



Grounded

A new approach to
evaluating Runway 3

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Foreword by Ian Cheshire



This new report from **nef** (the new economics foundation) establishes robust, well-rounded evidence for what many in business and civil society have suspected all along – that the case for a third runway at Heathrow is at best incomplete and at worst completely flawed. This authoritative study should be welcomed by all who recognise the need for robust argument, transparency and accountability to be brought to bear on this issue.

A well functioning communications system is essential for doing business in and beyond the UK. **nef**'s report demonstrates, however, that the economic case put forward by proponents of Runway 3 is highly problematic.

A combination of over-optimistic forecasts and unduly narrow assumptions helped to secure support from the Department for Transport in its impact assessment. But that appraisal was made in isolation from serious consideration of alternatives such as rail infrastructure and video-conferencing facilities. Mindful of the realities of climate change and future resource constraints, many businesses are actively investing in ways to reduce their need for air travel in the future.

By taking an approach based on Social Return on Investment (SROI) analysis, **nef** has produced a more rounded and realistic analysis of the costs and benefits of Runway 3. Its calculations have included capturing some of the important community costs that have been excluded until now. Never has it been more important to allocate our scarce environmental and economic resources sensibly. Without a transparent and multifaceted framework such as SROI, we cannot hope to appraise the range of economic, social and environmental factors that need to be properly evaluated if we are to make socially and economically efficient decisions.

Even if the economic case for Runway 3 was robust, the social and environmental costs would remain enormous. Along with others in the business community, I do not believe that purely economic considerations should take priority over all other aspects of life. Nor should they be seen in isolation from the society and the environment on which they depend. Asserting that 'business needs this' has too often been a cover for inadequately thought-out policy decisions.

Companies are in business to make a profit, but not at any cost. Now **nef** has shown how high the true cost of Runway 3 will be for the UK. I commend this important report to you.

A handwritten signature in black ink, appearing to be 'I Cheshire', written in a cursive style.

Ian Cheshire, Group CEO, Kingfisher Plc.



Contents

Executive Summary	2
Introduction	4
I. Runway 3 in context	6
II. A new approach to evaluating Runway 3	15
III. Measuring the economic impact of aviation	32
Conclusion	39
Recommendations	41
Appendices	42
Endnotes	52

Executive Summary

nef (the new economics foundation) has conducted a detailed, independent re-evaluation of the case for a third runway at Heathrow airport. Our study finds that the costs of the Runway 3 proposal outweigh the benefits by at least £5 billion. In light of our analysis and in view of the formidable targets for reducing greenhouse gas emissions our conclusion is that expanding Heathrow cannot be justified.

In January 2009 the Secretary of State for Transport announced the government's decision to support a third runway at Heathrow airport (henceforth, Runway 3).¹ The new runway is expected to open in 2020 and immediately increase by 25 per cent the number of flights departing from or arriving at Heathrow every year. By 2030, it is projected that the number of flights at Heathrow will be almost 50 per cent higher than today.

The official sanction for Runway 3 came after six years of consultation, debate and controversy. The 2003 Air Transport White Paper² asserted that there was a powerful economic imperative for an additional runway, with only the provisos that conditions relating to air quality, noise and improving surface access should be met. Analysis by the Department of Transport (DfT) in 2009 (*Adding Capacity at Heathrow Airport: Impact Assessment*) found a net benefit to society from Runway 3 of £5.5 billion.

In contrast with the optimistic outlook put forward by the DfT, our analysis has arrived at a net cost to society from the new runway of between £5 billion in our central case and £7.5 billion in a worst case scenario based on sensitivity tests using alternative carbon prices and higher community costs.

We have calculated the net cost using two approaches. First, we have rerun the DfT's model using new assumptions about economic growth, exchange rates, carbon prices and other factors. The model generates estimates of the economic benefits and carbon costs from the new runway as well as the infrastructure costs.

Second, informed by stakeholder engagement we have recalculated the costs to the local community of living with a new runway. The DfT's model does not take full account of the substantial and highly material community impacts. Based on stakeholders' insights and experience, our report looked again at the potential costs of additional noise and poorer air quality, and for the first time estimated costs for surface congestion and community blight – factors that were not quantified by the DfT. This compares with the DfT's estimate of local impacts (additional noise disturbance and air pollution) of just £0.4 billion.

Social Return on Investment (SROI) brings a fresh perspective to the debate on Runway 3. SROI differs from existing methods of appraisal in three ways. First, it is informed by the views of stakeholders who play a central role in determining the outcomes and values. Second, it starts from the principle that we should value the things that matter, rather than just those things that are easy to monetise. Finally, it measures explicitly across a 'triple bottom

line' of social, environmental and economic returns. SROI is concerned with the net value of Runway 3 when social, environmental and economic factors are examined together.

Much effort has been made by those in favour of airport expansion to 'prove' an incontrovertible economic case for it. But the economic benefits are often difficult to pin down. Not only is there lack of an agreed metric for accurately measuring the economic benefits but there are several unresolved and contested issues.

The proponents of a Runway 3 also face a formidable environmental hurdle because of the climate change impacts of air travel. Aviation policy clashes with objectives for sustainable development and policy to tackle climate change. The UK has a commitment in law to an ambitious target for reducing greenhouse gas (GHG) emissions by 80 per cent below 1990 levels by 2050, and also to an aviation specific target that requires the industry to emit no more CO₂ in 2050 than it did in 2005. This means that an impartial analysis invites caution in response to any proposals to expand the infrastructure and capacity of an industry that has particularly intense impacts on climate change.

Despite industry claims, there are no technological magic bullets on the horizon that will dramatically cut aircraft emissions. The Committee on Climate Change, set up under the auspices of the Climate Change Act of 2008, is clear that meeting the aviation target will require demand management measures.³ They demonstrate that advances in technology and emissions trading alone will not be enough.

Even if the industry achieves the target for emissions in 2050, by then it will account for at least a quarter of the UK's entire emissions budget. To allow the aviation industry to maintain its level of emissions means that all other uses of fossil fuels – for heating, road transport and food production for example – will have to be reduced much more dramatically. This will be not only very challenging in practical terms, but also problematic for society from an equality perspective. In effect, it would mean shifting the burden of emissions reduction from the rich to the poor, as it is predominantly the rich that fly.

In summary, our findings suggest that building a Runway 3 would destroy rather than create value, demolishing any case for Heathrow expansion. With such high social and environmental costs associated with it, the burden of proof should lie squarely with proponents to demonstrate that Runway 3 is in the public interest. But this report is about more than the Runway 3, or indeed aviation. Historically governments have often overplayed the economic arguments in favour of big infrastructure developments such as airport and road expansion. Many countries are strewn with 'white elephants' - costly development schemes of highly questionable value that began life with the force of apparently robust economic argument behind them.

In the context of binding emissions reduction targets, we can no longer afford to be cavalier about these decisions. Locking the UK into a high carbon infrastructure now may mean that we pay the price for generations to come. Research by **nef** has shown that from August 2008 we may have just 100 months to stabilise concentrations of GHG in the atmosphere (see: www.onehundredmonths.org). Even before Runway 3 is built, the UK will need to be well on its way to decarbonising its economy. This means capital investment should be directed to projects that put the UK onto a low carbon trajectory rather than taking us in the opposite direction. It is imperative that we allocate our carbon budget in the most efficient and equitable way, and that we direct this most scarce resource towards those things that will create the most social value. This must surely be the test for any proposed infrastructure project in the future.

Introduction

*'If nothing changes, Heathrow's status as a world-class airport will be gradually eroded - jobs will be lost and the economy will suffer.'*¹⁴

Former Transport Secretary, Ruth Kelly

Economic appraisal plays a major role in public sector decision-making. Nowhere is this more apparent than in the commissioning of large infrastructure projects – roads, shopping centres, power stations, industrial centres, railways and airports. Generally there is an economic imperative behind these projects; their potential contribution to jobs and economic productivity tends to be quantified and highlighted. Increasingly, standard cost-benefit analyses are taking account of other impacts: on the environment, climate change, and on communities. Yet these are often treated as secondary to the economic case. Where there is a strong economic case for a project it is rare that other 'spill-over' effects are sufficient to quash it, even if those effects are real and costly. There are three primary reasons why this happens:

Box 1: Externalities

Unintended consequences from a project or policy often remain hidden in assessments because they do not involve a financial transaction. In economic terms, this means that those responsible for imposing a cost on others that is not paid for (such as noise) are able to engage in their activity more cheaply than they should. Conversely where an activity creates a benefit that the provider is not rewarded for (such as care for the local environment), the supply of that beneficial activity will be less than optimal for society. These knock-on effects are known as 'externalities'

- Economic benefits are easier to measure and quantify and generally have established market prices. This means that they are more likely to be accounted for. Non-traded impacts such as effects on public health, or natural habitats are harder to monetise. This often means that they are excluded completely, or under-valued. Even where artificial markets are introduced as with carbon, prices vary and can be subject to controversy.
- Generally, appraisals focus on one stakeholder, usually the government, or the economy. When this occurs the economic returns (increases in tax or personal income, and economic growth) will take on greater importance relative to everything else than they perhaps merit. The assumption is that these are good proxies for wider welfare. In some instances this may be true but not in all. Forms of measurement are often based on narrow economic theories, or on causal relationships that have not been empirically established. In addition, they are often incapable of taking into account the 'externalities' linked to any economic gains – the social and environmental costs. Such costs are often borne by specific groups, and these are not represented in the analysis as separate stakeholders.
- The imperative to maximise economic growth, jobs and productivity is paramount for decision-makers. We live in a political culture in which it is difficult for anyone to question the efficiency of these arguments even where the costs generated in other areas are high.

A motivating factor in choosing to undertake this analysis was the way in which governments have repeatedly talked about the economic benefits of airport expansion. However, the official appraisal conducted by DfT failed to even examine the potential impact of the new runway on jobs and productivity or to explore what the detrimental effects not building it would be.

Runway 3 is intended to be in the public interest and yet stakeholders are highly polarised on the initiative. This is partly bound up with the low credibility of the cost-benefit analysis. Many groups simply do not 'believe' the results. This has the effect of undermining the credibility of economic modelling more generally in aiding decision-making in an impartial and evidence-based way.

This report argues that this should not be the case. Independent evaluations are vital if we are to compare the relative benefits of interventions and identify the potential trade-offs. It is essential therefore that they retain their legitimacy. To this end we have applied the principles of Social Return on Investment (SROI) to the runway proposal in an attempt to produce a more balanced and realistic analysis than currently exists.

SROI is a form of adjusted cost-benefit analysis that also uses techniques of economic appraisal and valuation⁵. SROI is based on seven principles that are explained in Appendix 1. The primary methodological difference between it and the DfT's approach is in the direct involvement of stakeholders which brings an added dimension of transparency and accountability to the process. Rather than seeing value largely in economic terms, SROI offers the concept of 'social value', which incorporates positive and negative social, environmental and economic impacts as defined by the people that experience them.

Overall, the exclusion of externalities from appraisals means that the true costs and benefits of an activity are not being properly accounted for. This has important consequences for effective decision-making and for the efficient allocation of resources. This is a problem for infrastructure projects, just as for any other area of policy, but poorly conceived infrastructure developments can have long-lasting negative consequences.

An SROI approach aims to ensure that unintended consequences, which matter to stakeholders but which the market struggles to value, are also counted. Aviation is a good example of an area where the economic benefits are better captured by the market than the environmental and social costs⁶. What the debate on Runway 3 has been lacking is a more dispassionate review of the evidence that challenges exuberant economic forecasts and properly values the social and environmental impacts. It is also important not to seek to deny potential economic gains simply because there are also negative social and environmental outcomes.

The value of an SROI approach has been demonstrated in a number of areas of social policy⁷. This is the first time that it has been used to appraise a major infrastructure project, and it serves as a pilot for applying this kind of approach more widely.

Report structure

The report begins by setting out the policy background against which the decision in favour of Runway 3 has been taken. This places aviation policy in its proper context, which includes the overarching political commitment to sustainable development and strong focus on decarbonising the UK economy. We conclude that continuing on a path of 'business-as-usual' for aviation within a highly carbon-constrained world should at the very least demand a high level of assurance that the benefits outweigh the costs.

The main body of the report explains the results of our detailed valuation exercise. The first part of this exercise tracked the DfT's own analysis by rerunning the DfT model with updated assumptions. In the second part of the valuation exercise, we quantified community impacts in the areas surrounding the airport, informed by stakeholder views. These included impacts excluded, or undervalued by the DfT.

This is followed by a discussion of a number of important issues that are the subject of debate around the economic impact of Runway 3.

We conclude with a discussion of the implications of our methodology and results for the decision about Runway 3, and potentially for decision-making on infrastructure projects more generally. The report ends with a series of key recommendations.

I. Runway 3 in context

'We support development of Heathrow provided that strict environmental limits can be met, including a new runway as soon as possible after Stansted.'⁸

The Future of Air Transport White Paper

UK aviation and aviation policy

Although the government's decision to support Runway 3 was announced in 2009, the case for official government support for expansion of aviation generally and Heathrow specifically was made as far back as 2003. That was the year when the key policy document, the Air Transport White Paper (ATWP) was published.

In the White Paper and subsequent official documents, aviation is considered to have a central role in ensuring the economic health of the UK and its place in the global economy. Around a fifth of all international air passengers worldwide are on flights that depart from or arrive at a UK airport.⁹

Box 2: Heathrow's place in UK aviation

Heathrow is one of the world's busiest airports, currently handling some 68 million passengers every year. This is nearly a third of the UK total. It is renowned for being Britain's hub airport, where a concentration of activity enables multiple connections between routes. The airport operator, BAA, refers to it as 'the hub of the aviation world'.¹⁰

Table 1: Annual passenger flows, greenhouse gas (GHG) emissions and capacity utilisation by airport

Airport	Millions of passengers	Share of UK total, %	Share of UK aviation's GHG emissions, %	Capacity utilisation, %
Heathrow	68	30	46	97
Gatwick	35	15	12	95
Stansted	24	9	3	69
City	3	1	0.3	82
Luton	10	4	2	72
Manchester	22	9	7	63
Birmingham	9	4	2	75
Edinburgh	9	4	1	79
Glasgow	9	3	2	95
Total UK	241	100	100	39

Source: CAA UK Airport Statistics 2009, Committee on Climate Change (2009) Meeting the UK Aviation Target, Options for reducing emissions to 2050, and DfT (2009) UK Air Passenger Demand and CO₂ Forecasts

Business passengers account for just below 40% of the total using Heathrow. The airport serves a higher-than-average share of long-haul destinations.

The location of Heathrow has long been a subject of criticism and controversy. The airport is surrounded on three sides by residential areas in close proximity. In addition, Heathrow sits on a main corridor to London, which suffers major road traffic and public transport congestion.

There can be no doubt that business and society in the UK, or sections of it, have benefited from the proliferation of international connections, overseas experiences and welfare gains that holidays abroad and contact with international family, friends and business associates can offer. It is in large part because of this enabling or catalytic role for other sectors of the economy, and individuals, that aviation is believed to be of such central importance to the economy. But the argument for airport expansion frequently goes further than this, claiming not only that there are new benefits to be gained from extra air travel, but also that restricting capacity to current levels will actually harm the economy as airports become more congested. The ATWP asserted that '*... not providing additional capacity would significantly damage the economy and national prosperity*'.

