

N) Air Transport

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1. Introduction

Worldwide, air transport is a constantly growing transport sector. The total distance passengers have travelled has increased every year except two since the International Civil Aviation Organization first began keeping statistics in the 1940s. Between 1988 and 2008 it more than doubled, from 1.7 trillion to 4.3 trillion passenger-km.¹ It is now growing at about 5% annually, but in China it has been growing at 12%.² As economic growth accelerates in other developing countries air travel is on track to sharply increase there as well unless measures are taken to reduce this.

Air travel uses 11.6 % of all energy used in the transport sector, and produces 2% of global greenhouse gas emissions, but these emissions could be as much as 10 times greater by 2050 given the growth in the sector.³ There have been significant improvements in aircraft engine design, aerodynamics, the lightness of materials and navigation technology. These have meant that, according to the IPCC, aircraft are 70% more efficient now than they were 40 years ago. And further improvements are in the development stage, included blended wing bodies, even more efficient engines and more lightweight materials, improved logistics systems and second generation biofuels.⁴

These may yield 40-50 % improvements in fuel efficiency by 2050,⁵ but considering that, as just noted, a 10 fold (or 1000%) increase in emissions is possible by 2050 (without efficiency improvements factored in) the anticipated improvements will go nowhere near to keeping up with the growth in air travel. Thus, a range of measures are needed to reduce greenhouse gases generated by air travel worldwide, including reductions in air travel itself, in the emissions it generates per passenger kilometre, and in emissions generated by activities associated with air travel.

Despite this overall problem with aviation two positive things can be said about the industry: first, it is a highly regulated industry due to safety concerns and hence regulations that begin to factor in carbon are coming from a long history of government concern; second, the aviation industry due to its growth and dynamism has been showing considerable innovation in addressing carbon as will be shown below.

The focus of this section is on what developing country governments can do to reduce greenhouse gas emissions from domestic aviation within their countries. Most governments have little control over the process of increasing efficiency in aviation. International air travel is not yet included in any inventory of greenhouse gases as it is not clear to whom responsibility should be directed. Even if they own national airlines, these airlines are constantly crossing borders, and they must choose from globally available aircraft technologies and fuels rather than having the many local options that land transport has available. Governments can regulate the types and ages of aircraft permitted to fly on their countries' domestic air routes – and this measure is advocated – but again they are limited to technologies that airlines are willing to invest in and operate in their domestic markets.

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Moreover, any government action needs to be based on a recognition that, although domestic aviation is a significant greenhouse gas producer, it also plays an important part in meeting a country's transport needs, specifically by providing fairly rapid transport for people and goods over medium to long distances.

Accordingly, this section focuses on five options, which can be adopted separately or collectively. These are ways in which governments can reduce greenhouse gas emissions associated with domestic aviation while still ensuring that people and goods can move fairly rapidly over medium to long distances. These options for government are as follows:

- providing higher-speed trains as an alternative form of longer distance transport that has lower GHG emissions, while at the same time refraining wherever possible from building additional airports or runways, and providing a suite of incentives and disincentives to encourage the switch from air to train travel
- assisting and encouraging the use of information and communications technology (ICT) as an alternative to travel for work-related and personal purposes
- ensuring, where airports already exist or must be built, that surface transport to and from them is as low-carbon as possible, by increasing mass transit services, and discouraging private vehicle use
- reducing greenhouse gas emissions generated at airports through a range of changes to designs, technologies and practices employed there
- regulating – to the extent that it is possible within a country's domestic aviation market – the types and ages of planes that are permitted to operate services.

Through the adoption of such measures, developing country governments can significantly reduce greenhouse gas emissions associated with air travel, while at the same time ensuring that citizens can undertake efficient travel over medium and longer distances for personal and work purposes, and that goods requiring rapid delivery can also be transported over these distances.

2. The benefits of these five measures

Economic benefits

The first four options can all provide new employment and stimulate new business enterprises. **Option One's** emphasis on the development of rapid train services rather than air travel can lead to the saving of space devoted to airports in urban areas and reinvigorate urban centres through station construction or upgrading. If rapid train services stop at towns along the route they provide better longer-distance alternatives for individuals and businesses in regional and rural areas situated between major cities. In some cases, rapid train trips may be faster than air, if one considers the time taken to get to and from, and to wait at, train stations (which are usually centrally located) in comparison to time taken getting to and from and waiting at airports (which are normally on the outskirts of town and are notoriously time consuming due to scheduling uncertainties). Also, greater reliance on transit and less on air and road travel prepares a country or locality for increasing oil prices.

