



postnote

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AVIATION AND THE ENVIRONMENT

Air travel is forecast to grow, possibly trebling by 2030.¹ The Government is consulting on whether and where this demand should be met, and a White Paper is due at the end of 2003. Growth in air travel affects the environment locally through noise, air pollution, and damage to wildlife, heritage and landscapes. More widely, emissions from aircraft engines contribute to global warming.

This briefing summarises a longer POST report on the environmental effects of civil aviation, and the options available to mitigate these effects.² The main findings of the report are that:

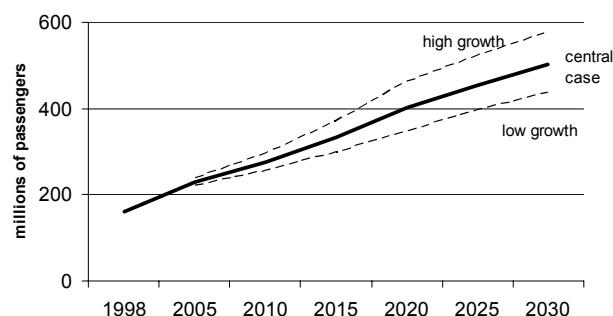
- historically, technology has been able to reduce the environmental impacts of aviation, but, in the face of forecast growth, cannot continue to offset all impacts
- there is scope to reduce impacts through operating procedures (e.g. flight paths) and land use planning
- there is broad agreement that the aviation industry should meet its environmental costs, although it is unclear how these costs should be defined, how they should be met, and whether this will reduce impacts
- considerable differences of view remain over what might be considered 'sustainable' in terms of aviation.

Aviation in the UK

The UK aviation industry

The UK has around 140 civil licensed airports. The largest are around London, with Heathrow handling around 1,250 flights a day, around 64 million passengers per annum (mppa), and serving direct flights to 170 destinations. Gatwick and Stansted handle around 30mppa and 16mppa respectively. Early in 2003, Stansted received planning permission to increase its terminal capacity to handle up to 25mppa.

Forecast growth of aviation in the UK, 1998 to 2020



Source: *Air Traffic Forecasts for the UK 2000*, Department of the Environment, Transport and the Regions, 2000.

The largest airport outside London is Manchester, which handles around 18mppa. Beyond these are smaller regional airports e.g. Glasgow and Birmingham, although these operate some international flights.

Estimates suggest that the airport and airline industries are worth around £10 billion per year – around 1.4% of gross domestic product (GDP) – and that they directly support about 180,000 jobs. Aviation contributes an additional 370,000 jobs indirectly through tourism, manufacturing of aircraft and components, regional development through improved transport links, and trade, particularly through handling air freight.

Growth forecasts

The forecasts for growth over the next 30 years are illustrated in the figure above. These forecasts assume unconstrained growth in air travel, i.e. that airport and airline capacity is provided to meet all demand. They show an average annual growth rate of around 4.25%, compared with average annual growth rates of around

5% during the 1990s. This reflects the increasing maturity of the aviation market. The Department for Transport (DfT) points out, however, that past forecasts have often underestimated demand, with it either following, or even exceeding the 'high' forecast growth curve; particularly for forecasts made before the emergence of the low-cost airlines in the later 1990s.

The figure shows that air passenger numbers are predicted to more than double between 2000 and 2020, and, under the high forecast, could almost treble by 2030. Were it decided that this demand should be met entirely, this would require additional capacity equivalent to that which can be handled through five new runways – with three of these needed in the south-east of England. Spare capacity exists at some airports (particularly at Stansted and Luton at off-peak times) and so some of the forecast growth could be met without the need for additional infrastructure. However, spare capacity is likely to be exhausted in the next decade and so if it were decided to provide capacity to meet the forecast growth to 2030, new infrastructure would be necessary.