Despite such bold claims, the direct contribution to the economy from aviation is no more than that of any typical medium-sized industry. It generates directly around £9 billion of economic output, or 0.7 per cent of the UK's total Gross Value Added. Indirectly, factoring in the supply chain for aviation (through services such as catering and fleet maintenance for example), aviation's contribution rises to £18.4 billion (1.5 per cent of the economy).¹¹ Aviation provides direct employment for 141,000 people, 0.5 per cent of the UK's total. This rises to 234,000, or 0.85 per cent, when the whole supply chain is included.

There is no doubting the economic role that aviation has played in the UK, as for other economies with a mature infrastructure. But an analysis of passenger trends and a breakdown of air travel by purpose raises legitimate questions about the extra economic contribution that additional aviation capacity would make. Box 3 sets out some summary information on passenger trends. One of the key messages is that leisure passengers, not business passengers, dominate the mix.

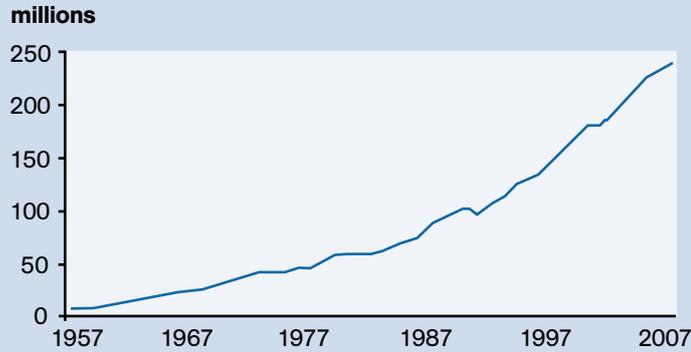
Taking all passengers together, leisure travellers outnumber business travellers by three to one. Looking just at UK-resident passengers the ratio of leisure to business trips is almost five to one. Leisure travel's share of the total market has been rising and is expected to continue rising. In this context it would seem important to be assured of the economic value of increasing leisure travel. There are undoubtedly economic benefits for destination countries, including the UK, when visitors fly in, although the overall societal benefit of tourism to destination countries is the subject of debate.¹² But the UK has a large and growing tourism deficit, since UK tourists spend more abroad than overseas tourists spend in the UK. Furthermore, it is domestic tourists who are the backbone of the tourism industry in the UK economy; in 2003, four-fifths of the UK's £74 billion tourism earnings came from domestic tourists. Cairns and Newson¹³ point out that despite this reality policy has tended '*to focus on the benefits of attracting overseas visitors rather than the potential for recapturing a share of the outbound UK tourist market*'. This topic is considered in more detail in section III of this report.

The perspective of the British Airports Authority (BAA), however, explained in a meeting with the authors of this report, is that it is the full range of passengers, business and leisure, that supports the large number of routes served. BAA argues that a reduction in leisure travel would undermine the viability of some routes which are important to business as well as leisure travellers.

Box 3: Passenger numbers and characteristics

Air travel has expanded rapidly in the past half century. The number of passengers using UK airports has risen dramatically, from 7 million in 1957 to 241 million in 2007. As the figure below illustrates, passenger numbers grew particularly quickly from the late 1980s onwards.

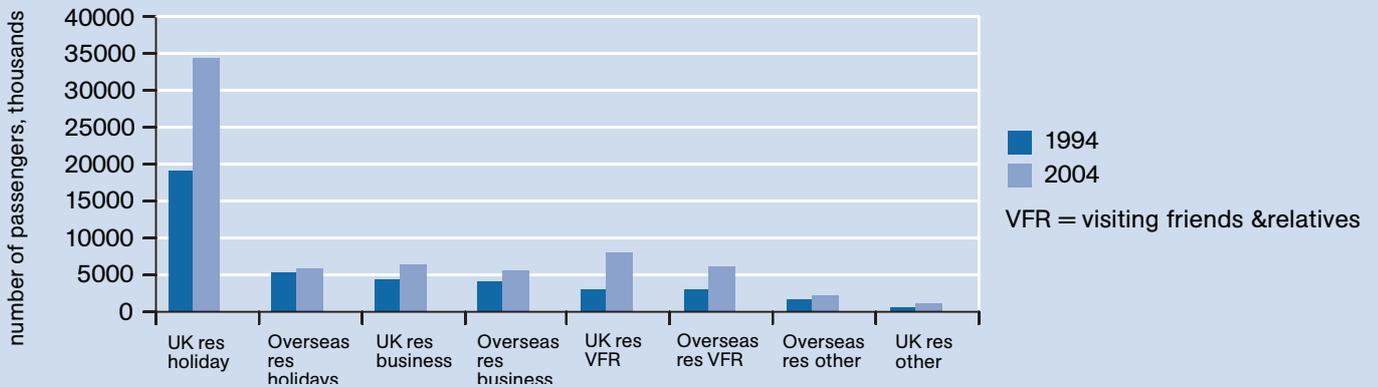
Figure 1: Number of passengers at UK civil airports



Source: Office for National Statistics, <http://www.statistics.gov.uk/cci/nugget.asp?id=1104>

75 per cent of all passengers using UK airports are those travelling for leisure. The large majority of passengers using UK airports (78 per cent) are travelling between short-haul destinations within Europe. Between 1991 and 2008, demand for holiday travel rose by 185 per cent while demand for business travel rose by 70 per cent. As a result of differing rates of growth, business passengers accounted for only a quarter of air travel in 2008, compared to 35 per cent in 1991. Figure 2 below illustrates the predominance of UK holiday-makers in the mix of passengers, and how that predominance has increased over time.

Figure 2: International passenger trips from UK airports



Reproduced from Cairns and Newson (2006), *Predict and Decide*, Environmental Change Institute

In considering the economic benefits of expanding the UK's aviation infrastructure, the ATWP (paragraph 11.51) openly acknowledged that there would be negative social and environmental impacts:

'There is a strong case for seeking to secure the large economic benefits achievable through the addition of a Runway 3 at Heathrow. At the same time, however, we recognise that these strong economic arguments must be weighed against the serious environmental disadvantages of Heathrow.'

In particular, support for the Runway 3 was subject to the provisos that air quality and noise pollution limits should be met and that appropriate improvements to surface access should be provided. Subsequent analysis of the ability to meet these targets¹⁴ resulted in adoption of a scenario in which the new runway could not be fully utilised upon opening but only later - once further technological improvements had allowed for expansion within the environmental targets. No condition was set for meeting greenhouse gas emissions limits because it was assumed that aviation would be included within the EU-ETS (European Union – Emissions Trading Scheme), and that aviation emissions would therefore be adequately offset in other sectors.

While the White Paper did discuss the serious nature of aviation's negative impacts, the emphasis of its message was firmly on the imperative of realising the economic benefits. Any trade-off between the costs and benefits was considered in terms of using price signals to manage aviation's externalities, deploying economic instruments such as trading systems.

'A balanced and measured approach to the future of air transport is needed, which:

- *recognises the importance of air travel to our national and regional economic prosperity, and that not providing additional capacity would significantly damage the economy and national prosperity;*
- *ensures that, over time, aviation pays the external costs its activities impose on society at large - in other words, that the price of air travel reflects its environmental and social impacts.'* (ATWP, paragraph 2.18)

This analysis reads in a way that suggests an assumption of economic benefits outweighing the environmental and social costs. If not, then payment for the externalities would exceed the returns from travel and make aviation un-viable. Fully considered, the externalities might indeed outweigh the economic benefits, but only a holistic assessment can reveal with any confidence whether they do or not. If they do, then a presumption that economic benefits outweigh environmental and social costs could lead to an economically inefficient outcome for society, with a net loss of social value.

Box 4: Aviation industry's incentives for additional runway capacity

Little discussed in the literature, but important for a complete understanding of the rationale for Runway 3, is the motivation of the airport operator, BAA, in seeking additional capacity.

Airport operations at key airports are regulated because they are not considered to be subject to competitive pressures through usual market means. As a result, the amount of revenue BAA can raise at Heathrow for example is set by the regulator with reference to a percentage return on the value of the 'asset-base', (the operator's land and holdings at Heathrow). One of the main ways in which the airport operator can seek to increase revenue is to expand the asset base. Adding runway and terminal capacity would increase the value of the assets BAA holds and allow it to make an additional return on the new asset base. This return is almost guaranteed for BAA because demand at Heathrow is high, and is likely to remain high. As a result, BAA faces little risk that it will not be able to make its agreed percentage return on the new asset base.

Industry motivation for Runway 3 at Heathrow may also be heightened by the Competition Commission's requirement for ownership of UK airports to be broken up. In 2009, the Competition Commission ordered BAA to sell off Gatwick airport, Stansted and either Glasgow or Edinburgh.

The case for the airlines is less certain. They face competition in the air travel market, and a recent dip in performance has seen falling revenues and profits. However, with the prospect of sustained demand airlines are still likely to bid for further capacity on the most profitable routes – many of which operate out of Heathrow.

Aviation and policy for sustainable development

The Sustainable Development Commission¹⁵ has noted that the ATWP is completely out of step with the government's commitment to sustainable development. Policy for a single business sector, including aviation policy, cannot be made in isolation from other policy areas. Since publication of the ATWP there has been a major shift in context with the adoption of the Climate Change Act. This has led to a commitment to reducing the UK's GHG emissions by 80 per cent below 1990 levels by 2050. Subsequently, the government has adopted an aviation target to limit emissions from UK aviation to no more than 2005 levels by 2050, that is 37.5 million tonnes of CO₂ (MtCO₂) per year.¹⁶

Despite these already ambitious targets for cutting the UK's GHG emissions, the evolving science suggests that climate change impacts are worse than previously thought, as discussed in recent research by the Tyndall Centre for example.¹⁷ To achieve the necessary global cuts, highly industrialised countries such as the UK may therefore have to reduce emissions by 70 per cent by 2030 and 90 per cent by 2050.

The policy landscape therefore raises an apparent inconsistency between stringent targets for emissions cuts, which may yet become more stringent in the medium-term, and plans to expand one of the most emissions-intensive industries.¹⁸ There are two issues of concern. First, that expansion plans will render the aviation emissions target impossible to achieve. Second, that even if the aviation target is met, it will mean that a very large share, at least 24 per cent,¹⁹ of the UK's total allowable emissions by 2050 will be taken up by air travel, at the expense of other more essential activities.

The seriousness of this policy inconsistency has very recently been expressed in the High Court. The outcome of the Judicial Review that challenged the basis for official support for Runway 3 is a major blow to the premise of the ATWP and aviation policy. The judge, Lord Carnwath, found that *'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 ATWP. They are clearly matters which will need to be taken into account under the new Airports National Policy Statement.'* The Judge called the idea of treating support for Runway 3 as having been settled back in 2003 *'untenable in law and common sense'*.²⁰

Meeting the aviation target

If there is an agreed limit to aviation emissions of 37.5 MtCO₂, which we have already reached, then there is no scope to further expand air travel unless efficiency improvements can deliver emissions cuts at current levels of use. This is the core message of the recent report by the Committee on Climate Change, which was asked by the government to advise it on how to meet the 2050 target.

The Committee found that the 'likely' scenario of developments in technology, operations and biofuel use would deliver efficiency improvements that allowed for only 370 million passengers a year (a 60 per cent increase from 2005) by 2050. This is compared to 455 million passengers a year by 2030 in the central forecasts of the DfT. In other words, growth in aviation would have to be a lot lower than that set out in the ATWP in order to meet the target for emissions.

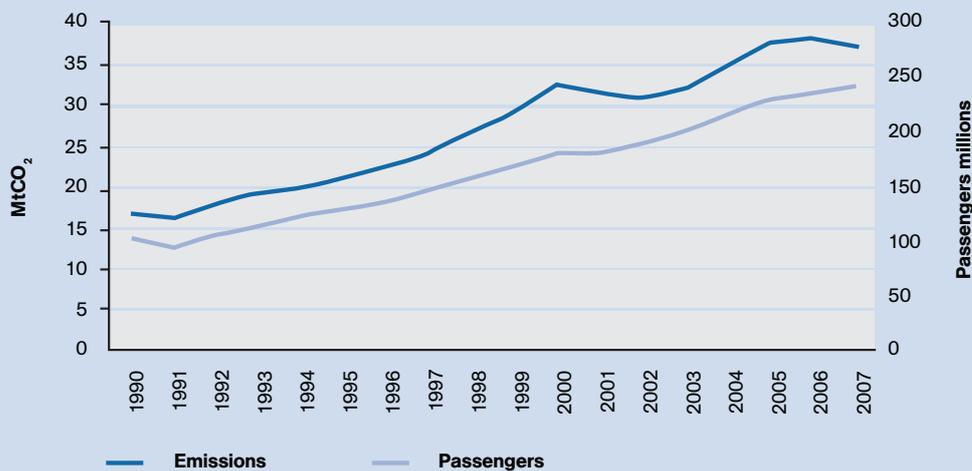
By contrast, in comments to the authors of this report, the DfT was relaxed about the industry being able to meet the target for aviation even with current airport expansion plans. The expectation was that the aviation sector would meet the target through efficiency gains. This is despite a clear recommendation from the Committee on Climate Change that the government should plan airport capacity on the basis of its 'likely' scenarios for technology, operational improvements and biofuels.

*'Future technological progress may make more rapid demand growth... compatible with the target but it is not prudent to plan on the assumption that such progress will be achieved.'*²¹

The conclusion of the Department's own Impact Assessment²² was that in the central scenario, adding Runway 3 at Heathrow would contribute to annual aviation emissions reaching 59.9 MtCO₂ by 2050, more than one and a half times the target. The DfT have said that in deriving this projection they had assumed a much lower efficiency gain than was really likely. The average annual efficiency gain over the past four decades has been approximately 1.75 per cent²³ (the bulk of which was achieved between 1970 and 1980) whilst for its forecasts the DfT assumed 1.1 per cent annual gains until 2030 and 0.75 per cent per year to 2050. The DfT suggested that a gain of 1.5 per cent a year would be more reasonable and enough to meet the target.

A full discussion of the prospects for efficiency improvements in aircraft and traffic management is beyond the scope of this paper.²⁴ However, we note that the historical efficiency gain has been 'spent' rather than 'banked', i.e. growth in passenger and flight numbers has eaten up efficiency gains. This factor accounts for the close relationship between passenger and emissions growth revealed in Figure 3 below.

Figure 3: UK Aviation Demand and Emissions 1996-2007



Reproduced from the Committee on Climate Change (2009) Meeting the UK Aviation Target, Options for reducing emissions to 2050

The figure shows that UK aviation CO₂ emissions doubled between 1990 and 2007, as passenger numbers also doubled. Under current expansion plans passenger numbers are forecast by DfT to almost double again, though emissions are only expected to rise by 60 per cent rather than 100 per cent, from around 38 MtCO₂ to 59.9 MtCO₂. It may be that we are witnessing what is known in economics as the 'Jevons Paradox' or 'rebound effect'; the proposition that technological progress that increases the efficiency with which a resource is used, tends to increase (rather than decrease) the rate of consumption of that resource.²⁵ This has been demonstrated with advances in fuel efficiency for cars and increased car use for example.²⁶ Rebound effects can be direct (e.g. driving further in a more fuel-efficient car) and indirect (e.g. spending the money saved on heading on an overseas holiday).²⁷ While efforts should be made to improve the efficiency of aviation, some caution is advisable in considering whether further efficiency gains, even were historic trends to continue, would be swept away by further demand growth.

