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Flight plan: taking responsibility for aviation emissions

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Aviation emissions make up less than 2 per cent of the world total, but are rising fast. These environmental costs must be balanced with development gains, however: air travel can hugely benefit poor countries' economies. The good news is that much can be done to curb emissions while keeping those benefits on board. Workable tools and guidelines for passengers, travel providers, government and airlines are waiting in the wings.

A vital area for improvement is the way emissions are reported and calculated. Airlines, travel providers and carbon companies currently report emissions using a hotchpotch of methods, all producing varying results. Basing reports on fuel usage will make standardised ecolabelling possible. With an informed choice, passengers can buy tickets strategically and so encourage airlines to use more efficient technology. Airports can integrate ways of limiting emissions into their daily operations, while governments can invest in better air traffic control. Collective responsibility — and action — could make flying a much more sustainable means of travel.

KEY MESSAGES:

- **Airlines need to report actual fuel usage by aircraft to allow for accurate emissions labelling.**
- **With informed choice based on aircraft and airline emissions efficiency, passengers can encourage the adoption of better aircraft technology.**
- **Passengers can also choose direct flights, support airlines that maximise passenger load capacity, and carry less baggage on short-haul flights.**
- **The travel industry can promote surface travel within Europe for trips of 500 kilometres or less.**
- **Tugs could be used in airports to reduce emissions from taxiing planes.**
- **The UK needs to work towards putting the Single European Sky initiative into action.**
- **Governments and the industry should expand airports only if demand is still rising once aviation is bearing its full environmental costs.**

Taking the measure of aviation emissions

Aviation emissions still make up less than 2 per cent of global greenhouse gases emissions, but are set to grow exponentially. This is borne out by figures from the Intergovernmental Panel on Climate Change (IPCC), the International Air Transport Association, the World Tourism Organization and figures from UK airports (see 'The sky's the limit' overleaf).

Despite all the available statistics, however, consumers tend to find the data on aviation emissions extremely confusing. This is not surprising, as emissions values are not based on actual reported fuel usage.

As a measurement or value, fuel usage determines the amount of carbon dioxide (CO_2) emissions created by fuel combustion. Aviation emissions are made up of a number of greenhouse gases, of which CO_2 is the largest single component. Carbon emissions are measured in kilograms or tonnes, and reflect CO_2 emissions. The aviation industry calculates its CO_2 emissions using a fixed ratio of CO_2 to fuel weight combusted.[6] But there are other factors in the calculation: combustion varies according to the weight of the plane (including passengers and cargo), the distance travelled and a range of performance factors. So the industry's CO_2 emissions are usually expressed as a total value or as a value per passenger per kilometre travelled.

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The sky's the limit: the rise in emissions

The IPCC estimates that aviation emissions produce 1.6 per cent of total world greenhouse gas emissions.[1] They also forecast an annual growth rate for world aviation of 5 per cent per year to 2015, basing this on a yearly increase in fuel consumption of 3 per cent — figures that reflect the improved efficiency of aviation fuel. The International Air Transport Association (IATA) supports this growth projection in the near term with their 2008 world aviation growth forecast of 6 per cent, and estimates that global aviation emissions make up 2 per cent of all emissions.[2] Estimates by aircraft manufacturers of future sales also show continued growth for aviation.

Data from UK airports provide further evidence. Passengers travelling through them have risen from 4 million in 1954 to 235 million in 2006. Aviation emissions have been increasing as a share of the total. Between 1990 and 2000, UK aviation emissions grew by 200 per cent whilst non-aviation emissions for the same period declined by 9 per cent.

Globally, the industry employs a massive workforce, generates substantial commercial benefits and supports up to 8 per cent of world GDP.[3] World tourism is a major beneficiary of aviation. The World Tourism Organization (WTO) estimates that world tourism revenues in 2006 were worth US$735 billion, accounting for 35 per cent of world export services and over 70 per cent in some developing countries.[4] The WTO estimates there were 760 million international tourist arrivals in 2004, producing aviation emissions of 594 million tonnes of carbon dioxide[5] from more than 30 million flights.