Option Two (promoting the use of ICT) can save individuals, businesses, governments and community organisations time and money, as can **Option Three** (mass transit to and from airports in place of cars). **Option Four** (greener airports) can reduce operating costs for government or private operators of airports. **Option Five** (mandated standards of aircraft efficiency) can also save airlines money on fuel, once initial investments in newer technology are made.

Figure 3.56 Higher speed trains can often get passengers to their destination in comparable time, when all aspects of the journey are considered



Picture Credit: (left) Alex Needham (right) <http://www.deletefearofflying.com/testimonials.htm>.

Social benefits

These options, between them, offer diversity of transport, reduced road congestion, and provide better access from city centre to city centre (a particular benefit, in the last case, for those without private vehicles). They lead to reduced road travel, which is less safe than train or air travel, better transport services for regional areas, and less noise for communities living near airports or under flight paths. More sustainably designed airports are also healthier and more pleasant for air travellers and those employed in the airline industry.

Environmental benefits

These options, in quite different ways, can all significantly reduce greenhouse emissions, as has been established, as well as reducing other pollutants such as oxides of nitrogen. As well, trains can operate on diverse kinds of fuel, including renewables, whereas aviation fuel is derived from oil. There are currently no fully developed alternative aviation fuels that do not pose additional threats to the environment or food production. Thus air travel is very vulnerable to the expected depletion of oil supplies. Options One and Three can save land – that might otherwise have been airports or freeways – which aids urban consolidation and perhaps conserves farmlands or natural areas on urban fringes.

3. Greenhouse gas emissions reduction potential

Flights of up to 300 miles (483 kilometres) emit 0.19 kg of CO₂ per passenger-km, while those over 700 miles (1,126 km) emit 0.09 kg of CO₂ per passenger-km.⁶ So flying is in general better than car use (0.209 kg per pass-km) though short flights emit more than twice as much CO₂ per km as long flights do, and it is short flights that are most common on domestic air routes. The reason for this is that so much fuel is used to get a plane airborne so long trips average out at much less fuel per passenger-km. Air travel is also responsible for nitrous oxide emissions, and for water vapour emissions at high altitudes, now also thought to worsen climate change. The combined effect of jet exhaust emitted at high altitudes has two to five times the climate change impact of the CO₂ alone emitted at ground level.⁷ Even without considering all these other greenhouse equivalents the trip between London and Nice by Eurostar and TGV (fast train) is estimated to emit 36 kg of CO₂ per passenger while flying emits 250 kg per passenger.

Option Two (substituting ICT for travel) has almost no greenhouse gas emissions, so its emission reductions are virtually equal to the emissions of the travel saved. The emission reductions of Option Three (more low-carbon travel to and from airports) are equal to the difference between those of car travel (0.219 kg/passenger-km) and those of train travel (0.0047-0.327 kg/passenger-km) or buses (0.118 kg/passenger-km).⁸

The measures described in Option Four (reducing greenhouse gas emissions at airports) are highly diverse and so will vary greatly from airport to airport, but as one example, Leeds airport achieved 12% energy savings, and thus an equivalent emissions reduction. With regard to Option Five (regulating the types and ages of planes permitted to fly on domestic air routes), it was noted earlier that aircraft are now 70% more efficient than they were 40 years ago, so this measure would result in greenhouse gas emissions savings equalling some portion of this, depending on the types and ages of the planes concerned and the stringency of the regulation.

4. The five options and their implementation in more detail

Providing rapid train travel and discouraging domestic air travel

The rapid train service, Eurostar, has now captured more than 70% of the London-Paris transit market from the airlines. This is because, all things considered, it is as fast as flying between the two cities, and more reliable at arriving on time.⁹ Since commencing a high-speed route between Seoul and Daegu in 2004, the Korean Train Express (KTX) has been in part responsible for a 34-75% drop in domestic aviation in that time. With the success of this first KTX, other services have now been introduced from Seoul to Busan and Mokpo.¹⁰ Rapid trains are thus a very feasible alternative to air travel, especially between cities up to 500 miles apart. Apart from the speed of modern trains, two aspects of train travel that make it competitive on travel times are that:

- stations are normally in central city areas, as opposed to urban outskirts, which normally means less travel to and from stations than to and from airports
- there is much less unavoidable waiting time at stations than at airports.