Aviation's share of emissions

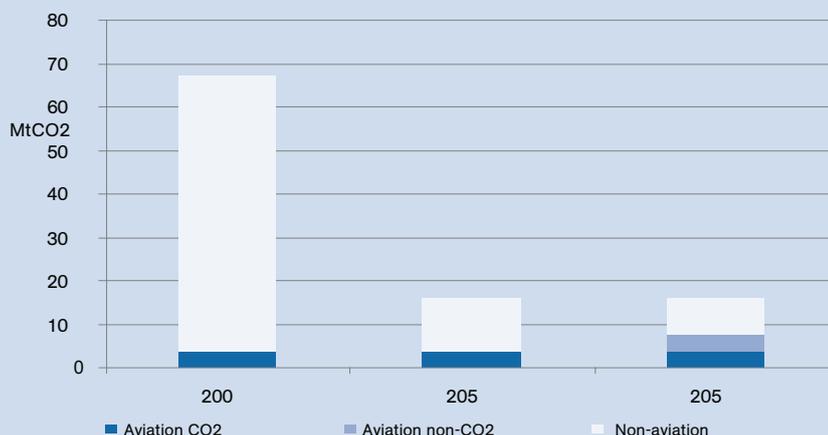
CO₂ emissions from aviation currently account for around 5.5 per cent of the UK's total GHG emissions.²⁸ It is generally considered, however, that non-CO₂ impacts of aviation (eg: NO₂ and contrail-cirrus) are at least as big again. By applying a conservative multiplier of 2, this implies that the sector is responsible for at least 11 per cent of the UK's total contribution to climate change.²⁹

There is a startling contrast between this current share of aviation emissions in the UK's total and even the most optimistic projections for the sectoral mix in 2050. Figure 4, uses Committee on Climate Change data to show how aviation emissions stack up against emissions across the economy as a whole in 2008, and in 2050, assuming that the aviation emissions reduction target is met.

We note that international aviation is not currently subject to the 80% reduction target for UK emissions by 2050. The Committee on Climate Change, however, has recommended that this be an interim situation only, and that UK aviation in full should be included in the UK's emissions budgets as soon as practicable.

In 2050, just taking account of the CO₂ emissions (shown in dark blue in the bars in Figure 4), aircraft movements will account for 24 per cent of the UK's entire emissions budget (159 MtCO₂). But including the non-CO₂ impacts as well (shown in mid blue) raises aviation's share of the total to 47 per cent. More than this, the DfT's figures from January 2009 show that on current expansion plans aviation could take up to 75 per cent of the UK's total emissions budget (59.9 MtCO₂, plus an equivalent quantity of non-CO₂ gases would make up 75 per cent of a total budget of 159 MtCO₂ under the cap for 2050).

Figure 4: Economy-wide and aviation-related emissions in 2008 and 2050



Source: Committee on Climate Change (2009) *Meeting the UK Aviation Target, Options for reducing emissions to 2050*.

At a strategic level, exempting a carbon-intensive industry from making cuts will leave less room for manoeuvre if it proves harder or more costly than expected to cut emissions across the economy.

Government policy (ATWP) recognises that:

*'reduction in greenhouse gas emissions across the economy does not ... mean that every sector is expected to follow the same path. The Government is committed to a comprehensive approach, using economic instruments to ensure that growing industries are catered for within a reducing total. The use of emissions trading allows coverage of environmental costs through a mixture of emissions reduction within the sector and purchase of reductions that can be produced more cheaply by other sectors.'*³⁰

By contrast, the House of Commons Environmental Audit Committee has commented that:

*'Power companies, manufacturers, retailers, households, motorists and hauliers are already going to have to make significant efforts to decarbonise their lives and livelihoods. If the government continues in its policy of allowing just this one industry to grow, it will either cause severe pain to all other sectors or provoke so much opposition as to fatally undermine its 2050 target.'*³¹

It may make sense to say that some sectors will be harder to squeeze than others and that sectoral shares need not be equal. Research to produce marginal abatement cost curves for different sectors of the economy has shown that cutting emissions in aviation would be relatively costly because of the lack of alternative clean technologies that could be deployed.³² However, in a carbon-constrained world, the wisdom of allowing one sector to expand its share to such a high proportion has to be questioned.

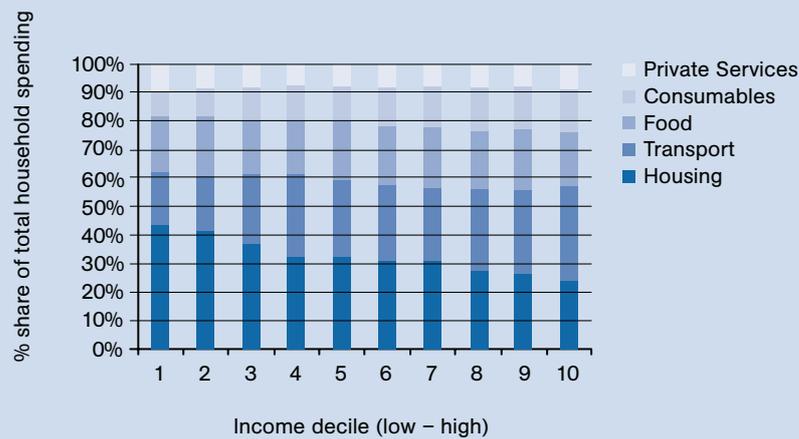
Inequality and aviation

There are questions about the distribution of the burden of emissions cuts across society.³³ Research shows that it is the comparatively wealthy who predominate among those travelling abroad more often since the advent of low-cost carriers. For example, the average household income of UK leisure passengers travelling through Stansted airport was £54,000 in 2006, according to CAA.³⁴ This is significantly greater than the average UK household income of around £31,000.

As the Committee on Climate Change explicitly acknowledges,³⁵ allowing aviation to emit such a large share of the UK's total inevitably means that other, more essential activities, including food production, heating and road transport, will have to be constrained more. The result of this would be highly regressive – taxing those on low incomes more than those on high incomes. Assessing the marginal costs of abating emissions in different sectors helps find an understanding of how to deliver economic efficiency but it is blind to the equity impacts.

Construction of a *social* marginal abatement cost curve could provide a much more rounded picture of the societal impacts of cutting emissions in different sectors. This could be informed by the principles of SROI. For example, to take account of impacts on inequality, it would be possible to weight different sectors according to the share of low-incomes that they absorb. Figure 5 below illustrates those sectors that are most important for the least well-off, in terms of the proportion of a household's income devoted to them. It shows that in decile 1, the 10 per cent who are least well-off, housing costs account for almost 45 per cent of total household spending, with food at around 20 per cent. For decile 10, the most well-off, transport costs account for the highest proportion of spending, over 30 per cent, whereas housing is only around 25 per cent.

Figure 5: Shares of total household spending by income group



Source: data for 2006 from Stockholm Environment Institute

A breakdown of spending on transport by income group reveals that for the group who are least well-off, air travel accounts for only 1 per cent of their entire travel budget. For the most well-off, however, the share commanded by air travel is 25 per cent. One of the arguments for expanding capacity for aviation is that it will open up the market across the income range, making air travel more socially inclusive. This does not appear to have happened even with the advent of budget airlines. Indications are that most of the growth in air travel is due to richer people flying more often.³⁶

If air travel is dominated by the richer people in society, then protecting the aviation sector uniquely from a fair share of emissions abatement lacks a credible defence. Conversely, constraining air travel by making it more expensive through additional taxes or charges could offer a double opportunity. First, in line with a central tenet of taxation, a higher charge on fares would help reduce demand for an environmentally harmful activity and so reduce emissions. Second, it offers a socially progressive way to reduce overall emissions. This is because air passengers are relatively wealthy, and so taxing air travel would raise public revenue from the better off to mitigate the impact of decarbonisation on poorer people.³⁷

Conclusion

We simply cannot be assured that at existing capacity even with substantially higher fares demand will adjust sufficiently to meet the current aviation target, let alone a more stringent one. But expanding infrastructure capacity will certainly tend to act in the opposite direction, lowering fares and catering for a higher level of demand. This point has echoes of the now discredited policy of 'predict and provide' for road transport which generated additional traffic and contributed to the UK's car-dependent culture. While we do not currently have an air-dependent culture in the same way, trends such as the rise in second homes abroad suggest that we are headed in that direction. This is not compatible with the strides that need to be made in emissions reductions to meet the UK's targets.

In summary, plans to allow aviation emissions to persist at current levels will mean that other sectors will have to make deeper cuts in order to bring UK emissions to within the 2050 target. This could have serious consequences in terms of social equity. We are facing the prospect, however, not just of business-as-usual in aviation, but of expansion of the industry, skewing an even greater share of national emissions to aviation. This demands at the very least a gold-plated assurance that the benefits of expansion outweigh the costs. In light of this we turn now to the results of our re-evaluation of the case for Runway 3.

The amount of government, industry and civil society resources devoted to the Runway 3 debate over the past seven years is evidence of how high the stakes are considered to be by stakeholders.

II. A new approach to evaluating Runway 3

Headline appraisal result

Our re-evaluation shows that the costs of Runway 3 will substantially outweigh the benefits.

We find that the net cost to the UK of Runway 3 will be at least £5 billion

A summary of the costs and benefits in our central case is as follows:

Benefit to users (passengers and airlines)	£2.3 billion
Benefit to producers (airport operator)	£4.0 billion
Benefit to government (revenue from air passenger duty and putative carbon levy)	£5.2 billion
Carbon cost	£6.2 billion
Community costs (noise, blight, congestion, air pollution)	£2.5 billion
Infrastructure costs	£7.8 billion
NET COST	£5.0 billion

Note: Our headline result combines out-turn numbers generated by rerunning the DfT's model, together with our own estimates of community costs.

The DfT's cost-benefit analyses of Runway 3, culminating in the January 2009 impact assessment, have been critiqued by environmental and other civil society groups.³⁸ nef's review revealed two concerns in particular; first that some of the highly material outcomes for local people near to Heathrow were excluded; and second that the underlying assumptions required interrogation and review.

Applying SROI to Runway 3

A cornerstone of SROI is direct engagement with stakeholders. This means that the outcomes that are identified as being material for measurement of the costs and benefits flow from the insights and lived experience of those affected. SROI picks up those factors, including spill-over effects or externalities, that matter for people and society, even if these are hidden or hard to measure in straightforward economic terms.

We identified three stakeholder groups as being significant for this appraisal.

- The economy (government, passengers and the aviation industry)
- Local communities
- Wider society

We conducted interviews with residents around Heathrow, business groups, environmental groups, academics and government officials. This enabled us to map the most important or material outcomes expected from an expanded Heathrow that should feature in the SROI. The stakeholder map below makes explicit the changes that are expected as a result of the new runway, together with the impacts that were captured in assessing the value of the project.

Table 2: Annual passenger flows, GHG emissions and capacity utilisation by airport

Stakeholder	Outputs from R3 activity	Outcomes for stakeholders	Indicator & measurement
Benefits			
UK economy			
Businesses passengers	More flights yield more opportunity and flexibility for travel – including potentially new destinations Also potential reduction in delays	Business returns to air travel: contributions to client contact, business operations, import/export	Surplus value generated per passenger over and above fare paid
Leisure passengers	More flights yield more opportunity to travel Also potential reduction in delays	Welfare benefits from air travel on holiday and to visit friends and family	Surplus value generated per passenger over and above fare paid
Government	Additional revenue from Air Passenger Duty on additional trips	Potential for increased public spending or reduction in taxes elsewhere	Revenue calculated on predictions of numbers of additional passengers and their destinations
Aviation industry	Opportunity to expand business activities	Revenues and profits from business expansion	Surplus value captured by aviation businesses over and above operating costs
Costs			
Local communities			
	More noise	Disturbance/ loss of privacy	Impact of noise on house prices
	More air pollution	Health impacts	Estimates of health costs from air pollutants
	Surface congestion	Longer, more stressful journeys	Proxy used: per mile cost of travel for predicted additional vehicle movements
	Blight	Uncertainty and loss of community	Loss of pride in the community demonstrated by lack of investment in refurbishment to properties and disturbance similar in scale to noise
Environment/wider society			
	Higher greenhouse gas emissions	Contribution to climate change	Value placed on a tonne of CO ₂

There is a body of literature developed over several decades around appraisal of transport projects, as well as established best practice for assessing a number of the environmental impacts. For our valuation exercise we followed best practice and latest evidence to capture many of the outcomes identified in our mapping exercise, such as the economic benefits and noise costs. Where there was no established best practice or agreed metric, such as for community blight, we modelled a value that corresponds reasonably with what those affected told us. This ensures that such a material outcome is included in the analysis, since without quantification it would fail to be counted in the appraisal.

Our evaluation exercise combined two principal phases:

1. A rerun of the DfT's model to generate iterative forecasts of passenger numbers, flight movements and emissions - key factors in making estimates of the main economic benefits and carbon costs associated with the proposed runway.
2. Derivation of our own modelled estimates of the community impacts of Runway 3 which are not captured, or well represented in the DfT's approach. We were able to combine these additional estimates with some of the outcome valuations from the DfT rerun.

Our evaluation exercise produced two distinct results:

- A.** An outcome net present value of £-4.0 billion (net cost) for Runway 3 produced exactly as the DfT produced its value of £5.5 billion (net benefit) in January 2009, for the purpose of direct comparison with the number used to back official support for Runway 3.
- B.** Separately, but most importantly, our central headline appraisal result of £-5.0 billion which combines some appropriate values generated by rerunning the DfT's model, together with our own modelled community costs. This is the outcome in our central case; our worst case result is £-7.5 billion.

It is important to note that the value of £-4.0 billion, produced as a direct comparison to DfT's January 2009 outcome of £5.5 billion, does not read directly into our headline appraisal result of £-5.0 billion. As explained later in this section of the report adjustments were made to numbers produced by our rerun of DfT's model in order to generate our headline appraisal figure.

The next section presents the findings from phase 1 in detail.

Updating the Department for Transport's impact assessment

In agreement with the DfT, **nef** commissioned consultants (Scott-Wilson) to rerun the DfT model using updated assumptions.

- Rerunning the model produces a result that can be directly compared with the DfT's January 2009 findings, which were used to inform the Secretary of State for Transport's decision on whether to support Heathrow expansion. This allows us to present our findings on the DfT's own terms.
- Deriving the costs and benefits of additional runway capacity is built on complex modelling of the inter-relationships between various factors which drive passenger demand, allocation of demand across the available infrastructure, air transport movements by route, the mix of aircraft types in the fleet, and consequent emissions, noise and air pollution outputs. Using the DfT's model allowed us to access these inter-relationships in as robust and tested a way as possible.
- Material factors outside the DfT's modelling framework, such as community impacts, and wider economic benefits, could be considered separately.

Results

Table 3: Net present value of the costs and benefits of Runway 3

Central case results	Outcome	Net present value	Benefit/Cost ratio
January 2009, DfT	Benefits > Costs	£5.5 billion	1.7 medium value for money
February 2010, nef	Costs > Benefits	£-4.0 billion	0.5 poor value for money

Rerunning the DfT's model on updated assumptions produced a markedly different result compared with January 2009. The result was a negative net present value (NPV) of £4.0 billion. This compares with DfT's January 2009 positive NPV of £5.5 billion. The Benefit to Cost Ratio (BCR) is the standard measure for value for money. Guidance from the DfT is that a ratio less than 1 shows poor value for money. The DfT's ratio of 1.7 indicates medium value for money.