The environmental impacts of aviation

Noise

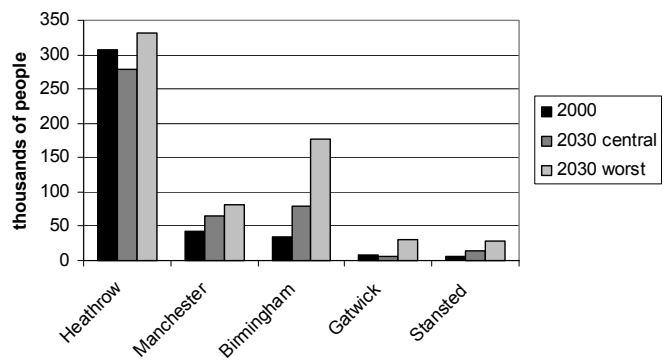
Aircraft noise already has the potential to affect the quality of life of at least half a million people living close to UK airports – with 80% of these living close to the major airports in the southeast of England. The full report outlines a number of potential policy mechanisms which could provide incremental improvements in the noise climate around airports. However, the forecast increase in air traffic movements, if realised, is likely to outstrip any progress in making individual flights quieter. Thus, the forecast unconstrained rate of aviation growth would be likely to worsen considerably the noise climate around many of the UK's airports over the next few decades. Larger numbers of people would be exposed to the risks of sleep disturbance, annoyance and possible health effects of aircraft noise.

The Government itself recognises noise as *"one of the most objectionable impacts of airport development"* and that *"for many airports, taking effective measures to control and mitigate aircraft noise is fundamental to their sustainable development."*³

This suggests that unless substantial improvements to the noise climate around certain airports are made, aircraft noise could well become a significant factor in constraining future airport expansion. The figure above shows the extent of noise pollution around five major airports in the UK under DfT's growth forecasts.⁴ In all situations, under worst-case scenarios, the numbers of people likely to be exposed will increase. Under the central scenarios, increases will be expected at Manchester, Birmingham and Stansted. Reductions at Heathrow and Gatwick would result from technological improvements alongside severely constrained growth. POST will shortly be producing a separate briefing on aircraft noise.

Forecast noise exposure

(actual figures for 2000, central and worst-case forecasts for 2030)



Source: based on figures quoted in *The future development of air transport in the United Kingdom: a national consultation*, Department for Transport, July 2002 (and second edition, February 2003).

Air pollution

Aircraft, airport vehicles and road traffic to access airports emit air pollutants, such as nitrogen oxides, fine particles, carbon monoxide and hydrocarbons.

Continuing improvements in the emissions from road vehicles and aircraft engines are likely to lead to reductions of about 20% from each source. However, set alongside the forecast growth in air travel, emissions from aircraft are likely to become more significant as a source of air pollution around airports.

Furthermore, even if the full potential of technical and operational measures to reduce emissions were achieved, overall levels of emissions from an increased number of all sources would still be expected to rise. The numbers of people potentially affected by these emissions would depend on their proximity to the pollution sources and the local conditions affecting dispersal of the pollutants.

Other local environmental impacts

While noise and air pollution are the most significant impacts from the operation of aircraft, there are also a number of other potential impacts arising from the siting and operation of airport infrastructure.

- **land take** – building an airport inevitably takes land away from its previous uses. In particular, it can affect wildlife habitats, landscape and heritage.
- **water pollution**, particularly from de-icing aircraft, runways and other parts of the airport site
- **waste management**, particularly waste generated inside terminal buildings.

Many of these impacts are generic to most large infrastructure developments and are amenable to mitigation to some extent. For example, careful location of airport infrastructure can avoid the most ecologically valuable sites and areas of great landscape or cultural value. Similarly, to minimise water pollution, controlling the run-off of surface water from an airport is readily achievable and subject to strict regulatory control. On waste management, airports and airlines increasingly acknowledge that action is necessary to minimise and recycle all types of waste. However, airport operators

point out that most waste is produced by sources outside of their direct control, so waste minimisation is rarely implemented.

Impacts on the global climate

Overall, the Intergovernmental Panel on Climate Change (IPCC) estimated that aviation may contribute ~3.5% of the total contribution of human activities to global warming. Aircraft engines emit a mixture of gases, with carbon dioxide (CO₂), nitrogen oxides and water vapour among the most relevant when considering effects on the global atmosphere. While CO₂ is a major contributor to the climate change effects of aviation, the effects of water vapour emitted at high altitude remain more uncertain. Further, the potential to create condensation trails (contrails), and possibly induce high altitude (cirrus) clouds may also be significant.