As well, rapid train stations are usually more accessible via local mass transit than airports are. And as already noted, rapid trains can be a more convenient form of longer distance transport for populations living between major cities, if those trains make stops along the way. Thus, rapid train services have much to recommend them, but they will not happen without the wholehearted support of government.

They are not cheap, as described in the cost section below. Government can contract out to private enterprise any aspect of their construction or operations (although it is strongly advised to maintain overall control of the service). Because they are expensive to build, fares will be expensive if they are not highly subsidised by government (which most governments cannot afford to do). If they are viewed as an alternative to air travel, which is also expensive for the average citizen in the developing world, then the cost of the fare may be not such an issue. Lower cost fast trains such as Tilt trains are able to use the present rail tracks rather than build whole new lines.¹¹ But it is vital that rapid trains do not displace the slower and cheaper trains that so many people of all income levels rely on for their longer distance travel. This has recently emerged as a problem in China, where a survey of travellers in Shanghai found concern about the affordability of the new Shanghai-Hangzhou rapid train, at a time when rapid train services in China are replacing some of the slower, cheaper services.¹² This is something to be avoided. Trains that are not quite so rapid can be promoted as another possible alternative to air travel – not so competitive on

speed, but more affordable for nations to build and for citizens to travel on. This may be the most feasible alternative for many low income nations.

If governments have clear and firm commitment to improving the speed and quality of train services over distances up to 500 km at least, then they will be better able to resist the inevitable calls from businesses and influential citizens for additional airports and extra runways at existing airports. In the twenty-first century it may not be necessary or desirable for cities to expand commercial airports, when other forms of longer distance travel can be as fast and convenient as well as being more sustainable. In the same way that freeways have become much less of an option in cities this century due to a realisation that other options may work better and save carbon, the awareness of air travel's inevitable and constant growth may also be questioned.

Governments can discourage air travel and encourage train travel through price mechanisms. They can tax flights, aviation fuel or airport use, or air travel can be taxed as part of a more general price on carbon. Funds raised can also help to finance the development of rapid and lesser-speed train services that provide an alternative to air services.

It is also necessary to ensure that train travel is able to project an image of a modern, efficient, fast, punctual, clean and comfortable travel mode, so that air travellers see it as an attractive alternative. This means that stations as well as the trains need to conform to this image, and that ticketing and information services need to be accessible online or by phone.

Encouraging and enabling the use of information and communication technology (ICT) as an alternative to air travel

This has already been discussed in the *Reducing the need to travel* section. When it comes to reducing the need for air travel, one of the purposes of travel that can be reduced through ICT are meetings and conferences for business people, government officials, health or education professionals or members of community organisations, as well as family meetings. The German company Deutsche Telekom is one of many companies that have saved time, money and greenhouse gas emissions through videoconferencing. With its subsidiary T-Mobile it has conducted over 40,000 videoconferences between 2004 and 2007, saving 7,000 tons of CO₂ emissions, mainly through reduced air travel, and 200,000 hours of employees' time.¹³

Making travel to and from airports more sustainable

If a journey involving a plane flight is considered to include all travel from point of origin to destination, then it also includes the transport to and from the airport. From this perspective, greenhouse gas emissions can be reduced if lower-carbon forms of transport are taken in these legs of the journey. This chiefly involves travellers switching from private cars or taxis to mass transit. If transit is to be at least as fast as private vehicle travel it needs to be either a rapid (or faster than normal) train service, or BRT with dedicated lanes. These services do not have to run just from the city centre to the airport (or vice versa). They can have stops in between or stops beyond the airport, but unless they are very direct and have only a few stops between city centre and airport, they will not be competitive with private vehicles.

Given the uncertain future of air travel in the face of oil depletion and the pricing of carbon, governments may need to invest in a train or BRT service rather than making a much larger investment in further road capacity (most rail or BRTs can replace 8 to 12 lanes of traffic equivalent, as discussed in the *Mass transit* section). If this means taking one lane of an existing highway or freeway as a train or dedicated BRT

lane, then private cars will have less road space and this can act as a demand management measure, encouraging car travellers to switch to mass transit. Road tolls can also encourage this switch. In addition, many airport authorities themselves are encouraging more low-carbon transport to and from airports.