Our result effectively reverses the original appraisal outcome which supported the case for Runway 3. According to the DfT's own methodology, and with latest estimates of driving variables, the rerun of the model found that the costs of Runway 3 substantially outweigh the potential benefits.

The difference in outcome results from changing the input assumptions fed into the model. This impacts on both passenger demand and flight movements, and emissions costs. Our rerun used latest official and independent forecasts for a number of key driving variables, including economic growth rates, which reflect the short-term and medium-term impacts of the financial crisis not accounted for in the DfT's exercise; exchange rates; oil prices; and carbon prices. Details of our assumptions and sources are shown in Box 5.

Box 5: comparison of nef and DfT input assumptions

The tables below give a comparison of the data used in the DfT's January 2009 assessment and **nef's** February 2010 rerun. DfT data was drawn from Annex B of the report Air Passenger and CO₂ Demand Forecast, January 2009.³⁹

Table 4: DfT (Jan 2009) and nef (Feb 2010) GDP growth rate assumptions, UK & other regions, year on year per cent change

	UK		Western Europe		OECD		Newly Industrialised countries		Less Developed Countries		UK consumer spending	
	DfT	nef	DfT	nef	DfT	nef	DfT	nef	DfT	nef	DfT	nef
2005-2012	2.43	-0.83	2.05	2.05	1.63	1.66	5.89	5.17	6.50	6.44	2.34	-0.86
2013-2017	2.53	2.13	2.00	1.93	2.51	2.37	4.70	5.36	4.91	5.47	2.28	1.88
2018-2020	2.17	1.82	2.00	1.80	2.51	2.37	3.5	3.50	4.0	4.00	1.92	1.57
2021-2030	2.17	1.83	2.00	1.79	2.38	2.23	3.5	3.50	4.0	4.00	1.92	1.58

For UK growth rates, **nef's** assumptions were drawn from data to 2009, and a review of independent forecasts from 2010. The lower rates forecast for **nef's** scenario are expected to persist since growth in the UK economy has depended fundamentally on the financial sector for the past 30 years. There is no reason to believe that we will return to the long-term growth rates that we have had post the financial crisis.

For overseas growth rates, **nef's** assumptions were derived from the IMF's World Economic Outlook, October 2009.

Table 5: DfT and nef oil prices assumptions, \$ per barrel, 2007 prices

	DfT January 2009	nef, February 2010	nef, source
2010	65	80	Energy Information Administration, International Energy Outlook 2009
2015	68	110	
2020	70	115	
2025	73	121	
2030	75	130	

Box 5: comparison of nef and DfT input assumptions cont.

Table 6: Other assumptions

Variable	DfT January 2009	nef, February 2010	Impact of new assumption
Exchange rates	US dollar exchange rate reported by the Bank of England for the 12 months to September 2008	Annual average US dollar exchange rate reported by the Bank of England for the 12 months to 31st December 2009	Weaker £ as a result of the crisis will increase the cost of overseas travel and dampen demand
Carbon prices	Department for Energy and Climate Change (DECC) central value for the shadow price of carbon dioxide emissions, published in 2007	Central traded carbon price series published by DECC, July 2009	DECC prices are substantially higher than previous ones used in DfT's Jan 2009 model run
Non-CO ₂ effects	Radiative forcing factor of 1.9 based on minimum estimate from analysis by Sausen, 2005 ⁴⁰	A mid-range Global Warming Potential factor of 2.4, from ABC Impacts: Aviation & the Belgian Climate Policy, 2008	A higher factor for non-CO ₂ effects of aviation emissions increases the CO ₂ equivalent quantity of emissions and so increases emissions cost
Efficiency gains	Efficiency gains of 1.1% per year to 2030, and 0.75% per year from 2030 to 2050	Efficiency gains of 0.8% per year across the period, following the Committee on Climate Change assessment (December 2009)	Lower efficiency gains mean a reduction in the amount by which emissions from more air travel are mitigated

Box 6: The Issue of Uncertainty

The outcome of our rerun highlights an important point around the uncertainty inherent in some variables. This is particularly the case for economic growth rates and exchange rates which are key driving variables of passenger demand. Assumptions about both of these variables are influenced by the point in the economic cycle at which an appraisal takes place. In the case of exchange rates, these have tended to be favourable to UK travellers in recent years but this may not adequately reflect future long-term average trends.

The point here is not to say that this consideration invalidates the results of cost-benefit or SROI analyses. Rather it suggests that the burden of proof on whether a project represents value for money and good value for society needs to be higher for outcomes that are particularly susceptible to unpredictable changes in the variables. These issues and the implications for decision-making are considered in more detail in Section III and in our conclusions.

Table 7, below, presents a breakdown of results into the principal cost-benefit categories generated by the model. A discussion of the individual costs and benefits is set out in Appendix 2. However, we would draw attention to the climate change costs, £5.1 billion in our rerun, versus £5.4 billion in DfT's appraisal in 2009. This result occurs despite much higher carbon prices in **nef's** rerun and therefore seems anomalous. The explanation is that as a result of lower economic growth and higher fares (because of higher oil and carbon prices) demand is reduced and this, along with the model's iteration of routes flown and aircraft types in the fleet, results in a much lower volume of additional GHG emissions in **nef's** rerun as compared with DfT's 2009 scenario.

Table 7: Passenger numbers forecast and costs/benefits of Runway 3 - a comparison of nef and DfT central case results

	nef, February 2010	DfT January 2009
Forecast unconstrained demand by 2030	347 million	463 million
Forecast passenger numbers for the UK each year by 2030	333 million	453 million
Benefits and Costs	Present Value, £bn	Present Value, £bn
Benefits:		
Users/passengers	2.3	9.4
Producer	4.0	6.2
Government	2.9	3.7
TOTAL	9.2	19.2
Costs:		
Infrastructure	7.8	7.8
Climate change	5.1	5.4
Noise	0.3	0.3
Air Quality	0.1	0.1
TOTAL	13.3	13.6
Net Present Value	-4.0	5.5

Note: Net present value results do not sum exactly in this table due to rounding.

Sensitivity analyses

As well as running our central case assumptions, two sensitivity tests were carried out. These use alternative carbon prices:

- 1. Test 1 – NPV of £-4.6 billion:** DECC's non-traded price series was used in place of the central traded price series used in our central case. Non-traded prices are intended for use in valuing emissions from sectors that are not subject to carbon trading. The assumption for aviation in official and business circles is that it will become part of the European Union's Emissions Trading Scheme (EU-ETS) in 2012, and so should be subject to the traded price series, as in our central case. But non-traded prices are higher than the traded prices until 2030 when they converge. This suggests that there is an assumption that the market will be undervaluing carbon emissions in the early years because the cap on emissions will be too loose. This means there is an argument that the non-traded prices will be more in accord with an understanding of the real abatement costs, thereby better reflecting the true cost to society of emissions to 2030. Furthermore, as the government has established a target for aviation that relates to 'absolute' emissions, this price may be more appropriate, as offsets and trading will not be counted towards the target.
- 2. Test 2 – NPV of £-9.7 billion:** DECC's high traded price series was used in place of the central traded price series. Evolving scientific evidence has consistently suggested a worsening outlook for climate change impacts.⁴¹ If international progress towards a low carbon pathway continues to be delayed, there will be a need for deeper cuts in emissions in future and this will demand higher prices.

These sensitivity tests produce a more deeply negative NPV than the central case because emissions are attributed a higher value.

Treatment of carbon costs in the model

Following our rerun of the DfT's model, the department raised an issue about what they consider to be double-counting of the carbon emissions cost. This was said to occur because DfT assumes that a levy or carbon top-up will be raised on fares which together with Air Passenger Duty cover the emissions cost (variable according to carbon prices) associated with each seat, ie: passengers pay an amount equivalent to the value of the carbon they are emitting when they fly. Whether channelled through a trading system or imposed directly by government, revenue from the top-up should, according to DfT, appear as a benefit to government over and above the benefit it gains from Air Passenger Duty. But this does not show up in the model as it stands, ie: the assumed offset – or balancing item – for the carbon cost via the top-up that accrues to government is not accounted for.

There is a legitimate concern about treating the carbon cost in this way. Climate change policy is being framed very much in terms of the polluter pays principle. For greenhouse gas emissions and climate change, this means pricing carbon so that air passengers, for example, pay for the costs of the pollution they cause. Through the price mechanism, higher prices should dampen demand for the polluting activity, and encourage the cost-effectiveness of investment in new, clean technologies. But this may be confusing the value placed on the pollution (reflecting its harm or risk) with a price paid for it. The two are not synonymous. Whether or not a polluter has paid for the harm or potential harm caused through a financial transaction, the pollution remains – in the atmosphere in the case of greenhouse gas emissions. Whether or not the pollution is within an agreed limit, such as an emissions cap, there is still an argument that the impact of the pollution on the environment and society should be counted. And, in any case, it is not assured that a carbon trading system will be water (or emissions)-tight enough to ensure that extra pollution in one sector will be matched by lesser pollution in another so that the overall effect is neutral.

Since this issue raised by DfT applies both to our rerun and the DfT's January 2009 run, a comparison of our net cost of £4 billion with their announced net benefit of £5.5 billion remains valid.

Separately, however, despite concerns, we adjusted for this issue in finalising the numbers from our rerun to input to our overall headline NPV result. In so-doing the net cost generated by DfT's model reduced from £4.0 billion to £1.8 billion.

An Issue of discounting

Cost-benefit analysis applies discounting of future costs and benefits, according to government guidance in The Green Book by 3.5 per cent a year and then by 3 per cent a year after 30 years if an appraisal period extends that far.⁴² This means that a benefit or cost of £100 which occurs in ten years' time is only counted as £71 today in adding up costs and benefits in an appraisal.

The rationale for discounting is that people value present income or consumption more highly than future income or consumption. This reflects an 'impatience' factor as well as the fact that we can be more certain of having something now than if it is subject to unforeseen circumstances in the future. It is also a reflection of the fact that future generations are assumed to be richer than we are, so why should we pay to do something now that in future will absorb fewer financial resources?

Environmental economists raise several objections to the application of the same discount rates to natural resources or pollution as to economic outcomes. One of the key ones is that if an activity is polluting the environment in a way that threatens life, then action must be taken now and not put off. The following extract is from the 2006 Stern Review on the Economics of Climate Change:

*'...the issue of pure time discounting is important. If the ethical judgement is that future generations count very little ... then investments with mainly long-run pay-offs would not be favoured.'*¹⁴³

This is the case with climate change. If we discount the social value of environmental improvements in the same way that we discount economic benefits not only are we likely under-estimate the costs to future generations but we will also actively discourage behaviour aimed at minimising environmental damage. In short, there is nothing to suppose that today's children will place any less value on the damage from climate change than we do now. In supplementary guidance on cost-benefit analysis, the government accepts that it can be appropriate to vary the discount rate in such cases, from 3.5 per cent to 3.0 per cent for the first 30 years, and from 3.0 per cent to 2.57 per cent for the subsequent 45 years.⁴⁴

We applied these adjusted discount rates to the emissions cost estimates derived from our rerun of the DfT's model. The results are shown in Table 8.

Table 8: Present value of carbon costs in nef scenarios, with original and revised discount rates, £ billion

	Original discount rates 3.5% & 3.0%	Revised discount rates 3.0% & 2.57%
Central case	5.1	6.2
Sensitivity 1: non-traded carbon prices	6.3	7.5
Sensitivity 2: high traded carbon prices	11.3	13.9

By discounting at these lower rates, the value of the stream of future climate costs increased by £1.1 billion in the central case, and by as much as £2.6 billion with high traded prices for carbon. Table 8 below reveals what this means for the net outcome.

Table 9: Costs and Benefits adjusted for carbon levy and discount rates

	nef, central case	nef, sensitivity case 1	nef, sensitivity case 2
Benefits & Costs	Present Value, £bn	Present Value, £bn	Present Value, £bn
Benefits:			
Users/Passengers	2.3	2.4	2.6
Producer	4.0	4.1	3.9
Government (APD + carbon levy)	5.2	6.3	11.3
Total Benefits	11.5	12.8	17.8
Costs:			
Infrastructure	7.8	7.8	7.8
Climate change (at adjusted discount rates)	6.2	7.6	13.9
Noise	0.3	0.3	0.3
Air Quality	0.1	0.1	0.1
TOTAL COSTS	14.4	15.8	22.1
Net Present Value	-2.9	-3.0	-4.3

Note: Net present value results do not sum exactly in this table due to rounding.

Amending the discount rate for carbon costs, and adjusting for the issue of double counting described under the previous heading produces a central-case result from our rerun of DfT's model equal to a net cost from Runway 3 of £2.9 billion. This is the result we input to our central case headline appraisal result.

Summary

Rerunning the DfT's model indicates that the costs associated with Runway 3 outweigh the benefits.

- The result generated by the model that is directly comparable to the DfT's result from January 2009 reverses the outcome from net positive (£5.5 billion generated by DfT in January 2009) to net negative (£-4.0 billion generated by nef's rerun in February 2010).
- In generating our overall headline result we use net costs produced by DfT's model in the range £-2.9 billion in the central case, to £-4.3 billion in the worst case. To these figures we add the range of additional community costs as described in the rest of this part of the report.

Measuring community impacts

As with many infrastructure projects, the benefits of Runway 3, and the costs, in environmental and social terms, are likely to be experienced by different groups in society. People living near Heathrow may be relatively small in number compared with the potential beneficiaries of more air travel, but as we reveal in this section, the costs they bear are far from negligible.

Our stakeholder engagement exercise with the community was conducted in the second half of 2009. It involved local residents, residents groups and local authorities. These groups were strongly of the view that the community impacts of Heathrow operations, and particularly the Runway 3 proposal, have not been adequately evaluated in studies to date to reflect the experiences of those affected.⁴⁵ Our interviews also found that people did not feel that the DfT's consultation process in 2007 had been a genuine engagement. In particular, they felt that they did not have the opportunity to register their objections; they were simply asked a series of closed, prescribed questions. Consultation was not sought on the principle of supporting Runway 3, but rather on whether and how the environmental conditions for noise and air quality could be met. As a result, a review of the DfT's impact assessment does not give a sense that the consultation process was used to inform the valuation process.

What we have found is that the DfT's model only allowed for monetisation of noise and air pollution costs, at levels that are not commensurate with people's lived experience. Surface congestion costs and blight, along with biodiversity and heritage impacts were omitted from the DfT's valuation. A key part of our re-evaluation involved attempting to put this right by examining the community costs that local residents identified as material for them. Drawing on feedback from stakeholder interviews, this part of our valuation exercise focused on four key areas:

- Noise
- Air quality
- Blight
- Surface congestion

For measurement of noise and air pollution impacts, we drew on recent work by Wadud,⁴⁶ who reviewed the literature on the valuation of externalities in aviation. His paper argues that under-accounting for these costs will result in inefficient economic decisions:

'A better estimate of the environmental costs would allow the policy makers to compare the benefits with the costs of aviation. At the same time, there could be trade-offs between policies to reduce adverse impacts on different environmental resources...It is therefore important to value the environmental impacts of different types into one common basis, often in monetary units.'