The quantities of CO₂ and water vapour emitted from aircraft engines are proportional to the amount of fuel used. Thus, a key to reducing these emissions is to increase the fuel efficiency of aircraft. Potential for fuel efficiency gains is concentrated in two areas:

- technological options such as improvements in engine efficiency, using alternative fuels and power sources and improvements in aircraft aerodynamics
- operational procedures such as changes to air traffic control practices and flight arrangements.

Mechanisms have been proposed to provide incentives for further technological and operational improvements:

- voluntary agreements – where industry and governments collectively agree target reductions in emissions, either at EU or international level
- emissions charges – where airlines or passengers are charged a fee related to the emissions produced by a particular flight
- emissions trading – where airlines could buy and sell emissions permits related to a capped quantity of greenhouse gas emissions
- aviation fuel tax – Both the European Commission and the UK Government have considered introducing an aviation fuel tax for environmental reasons. However, under ICAO regulations, fuel tax cannot be introduced on fuel for international flights, although it could be promoted for domestic or EU-wide aviation fuel taxes.

These mechanisms could contribute to reducing the climate change impact of aviation, but the timescales over which they could be introduced vary. In the short-term, voluntary agreements may be achievable on issues such as increasing the efficiency of air traffic management and using aircraft most appropriate for specific journeys. However, these options are unlikely to reduce emissions significantly in the medium term. Further improvements in engine design, airframe aerodynamics, and an EU-based emissions charge could be effective - although the latter would not reflect the full climate change impact of long-haul flights. In the longer term, it is widely suggested that a move towards an international global emissions trading scheme could stimulate radical innovation and help manage demand,

although significant questions remain over the detail of how such a scheme would be set up, administered and operated.

Cross-cutting themes

The report considers specific environmental impacts of aviation such as noise, air pollution, and other effects on the local environment around an airport and on the global atmosphere. In considering these further, it will be necessary to examine in more detail the issue of demand management, such as shifting passengers onto trains. However, given the space and time constraints of this study, this has not been possible.⁵ Nevertheless, the report identifies a number of cross-cutting themes.

Technological limitations

There is scope to reduce the environmental impacts of aviation using technological means:

- aircraft engines and airframes can be made quieter
- the emissions of air pollutants and greenhouse gases can be reduced by improving the efficiency of engines
- the environmental impacts of airport operations can be lessened through careful engineering and mitigation (e.g. recycling wastes, ensuring energy efficiency in buildings and locating infrastructure away from sensitive habitats).

However, there are likely to be diminishing returns of incremental improvements to the environmental performance of aircraft. Furthermore, significant improvements in the technology to control noise, air pollution and greenhouse gas emissions will not become widely available or adopted throughout national or global aircraft fleets within the next 20 years. Moreover, even if available in the short term, were air travel to grow at forecast rates, these improvements would be negated within a decade.

Therefore, within the time horizon for the government's current consultation on aviation (to 2030), it is highly likely that after a period of relative improvement to around 2015-2020, local environmental impacts from aviation could worsen. With regard to climate change, year-on-year increases in emissions are likely as growth in air travel outstrips technological improvements.

Environmental capacity

This is the concept that limits can be defined within which activities can take place without causing significant environmental damage. The European Commission Transport Directorate General, has considered that where limits are set on environmental capacity around airports, these could constrain aviation growth. As such, any future growth in air travel would need to be planned so that it remained within the local environmental capacity limits. The Government has asked in its consultation whether the concept of environmental capacity limits can be applied successfully to UK airports, and what limits could be set.

Natural systems are inherently uncertain, complex and contain many feedbacks that can make precise and

stable predictions very difficult. As such, defining, measuring and evaluating environmental capacity limits is far from straightforward. Therefore, subjective judgements are required on issues such as the levels of environmental quality desired, and the extent to which social and economic issues are taken into account in deciding these limits.

