. The 2006 White Paper Progress Report did little more than confirm existing policies, despite a campaign mounted by AirportWatch, calling on the Government to carry out a fundamental rethink in the light of developments in climate change science and policy – notably the Stern Review, which had been published a few months earlier.

The Climate Change Act

The Climate Change Act, which received Royal Assent in November 2008, was a watershed in UK climate change policy. It ensured that for the first time, emissions reduction targets (for 2020 and 2050) were legally binding, and it established five-yearly budgets to ensure progress towards the targets. The Act was considerably stronger than the draft Bill initially published: the headline 2050 target became an 80% cut on 1990 levels of all greenhouse gases, not a 60% cut, and although emissions from international aviation and shipping were not formally included in the carbon budgets, the Act required that the budgets were set 'with regard to' those emissions – and required the Government to include them formally by 2012 (or explain why not).

The Act also established an independent advisory body, the Committee on Climate Change (CCC), whose advice made it clear that carbon budgets should be set lower if aviation emissions were not being reduced – in other words, they should be set as if aviation emissions were included. The Committee's first report under the Act in December 2008 (*Building a low-carbon economy – the UK's contribution to tackling climate change*) modelled ways for the UK economy to reach the overall 80% cut in 2050. It advised that if international aviation (and shipping) emissions remained broadly stable – the most ambitious target it could then foresee – the rest of the economy would be required to make a 90% cut to compensate.[8]

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6 *Reducing Carbon Emissions from Transport*, Ninth report of Session 2005-2006 Session, para 113 and 116.

7 *The Hidden Cost of Flying*, AEF 2003, page 18ff.

8 The '90% scenario' also included some extra effort in land-based sectors to compensate for achieving only a 70% cut in non-CO_2 emissions – mainly due to the difficulty of very deep cuts in agricultural emissions.

The 2050 target and CCC report

In January 2009, then Secretary of State for Transport Geoff Hoon announced the Government's support for a third runway at Heathrow. In doing so, he established a new target for CO_2 emissions from UK aviation: that they should be no higher in 2050 than in 2005 (ie 37.5 $MtCO_2$). This target is 'absolute' – ie it cannot be met using offsets or permits bought through the EU Emissions Trading System.

The 2050 Aviation Target is in line with advice from the CCC about aviation's contribution to the UK's overall climate targets, and provides a mechanism to ensure that one of the few sources of emissions in the UK that is still growing is kept under control. The Secretary of State asked the CCC to advise on how the 2050 Target could be met.

In December 2009 the CCC produced its report, *Meeting the UK Aviation Target*. The report analyses trends in aircraft fuel efficiency and forecasts likely improvements. Because the premise of the report is that emissions must be no higher in 2050 than in 2005, the equation it presents is very simple: aviation can only grow in line with the efficiency gains that it can achieve. The CCC presented three scenarios for technological improvement and uptake of biofuels: Likely, Optimistic and Speculative, and made it clear that airports policy should be planned on the basis of the Likely Scenario.

In the Likely Scenario, annual fuel efficiency improvements were 0.8% per annum and biofuels accounted for 10% of total fuel usage by 2050. Factoring in a small improvement in passenger load factors by 2050, the CCC concluded that passenger numbers could grow by 60%. This means that passenger numbers should be no higher than 370 mppa in 2030. By contrast, the White Paper provided for growth to 470 mppa in 2030. The latest DfT forecasts, from Jan 2009, have revised this figure slightly to 455 mppa in 2030, but also provide projections to 2050, by which time the White Paper would have enabled 572 mppa.[9]

Figure 2: Comparison of White Paper and CCC target-compliant scenarios

Year	Passengers (mppa) / growth on 2005 levels	Passengers (mppa) / growth on 2005 levels
	White paper (updated)	CCC 'Likely' Scenario
2005	230	230
2030	455 / +98%	300* / +30%
2050	572 / +149%	370 / +61%

* The CCC report does not give 2030 figures; the figure here is an interpolation.

9 *UK Air Passenger Demand and CO_2 Forecasts* (DfT 2009) Table 2.16 on page 59 incorrectly reports the figure for 2050 as 525 million. The error was confirmed in correspondence between the author and the DfT, and the figure of 570 million was used, uncontested, throughout proceedings in the Heathrow legal challenge.

The CCC report did not make recommendations about particular airports, or the exact mix of policies that would be needed to meet the target. But it was very clear that the Government must now plan to constrain demand, either through economic measures or the planning system, to a 60% increase in passengers[10] (or a 55% increase in air transport movements (ATMs)) – well below what was set out in the White Paper:

The Committee's clear conclusion is however that the combination of future aviation policies (combining tax, capacity expansion and slot allocation decisions) should be designed to be compatible with a maximum increase in ATMs of about 55% between now and 2050, and that this should continue to be the policy approach until and unless technological developments suggest that any higher figure would be compatible with the emission target.[11]

It should also be noted that the CCC carried out forecasts that estimated passenger demand under a scenario of White Paper expansion, but with a carbon price that rises from £70/tCO_2 in 2030 to £200t/CO_2 in 2050. Applying this price reduced demand from 570 mppa (without a carbon price) in 2050 to 490 million.[12] Applying an even higher carbon price (rising to £300 t/CO_2 in 2050) reduced demand further, but only to 455 mppa – still well short of the target. So it can be seen that carbon pricing for aviation is not a complete answer to achieving the emissions target, even assuming that pricing at these levels can be achieved in practice.

The CCC also modelled a scenario where no new runways are built in the UK (effectively the Coalition Government's interim policy). This reduced demand to 475 million passengers in 2050. Again, it can be seen that a policy of no new runways will not in itself be sufficient to meet the 2050 target.

After the report was published, at the request of WWF, the CCC also modelled a scenario of no new runways, together with the central carbon price. In this scenario, demand was reduced to 425 mppa. Therefore even a policy of imposing a substantial carbon price on aviation, and building no new runways, will not be sufficient to meet the Target if regional airports are allowed to continue expanding.

10 Equivalent to annual growth of around 1.2%.

11 *Meeting the UK Aviation Target – options for reducing emissions to 2050*, CCC (2009) page 150.

12 These carbon prices have been the Government's central forecast since July 2009. Previous DfT forecasts, from January 2009, use the previous carbon price, which is much lower in the longer term – hence the CCC forecast without the carbon price corresponds closely to the figure given in the 2009 forecasts for 2050.

Figure 3: Summary of CCC demand projections

Scenario	Passenger demand in 2050 (mppa)
White Paper capacity, no carbon price	570
White Paper capacity, central carbon price	490
White Paper capacity, high carbon price	455
No new runways, no carbon price	475
No new runways, central carbon price	425
Maximum demand to meet 2050 target	**370**

Heathrow Judicial Review

The CCC report exposed the fact that the expansion set out in the White Paper could not be reconciled with the 2050 Target. Since that Target is derived from the overall targets under the Climate Change Act, the report implied by extension that aviation policy was incompatible with the Climate Change Act. This disparity was a key argument in the legal challenge to the Government's support for a third runway at Heathrow that was brought by a coalition of residents' groups and environmental organisations in February 2010.