Headline results

Table 10 summarises the outcome of our community impacts modelling exercise, and presents the results alongside those generated by the DfT's model for comparison. In total we derive a valuation for the material community costs associated with Runway 3 over a 60 year appraisal period of £2.5 - £3.6 billion. This is at least £2.1 billion higher than DfT's estimate. This figure represents the value of costs that have been under-estimated or excluded from official cost-benefit estimates.⁴⁷

Table 10: Value of community impacts from Runway 3

	nef present value, £ billion	DfT present value, £ billion
Noise	0.9 – 2.0	0.3
Air quality	0.3	0.1
Uncertainty and general blight	0.3	-
Surface congestion	1.0	-
TOTAL	2.5 – 3.6	0.4

Of particular note is that our minimum estimate for noise costs is substantially higher than the DfT's, at £0.9 billion compared with £0.3 billion. Also, for the first time in appraisals of Runway 3, we have placed a value on the impact on surface congestion around Heathrow, which amounts to £1.0 billion. Surface congestion was identified as a major cause for concern by claimants in the recent Judicial Review of the Runway 3 decision, so its inclusion in an analysis of Heathrow extension is imperative from a stakeholder perspective.

It is important to note also that whilst academic studies have found that climate change costs can be of a higher order of magnitude than any other environmental disbenefit, the costs of noise, air pollution, biodiversity and landscape impacts are comparable to each other.⁴⁸ This result does not appear in our table because each outcome has been valued separately using current best practice methods, but it suggests that combined community costs could potentially be significantly higher than assumed here.

In deriving our overall headline result as shown in the box at the beginning of this Section II we combined numbers on the economic benefits and carbon costs from our rerun of the DfT's model (as shown in Table 11) with our estimates of the community costs as shown in Table 11 here. The results are presented as follows:

Table 11: Headline results from nef's re-evaluation of Runway 3

	Central case (£ billion)	Worst case (high traded price of carbon, £ billion)
Benefit to users (passengers and airlines)	2.3	2.6
Benefit to producers (airport operator)	4.0	3.9
Benefit to government (revenue from air passenger duty and putative carbon levy)	5.2	11.3
TOTAL BENEFITS	11.5	17.8
Carbon cost:	6.2	13.9
Community costs (noise, blight, congestion, air pollution):	2.5	3.6
Infrastructure costs:	7.8	7.8
TOTAL COSTS	16.5	25.3
NET COST:	5.0	7.5

A discussion of each aspect of the community costs we measured is outlined in detail in the rest of this section.

Noise

'Daytime noise impacts at Heathrow are many times worse than at any other airport in the UK.... The Government's policy... is to take all practicable steps to prevent any deterioration in the noise climate at Heathrow, and to continue to do everything practicable to improve it over time'

ATWP (paragraph 11.52)

'... my house is currently not located under a flight path and consequently my family and I do not suffer too badly from aircraft noise. Were the proposed expansion to take place, I would be located approximately 200 metres from the Runway 3 . During the pre-White Paper consultation in 2002 ... I was shown the noise maps and told that following expansion I would experience noise levels of 72dBA'

Witness statement of Geraldine Nicholson.⁴⁹

The extract from the ATWP above reveals official recognition that noise around Heathrow is already at the extreme. In our meetings with stakeholders, we heard repeatedly that people understood the need for the airport and they could tolerate the noise as it is now, but felt they could not cope with any more. It is interesting to note that a government commissioned study (the ANASE study, Attitudes to Noise from Aviation Sources in England) found that for the same level of aircraft noise, people were more annoyed in 2005 than they were in 1983. This suggests that people's tolerance of noise disturbance has reached a limit.

Valuation

Our valuation used the method recommended by Wadud⁵⁰ as a result of a major academic literature review of noise cost methodology. The approach uses the economic valuation technique of hedonic pricing, whereby the impact of noise on property prices is used to proxy the disturbance effects on residents (see Appendix 3).

Valuing noise effects has two key components:

- Measuring the quantity of noise experienced, and determining the threshold for disturbance;
- Deriving a cost to represent the disturbance experienced.

Threshold for disturbance

Our literature⁵¹ and interviews with civil society groups established that 50 dB can be assumed to be the appropriate threshold for measuring the impact of noise. We therefore applied this cut-off point in our modelling work. The map below illustrates the geographical area around Heathrow airport, assuming addition of Runway 3, bounded by the 50dB contour. It means that moderate noise from the expanded airport would be experienced as far east as Central London and as far west as Reading.

In calculating the additional impact of Runway 3 on noise disturbance, we used estimates from those who would be newly affected by noise as a result of airport expansion, and the assessment of those who already experience noise from Heathrow but who would experience more as a result of expansion.

Attaching a value to noise disturbance

The methodology used here looks at the impact of noise exposure on house prices, explained more fully at Appendix 3. Hedonic pricing in relation to house prices generally applies the cost to each household. However we take the view that it is valid to apply the cost to each resident because the noise is experienced individually, regardless of how many people reside in a house.

Table 12 sets out our results. It shows a value of the noise disturbance per person of £2,637 where the cost is worked out on a per household basis, and assuming two residents on average per home. Across a 60 year appraisal period that represents £44 per year for every person who suffers noise disturbance from Runway 3. Even working out noise costs per person rather than per household yields a per year, per person value of just £97, not much of an indicative compensation for living with frequent disruptive noise every day of the year.

Table 12: The cost of noise disturbance

	Total aggregate cost of noise disturbance, £	Number of households/ residents within 50 dB contour	Total value of noise disturbance per person, £	Value of noise disturbance per person, per year, £
By household	900,643,278	170,800	2,637	44
By resident	1,964,651,917	338,900	5,797	97

The health and educational impacts of aircraft noise

We note that although the hedonic pricing method is a widely accepted approach in economic analyses, there are other effects from noise that are not captured. The implications of aircraft noise for health, hypertension especially, and for educational outcomes has been highlighted in some previous studies.

On education, the DfT's Equalities Impact Assessment commented that: *'Aircraft noise is noted as a potential contributor to low educational achievement such as poorer reading comprehension, recognition memory and motivation.'*⁵²

The following comments were made by staff when we visited a primary school close to Heathrow for this study:

'Until the school got triple glazing there was constant interruption with a plane overhead every 55 seconds, and with the noise from that plane lasting 25 seconds... Now there is a statutory requirement for outdoor education. The ability to deliver this is severely compromised. The noise is relentless.'

'I find aircraft noise particularly difficult when on playground duty. Playtime is one of the few opportunities to talk to all the children informally. Children who I haven't seen for days come up desperate to share some news or just to chat and an aircraft flies overhead making it impossible to hear or respond to them. As a result the conversation loses its impetus and we both end up smiling at each other. These are lost educational and social opportunities.'

The community group, NoTRAG (No Runway 3 Action Group), has suggested that there are seven schools close to Heathrow that will be severely affected by the new runway.

Studies have established a link between aircraft noise and impaired reading comprehension once other variables have been taken into account,⁵³ and also a link between aircraft noise and health outcomes.⁵⁴ These studies did not quantify the effects and a method for doing so appears not to have been established at this stage. Owing to the complexities of valuing health and educational outcomes in the absence of guidance on effective measurement, we did not attempt such a quantification in this SROI. We note, however, that any such quantification would raise the estimate of noise disturbance from Runway 3 above our estimate of £0.9 - £2 billion, based solely on hedonic pricing.

Air quality

*'All the pollution monitors in the area are over the limit, but no health assessment has been done.'*⁵⁵

In the DfT's impact assessment, the value assigned to the cost of air pollution, at £0.1 billion, was significantly less than the cost of noise at £0.3 billion. The impact assessment found that relative to other costs and benefits, the damage effects of air pollution are slight. Based on this valuation, the impact of air pollution could arguably be 'immaterial' from an SROI perspective – meaning that removing it completely from the calculations would not affect the overall ratio.

What stakeholders told us paints a very different picture however. Of all of the 'disbenefits' that residents experienced, they were most concerned with the health impacts of air pollution, on them and their children. It was quite widely known that Heathrow was breaching EU regulations on safe levels of pollutants and this caused people serious concern.

'You get used to it, but you can smell kerosene if you are out and about especially if it's cloudy. You see a black line on the washing line. People who come to visit comment on how the air is making them cough'.

Local resident, Heathrow villages

The analysis of air pollution carried out for the DfT by consultants AEA on Runway 3⁵⁶ drew on the methodology recommended by The Committee on Medical Effects of Air Pollutants (COMEAP), a panel of health experts that advises the UK government on air pollution-related health issues. Wadud⁵⁷ identifies a number of problems with data and valuations that COMEAP recommends. In our study we focused on the two most material assumptions: the relationship between pollutants and mortality and the magnitude of the value used to represent that cost. Our full critique is available in the technical appendix. Here it is sufficient to say that a 'downward bias' was detected in the analysis, in other words that there is an inbuilt tendency to underestimate.

Valuation

It is beyond the scope of this study to do any remodelling of the costs of air quality, and an alternative metric was not easily identified. Instead, to correct for potential underestimations described in the appendix we have used the numbers derived by Clean Air for Europe (CAFE) in our central case.⁵⁸ This was modelled for the DfT by their consultants in their sensitivity analysis and yielded a present value of £0.3 billion. The CAFE study uses a higher valuation for the costs of mortality but it is still based on drawing a less strong link between particulate matter and mortality than Wadud recommends. We would argue that this is therefore still an undervaluation. This is an area that requires further work, particularly in light of stakeholder concerns over it. From an SROI perspective the optimum approach would be to value the anxiety associated with living with the threat of air pollution, as well as the actual impacts on health and mortality.

Uncertainty and blight

Residents are, and have been, bearing a cost due to uncertainty for a number of years. They have been physically trapped and psychologically disempowered.⁵⁹

Our interviews with stakeholders highlighted the difficulties that local residents in the Heathrow villages of Sipson, Harmondsworth, Longford and Cranford have had in living with the uncertainty of Heathrow expansion. Plans for an additional runway, or alternative means for expanding Heathrow were first mooted seriously in 2001. Since then residents have been unsure whether and when expansion will take place. This has had impacts on individual choices, plans, prospects and fears for the future, and on the fabric of the community. A number of our interviewees said they no longer cared what the outcome was, they just needed to know either way so they could plan accordingly.

'No-one is renovating their properties because they don't want to invest if they are going to lose them. No-one has any pride in their properties – everything is temporary'.⁶⁰

Some of the key impacts are as follows:

- Runway 3 will involve the demolition of Sipson village, so 3,000 Sipson residents and businesses face the prospect of having to relocate. Especially for older members of the community, some of whom have lived in Sipson for many decades, this prospect is alarming. In practical terms, it means that support ties and contacts will be broken and hard to replace. Sipson residents we spoke to said they felt they were being 'forced out'.
- The threat of expansion has destabilised and begun a process of change in the Sipson community in ways that probably cannot be reversed. This includes an increase in tenanted properties, and lack of investment in the physical fabric of the village. Tensions have developed between the permanent residents and temporary residents.
- Runway 3 will also mean the loss of part of Harmondsworth village, and will take the airport boundary right up to the centre of the village. While villagers do not face eviction, they fear for the future look and life of the community, loss of pleasure in their surroundings, loss of tranquillity and difficulties accessing amenities.
- Parents have reported that the proposed demolition of Heathrow Primary School has caused worry among the children. They face not only the loss of their school but also the prospect of friends moving away from the area.
- Access to public services and amenities north of the villages towards West Drayton will be cut off by the construction of Runway 3. Local residents are unsure how they will access the services they need.

It is easy to imagine the stress that living with uncertainty such as this could cause. On an entirely practical level though there is an impact on the ability of residents to sell their properties if they should want or need to. Although there is a scheme under which residents are able to sell their homes to the airport authority for less of a discount than the market would impose in these circumstances that right can only be exercised once the authority has announced its intention to apply for planning permission for a Runway 3. This leaves a period of time during which many houses will be practically unsellable because of the uncertainty over whether Heathrow will be expanded. If a home-owner needs to move during that period for any reason, they are highly likely to be compromised or prevented from doing so. Local residents have also highlighted the fact that in many cases it is not clear whether they will become eligible for the house purchase facility at planning stage.

Valuation

There is no direct measure available for living with uncertainty, and generalised blight inflicted by changing circumstances. Very little research has been done on this issue in general. Nonetheless, because of its importance to stakeholders we did not want to leave it unmonetised in our analysis. Two reasonable proxies were identified: the average spent per household on home refurbishments in the UK; and house price effects of close proximity to the airport as used to measure noise disturbance. The first of these is a measure of people's pride in and enjoyment of their neighbourhood. This is something that is being eroded by blight and uncertainty. The second applies the methodology used to value noise disturbance to estimate the effects on residents of blight on the assumption that both outcomes could be expected to be of a similar order of magnitude.

Either of these approaches produces a figure close to £0.3 billion. For the purposes of this study we have used this number, though we recommend that further research be conducted on this issue. To put this sum in context, when broken down to reflect the numbers of all affected residents it amounts to £830 per person. This is arguably very little in terms of compensation for having to live with the negatives of uncertainty and blight.

Surface access

Both Transport for London (TfL) and claimants in the Judicial Review of the DfT's decision to support Runway 3 highlighted surface access as a major consideration for a cost-benefit analysis of the proposal. Yet this was omitted from the DfT's impact assessment. The government's position was that it was inappropriate for issues of surface access to influence policy; these were issues to be considered at the planning stage.

Lord Carnwath, who presided at the Judicial Review, found that the claimants concerns over surface access were justified. He noted that the government was 'unable to provide a convincing answer' in court when it was pressed about over-crowding on the Piccadilly line that would result from construction of a Runway 3.⁶¹

Public transport congestion in West London

The DfT's 2007 Consultation Document⁶² assessed that for the Piccadilly line

'With a Runway 3 we expect a three-fold increase in in-bound peak hour demand and a four-fold increase in peak hour demand in the same hour'.

The DfT appeared to suggest, however, that that current plans for upgrades to tube and rail lines would be sufficient to manage the increased levels of demand forecast once Runway 3 is built. TfL's opinion is that even with an upgrade, the Piccadilly line will be crowded by 2026. It points out that all upgrade plans – to the Piccadilly Line, Crossrail, and Airtrack, are on the basis of existing capacity issues, and predicted population and employment growth. The assumptions do not take account of extra demand as a result of Runway 3.

Road congestion

The M4/M25 area immediately around Heathrow is one of the most congested parts of the entire UK road network. The Consultation Document estimated that for mixed-mode expansion of Heathrow there would be an additional 25 million extra road passenger trips every year. This is a significant increase, but additional flights from mixed-mode would be less than from Runway 3 which suggests that the number of additional road passenger trips from Runway 3 will be higher still.

There is no detailed work in the public domain that appraises the impacts of Runway 3 on road capacity, requirements for extra junctions on the M4 and the knock-on effects of more road traffic on local road systems. The only work on surface access has concerned air pollution not traffic management. Officially, such assessments would take place at the planning stage. But as the claimants in the recent Judicial Review argued however surface congestion is a material consideration for whether or not to support Runway 3 in the first place.

Valuation

As described, no estimates have been put on the cost of increased surface congestion as a result of more flights and passengers using Heathrow. Our estimate of additional surface access costs looked only at the costs of traffic congestion. We did not include an estimate of the cost of increasing congestion on public transport, partly because we assume that BAA will cover the costs of essential upgrades and partly because of the lack of an appropriate metric.

It has been estimated that the additional passenger numbers as a result of Runway 3 will create 25 million additional vehicular movements per year when it is fully functional by 2030. For our calculation, we allowed for a growing proportion of passengers to travel to Heathrow by train or tube rather than car or coach. By applying a cost per mile to an average length journey we derived a figure for surface access costs of £1.0 billion in present value terms across the appraisal period (numbers are fully explained in Appendix 3).