Reducing greenhouse gas emissions associated with airports

Greenhouse gas emissions generated at airports, and by their staff and the travelling public when at airports, are also part of the total emissions output from air travel. Fortunately, things are changing on this front. According to an Airports Council International report, as of May 2008, at least 45 airports around the world have been taking a wide variety of measures to make airports more sustainable, and most of these measures involve significant reductions in greenhouse gas emissions. They include:

- solar and wind power generated on site, solar water heating, and cogeneration of electricity and thermal energy from gas
- reduced energy use through insulation, use of natural light and ventilation, and ‘smart’ building systems that regulate lighting, climate control and other energy uses on the basis of ambient light and temperature, the presence or absence of people in particular areas, and other variables
- recycling of water, garden waste, food waste, food and drink containers, paper products, concrete and materials from demolished buildings, and batteries
- airport vehicles, including shuttle buses for the public, powered by alternative fuels
- facilities to enable planes to switch to airport power sources as soon as they land, so that they don’t need to remain powered up to maintain internal operation conditions, as well as pre-conditioned

Figure 3.57 Airport Express Ticket Counter, Hong Kong



Picture Credit: Mailer Diablo, Wikimedia Commons, <http://commons.wikimedia.org/wiki/File:HKStation-AETicketCheckIn.JPG> viewed 22 March 2011.

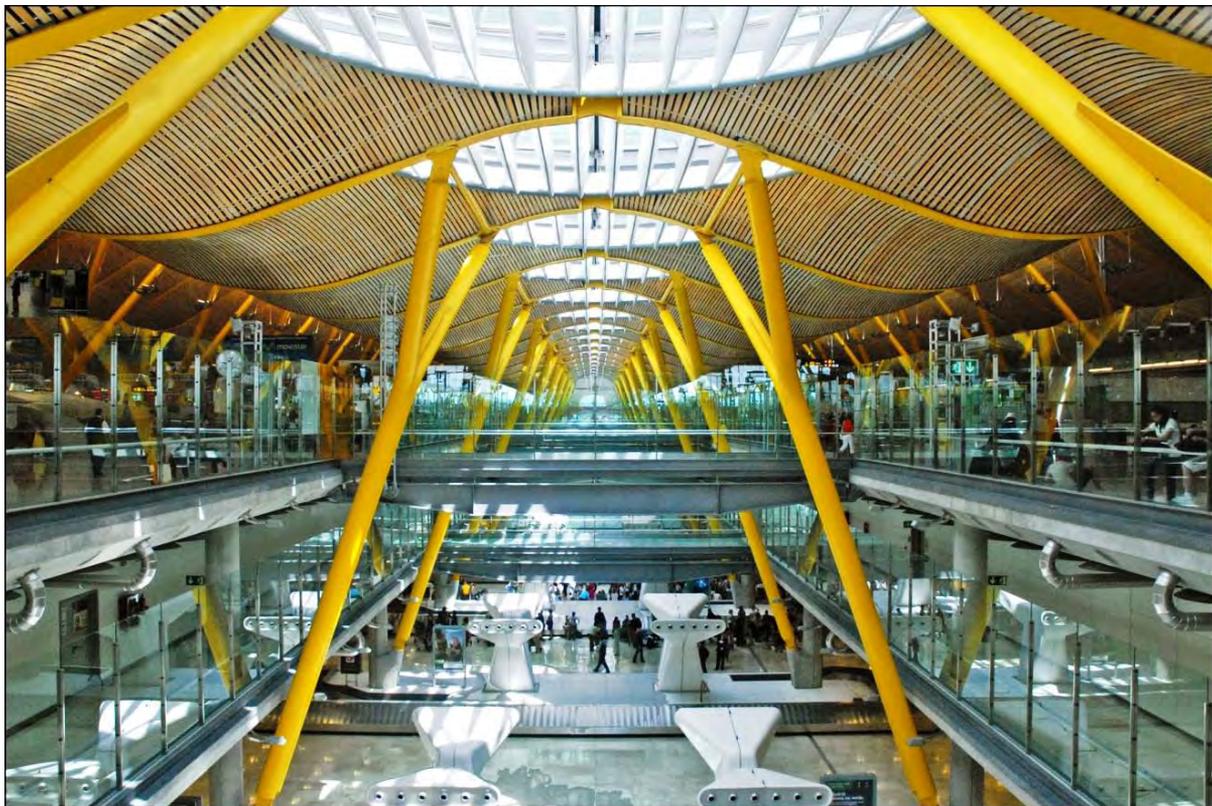
air units to provide ventilation, cooling, dehumidifying, filtering and (if necessary) heating of air for parked aircraft