Operations and land use planning

It is widely recognised that addressing the environmental impacts of aviation requires a 'balanced approach' which incorporates both technological improvements and non-technical measures such as modifications to aircraft operations (e.g. routing aircraft onto flight paths that minimise the numbers of people exposed to high levels of noise). In addition, there are opportunities within the land use planning system to address the environmental impacts of aviation. These include using environmental assessment to design out adverse effects and enhance positive opportunities at an early stage in airport developments. Also, meaningful public involvement in environmental decision making is also needed.⁶

The Government introduced the Planning and Compulsory Purchase Bill into the House of Commons in December 2002 to speed up the planning system, particularly for major infrastructure projects. The bill includes provisions for planning applications to be referred to the Secretary of State rather than dealt with by the local planning authority if he considers the development to be of national or regional importance.

Costing the environmental impacts

There is a broad consensus that the aviation industry should pay its environmental costs. However, there is a diversity of views over how these costs should be defined, and how they should be met. Internalising external costs and passing these on to customers, or through the supply chain, will not change actual behaviour unless it is at the margin of cost acceptability. This has prompted some to argue that additional government intervention is needed, e.g. through regulation, charging, or further taxation, beyond the immediate external costs. However, others counter that if environmental costs are fully internalised, but nevertheless, consumers choose to incur them rather than change their behaviour, this simply serves to reflect the high value they place on the availability of the goods or services (the 'inelasticity of demand').

The Treasury and DfT have reviewed the economic costs of the environmental impacts of aviation and are now consulting on what economic instruments could be used to tackle these. They wish to determine which instruments would be most desirable in terms of providing the best incentives for the aviation industry to take account of its environmental impacts, their administrative feasibility and ways to ensure that undesirable economic impacts are minimised. The House of Commons Environmental Audit Committee is examining this issue. Also, POST will be producing a separate briefing on this topic in autumn 2003.

The wider context

The focus of this briefing (and the full report) is on the environmental impacts of aviation. Nevertheless, environmental issues are being seen increasingly as part of a wider debate about the need to reconcile environmental, economic and social implications of development ('sustainable development'). Underpinning the discussion is the question of whether and how the effects can be mitigated, while still allowing growth in aviation. This leads to two schools of thought about how aviation could tackle its environmental impacts:

- eco-efficiency – consuming fewer resources for each unit of productivity (e.g. less fuel per passenger-kilometre).
- reducing absolute impacts – minimising the absolute quantities of materials and resources flowing into, and wastes flowing out from the aviation system.

Overview

The Government is consulting on the future of aviation in the UK over the next 30 years. It will identify which airports should be expanded, or whether new airports need to be constructed. However, it is concerned that any expansion should have minimal environmental impacts. There are signs that limits on air pollution and noise could well constrain the growth of aviation in some locations. This raises the issue of how far it is possible to define and put in place limits to the growth of aviation based on the wider ideas of environmental capacity.

The forecast growth in air traffic is likely to outstrip technological improvements which would otherwise reduce environmental impacts. The key question remaining is whether growth should be constrained to stay within environmental limits, or whether the environmental impacts arising from meeting anticipated demand can be justified against other social and economic factors.

Endnotes

- 1 *The Future Development of Air Transport in the UK: A National Consultation*, Department for Transport 2002.
- 2 *Aviation and the Environment*, POST report 195, Parliamentary Office of Science and Technology, April 2003. This report is available from POST. It is free to Parliamentarians, and costs £10 for non-parliamentarians. See below for details.
- 3 *Guidance to the Civil Aviation Authority on environmental objectives relating to the exercise of its air navigation functions*, Department for Transport, 2002.
- 4 This is related to noise above a threshold for 'community annoyance' adopted by the government. This threshold is 57dB(A) L_{eq} and is discussed further in the full report.
- 5 An initial assessment of this is given in *A Comparative Study of the Environmental Effects of Rail and Short-haul Air Travel, Advice to Ministers*, Commission for Integrated Transport, December 2001.
- 6 *Appraising major infrastructure projects*, POSTnote 173, Parliamentary Office of Science and Technology, February 2002.

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