Compensating for Community Impacts

Clearly, infrastructure projects are needed and are often highly beneficial to UK society. However, as noted at the start of this section, for the most part it is not those who experience the benefits of air travel who carry the costs arising from noise, air pollution and local congestion. This means that for people who live close to an airport there is little if any direct cost-benefit trade-off.

According to economic theory's polluter-pays principle, those who bear the costs of Heathrow's activity should be adequately paid for doing so by those who benefit. Where there is no market structure to allow a direct trade or economic transaction payment needs to be made through compensation. The airport operator, BAA, does indeed pay compensation in the form of payments for insulation, or even house purchase for residents who meet the criteria. But only if the costs borne are adequately quantified can we gain some assurance that a decision to go ahead will be economically sound, creating net value for society, and also that payments to local groups are commensurate with the disbenefits they bear.

Our analysis suggests strongly that the environmental and social costs of Heathrow have been consistently under-estimated. The Sustainable Development Commission put it strongly in its response to the ATWP: '... the well-established principle of compensating losers from the gains of the winners appears to be rejected by the ATWP'. As a result, it may be necessary to review current compensation levels to ensure that there is a fair trade-off between those that benefit from airport expansion and those that suffer as a result of it.

The following extract from the ATWP Progress Report 2006,⁶³ acknowledges the problem and gently invites BAA to consider the impacts on those living close to the airport. But it also highlights the issue of cut-off points or boundaries, whereby qualification criteria for compensation can be arbitrary and insensitive. At the very least, this indicates a need for compensation schemes to be adaptable and responsive to evolving circumstances.

'In confirming support for a Runway 3... the Secretary of State also recognises that such a development would particularly impact two categories of local residents. First, those living just outside the perimeter of an expanded airport and whose properties would not either be compulsorily purchased or qualify under existing compensation schemes for noise insulation but would be significantly affected by the new runway and terminal building. Second, those newly affected by noise from a Runway 3... The Secretary of State is asking the airport operator... to give particular consideration to addressing the impacts on those households who find themselves located closest to the new airport boundary.'

III. Measuring the economic impact of aviation

'It is our main international hub airport, the lifeblood of our economy depends upon it and this government will not betray the national interest by refusing to take a decision that is manifestly in the best interests of the country.'

Lord Adonis, February 2010⁶⁴

'The business community must take account of the strongly held views of those living in the broader community in which we operate... To say that all those from the business community support the Runway 3 is wrong. It is a misconception and one that we wish to put right '

Letter to The Times from 13 business leaders, May 2009⁶⁵

Introduction

The statement by Lord Adonis above suggests that the economic case for expanding Heathrow is clear cut. It suggests that airport infrastructure is part of the 'lifeblood' of the economy, and that anyone who opposes it is opposing the public interest. This message – that the Runway 3 is crucial for the UK economy – has been repeated by successive transport ministers. However, these comments are not supported by any independent analysis of the empirical relationship between Heathrow expansion and the UK economy.

As the letter to The Times also quoted above shows, the view that the economic case for Heathrow is clear cut is not held across the business community, and this has been confirmed by other research⁶⁶ In a major year-long stakeholder assessment process conducted between 2007 and 2008,⁶⁷ the Sustainable Development Commission found that the key area of disputed evidence for the impact of aviation was around the economic impacts:

'In the economy discussions, the participants found it difficult to see any of the aspects of the economy as easy or difficult. Rather all are difficult'.

This is partly about the lack of an agreed metric for robustly capturing the full economic benefits. In addition, however, there are other contested or unresolved issues. Because of the centrality of these economic arguments to the political arguments in favour of expansion, these will be explored in this section.

Approaches to measuring economic benefits

Capturing the benefits of airport expansion to the economy is difficult and there has been much debate as to methodology. In this section, we look at the different approaches that have been taken.

1. The consumer-surplus approach

The DfT's model is built on an established methodology for transport appraisals. This counts the economic benefit of a proposal as the welfare benefit to the passengers and aviation service providers.⁶⁸ The concept of consumer surplus theory, which underpins this is explained in Box 7. However, we are far more likely to think of the economic benefits in terms of extra trade, revenues and profits for businesses, and especially additional jobs. These are not directly and transparently captured in the existing approach, yet it is these that are being referred to by politicians that support a Runway 3. In addition, there are potential economic benefits in terms of trade, inward investment, and agglomeration effects (where firms locate in proximity to each other which can help deepen their markets). The Eddington Transport Study published by the government in 2006⁶⁹ also identified the potential from cross-market labour activity.

This view that consumer surplus measurement underestimates economic benefits was reflected in comments by the DfT's own peer reviewer.⁷⁰ We note, however, that the January 2009 Impact Assessment explains that

'...in the absence of a direct measure of the wider economic benefits of a scheme, appraisals include the user benefits to non-UK residents and firms'.⁷¹

To what extent this might capture some of the benefits to the UK of additional trade or inward investment is not clear, but there is a need for some caution in making any assumptions about the extent to which Runway 3 might bring wider, catalytic benefits that are additional to welfare benefits captured by consumer surplus. There is a real danger of double counting a portion of the overall economic benefits.

Box 7: Consumer surplus theory and its application in the DfT's model for Runway 3

From a theoretical perspective, the benefit of a purchase of a good or a service to the purchaser is taken to be the measure of 'consumer surplus'. That is the welfare benefit that a consumer experiences from purchase of a good or service in excess of the price paid for it, the difference between what a consumer would be willing to pay for something and what they actually do pay.

A key criticism of the consumer surplus approach is that it assumes that a price decrease (or conversely an income increase) is necessarily a good thing by definition. This ignores important distributional issues about how people on different incomes experience increases in income. In the case of Runway 3, the additional consumer surplus from the new runway comes about because extra capacity for air travel reduces the price that passengers have to pay. By itself this price reduction does not indicate that material social value has been created. In the case of air travel, most passengers are relatively wealthy. Because the marginal utility of each additional unit of spending decreases, extra spending by this group may not have much of an impact on their welfare. This is less likely to be the case with bus travel which is used by less well-off people for whom small increases in income can make a huge difference to their welfare.

In this case, even if the valuation methodology successfully captured all the externalities from the extra runway the measurement of the economic benefits using consumer surplus theory would be applying a blunt tool to valuation of complex economic impacts.

2. Returns to businesses

If the welfare approach used in the DfT analysis does not transparently relay what we generally understand to be the 'true' economic benefits of additional airport capacity then there would appear to be a need for developing a fuller, more transparent relationship between air travel and the UK economy. The returns to businesses from additional executive travel and import/export opportunities are not easy to assess, however. A wide-ranging study of business estimates of the returns they make to travel and import/export costs might tell us something of the economic benefits being gained from existing aviation infrastructure. But arguably it would not capture the potential that might be generated by further expansion of capacity. Even harder to capture are the potential knock-on effects of air travel through the economic supply chain. Attribution of the indirect and catalytic impacts of the aviation industry itself on other businesses which supply it is already the subject of some controversy.⁷²

In a recent report, the British Chambers of Commerce attempted to quantify the economic benefits of a Runway 3 at Heathrow in terms of the time savings to businesses. It is questionable, however, whether a measure of time saving robustly captures the benefits to businesses. Cairns and Newson (2006, *Predict and Decide*), point out that if time is valued very highly by firms, then the cost of flying as opposed to video-conferencing would be prohibitively high.⁷³ In addition, aggregating small time savings to individual firms across all firms may overstate the macroeconomic gain.

3. Contribution to GDP

There is substantial discussion in the literature about the relationship between air travel and GDP, but there are relatively few examples where an attempt has been made to quantify it. As the authors of a recent Omega report point out 'definition of these wider GDP effects is intrinsically difficult and quantification raises formidable challenges'.⁷⁴

The consultancy, Oxford Economic Forecasting (OEF), has been working on a model since 1999, which attempts to reliably assess an econometric relationship between business travel and GDP, which can then be applied to estimate the potential benefits of expansion. The estimate emerging from this work⁷⁵ is that for a 10 per cent increase in business travel there will be a 0.6 per cent increase in productivity in the economy.

A detailed critique of OEF's approach was prepared by economic consultants, CE Delft.⁷⁶ One of the main problems they identified was that OEF's estimate of the benefits of air travel of a business trip (at £400) was way in excess of the consumer surplus benefit derived from the DfT's work (around £30).

In contrast to the estimate by OEF, the International Air Transport Association (IATA) commissioned consultants InterVISTAS to define an econometric relationship between aviation and the economy.⁷⁷ The result was that for an addition of 10 per cent to connectivity 0.07 per cent would be added to GDP. This factor was an aggregate across different countries, including low-income countries. It is conceivable that in these countries, where infrastructure is less developed, capacity for extra air travel would contribute more to the national economy. This means that for an economy such as the UK, the estimated factor could be lower. Either way, there is clearly a very substantial difference between the estimates proposed by OEF and IATA, calling into question the reliability at this stage of any such estimate.

Finally, these analyses observe correlations between aviation and economic growth. However, in considering the relationship between the two, there is an important question over the direction of causality – is it more air travel that is driving economic growth or is it economic growth that is driving demand for more air travel? Or a bit of both?

4. Employment/ regeneration

The DfT estimates that Runway 3 would deliver around 12,000 additional jobs at Heathrow. From an appraisal perspective it is important to determine whether these jobs would be truly additional to the economy. Observers are often suspicious of the employment gains claimed by proponents of airport expansion, as these have been found to be overstated in the past. This is particularly relevant in an industry moving increasingly towards automation and greater efficiencies in its workforce costs. The case of Manchester Airport is a case in point:

*'When Manchester Airport announced in 1991 that it wanted to build a second runway, the Chairman of the Airport company claimed that this would create 50,000 new jobs... In the real world the runway was built and opened in 2001. The total number of jobs at the airport in 2006 was 4,000 more than ten years previously. Even adding indirect and induced employment at the usually quoted ratios, the increase would be around 6,400.'*¹⁷⁸

It is important to understand the nature of any forecasted jobs in order to determine their social value. This means evaluating who will get the jobs and what the productivity gains and terms of employment are likely to be. For example, Heathrow itself is not a regeneration area, so there are no spatial inequality benefits to be gained from establishing the jobs here. Again however, there is no independent economic analysis of whether these could be realised and who would benefit from them.

Unresolved issues

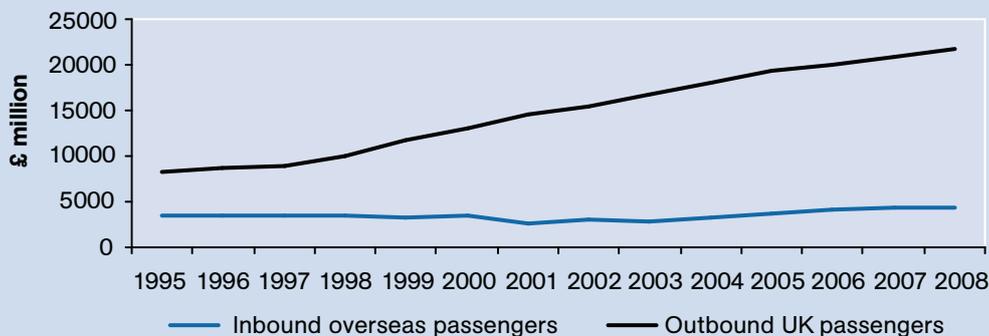
The tourism deficit

Another area of controversy in terms of the economic benefits of air travel concerns the impact of tourism.

It is well known, and officially acknowledged, that the UK runs a 'tourism deficit'.⁷⁹ In other words, holidaymakers from the UK spend substantially more money holidaying abroad than overseas tourists spend in the UK. The deficit among those arriving and departing by air currently runs at some £17 billion a year, and has grown exponentially over the past 20 years (ONS, Travel Trends 2008). The implication, simply put, is that more leisure travel by air has not delivered a net benefit to the UK economy.

Figure 6 shows the extent to which spending overseas by UK tourists has been pulling away from the amount of spending by foreign tourists in the UK.

Figure 6: Holiday spending: overseas air passengers visiting the UK vs. UK air passengers visiting overseas



Source: Travel Trends, 2008, 2004, 2000, Office for National Statistics

Trends indicate that most of the increase in passenger numbers on aircraft has come from leisure passengers, and these will account for the bulk of the increase in future passenger numbers. Unless trends reverse and inbound tourists grow faster than outbound tourists, the deficit is set to grow. This is important to recognise in a context where large claims are made for the importance of air travel for the health of the British tourism industry:

'Britain's economy is increasingly dependent on air travel... Around 25 million foreign visitors a year contribute to a tourism industry that directly supports more than two million jobs; two thirds of these visitors come by air'.⁸⁰

In fact, as Cairns and Newson point out,⁸¹ the majority of spending in the tourism sector in the UK comes from domestic tourists not those from overseas. In 2003 four-fifths of the UK's £74 billion tourism earnings came from domestic tourists.

Studies of the costs and benefits of aviation or additional air travel capacity have shied away from netting off the tourism deficit from overall economic benefits. There are issues over freedom of choice, welfare benefits, and other hard-to-quantify benefits that come back to the UK as a result of overseas cultural experiences. And although the UK economy may make a net loss, there may be net benefits to some overseas destinations from UK tourist spending that should not be discounted in a holistic analysis of global resource use. While some studies, such as **nef's** earlier report *Plane Truths*⁸² have gone some way to quantify these benefits, this is still an under-researched area. However, work to date does suggest that net benefits to overseas destinations, particularly long-haul developing nation destinations, are often overestimated.

From a social value perspective the benefits of tourism should also be taken seriously. In line with our earlier analysis, we cannot assume that these areas are not important simply because they are difficult to monetise or measure. More needs to be done to understand the trade-offs between these issues. At the least, it is important to highlight the tourism deficit in narrative terms in order to challenge exaggerated claims about the importance of tourism flows for the UK economy.

Hub airport status and transfer passengers

In its stakeholder feedback for this study, BAA described Heathrow's unique role as the UK's only major hub airport which means that it can offer a more comprehensive network to long-haul destinations than any of the UK's other point-to-point airports. BAA's view is that by increasing capacity at Heathrow, the effect on connectivity in terms of number of destinations and frequency of flights will be magnified compared to increasing capacity at the point-to-point airports.

The hub model, for example at Heathrow, means that a sizeable proportion of passengers are simply transferring from one plane to another to access their final destination. According to a report commissioned by the business group London First,⁸³ the increase in passenger numbers at Heathrow is largely accounted for by transfer passengers. These now account for 35 per cent of the total, compared with less than 30 per cent in 2000. In 1992 transfer passengers accounted for only around 9 per cent of Heathrow's passengers.⁸⁴ Some argue that these passengers contribute little directly to the UK economy because they are not stopping in Britain. Bob Ayling, former British Airways Chief Executive, famously noted that:

'What Ruth Kelly and the government do not see is that transfer passengers for whom such a hub would be built spend no money in Britain, at least little beyond the value of a cup of tea'.⁸⁵

Transfer passengers do not pay Air Passenger Duty. This means they make no contribution to the public purse that could help cover the infrastructure or environmental costs of aviation.

BAA argues strongly, however, that transfer passengers allow routes to be served from the UK, that otherwise would not be viable just with UK passengers. The case is made that transfer passengers through Heathrow help improve the access UK residents have to certain destinations, widening choices and bringing welfare and business benefits including through cost and time savings. The logic of this is clear. However, we might therefore expect that as the number of transfer passengers has grown, the number of destinations served would too. In fact routes have been closing at Heathrow. The number of routes served has fallen from 227 in 1990 to 180 today.⁸⁶ BAA's fear is that more pressure on capacity will reduce the range of routes even more.