Lord Justice Carnwath found great force in these arguments:

Common sense demanded that a policy established in 2003, before the important developments in climate change policy, symbolised by the Climate Change Act 2008, should be subject to review in the light of those developments.

The claimants' submissions add up, in my view, to a powerful demonstration of the potential significance of developments in climate change policy since the 2003 White Paper.

The CCC's December report on the 2050 cap, […] on its face raises serious issues about the overall aviation growth assumptions on which the 2003 ATWP was based.[13]

The Government had an opportunity to revise its policy in the light of climate change developments when drawing up an airports National Policy Statement (NPS), and the Court invited it to sign an undertaking that it would not simply import the contents of the White Paper into the new airports NPS.

By signing the undertaking, the Government accepted that the White Paper was not a fixed and final document; indeed the Heathrow judgment strongly suggested it was out of date. However, regional airports and planning authorities have continued to

13 Judgment in *Hillingdon LBC v Secretary of State for Transport*, March 2010, paras 52, 77 and 96.

rely on the White Paper as setting the policy basis for expansion projects, and this reliance has been challenged in the courts. A Judicial Review of permission to expand London City Airport was rejected by the High Court, although the decision is being challenged on appeal. Bristol Airport was granted permission to expand in February 2011, in the belief that the White Paper remained the correct basis for determining planning applications. Again, this decision is being challenged by way of Judicial Review.

Although permissions for the expansion of London City and Bristol were granted before the Scoping Document in March 2011 unambiguously rejected the White Paper, the current planning situation remains indeterminate. To give certainty to local planning authorities and residents, and to ensure that piecemeal expansion does not swallow up in a non-strategic way any remaining airport capacity increases compatible with climate change targets, the Government should clarify that its rejection of the White Paper means that there is no current policy basis for regional airport expansion.

Chapter 3. Non-CO_2 impacts of aviation

Aviation contributes to climate change in several ways, not only though its CO_2 emissions. When released at high altitude, oxides of nitrogen (NO_x) cause changes to atmospheric chemistry that have a net warming effect.[14] Water vapour and soot both cause a small direct warming effect. Aircraft also produce contrails in certain atmospheric conditions, and these can develop into additional cirrus clouds – both of which have a warming effect. Finally, aerosol particles in aircraft exhaust change the reflective properties of existing cirrus clouds, and although these effects are still poorly understood, it seems likely that they cause warming – and potentially a very significant amount.

There is scientific uncertainty (to a varying degree) over the size of each of these effects. However, according to the precautionary principle, scientific uncertainty should not be used as an excuse for inaction. There is also debate over the most appropriate way to relate these effects to the warming effect of CO_2 – the main difficulty being that they all last for different lengths of time.[15]

The 1999 report from the Intergovernmental Panel on Climate Change introduced a metric known as the Radiative Forcing Index (RFI). This measured the present-day radiative forcing (warming where the forcing is positive, or cooling where it is negative) from each of the non-CO_2 elements, and compared it to the present-day warming from aircraft CO_2. The IPCC gave a range of 2-4 for the RFI, and a best estimate of 2.7.

Since that time, the RFI of 2.7 has often been cited as an emissions multiplier. This is technically incorrect. RFI looks backwards, and measures the present-day effect of all historical aviation activity. The incorrect use of RFI as a multiplier has played into the hands of the aviation industry, which has been able to cite scientific opinion condemning it. In doing so, the industry has left policy-makers with the impression that the non-CO_2 effects can be ignored for the time being. But this is highly misleading, since despite the uncertainties, it is clear that aviation has significant non-CO_2 warming effects.

Recently however, estimates have been published by the leading scientists in the field for a forward-looking Global Warming Potential for aviation emissions.[16] Global Warming Potential measured over 100 years – GWP(100) – is the metric used to weight the different gases covered by the Kyoto Protocol, so it is a well-accepted and understood measure. It is also appropriate to use as an emissions multiplier – ie for

14 NO_x destroys methane (a cooling effect), but increases ozone (a greater warming effect). In both cases these effects are the end product of more complex reactions.

15 For instance, the effects of NO_x are strong but short-lived, whereas the effects of CO_2 can go on for several hundred years. So measured over a short time, the total warming impact from a flight would be dominated by NO_x, and be many times higher than the impact of CO_2 alone. Measured over 500 years, the total impact of a flight would appear to be little more than the effects of CO_2.

16 Lee et al. (2009) 'Aviation and global climate in the 21st century', Atmospheric Environment

expressing the extra damage caused by a flight, or by a year's worth of aviation emissions – because it looks forward to the future warming caused by emissions.

The estimate published for the GWP(100) was 1.9-2.0, suggesting that a multiplier of 2 applied to CO_2 emissions is justified on a precautionary basis to account for the non-CO_2 effects of aviation.[17]

At present, the DfT accounts for non-CO_2 emissions using a multiplier of 1.9 (for excercises such as cost-benefit appraisals). The non-CO_2 effects, however, are not included in the Climate Change Act, the UK's carbon budgets, or the 2050 Target for aviation.

The CCC considered these issues in its December 2009 report, and while it did not recommend including non-CO_2 effects in UK carbon budgets at this stage, because this would put the UK out of step with international accounting practices, it envisaged that

as scientific understanding develops, and to the extent that this confirms the significant additional warming from aviation non-CO_2 effects, it is very likely that these will become fully accounted for in the international framework for limiting climate impacts[18]

and that when this happened, its advice to UK government would change. Including aviation non-CO_2 effects within the budgets using a multiplier of 2 would either require other sectors to make even more effort to meet the overall 80% cut, even beyond the 90% cut that the present aviation target imposes on them (if the aviation CO_2 target remained the same), or would mean that aviation CO_2 emissions would have to be reduced by 50% (for the same effort in other sectors) – or some combination of the two. The CCC's view was that

It is reasonable to assume […] that some additional emissions reduction effort would be required in aviation.[19]

In other words, the present allowance for aviation emissions should be regarded as a provisional maximum that will in all likelihood have to be reduced further if aviation is to play its fair share in the UK's overall effort to combat climate change. The implications for sustainable aviation policy are considered further in Chapter 6.

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17 The figure of 1.9-2.0 quoted includes the effect on cirrus clouds, which is the least well-understood element of the overall impact. Very recently, however, research has been published that calculates cirrus cloud warming by a much more robust method than previously, but produces a similar value to earlier, rougher estimates. This work therefore lends weight to the GWP estimate of 1.9-2.0. It is also worth noting that this value is very close to more recent estimates of aviation's RFI – a value of 1.9 is implied by the IPCC Fourth Assessment Report – in other words the choice of metric does not have a major effect on the policy-relevant conclusions – that aviation's overall warming effect is around double that of its CO2 alone.