- airport assisted aircraft landing by gliding or ‘coasting’
- towing of aircraft to the runway
- measures to encourage the public and staff to reduce private vehicle use getting to and from airports, including free and discounted public transit tickets, and encouragement of car-pooling
- priority parking for hybrid or otherwise energy-efficient taxis and cars owned by staff or the public
- noise and pollution reduction in vehicles and machinery.¹⁴

A number of airports have now declared themselves carbon neutral as a result of adopting these kinds of measures. Dublin Airport has published its own sustainability report to outline measures it has taken.¹⁵

Most new and sustainably designed airports have been fitted with advanced mechanical systems to increase the circulation of fresh air, and have large windows installed to maximise daylight. These are two elements that create a healthier and a more enjoyable experience for travellers. For example, terminal three at Changi Airport in Singapore has been fitted with floor-to-ceiling glass walls and 919 skylights as well as a five-story vertical garden. These sustainable adjustments have created a more pleasant waiting area for travellers.¹⁶

Figure 3.58 Madrid Barajas Airport maximise natural daylight while reducing solar gain through extensive external shading



Picture Credit: Jean-Pierre Dalbera.

Mandating efficiency standards for aircraft

Any country, through its government, can set standards about the types, ages and conditions of aircraft that are permitted to fly on its domestic routes. At the moment such standards are set for safety, and for emissions of carbon monoxide, hydrocarbons, oxides of nitrogen and smoke.¹⁷ There is no overriding reason why they cannot also be set for fuel efficiency, and thus greenhouse emissions, and in fact the IPCC mentions this as a policy option.¹⁸ Governments could either give a date in advance – for example, five years – by which time commercial aviation services were required to conform to new standards, or they could require airlines to meet the new standards for any new planes in their fleet.

Aircraft being manufactured today are about 70% more fuel efficient per passenger-km than they were 40 years ago.¹⁹ So there is much fuel efficiency to be gained from the use of more recent aircraft, and good reason for governments to mandate newer and more efficient aircraft. What's more, a further 20% fuel efficiency improvement is predicted by 2015, and a 40 to 50% improvement by 2050 relative to planes produced today.²⁰ So if governments begin to set efficiency standards, then they can update these as newer aircraft demonstrate even greater efficiency.

5. Costs and how funds can be obtained

The costs of all these measures are highly variable in most cases. With regard to the various costs of a rapid train service, one report put the cost of a 500 km line at €9,900 million, line maintenance at €30 million, a train at €30 million, annual operating costs at €25 million and rolling stock maintenance at €1.5 million.²¹ However, these are based on developed world costs, and costs for line construction, train operations and maintenance of both tracks and rolling stock would be substantially less in developing countries. However, if the establishment of train services leads to airports or runways not being built then this is a cost saved. With regard to the costs of ICT, as noted in the *Reduced need to travel* section, the hardware, software and services are private costs, with sufficient variation to allow even low-income earners to participate to some degree, and infrastructure costs also vary greatly such that different levels of technology can be implemented to suit government budgets. The costs of transit services in comparison to the cost of private vehicle travel are covered in the *Mass transit* section. The designs, technologies and practices at airports that can save greenhouse gas emissions are so diverse that it is hard to generalise about costs, and the costs of regulating aircraft permitted to fly on domestic routes would be minor.

At least a proportion of these costs can be met from faster train and local transit fares, from airport fees, from cross-subsidisation of transit costs using funds generated by pricing of airline and private vehicle travel, and from charges for the use of ICT infrastructure. Multilateral funding may also be available, particularly if a sound case can be made for the emissions-saving potential of these measures, and this is discussed in Chapter 4.

6. Conclusion

Air travel has grown dramatically in recent times, much faster than increases in aircraft efficiency, and as a result, greenhouse gas emissions from air travel have also seen substantial increases. In order to reduce these, a number of measures are suggested in this section: building higher-speed rail services that can compete with domestic air services, avoiding the building of new airports and runways, and encouraging travellers to switch from air to rail trips; encouraging the use of ICT in place of air travel; providing low-carbon transport to and from airports; making airports and their operations more low carbon; and regulating the types and ages of aircraft permitted to fly on domestic routes. Through these measures

developing countries can achieve significant reductions in greenhouse gas emissions while still providing rapid transport for their citizens over longer distances.

Endnotes

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