The matter of transfer passengers and destinations served has been examined by London First. They note that Vienna airport has a similar proportion of transfer passengers as Heathrow but serves almost 50 more destinations. And that Stansted, with transfer passengers comprising only 17 per cent of its passengers, serves 160 destinations compared with Heathrow's 180. It may be that in the case of Heathrow competition for slots is so fierce and capacity so compromised that the focus is inevitably on the most profitable routes. But there can be no assurance that more slots at Heathrow would not simply mean more flights to existing profitable destinations. (This could bring benefits from greater flexibility but that is a separate point). Interestingly, despite the finding that Heathrow underperforms expectations in terms of the range of destinations served, London First's survey of business passengers found that they were exceptionally positive about the range and reach of flight services from Heathrow, indicating that this was not a concern.

The survey did highlight two particular concerns of interest. Respondents said the sheer volume of passengers using Heathrow was a major factor in the length and unpredictability of waiting times, which was a major source of frustration. This suggests that there may be an issue of critical capacity – the idea that beyond a certain size it is not possible, even for a hub airport, to function effectively. We have not researched this topic but it is an area that could be explored further.

The second area of concern, which relates to the first, is the issue of surface access to Heathrow. London First notes that

'one point that was constantly reiterated was the uncertainty associated with the time taken to get from central London to Heathrow'.

The issue of surface access being omitted from the DfT's impact assessment was a cornerstone of the claimants' case at the Judicial Review. As London First discovered, it is a highly material issue for business passengers.

A globalised context, especially one where climate change will dictate closer co-operation, suggests that at say a European level, it may be time to think about the possibility of building on the hub and spoke model or adapting it.

Alternatives to expansion

Stakeholders consulted during this study from environmental NGOs to powerful business groups, have argued that alternatives to more air travel exist but have not been adequately explored or invested in.

From a business point of view, national and international connections are vital, but they do not all need to be met by flying executives around the world. Absences from the office are costly both in time and money for employers and in personal terms for employees, who may have to be away from their families more than they would like. WWF-UK conducted a survey which found that 89 per cent of companies were seeking to reduce the amount they fly in the next ten years.⁸⁷

It is beyond the scope of this report to discuss alternatives to air travel at length, but we would highlight the potential of video-conferencing in particular, alongside investment in enhanced high-speed rail networks. In our interviews stakeholders expressed different views on the scope for substituting video conferencing for face-to-face meetings, although the technology is clearly improving.

What is promising is that looking just at the case for expansion at Heathrow, the report commissioned by London First found that:

'...respondents felt that if any plausible alternative to travelling through Heathrow existed, then their organisation would actively consider making use of alternative airports (or alternative modes of transport)'.⁸⁸

In fact, this report identified problems with operations at Heathrow, rather than the range and frequency of destinations, as the greatest hindrance to its performance in the eyes of business travellers.

Summary

The overview of issues presented here highlights a number of areas of uncertainty around accounting for the economic benefits of aviation, and its expansion. This is and should be an area of ongoing consideration and review. But for current decision-making it demonstrates the lack of consensus around the scale of social value that can be attributed to the economic benefits of aviation. The Sustainable Development Commission and Institute for Public Policy Research (Sustainable Development Commission (2008) *Breaking the Holding Pattern*, see endnote 67) have identified this lack of consensus about the impacts of aviation expansion as a significant risk for decision-makers, but also as an opportunity to build dialogue. What is certain is that assuming that there is a straightforward relationship could be a costly mistake.

Conclusion

'While the credibility of policy is still being established and the international framework is taking shape, it is critical that governments consider how to avoid the risks of locking into a high- carbon infrastructure.'

Stern Review on the Economics of Climate Change⁹⁰

'With so much evidence in dispute, we believe that the burden of proof lies with those who are in favour of increasing the use of flying, and that the case has not yet been sufficiently demonstrated'.

Sustainable Development Commission, 2008⁹¹

Our re-evaluation of the costs and benefits of Runway 3 shows convincingly that the case for expansion does not answer in appraisal terms. This is particularly crucial when we take account of the wider policy context – the emissions reduction targets that the UK must meet. The findings of this study appear to render plans for airport expansion a socially costly anomaly.

Official support for Runway 3 views the economic benefits as irresistible. While supporters acknowledge there are negative externalities, the assumption is that these are smaller in value than the benefits and therefore affordable. But we have highlighted the difficulty of establishing an incontrovertible economic case for an expanded Heathrow when forecasts rest on highly unpredictable variables, and when there are areas of reasonable contention.

A decision such as one on airport expansion will excite strong emotions and responses because the stakes are so high for all concerned. The burden of proof rests with those proposing a change, which once made cannot be reversed. This is especially so when there are significant opportunity costs; first because the carbon budget could be used for other perhaps more socially valuable ends than more air travel; and second because alternatives to air travel have not been factored into the Runway 3 analyses so far. Revitalising our rail infrastructure and investing in public video conferencing could be real alternatives to increased air travel in preserving UK economic productivity and competitiveness.

In addition, and arguably most importantly, the issue of political accountability is at stake. A presumption of net benefit that fails to stand up to scrutiny, as in a case such as Runway 3, carries real dangers that the public and business alike will lose faith in the decision-making process itself. Such loss of faith could extend, in particular, to undermining the ability of cost-benefit analysis to help reach decisions that adequately represent social and environmental concerns. The provision of public goods should be in the interests of public benefit and should not result in the kind of polarisation we have seen with Runway 3. A process that is far better informed by stakeholders' perspectives and is based on principles of transparency and accountability could do much to raise the confidence of the public, business and civil society in the process of government decision-making. It is also highly relevant when considering how to properly compensate groups that have been adversely affected by infrastructure developments.

Once completed, infrastructure projects and their impacts are with us for generations. Poor decisions are likely to cost us dearly in the long run. If we are to meet our emissions reductions targets, all sections of society will have to make cuts. It is imperative that this should be done in the most efficient and equitable way. Our findings would suggest that building a Runway 3 would destroy rather than create value, demolishing any case for Heathrow expansion. If we think about efficiency in terms of social value creation, then this has implications for all aviation and infrastructure projects.

Recommendations

- 1.** This analysis further discredits the decision to proceed with the Runway 3 proposal. Official support for Runway 3 should be withdrawn.
- 2.** The UK economy needs connectivity. Instead of assuming, however, that this need can only be met with an expansion of aviation, a thorough examination of the alternatives to more air travel is critical, taking into account the UK's transport needs and priorities for sustainable development. Alternatives, such as investment in video-conferencing facilities and improved rail networks, would also contribute to relieving the congestion at Heathrow.
- 3.** Robust, economically efficient decisions about future transport projects will depend on appraising the value generated for society. An important part of the process is to ensure meaningful engagement with stakeholders to determine where value is being generated and more thorough research on the costs of impacts such as noise and air pollution.
- 4.** Policy-making needs to be underpinned by high-quality cost-benefit analysis that stakeholders can believe in. This means that analysts must be seen to be truly independent, and that findings are communicated in a way that is consistent with the evidence. In the case of a Runway 3 at Heathrow, it is clear that claims were made for jobs and growth that could not be substantiated by the evidence. This is an unhelpful contribution in an already polarised debate.
- 5.** In appraising new infrastructure projects, there is an important role for government in taking account of the implications for social inequality of positive and negative impacts falling on different groups.

Appendices

Appendix 1: Social Return on Investment

SROI is an approach that measures and reports on the social, environmental and economic value that is being created by an initiative, and provides a valuable framework for understanding the long-term impacts of different public policy interventions. It enables decision-makers to balance financial concerns alongside social and environmental concerns, and account for externalities.

Although based on traditional financial and economic tools such as return on investment and cost-benefit analysis, SROI builds on and challenges these. It includes a formal approach to identifying the things that matter to stakeholders and includes these in the analysis. Financial proxies are then used to assign values to those things that are not traded in the market place. SROI encourages decision-makers to establish a dialogue with their stakeholders in order to help optimise the value that they are creating.

The principles of SROI

1 Involve stakeholders

Stakeholders are those people or organisations that experience change as a result of the activity and they will be best placed to describe the change. This principle means that stakeholders need to be identified and then involved in consultation throughout the analysis, in order that the value, and the way in which it is measured, are informed by those affected by or who affect the activity.

2 Understand what changes

Value is created for by different stakeholders as a result of different types of change; changes that the stakeholders intend and do not intend, as well as changes that are positive and negative. This principle requires the theory of how these changes are created to be stated and supported by evidence. These changes are the outcomes of the activity, made possible by the contributions of stakeholders, and often thought of as social, economic or environmental outcomes. It is these outcomes that should be measured in order to provide evidence that change has taken place.

3 Value the things that matter

Many outcomes are not traded in markets and as a result their value is not recognised. Financial proxies should be used to recognise the value of these outcomes and to give a voice to those who are excluded from markets but are affected by activities. This will influence the existing balance of power between different stakeholders.

4 Only include what is material

This principle requires an assessment of whether a person would make a different decision about an activity if a particular piece of information were excluded. This covers decisions about which stakeholders experience significant change, as well as information about the outcomes. Deciding what is material requires reference to the organisation's own policies, its peers, societal norms, and short-term financial impacts. External verification becomes important in order to give comfort that material issues have been included.

5 Do not over claim

This principle requires reference to trends and benchmarks to help assess the change caused by the activity, separate from other influences, and to take account of what would have happened anyway. It also requires consideration of the contributions of other people or organisations to the reported outcomes of a project in order to match contributions to the outcomes.

6 Be transparent

This principle requires that each decision and every step of the process should be documented and explained. This should include details of the stakeholders consulted; the outcomes, indicators and benchmarks identified and used; the sources and methods of information collection; the difference scenarios considered. There also needs to be an account of how those responsible for the activity will change the activity as a result of the analysis. The analysis will be more credible when the reasons for the decisions taken are transparent.

7 Verify the result

Although an SROI analysis provides the opportunity for a more complete understanding of the value being created by an activity, it inevitably involves subjectivity. Appropriate independent verification is required to help stakeholders assess whether reasonable conclusions have been reached and reasonable decision taken by those responsible for the analysis.

Appendix 2: Assumptions and calculations – rerunning DfT's model

The premise for the DfT's model of the impacts of additional airport capacity is that there is an underlying level of demand for air travel, a portion of which is suppressed because of capacity constraints in the UK's air transport infrastructure. In other words, more people would fly, or people would fly more often, if they could. Adding capacity acts to alleviate part of the constraint by enabling more flights to be put on, and more destinations to be served.

Step 1 of the DfT's model is to project levels of demand for air travel as if there were no capacity constraints and any level of demand could be catered for. This process involves an examination of the factors that determine whether and how much people wish to travel by air. The principal factor, for leisure and business passengers, is income – the higher incomes are, the higher the demand for air travel. This link is illustrated by the fact that air travel has grown dramatically as living standards and GDP have increased since World War II. This means that for forecasting purposes a view of future economic growth is a principal driving assumption. Other factors include: exchange rates – since the cost of a trip overseas is not limited to the cost of an air ticket; and fares – which are dependent on other assumptions such as projected oil prices, and, of increasing importance going forward, carbon prices.

Once the underlying level of demand has been forecast, Step 2 of the modelling process takes account of the likely impact of capacity constraints in the UK's air transport infrastructure. It then fits passenger demand to particular airports reflecting passengers' geographical preferences.

Step 3 turns the resulting passenger demand forecasts at the different airports into flight movements, or 'Air Transport Movements' (ATMs). Forecasts are translated into the allocation of routes and destinations, and different aircraft types. For the final stage in which costs and benefits of an expansion project are derived, the allocation of passenger demand to different airports, some of which will be oversubscribed, and some under-subscribed, allows the benefits of additional capacity at a particular airport to be calculated. In addition, information about the mix of journeys and fleet of aircraft is used to calculate the projected emissions of greenhouse gases, as well as noise and air pollution costs.

In line with DfT appraisal guidance, the benefits and costs for Runway 3 are calculated across a 60-year period, from 2020, when the new runway is due to open, to 2080.

Since it was only possible to access one rerun of DfT's model, we chose to rerun the DfT's central case, which assumes a second runway at Stansted from 2015 (referred to as s12s2 in DfT documentation). This was in large part because we wanted to replicate the DfT's central, headline figure of a net benefit of £5.5 billion, the one most commonly referred to, but under latest realistic assumptions. In addition, Stansted runway 2 remains part of current aviation policy, and it was beyond the scope of this study to interrogate policy plans.

nef input assumptions

For ease of reference, nef's input assumptions are set out in detail in Box 5 in the main report. This also explains the separate impacts that each amendment to the assumptions contributes.

Results

Table 13, below, presents a break-down of the results into the principal cost-benefit categories generated by the model. It should be noted that the numbers do not just apply to Heathrow operations, but refer to the outcome for UK aviation in aggregate, taking account of a new runway at Heathrow. An increase in capacity at Heathrow is assumed to draw passengers away from alternative airports. The DfT takes account of this through its passenger allocation model which is an important part of the system for generating the value of the outcomes.

Table 13: Passenger numbers forecast and costs/benefits of Runway 3, a comparison of nef and DfT central case results

	nef, February 2010	DfT January 2009
Forecast unconstrained demand by 2030	347 million	463 million
Forecast passenger numbers for the UK, per year by 2030	333 million	453 million
Benefits and costs	Present value, £bn	Present value, £bn
Benefits:		
Users/passengers	2.3	9.4
Producer	4.0	6.2
Government	2.9	3.7
TOTAL	9.2	19.2
Costs:		
Infrastructure	7.8	7.8
Climate change	5.1	5.4
Noise	0.3	0.3
Air quality	0.1	0.1
TOTAL	13.3	13.6
Net Present Value	-4.0	5.5

Benefits

As Table 12 shows, benefits accrue to passengers, the airport operator (the producer) and the government. User benefits include benefits to the airlines, but in the DfT model the benefits to the airlines are attributed to passengers under the assumption that with competition, reduced costs to airlines would be passed on to passengers.⁹²

The passengers who benefit from Runway 3 in the model are those who would not have been able to travel through Heathrow without the new runway because of capacity constraints. In the DfT's model these passengers include business and leisure passengers, both from the UK and overseas.

The benefit to generated users reported in **nef's** rerun is less than a third as much as that found by the DfT. This fall in benefit is due to a reduced level of passenger demand in the rerun because of a combination of more subdued economic growth projections, which reduce income and therefore spending on flights, and higher oil and carbon prices which increase fares, choking off some demand.

According to HM Treasury's appraisal guidance,⁹³ proposals that have a significant impact on foreign residents should include a separation of the impacts on UK and non-UK residents. A separation of impacts from **nef's** rerun, shows that a third of the benefits to passengers accrue to non-UK residents, whilst none of the costs in the analysis are borne by non-UK entities. If we wanted to look just at the impact on the UK, therefore, we would see passenger benefits reduced from £2.3 billion to £1.7 billion and a change in net cost of Runway 3 from £4 billion to £4.6 billion. In fact, the Department for Transport uses the benefits to foreign passengers as a proxy for the wider economic benefits to the UK economy. This is discussed in more detail in Section III.

The producer benefit occurs because the airport operators in aggregate are able to expand activity and therefore earn higher revenues. Producer benefits in **nef's** rerun are two-thirds as much as in the DfT's run, because fewer passengers translates into fewer air transport movements and so for the airport operator, levy income on fewer aircraft.