18 CCC (2009) page 130

19 CCC (2009) page 132

Chapter 4. Prospects for reducing emissions: technology, operations and biofuels

Aircraft engines have become substantially more fuel efficient since the beginning of the jet age around 1960. However, there are several reasons to be cautious about assuming that this trend will continue into the future (and it should be noted that the historical gains are routinely overstated). This chapter examines claims about historic gains in efficiency, and then considers the prospects for further reductions in future, including through the use of biofuels and from improved air traffic management.

These questions are crucial to planning for a sustainable level of airport capacity, as they are the main factors linking the number of passengers using UK airports, and the resulting level of emissions. However, other factors are in play, such as passenger load factors, and the average distance flown by each passenger. These complicate the equation and argue for a precautionary approach to planning capacity. Policy-makers should be aware that since 1990, UK aviation emissions have grown at a virtually identical rate passenger numbers (see Figure 5 below), despite the claimed gains in fuel efficiency during this period.

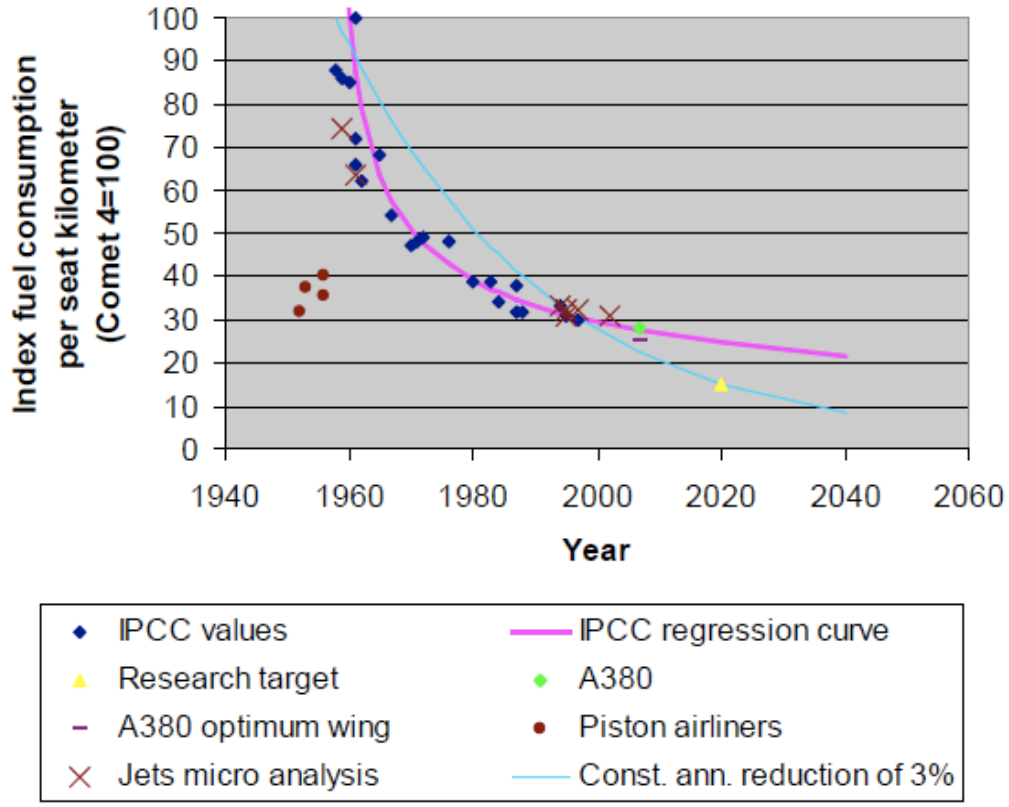
Historic trends

The aviation industry often states that aircraft have become 70% more efficient sine 1960. However, the reference aircraft used to calculate this figure is the DH Comet 4, a very early design of jet that was significantly less efficient than its competitors (and was soon withdrawn for that reason). A truer comparison with the first successful jet aircraft (the Boeing 707 family) yields an improvement of 55% over the same period.[20] (Since jet aircraft were significantly less efficient than the piston-engined aircraft they replaced, aircraft efficiency has not improved at all if this comparison between different types of plane is admitted.)

Furthermore, the bulk of these efficiency gains were made in the 1960s and 70s, as the basic design of the jet engine was rapidly improved. But jet engine technology is now highly optimised, and in recent decades fuel efficiency gains have slowed down, as shown in Figure 4 below.

20 Peeters et al, *Fuel efficiency of commercial aircraft - an overview of historical and future trends* (2005) page 18.

Figure 4: Fuel efficiency of jet aircraft



Source: Peeters et al, *Fuel efficiency of commercial aircraft - an overview of historical and future trends* (2005)

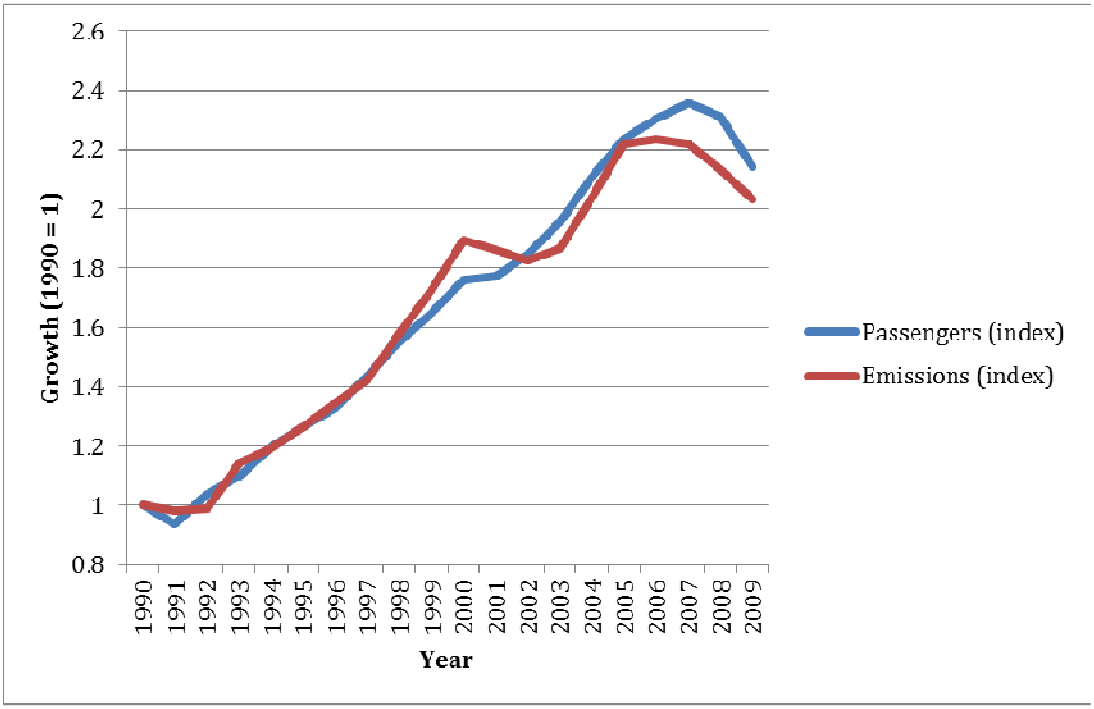
Aircraft design is also constrained by the need to reduce noise and NO_x emissions, in order to minimise the local environmental effects of aviation.[21] The effects of these trade-offs on future aircraft are considered in more detail below, but it should be noted that they already affect aircraft design: the A380 was designed to be around 2% less efficient than it could be (by increasing the size of the engine fans) in order to meet the noise criteria for flying into Heathrow at night.

Finally, even if aircraft themselves are becoming more efficient, there may be other factors in play that affect the relationship between passenger numbers and overall emissions, such as passenger load factors and the average distance flown by each passenger. These factors may be the reason why growth in UK emissions has tracked growth in terminal passengers extremely closely in the period 1990-2009 (see Figure 5 below), despite the claimed gains in fuel efficiency during this period. Historical data on average flight distances from UK airports is not readily available, meaning that is not possible to identify the reason for this trend with certainty (although

21 As described in Chapter 3, NO_x emissions have a warming effect at high altitude; at ground level they cause local air pollution. High levels of nitrogen dioxide can aggravate asthma and other respiratory conditions.

global data suggests that there is in fact a trend towards longer flights). It may be the case that manufacturers' claims for aircraft performance are not achieved under real-world operational conditions. Whatever the reason, the marked failure to decouple passenger growth from emissions growth argues for extreme caution in planning any future increase in airport capacity.

Figure 5: Trends in UK terminal passengers and emissions from UK aviation



Source: CAA airport Statistics and UK National GHG Inventory data (DECC)

Future technology trends

As argued above, aircraft are already highly optimised, and achieving substantial improvements in future will be difficult, and costly. The aviation industry, on the other hand, argues that the fleet will continuously and rapidly improve its efficiency.

The industry's vision is set out in a document called the Sustainable Aviation Roadmap, which claims that fuel consumption can be cut by 69% between 2000 and 2050, allowing passenger numbers to triple while emissions do not increase.[22]

The first pillar of the Roadmap is achievement of the targets established by the Advisory Council for Aeronautical Research in Europe (ACARE)[23] to drive reductions in aircraft noise, CO_2 and NO_x emissions. It then assumes that the fleet will quickly

22 Sustainable Aviation is a body comprised of UK airlines, airport operators, manufacturers and the UK's Air Navigation Service Provider, NATS.

23 This target is represented by the yellow triangle in Figure 4 above.

be filled with ACARE-compliant planes, and that further improvements can be made by both 'incremental' improvements (0.5% a year from 2021) and 'radical' new technologies (20% after 2030).

Most experts doubt that the ACARE targets will be met, in part because of trade-offs between the three targets for noise, NO_x and fuel efficiency. The most straightforward way to reduce fuel consumption is to increase pressure inside the engine (more technically, increase the 'by-pass ratio'). But this leads to an increase in NO_x production. Other technologies under consideration, such as open-rotor engines are much noisier, and although the noise can be dampened, doing so increases weight, meaning that the aircraft's overall improvement is lower.

A study carried out for the German Government and published in March 2008 examined the feasibility of meeting all three ACARE targets and concluded that

As far as trade-off problems are concerned, joint achievement of the three most important ACARE environmental objectives by 2020 is not yet realistic without effects concerning an increase in total weight.[24]

Greener by Design also questions whether the ACARE climate change target can be met:

we must recognise that the nature of the technical challenges facing aircraft and engine designers […] cast some doubt on the achievability of the most environmentally important ACARE goal, the reduction of fuel burn by 50%[25]

Greener by Design notes that the most promising technology to bring ACARE targets 'within reach' (a contra-rotating open propeller) only applies to short-haul aircraft. The fact that options for meeting the target for long-haul aircraft are much less well developed significantly undermines the Roadmap forecasts, since 66% of UK aviation emissions are from long-haul flights.[26]

Given the large uncertainty regarding the first step of the Roadmap, serious doubt must be cast on the more speculative assumptions it relies on after 2020. In particular, the only 'radical' technology it names is the blended-wing-body aircraft: a new concept that fundamentally changes the aircraft layout by seating passengers within an enlarged wing rather than a central fuselage. The CCC has said that development of such an aircraft would require 'as yet unplanned high levels of investment.'[27] (There is also the unresolved question of the comfort of passengers seated towards the wingtips, who would suffer major vertical movement as the aircraft banked.) Given the well-publicised delays associated with the launch of even

24 *Zusammenfassende Darstellung der Effizienzpotenziale bei Flugzeugen unter besonderer Berücksichtigung der aktuellen Triebwerkstechnik sowie der absehbaren mittelfristigen Entwicklungen* (2008), page 4, author trans.
25 *Annual Report 2009-2010,* Greener by Design, page 12.
26 CCC (2009) Figure ES2 on page 14
27 CCC (2009) page 18.

evolutionary aircraft such as the Airbus A380 or Boeing Dreamliner, the lead-time for such a revolutionary aircraft, if it ever enters production, is likely to be very long indeed.

Operational improvements

There is some scope for improvements to Air Traffic Management (ATM), in particular from rationalising the use of European airspace – the so-called Single European Sky. This could achieve a theoretical maximum of a 10% reduction by 2020 (on 2006 levels), although less may be achievable in practice. Such a reduction would only apply to a maximum of one third of UK emissions (since two-thirds are from long haul). Looking worldwide, the global Air Traffic Management body CANSO estimates that air traffic management is already 92-94% efficient, and has set a target for it to be 96% efficient by 2050 – meaning that further feasible efficiency gains are only 2-4%.

The Sustainable Aviation Roadmap factors in a 10% ATM improvement; the CCC report assumes 6% in its Likely scenario.

Other practices such as towing aircraft using electric vehicles instead of allowing them to taxi using main engines, or reducing cabin weight (currently the focus of an international airline PR initiative) could each offer one-off reductions of around 1%.

Technology and operations – Summary

The Sustainable Aviation Roadmap is significantly more optimistic than most other technology forecasts, and assumes an annual improvement around twice as fast as the Department for Transport (see Figure 6 below).

Figure 6: comparison of estimates of future fleet efficiency improvements

Source	Year	Scope	Average annual improvement
Sustainable Aviation	2008	UK	2.10%
DfT (central)	2009	UK	1.1% (to 2030), 0.75% (to 2050)
CCC	2009	UK	0.8% (Likely), 1.0% (Optimistic), 1.5% (Speculative)
US FAA	2009	Global	1.0% (Low), 1.5% (Optimistic)
IEA	2009	Global	0.9% (High Baseline), 1.1% (Baseline), 1.5% (BLUE Map scenario)
QinetiQ	2008	Global	Up to 1.5%
IPCC	1999	Global	1.3% (to 2010), 1.0% (to 2020), 0.5% (to 2050)

Source: Adapted from CCC 2009, table 4.3 on page 94

ICAO has adopted a target for an annual efficiency improvement of 2% per annum, and the UK is preparing an action plan this year for how to achieve this target.