The smallest difference in benefits between the **nef** and DfT runs occurs for the government, which raises revenue from air passenger duty (APD) collected via a levy on fares. As would be expected, fewer passengers and air transport movements would reduce revenue.

Costs

The costs associated with Runway 3 combine the financial costs of construction, borne by the airport operator, with the spill-over costs resulting from more aviation activity – higher greenhouse gas emissions, more noise and worse air quality around Heathrow.

Table 13 shows that each of the costs remains broadly the same in the rerun as in the DfT's run. This seems especially curious in the case of the carbon cost where **nef** assumptions included much higher carbon prices and an updated assumption about the non-CO₂ impacts of air travel. The reason for this lies in the impact of less exuberant economic conditions on demand and therefore lower emissions. **nef's** rerun produced a lower projection for passenger numbers in both 2030 and 2050 because of a combination of lower economic growth and less favourable exchange rates – key drivers of passenger demand in the model – as well as the impacts of higher oil and carbon prices on fares.

Appendix 3: Assumptions and calculations for community impacts

Noise

The DfT's estimate for noise costs associated with Runway 3 used values derived for road and rail noise impacts on households. Guidance on community noise from the World Health Organisation (Guidelines for Community Noise. <http://www.who.int/docstore/peh/noise/Comnoise-4.pdf>) notes, however, that data from a number of sources show that aircraft noise is more annoying than road traffic noise, which, in turn, is more annoying than railway noise.⁹⁴

'Studies that have estimated the costs of road transport proved not to be useful for estimating aircraft noise because the hindrance from aircraft noise has a typical peak intensity, largely absent in road transport noise, which can be described as a more general 'humming'. Proost et al. (1999) have shown that this effect is so substantial that we do not recommend to use figures from road transport to evaluate aircraft noise'⁹⁵

Our valuation of noise costs followed the methodology recommended by Wadud, 2009.⁹⁶ Following accepted practice in economic valuation, this quantifies the disturbance effect of noise with reference to house price differences between noisy and peaceful areas. We would expect a house in a peaceful area to be more expensive to buy or rent than the same house in a location subject to noise, in this case aircraft noise. In this way, the price difference reflects how much someone is willing to pay to avoid the noise, or the value attached to quiet. Using econometric techniques, the methodology controls for the effects of other differences affecting property prices, such as neighbourhood quality, and accessibility attributes, to avoid over-estimating the effects of noise.

For quantification of noise costs, the calculation uses the following formula:

Noise costs = NDI x decibel reduction x property price x no. of properties

An explanation of each part of this formula is as follows:

- NDI, the Noise Depreciation Index, captures the costs of noise by measuring the depreciation of property prices exposed to it. The NDI is defined as the per cent increase in the loss of property values due to a unit increase in noise exposure.
- To get an appropriate cost estimate relative to the extent of noise exposure, the decibel reduction that would be sought to escape noise down to an acceptable level forms part of the equation.
- Typical property prices for an area are applied.
- An aggregate estimate of the noise cost is reached by applying the NDI to the number of properties that could be expected/ assumed to seek noise reduction.

For our valuation, we used World Health Organisation guidance that moderate noise disturbance begins at 50dB. The methodology described above allows us to attach a cost for each decibel increase in noise above that level. We assumed that households would like to reduce their noise exposure to 50dB, so for those exposed to 72dB, for example, we assumed they would seek a 22dB reduction.

In order to capture just the additional noise likely to be generated from Runway 3, we used estimates of households and populations that would be newly exposed to noise as a result of the airport expansion. We divided the range of noise exposure into bands of three decibels each, following the approach used by the DfT. Our household and population estimates from 54

decibels upwards were derived from the ERCD 0705 report⁹⁷ as used by the DfT in its modelling exercise in January 2009. This compares populations affected by noise in the base case, with no Heathrow expansion, and the Runway 3 case. This comparison enables us to separate out the Runway 3 effect from noise disturbance expected from Heathrow's existing runways. Our population estimate for the 51-54 decibel band, was provided by the civil society group HACAN.

We used average house prices, measured for April - June 2009 prices, sourced from BBC News: http://news.bbc.co.uk/1/shared/spl/hi/in_depth/uk_house_prices/html/as.stm

We show two tables of results below that indicate how the application of the noise cost formula with our assumptions produces overall noise costs per band of measured noise, and an aggregate total for Runway 3.

Table 14 shows a total cost of £900 million. This is estimated by applying the formula to the number of households, not individual residents. This is accepted methodology. But noise is experienced by each person who is exposed to it, so capturing numbers of households alone dilutes the measure of annoyance. We therefore also applied the formula on a per person basis in each band (Table 15). This raises the noise cost to £2 billion. Even at this higher estimate, the individual noise cost works out as a mere £5,797. Given that the appraisal period is 60 years, this means that an estimate for the cost to each person living with noise from Runway 3 of £97 per year, a seemingly modest sum.

Table 14: Noise costs by household

	dB threshold	Population in each band	dB reduction to 50dB	NDI	Av. House Price (£)	Noise Cost (£)
Heathrow villages	72	100	22	0.67	248,566	3,663,863
	69	400	19	0.67	248,566	12,656,981
	66	200	16	0.67	248,566	5,329,255
	63	2,000	13	0.67	248,566	43,300,197
	60	5,000	10	0.67	248,566	83,269,610
North towards Slough, east towards Chiswick	57	17,000	7	0.67	199,606	165,698,929
Further north into Bucks & Southall & east to the edge of Battersea	54	60,000	4	0.67	270,616	435,150,528
Further expansion west and east	51	85,400	1	0.67	264,906	151,573,915
		170,800				900,643,278

Table 15: Noise costs by resident population

	dB threshold	Population in each band	dB reduction to 50dB	NDI	Av. House Price	Noise Cost
Heathrow villages	72	200	22	0.67	248,566	7,327,726
	69	800	19	0.67	248,566	25,313,961
	66	400	16	0.67	248,566	10,658,510
	63	5,300	13	0.67	248,566	114,745,523
	60	13,600	10	0.67	248,566	226,493,339
North towards Slough, east towards Chiswick	57	43,200	7	0.67	199,606	404,416,724
Further north into Bucks & Southall & east to the edge of Battersea	54	125,400	4	0.67	270,616	909,464,604
Further expansion west and east	51	150,000	1	0.67	264,906	266,230,530
		338,900				1,964,651,917

Supplementary indicators for noise disturbance

*'What is measured and/or modelled is the physical phenomenon of exposure to aircraft sound; however it is the human response to this (i.e. disturbance) that explains opposition to airport development. Thus any attempt to improve noise management should engage with the physiological, psychological and sociological determinants of disturbance'*⁹⁸

As the quote above illustrates, what gets measured does not necessarily capture the experience of living with noise exposure. Conventional metrics are complex and designed to capture aggregate effects. A recent study found that this contributes to a climate of misunderstanding and mistrust, to obscurity in the measure, to heightened community concerns, and reduced potential for constructive communication on noise impact between airports and their local communities.⁹⁹

Work is being developed on supplementary indicators in the valuation of noise. These are descriptors that are less technical and more transparent, and disaggregated as much as possible to reflect the different elements that people care about: noise intensity, frequency of events, and time of day. Supplementary indicators have been used at Sydney Airport where it was felt they made a positive contribution to consultation on airport expansion. As yet, however, it appears that there is no quantification method for supplementary indicators that we could apply here.

Air pollution

The analysis of air pollution carried out for the DfT by consultants AEA on Runway 3¹⁰⁰ drew on the methodology recommended by The Committee on Medical Effects of Air Pollutants (COMEAP). COMEAP is a panel of health experts in the UK that advises the government on air pollution related health issues. Wadud identifies a number of problems with data and valuations that COMEAP recommends. In our study we focused on the two most material assumptions: the relationship between gases and mortality and the magnitude of the value used to represent that cost.

Relationship between gases and health outcomes

There are four gases that cause analysts most concern: particulate matter (PMs), the oxides of nitrogen (NOx) and ozone (O3). Of these, PMs are seen as the most damaging both in terms of mortality and hospital admissions. To assess the relationship between PMs and mortality, which is the largest of these costs, COMEAP¹⁰¹ has identified the American Cancer Society study (ACS)¹⁰² as the 'best source of coefficients suitable for application in the UK'. However, more recent estimates suggest that this might be an undervaluation of the costs because the ACS study had an overrepresentation of well-educated people in the sample; more educated people were earlier found to be less susceptible to increases in mortality due to exposure.

To correct for this overrepresentation, different weighing schemes were used during a reanalysis of the ACS study and the resulting mortality risk increased to 8 per cent to 11 per cent, which is closer to the findings of another analysis - the Harvard Six Cities study¹⁰³ (16 per cent).

Wadud argues that once this is combined with other critiques of the ACS it results in a 'downward bias' of the estimate, in other words an in built tendency to underestimate.¹⁰⁴ He concludes that the most likely estimate is an 11 per cent increase in mortality rates due to each 10 µg/m³ increase in ambient PM_{2.5} concentrations, which is almost double that used by the DfT study (6 per cent). The choice of 11 per cent falls exactly midway between the most recent ACS study (6 per cent) and the Harvard Six Cities study (16 per cent). The reweighted ACS study estimate also falls around this value.

Apart from a small cost for NO₂, COMEAP excludes the oxides of nitrogen. This is because information relating to these gases is not robust enough. We know however that NO_x gases are significant contributors to secondary particulate matters, which can be responsible for premature mortality. As Wadud notes, regulation of NO_x could still have important benefits through reduced particulate formation, even though not represented on the balance sheet.

Valuation

There are two main approaches to valuing the loss of life: Value of Life Years (VOLYs) and the Value of a Statistical Life (VSL). COMEAP recommends the former.

VOLYs are calculated by asking people directly how much they are willing to pay to increase their life expectancy by a year, when in poor health or in good health. The underlying assumption is that 'willingness to pay' during poor health reflects VOLY for acute deaths, whereas willingness to pay among those in good health reflects VOLY for chronic deaths. A survey identified that an extra year of life in poor health is valued at much less than in good health.¹⁰⁵ However, according to Wadud's review, this survey and many studies suffered from scope sensitivity problems.¹⁰⁶

Concern has also been raised that the studies often captured discretionary income of the respondents instead of true willingness to pay for a reduction in health risks. DEFRA results¹⁰⁷ have found that the VSL approach, which is based on the hedonic method, reports almost four times the costs reported through the VOLY approach. Wadud argues that the large difference between these two values could mean that there are also large differences in the relative weighting of noise and local air quality issues in the two approaches and this could distort policy decisions. He concludes that until the VOLY estimates are further refined, VSL appears to be a marginally better choice.

It is outside the scope of this study to carry out additional modelling on the costs of air pollution using these new results. Instead, to correct for potential underestimations described above we have used the CAFE¹⁰⁸ in our central case. This was modelled for the DfT's consultants in their sensitivity analysis and yielded a net present value of £0.3 billion. CAFE uses the VSL valuation approach but it is still based on the lower relationship between PMs and mortality of 6 per cent. In addition, as the DfT's consultants noted, the VSL/CAFE approach used in the sensitivity analysis does not take account of the fact that Heathrow is adjacent to a major city, resulting again in a potential under-valuation.

Finally, as pointed out above noise and air pollution costs should be of a similar order of magnitude.¹⁰⁹ In the January 2009 analysis noise was three times that of air pollution. If we are to bring the costs of air pollution in line with our new noise valuation set out above, it would be closer to £0.6 billion.

Blight

There is no direct measure for generalised community blight, including loss of value in the fabric of the community and the costs of living with uncertainty prior to a decision, or prior to a scheme coming into operation. In the absence of a recommended approach, in this study we estimated generalised community blight for the villages adjacent to Heathrow airport (the 'Heathrow villages' of Sipson, Harmondsworth, Longford and Cranford) using two proxies, for comparison, as follows:

- Average spending on home refurbishments per household per year in the UK applied to the number of households in the Heathrow villages;
- Noise disturbance costs per head for the populations of the Heathrow villages.

Our calculation using the proxy of average spending on home refurbishments was based on the following assumptions:

- The number of households that are expected to suffer more noise within the 60dB threshold, as an indicator of proximity to the proposed runway. This represents an approximation for the number of households in the Heathrow villages which we assume might experience generalised blight from Runway 3. Our source was the official ERCD 0705 report¹¹⁰ used by the DfT in its impact assessment for noise costs. This finds 7,700 households within the 60dB range.
- According to Table A1 of the 2009 Edition of the Family Spending Survey,¹¹¹ average spending on DIY and home improvements per household per week in the UK is £20.50. Across a year that works out as £1,066 per household.
- We applied this figure of £1,066 average annual spending on DIY and home improvements to the 7,700 households close to Heathrow across the appraisal period 2020-2080.
- Our result is an overall proxy to represent a notional cost of blight from Runway 3 of £0.2 billion.

Wadud has noted that disturbance or blight from noise and air pollution are found to be of comparable orders of magnitude. Generalised blight, in the form of impacts on community cohesion and the physical fabric of a community might be considered to be just as disturbing for residents. We therefore compared the cost for blight derived by the method using home improvement spending as described above, with the noise costs calculated for the individual populations in the Heathrow villages. This reveals an approximation for blight of £0.4 billion for Runway 3.

Our two methods produce similar cost estimates, of £0.2 billion or £0.4 billion, to represent uncertainty, loss of community cohesion and deterioration in pride and investment in the physical fabric of properties that will suffer effects from Runway 3. For our central case we took the mid-point, £0.3 billion.

Surface congestion

That road congestion creates a significant economic cost has been well-established by a number of studies. It has been estimated that it costs the UK economy anything between £7 billion and £10 billion per year.¹¹² The M4/M25 area immediately around Heathrow is one of the most congested parts of the entire UK road network. The Consultation Document estimated that for mixed-mode expansion of Heathrow there would be an additional 25 million extra road passenger trips every year. This is a significant increase, but additional flights from mixed-mode would be less than from Runway 3 which suggests that the number of additional road passenger trips from Runway 3 will be higher still.

For our analysis we have assumed that the 25 million additional vehicle movements will take place by 2030.¹¹³ Prior to that, we assume that the same ratio of flights to vehicle movements exists; starting at 7.75 million in 2020 and rising incrementally thereafter. Goodwin has reviewed the literature on the marginal cost of each additional road user. The low estimate that he quotes for a vehicle on an outer London road is 31p per mile and the high estimate is 44p.¹¹⁴ For the cost of each movement we have taken a mid-point. BAA has claimed that 25 per cent of road users will move to public transport between now and 2030.¹¹⁵ In order to arrive at the number of users that will be using roads in the coming years as a result of Runway 3, we took the figure for all additional road users attracted by Runway 3 as a proportion of the total and applied the 25 per cent to it.

We do not know what the average journey length by car to Heathrow is but we do know the route that the majority of road users will have to use. Heathrow is located close to a major city, so we have used the distance from London (17 miles) as the average journey length. Given that Heathrow serves the whole of the south of England, this is highly likely to be an underestimate. The stretch of road between the M4 and M25, already suffers severely from congestion, which has not been factored into our calculations. If we multiply the number of additional car journeys by the number of miles by the cost of each journey this gives us the annual present value of the increased congestion. The net present value of this, between now and 2080, amounts to £1 billion.

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One of the other things we do

Social Policy

nef aims to find ways of achieving sustainable social justice: a fair and equitable distribution of natural, social and economic resources between people, countries and generations.

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