However, the target is only intended to be binding to 2020, and is explicitly 'aspirational' from 2021-2050. The difficulty of achieving this target is underlined by the fact that the International Air Transport Association (IATA) lobbied for the ICAO target to match its own weaker, aspirational goal of a 1.5% annual improvement up to 2020.

Industry group Greener by Design noted the difference between the CCC forecasts and the more ambitious scenario of the Roadmap, and while it stood by the Roadmap as a stretching goal for industry, it agreed that it was better to base policy on the CCC scenario, especially in light of recent trends:

The more cautious view taken by the CCC, which is acknowledged and justified in its report, is arguably a more defensible basis for advising Government on future policy. […] Some recent evidence […] suggests that this caution is probably justified.[28]

Biofuels

There is much debate in the airline industry at present about 'sustainable' aviation biofuels, as at first glance these appear to offer one of the few options for deep decarbonisation of aviation. However, there are major caveats:

Specifications for aircraft fuel are extremely demanding: it must be certified at a wide range of temperatures and have a high energy density. That said, early problems with the viscosity of biofuels at low temperatures have now been addressed for hydro-treated vegetable oil-based fuels, and certification for commercial use is expected soon. However, the stringent requirements for aviation fuel may tend to make it more expensive to produce than biofuels for road use.

'First generation' biofuels, such as those made from palm or soy, can replace food crops or drive deforestation, have been linked to rising food prices, and in many cases have higher lifecycle GHG emissions than fossil fuel once land-use changes have been considered. Although the aviation industry has pledged not to develop these unsustainable sources, this has not been the case in practice: Lufthansa (with funding from the German Government) is planning a series of test flights using a 50% blend of biofuel in one engine. Although Lufthansa has insisted that all fuel used will be certified sustainable, it has not publicly revealed the biomass it intends to use. The fuel will be supplied by Neste Oil, which sources palm oil feedstock from IOI, a Malaysian corporation heavily implicated in rainforest destruction and land-rights conflicts. Rainforest campaign groups state that Lufthansa has privately confirmed that palm oil will be used in these flights.[29] Finnair has recently dropped plans to source biofuels from Neste, citing sustainability (and price) concerns.[30]

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28 *Annual Report 2009-2010,* Greener by Design, page 7.

29 www.actforclimatejustice.org/2011/01/german-government-funds-lufthansa-partnership-with-leading-palm-oil-agrofuel-producer/

30 www.makebiofuel.co.uk/news/finnair-postpones-introduction-of-biofuel

Biofuels from 'alternative feedstocks. Sustainability concerns about palm and soy have led to increased interest in crops such as jatropha or camelina, which can be grown on supposedly 'marginal' land, and therefore in theory do not compete with food production or drive deforestation. However, there is no agreed definition of 'marginal' land, meaning that in practice there is little additional sustainability guarantee offered by these crops. Nor are there reliable estimates of the global availability of marginal land, making it very unclear whether such sources could ever be scaled up to meet a significant fraction of demand – especially as the crops are not as energy rich as palm oil.

Future biofuels, such as those produced from algae, do have potential to avoid the sustainability problems of other crops, as the only requirements would be sunlight and seawater (meaning certain desert areas could be used to produce them). However, this is at present an embryonic technology, and current processes are extremely expensive.

Land availability and sustainability concerns: generally-speaking, first generation biofuels compete directly with land used for food, or drive direct deforestation (as has happened with palm oil plantations in Indonesia).[31] While other biofuel crops can be grown on supposedly 'marginal' land, in future agriculture may need to expand into areas that are currently 'marginal' in order to feed a growing population. Additional pressure on land use from biofuels can then lead to indirect land use change, where agricultural activity is displaced or cannot expand due to biofuel production, and therefore expands into areas that are currently forested or have carbon-rich soils (such as peatlands). There are also likely to be negative effects on biodiversity as a greater proportion of land comes under direct human control.

While it is possible in theory to regulate to prevent direct land-use change, existing sustainability safeguards have proved hard to enforce in areas with weak governance. It would be even more complicated to regulate against indirect land-use. This implies that meaningful sustainability criteria would have to severely restrict the allowable types of feedstock.

Competition with other users of biofuel and biomass: globally, aviation demand for biofuels is likely to be small in relation to other users such as the road haulage industry, or private motorists. When this is combined with the extra technical difficulty inherent in developing aviation biofuels, it may have serious implications for investment decisions: biofuel manufacturers are more likely to target their products at bigger and less demanding market segments. Biomass can also be used for applications that do not involve converting it to liquid fuel, such as directly in power stations, or for home heating and cooking. Aviation would be in competition for its biofuel feedstock (or the land used to grow it) with uses such as these, which may be driven more strongly by public policy, as the lack of an energy-intensive refining stage means that in the main they offer greater overall emissions savings.

31 See for instance *Cooking the Climate*, Greenpeace 2007

On the other hand, aviation is perhaps the sector with fewest viable alternatives to hydrocarbon fuels, meaning that it may be willing to outbid other biofuel users (although this would increase costs), or be able to secure targeted policy support as a priority sector.

Non-CO_2 impacts of aviation are not addressed by biofuels, which current research suggests would produce broadly similar NO_x, contrail and cirrus cloud effects. This means that even a hypothetical 'perfect' biofuel that had zero lifecycle emissions would only reduce aviation's warming impact by half.

Policy implications

The factors discussed above mean that it would be unwise to plan UK airport capacity on the basis that there will be a major expansion in the use of aviation biofuels. The Committee on Climate Change has advised Government to plan for no more than a 10% penetration of biofuels by 2050. In its view these are likely to achieve a lifecycle GHG reduction of 50% - in other words biofuels should not be expected to reduce aviation CO_2 emissions by more 5% in 2050. This equates to a reduction in aviation's overall climate impact of 2.5%.

Policy lessons should be learned from the experience of the Renewable Transport Fuels Obligation, which sets targets for biofuel use in for road transport and has led to the unsustainable expansion of palm and soy plantations in rainforest countries. The Government-commissioned Gallagher Review advised in 2008 that these targets should be lowered, and stricter controls introduced in order to avoid this effect.[32]

Aviation biofuels policy must not repeat these mistakes: strict sustainability criteria should be introduced as part of the certification process so that unsustainable biofuels cannot be developed, rather than relying on the aviation industry to ensure sustainability. As argued above, problems with policing land-use changes imply that feedstocks that have been associated with unsustainable land-use in the past should either be excluded altogether, or be subject to even stricter requirements to demonstrate that they have been sustainably cultivated.

Certification should also involve an assessment of the full lifecycle GHG savings from the biofuel in question, and only the actual reduction achieved should be credited in any policy measures. Currently, the EU ETS rates any biofuel as carbon neutral, whatever its actual lifecycle GHG emissions. As well as being unsound from a GHG accounting perspective, this rule provides a significant economic incentive to develop aviation biofuels, before sustainability criteria have been agreed; it is likely to be a key factor in Lufthansa's push to commercialise biofuel. This rule should be amended at the first opportunity.

32 Gallagher Review, Renewable Fuels Agency 2008, page 10.

Chapter 5. The alternatives: rail, video-conferencing, 'staycations'

A major weakness of the *Future of Air Transport* White Paper was its exclusive focus on promoting aviation growth, without any serious consideration of whether the drivers of that growth could be tackled, and what the alternatives to air travel might be. A genuinely sustainable framework for aviation must grapple with these questions, as it is now clear that growth in the sector will need to be restrained if it is to play its part in tackling climate change. And just as it must be coherent with wider climate change policy, any aviation strategy should join up with other Government policies, such as the recent Tourism Strategy, which seeks to support the British tourist industry.

This chapter considers three alternatives to air travel – rail (including high-speed rail), replacement of business travel with 'virtual meetings' through technologies such as videoconferencing, and holidaying nearer to home – the 'staycation'.

Rail

Travelling by rail produces significantly lower CO_2 emissions than travelling by air. Although this much is clear, exact comparisons are difficult, because trains can run on either diesel or electric power, and where they are electric, the generating mix will affect the overall CO_2 emissions. Eurostar has published audited research showing that a trip on its trains to Paris or Brussels produces around 10 times less CO_2 than the equivalent trip by air.[33] The Association of Train Operating Companies in the UK estimates that emissions for UK train travel are around a quarter of those for a domestic flight.[34] The extra savings on Eurostar may be attributable to the high proportion of nuclear power in the French electricity mix – but this variation highlights the potential for reducing rail emissions in future: any path to achieving the UK's overall climate target will require deep decarbonisation of the power sector by the 2030s – meaning that electric trains will be running on extremely low-carbon power within a few decades.

Today, a significant number of flights are on routes where rail could compete:

Domestic flights: there were around 18.8 million passengers on domestic flights in 2010[35] – equivalent to almost one in five passengers taking a flight from a UK airport. Of these, around 7.8 million were flying to or from Edinburgh or Glasgow airports,

33 www.eurostar.com/UK/uk/leisure/travel_information/before_you_go/Green_Eurostar.jsp
34 *Environment and Energy* briefing paper, ATOC 2010
35 Excludes trips to the Channel Islands and Isle of Man. All passenger destination data in this section is taken from the Civil Aviation Authority airport statistics for 2010.

suggesting that improving train services to Scotland should be a priority in transferring journeys to rail. Although some of these passengers will be catching connecting flights at Heathrow, for point-to-point travellers the total journey time from the centre of London to the centre of Edinburgh or Glasgow is already close to competitive for the fastest trains, and for business travellers offers far more continuous working time in a more comfortable environment. The main disincentive is price: taxation of domestic aviation fuel, or VAT on domestic air tickets would go some way to redressing the balance. Any improvements to intercity train services would also see benefits in terms of reduced motorway journeys.

South East to Paris/Brussels: in 2010, around 0.25 million passengers flew from Heathrow alone to Brussels. (The Gatwick to Brussels service, which carried around 25,000 passengers in 2009, was no longer operational in 2010.) Some 0.8 million passengers flew from the London airports to Paris. So overall, there are around 1 million trips a year on the routes covered by Eurostar, which can reach Paris in two and a quarter hours and Brussels in under two hours.

There has been significant debate around the building of a second high-speed line (HS2) in the UK that would reduce journey times between London and major cities in the Midlands and North. At the same time, the high-speed network in Europe is being expanded and there are plans for improved integration of timetabling, that would make through journeys to a wider range of European destinations more attractive by rail (even without HS2, Eurostar now offers through tickets from any UK station to wide range of destinations in France and Belgium, as well as further destinations in the Netherlands, Germany and Switzerland).

Sustainability concerns around HS2 are discussed below, and a series of potential conditions proposed that would ensure the project is designed to reduce emissions. But regardless of HS2, there is potential for air-rail substitution with an expanded and integrated European high-speed rail network:

South East to near Europe: Figure 7 below lists a number of additional near-European destinations, their distance from London and the annual passengers flying from the London airports to those destinations.

Figure 7: air passengers to selected near European destinations

City	Distance from London (km)	Passengers in 2010 from London Airports (million)
Amsterdam	356	1.2
Cologne	498	0.2
Lyon	734	0.2
Geneva	740	1
Zurich	780	0.8
Marseille	1001	0.2
Frankfurt	1012	0.7
Total		**4.3 million**

Other UK to Europe: Finally, we illustrate a range of other routes that could become feasible for air-rail substitution, with total outbound passengers in 2010:

- To Paris from major UK mainland airports[36] – 0.8 million;
- To Brussels from major UK mainland airports[37] – 0.2 million;
- Birmingham to near European cities listed above – 0.4 million;
- Manchester to near European cities listed above – 0.6 million.
- **Total – 2 million**

High Speed Rail – conclusions and caveats

A brief survey of air routes from UK airports suggests there is significant potential for switching short-haul air travel to rail – nearly 19 million domestic passengers, and over 7 million more to near European destinations – in total around one in four flights from UK airports. Not all of this potential can be realised, of course. In particular it will be hard to persuade passengers on feeder flights to Heathrow to travel by train when their destination is the airport rather than the city centre. On the other hand, the list of European destinations at or under 1000km cited above is by no means exhaustive; major tourist destinations reachable by sleeper train have not been considered (eg Berlin, Milan, Rome, Barcelona); nor, in this section on rail, has substitution of flights to Dublin been considered – although over 3 million passengers flew there from major UK airports in 2010. It should be noted, however, that such routes represent a smaller proportion of emissions than passengers – only 13% of UK aviation emissions are from flights under 1000km.[38]

To draw passengers from planes, the rail alternative will need to be competitive on both price and time. Whether rail competes on price is due in part to the tax and subsidy treatment of the two sectors and is beyond the scope of this paper. To make a number of the routes identified fully competitive in terms of journey time would require the building of new a high-speed line in the UK (as well as concerted effort to ensure the integration of the wider European network).

The Government supports a new high-speed line running from London to Birmingham initially and at a later date to Manchester and Leeds ('HS2'). A new high-speed rail line could draw travellers out of planes and cars, and free up existing rail capacity, but building new lines causes local environmental damage, is itself a carbon-intensive process and carries risks of 'hypermobility', whereby people are simply enabled to travel ever further and faster, at a higher and higher energy cost. The HS2 project is only said to be 'broadly carbon neutral' by the Government.

36 Birmingham, Bristol, Edinburgh, Glasgow, Liverpool, Manchester, Newcastle
37 Birmingham, Bristol, Manchester
38 CCC (2009) figure ES2 on page 14.

However, given its potential to reduce short-haul flights, and thus aircraft noise, GHG emissions and local air pollution, HS2 could also be an attractive alternative to airport expansion. In order to realise its potential benefits, HS2 should be designed with emissions reductions in mind, and be part of a wider sustainable transport policy. The following conditions for support of HS2 are therefore proposed:

- it should be part of a wider strategy to reduce short-haul air travel and car use, so that it does not generate additional demand but substitution from higher carbon modes;
- it should primarily serve cities, not airports: the connection to Heathrow should be a spur rather than the main line;
- it should be extended to Scotland as soon as possible in order to compete with the busiest UK domestic air routes;
- it should be designed to minimise local environmental impacts.

Virtual meetings

Whereas high-speed rail requires major new infrastructure and can only ever compete with short-haul flights, business travel can be avoided altogether by holding virtual meetings using video, audio, Skype or web conferencing over existing broadband infrastructure. As internet speeds increase, and both hardware and software evolve, the videoconferencing (VC) experience is improving all the time. In particular, so-called 'telepresence' – premium VC where participants appear as life-size in a room configured like a normal meeting room – now offers a high-quality alternative to travel to many smaller meetings.

The financial benefits to companies that can reduce employee travel are very significant – as it saves not only on air fares but hotel costs and insurance; it also avoids the loss of working time while travelling, and can improve the work-life balance of employees who would otherwise spend many nights away from home.

Of course, not all business travel can be avoided in this way, and physical travel will still be necessary, for instance for larger and longer meetings, or for meeting clients for the first time. WWF-UK, an AirportWatch member, has set up the One in Five Challenge, a guided award scheme that aims to help businesses reduce air travel by 20% over five years. A number of participants have already achieved this challenge and, in the scheme's first year, participants overall cut 33,000 flights, saving £6 million and 6,000 tonnes of CO_2[39]

It is sometimes argued that VC actually generates more travel by creating new business opportunities, and that this effect offsets any reduction. This might be the case if there is no imperative to reduce air travel, but where there are sound environmental or financial reasons to do so, VC is a crucial tool to maintain business connectivity while flying less.

39 *One in Five Challenge Annual Report 2009/10*, WWF-UK

The WWF experience suggests that making reductions of 20% of business travel are feasible for progressive businesses today, even over a very short timescale. As the technology continues to improve, airfares increase in response to carbon and oil price rises, the network of interoperable VC systems spreads, and a generation that has grown up with internet-based video calls enters the boardroom, it may be that as much as half of all business travel can be avoided in this way.

There are good reasons for Government to have a proactive strategy to support VC:

- Business travellers subsidise leisure passengers in many airline price models. Reducing business air travel will therefore force leisure fares to rise, restraining demand without the need for politically difficult tax rises.

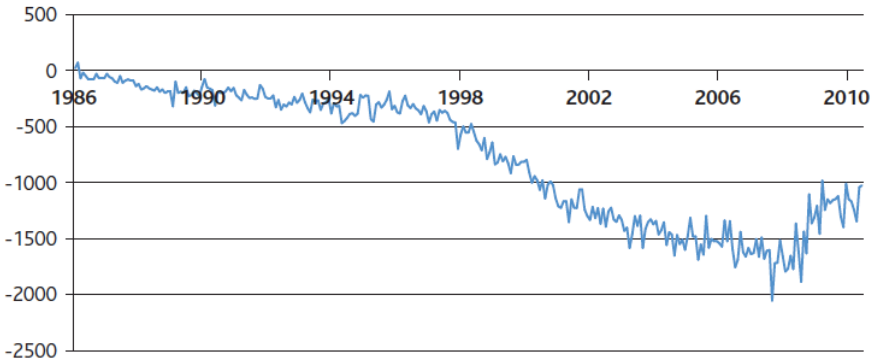
- Maintaining strong virtual connections improves the resilience of British business to shocks such as the 2010 volcanic ash-cloud (when VC-enabled businesses suffered far less than competitors, and overall VC use increased dramatically) or any future oil price shock.

- Government itself can save significant time and taxpayers' money by substituting virtual meetings for air travel by Government employees.

Staycations

Air travel can also be avoided when UK residents holiday in the UK. There has been a rise in the so-called 'staycation' in recent years. Although this was due partly to the recession and weakening of the pound against the euro, encouraging this trend though Government policy would have a beneficial effect on the UK economy. Currently, the UK runs a tourism trade imbalance – the difference between the spending of UK residents abroad and that of foreign visitors to the UK – of around £12 billion, down from a peak of around £17 billion in early 2008 (with seasonal spikes of up to £20 billion) – see Figure 8 below (NB values are monthly, not annual).

Figure 8: Tourism's Trade Imbalance – monthly UK spend abroad, less foreign spend in UK (£m)



Source: Government Tourism Policy, DCMS (2011), page 16

The graph reveals a very clear trend: the UK ran a modest deficit throughout the late 1980s and much of the 1990s, but in the late 1990s, as low-cost air travel began to boom, there was a relentless increase in the tourism deficit, with more and more discretionary spending being exported. The reversal of this trend that began in 2008 is not entirely due to people taking fewer foreign holidays – they are taking more domestic holidays too: spending in the domestic holiday market rose by around £1 billion between 2008 and 2009 and was maintained at that level in 2010.[40]

The economic benefits of this trend are significant: boosting spending on goods and services in the UK generates additional jobs in the leisure sector and increases tax revenues for the Exchequer. The Government has recognised these benefits and set itself the following target:

… we should Increase the proportion of UK residents who holiday in the UK to match those who holiday abroad each year. For longer stays (4 nights or more) this would mean 29% of travellers holidaying in Britain rather than just 20% today (creating 4.5m extra domestic trips each year, £1.3bn more spend and 26,000 new jobs). And if we can replicate this scale of improvement for shorter stays as well, we will create a further £750m of spend and 11,000 new jobs.[41]

As it draws up the new aviation framework, the Department for Transport should work closely with the Department for Culture Media and Sport, to ensure that airports policy reflects the Government's ambitions for the UK domestic tourism sector. Reducing the demand for outbound air travel will also help to meet UK climate change targets: trips by train and even car are already less carbon-intensive (and usually shorter) than trips by air – and the gap will widen as surface transport becomes increasingly electrified, and electricity decarbonised, in line with the Government's wider climate change strategy.

40 *UK Tourism Survey Trend Charts 2005-2010*, Visit England 2010, page 14
41 Government Tourism Policy, DCMS (2011), page 16

Chapter 6. Implications for UK airports policy: "a genuinely sustainable framework"

The Government's recognition that its predecessor's aviation policy is unsustainable and out of date is welcome. But it will be judged, ultimately, not on this insight but on the policy it develops to replace the 2003 White Paper. This chapter draws together themes of the rest of the paper to set out the crucial elements for any genuinely sustainable framework for UK aviation.

The over-riding aim for a sustainable aviation policy should be to ensure the sector makes a fair contribution towards meeting the UK's overall climate change targets, especially the legal requirement for an 80% reduction in GHG emissions from 1990 levels by 2050.

International aviation emissions are not yet formally within the carbon budgets established under the Climate Change Act to drive progress towards this target – although they are virtually included by the requirement for the Government to 'take into account' projections of aviation emissions when setting the budgets. Nevertheless, it would be beneficial to formalise this arrangement, and the Government should include international aviation emissions by the end of 2012 (as the Climate Change Act requires it to do), unless the Committee on Climate Change advises otherwise.

Including aviation within the targets is not, however, a magic bullet that guarantees the sector will develop in a sustainable direction. Outside of the current recession, aviation emissions have grown at rates above GDP (whereas emissions from almost every other sector are stable, if not falling), and the CCC's modelling suggests that carbon pricing at levels currently envisaged for other sectors will not have a sufficient restraining effect on aviation emissions. These factors argue in favour of an aviation-specific target to act as a backstop, since including the sector within frameworks such as the Climate Change Act or the EU Emissions Trading System may well fail to deliver the necessary GHG reductions.

What then, is the correct target for aviation? The target for absolute emissions to remain at 2005 levels by 2050 is a good starting point. It is based on CCC analysis of feasible reductions in other sectors – although it should be recognised that the special treatment of the aviation sector will require other sectors to reduce emissions by 90% to achieve an overall 80% cut, and this will come at a cost to society, for instance in terms of higher energy prices. The need for the target to be in absolute terms was also spelled out by the CCC:

The fact that the target is set in terms of gross rather than net emissions […] reflects an assumption that the supply of cheap credits will be exhausted over time and that

it is therefore important for the aviation sector to focus on reducing its own emissions.[42]

The Government should therefore retain the 2050 Target, and include interim milestones between now and 2050 to ensure that the industry is on track to meet it. The Target should also be reviewed periodically to take account of developments in the understanding of aviation's non-CO_2 impacts, and adjusted once these can be included in carbon budgets.

The second of these caveats is very serious. Already the best estimate for the non-CO_2 impacts of aviation is that they double its warming effect. If this is confirmed, it would mean that the aviation target would have to be reduced by half, or additional reductions found in other sectors beyond the 90% already demanded by the special treatment of aviation. For this reason, the proposed milestones should be part of a highly precautionary approach to meeting the target, whereby emissions are not allowed to increase above today's levels (see further under Policy Recommendations below). Only this approach would allow the industry to meet a tougher target, which current science strongly suggests will be necessary within a decade or so.

European and global action

This paper has focussed on UK-specific policies, but the centrepiece of aviation policy for the previous Government was inclusion of the sector in the EU Emission Trading System, which will come into effect in 2012.[43]

As currently constituted, the EU ETS for allows growth in absolute emissions, on condition that this is offset by the purchase of reductions in other sectors, or from clean energy projects in the developing world. As argued above, the UK target should be on the basis of absolute, not net emissions, meaning that the EU ETS cannot be a complete policy solution.

Nonetheless, the EU ETS is a useful tool because it begins to price carbon emissions across a significant bloc of aviation activity. Concerns about the leakage of aviation emissions in response to unilateral national measures are routinely over-stated by the industry – witness the strong growth of UK aviation despite the fact that APD is several times higher than equivalent taxes in neighbour countries. However, it is certainly preferable for carbon pricing to cover as wide a scope of aviation activity as possible, particularly as it will need to rise very significantly if it is to have the necessary impact on absolute emissions.

So the Government should seek to strengthen the ETS for aviation, while recognising the difficulties of doing so multilaterally and therefore not relying solely on this instrument. If the economy-wide EU climate change target is strengthened to 30% (as the Government is calling for), this will trigger a review of the terms of the ETS.

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42 CCC (2009) page 41

43 Assuming that the current legal challenge by a group of US airlines, due to be heard on July 5th in the European Court of Justice, is unsuccessful.

As part of any such review, the Government should push for the aviation cap to be tightened, the non-CO_2 impacts of aviation to be included (if the science has developed sufficiently to allow this), the accounting of biofuels to be amended so life-cycle GHG emissions are considered, and the percentage of permits auctioned to be increased – on current rules the industry will receive 85% of its initial allowance of credits free of charge, and in all likelihood will be able to generate significant windfall profits from this arrangement.

Any additional revenues should be earmarked for global climate initiatives, to increase the acceptability of EU action in the rest of world and bring a global scheme for aviation emissions a step closer, by demonstrating the benefits that could accrue to developing countries. While a global scheme is desirable, it is likely to be weaker than EU ETS and may take some time to develop, meaning that it cannot yet be assessed as a credible tool to control UK aviation emissions.

Using the planning system

Although the White Paper was not a planning document and did not authorise development at any airport, it has been taken as offering policy support to numerous airport expansions since 2003: Southampton, Aberdeen, Stansted, Farnborough, Gatwick's North Terminal extension, London City and most recently Bristol, which was granted permission for a terminal expansion in February 2011 – although the last two named are subject to on-going legal actions.

The White Paper also invited airport operators to draw up Airport Master Plans that reflected its expansion policies. Since planning policy guidance stipulates that Local Development Frameworks and Regional Spatial Strategies need to take account of these Master Plans, the White Paper has effectively worked its way into the planning system, via documents drawn up by airport operators (which in many cases nudged forecast demand at their airports up beyond what was set out in the White Paper).

As a matter of urgency, the Government needs to reverse this situation and give an explicit direction that the White Paper, and all planning documents that flow from it, are now out of date. This should be done pending the adoption of a new policy in 2013. The situation is urgent, because forthcoming research[44] suggests that current airport capacity, in the sense of current development permitted already under the planning system, is very close to allowing the maximum passengers that the CCC determined would be sustainable in 2050.

Revoking planning permission is expensive and legally difficult, so every new grant of permission today makes the 2050 target more difficult to achieve by locking in capacity – and every new grant fetters the Government's discretion to distribute the very limited amount of additional capacity in the way it determines would be of greatest economic benefit.

44 Aviation Environment Federation and WWF-UK, in press.

Policy recommendations

- An immediate declaration voiding the *Future of Air Transport* White Paper and planning documents that flow from it, revoking the requirement for planning documents to take account of Airport Master Plans, and establishing a freeze on expansion pending the adoption of new policy;

- Confirmation of the target for absolute emissions from UK aviation to be no higher than 2005 levels in 2050, strengthened by:

    - A requirement for average emissions not to exceed that level in any five year period to 2050;
    - A five-yearly assessment of improvements to the carbon intensity of the UK fleet;
    - Periodic updates on the non-CO_2 impacts of aviation, and any adjustment to the Target necessary in light of evolving science;

- Depending on the outcomes of the review of progress towards the Target, the Government may be in a position to release new airport capacity. This could either be done via a centrally-taken decision, or by an auction of the right to new take-off slots;

- A package of measures to promote alternatives to air travel:

    - Pricing and capacity policies for rail that improve its competitive position vis-à-vis aviation;
    - Tax breaks for companies incentivising staff to use more videoconferencing, enhanced capital relief on the purchase of videoconferencing equipment and a government programme to replace civil service flights with virtual meetings;
    - Tax support and promotion for UK tourism destinations.

- An Air Passenger Duty 'escalator' of regular incremental rises to manage demand and move towards fiscal equality with motoring, while reducing public opposition to sudden tax hikes;

- A strengthening of the ETS for aviation, by tightening the cap, increasing the levels of auctioning, accounting for the true effects of biofuels and including non-CO_2 impacts when appropriate. Any additional ETS revenues should be earmarked for climate change action in developing countries, as a step towards achieving a global deal on aviation emissions.

- A requirement for strict sustainability standards before aviation biofuels can be certified.

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