Some airlines report fuel usage in relation to the number of passengers they carry. In the absence of complete declarations from all airlines, different models are used to calculate the fuel burn of an aircraft and deliver an emissions value per flight and passenger. Either of these values will vary according to the methodology and modelling employed in their calculation. In the UK, the standard for reporting and measurement is set by the Department for Environment, Food and Rural Affairs (DEFRA).[7] But carbon calculators provided by offset companies are a major source of aviation emissions information, and these are not always consistent with DEFRA values.

A recent comparative analysis[8] found a 300 per cent difference in reported emissions for the same flight using carbon calculators, and a difference of over 20 per cent using calculators provided by airlines to their passengers.[9]

Efficiency-based purchasing

Once all airlines provide detailed fuel-based reporting of emissions, an accurate comparison of emissions at an industry and per-flight level will be possible. An eco-labelling scheme, like those in use by car and white goods manufacturers, can then be launched. Making the eco-labels easily accessible, through travel agencies and websites, will allow customers to buy tickets on the basis of emissions efficiency.

Currently over 20 per cent of airline seats worldwide are empty during flight, despite moves such as decreasing the number of aircraft flying selected routes. While airlines have become more proactive on capacity issues, through strategic purchasing consumers can also do their bit to accelerate efficiency in the industry.

Passengers can also encourage reduced per-flight emissions by buying direct flights, where possible. Flying via indirect routes can create up to 29 per cent more emissions than flying direct. And if consumers understood the relative emissions values of air and surface travel, they could help cut emissions even further, by choosing rail or coach for trips of 500 kilometres or less — which currently make up 40 per cent of flights within Europe.

Aviation technology has supported advances in fuel efficiency but, unlike the car industry, there is no short-term prospect of alternative fuel cell technology powering commercial aircraft. The future benefits of advanced technology are welcome, but are likely to be outweighed by the substantial expansion in aviation activity (see also 'Efficient flying' opposite).

Voluntary emissions reductions

There are other areas where consumers, along with the travel and aviation industries, can take responsibility for reducing emissions.

Carbon offsets Airlines, tour operators, travel agents and consumers have so far seen carbon offsets as the primary method for reducing the impact of emissions. Offset schemes have operated as a voluntary pollution tax on aviation, with the proceeds supporting a wide variety of projects to save and store carbon emissions. These offsets represent only a small fraction of total aviation emissions, however and, while the approach raises awareness, this has been undermined by a lack of standards and extravagant claims about the 'carbon neutral' benefits they confer on purchasers. The net result is that offset schemes can often be used as a means to abdicate responsibility, and continue with 'business as usual' emissions.[10]

A wider voluntary response is needed to reduce emissions. The travel industry should focus on delivering emissions ecolabelling using existing national guidelines for reporting, and avoid presenting offsets as their main aim.

Airport management Using tugs to bring aircraft to the runway would have a significant impact on cutting aviation emissions. For an Airbus A320, on a flight of 500 nautical miles (nmi), taxiing in and out equates to 9.1 per cent of total flight emissions. For a Boeing 747-400, on a 3000nmi flight, the value would be 2.2 per cent of the total emissions. Airport size and congestion levels would need to be factored in for the figure to be completely accurate.

Weight restrictions Passengers can reduce emissions by carrying less baggage, especially on short-haul flights. On

the main short-haul route from the UK to Spain, which accounted for 34 million passenger movements in 2005, if each passenger had carried 5kg less in baggage, they would have saved between 54,400 and 68,000 tonnes of CO_2. The higher figure is the equivalent of 2,950 aircraft flights from London to Malaga.[11]

A related consideration is average human body weight. In some countries, such as the US, standard passenger weight has increased significantly. If average weight continues to rise, this will result in reduced fuel efficiency per passenger kilometre.

What governments can do

Many people see governments as responsible for reducing emissions from all sources. In the UK, recent increases in Air Passenger Duty have helped to create the impression that the government is taking responsibility for the impact of aviation emissions via taxation. A lack of clarity over the use of tax revenues compromises this notion, but there are a number of areas where government could act in the meantime.

Emissions trading Government action on emissions centres on the European Emissions Trading Scheme (ETS), a mechanism for pricing carbon and trading emission allowances throughout the EU. Under the guidelines of the UN Framework Convention on Climate Change, non-domestic aviation is not included in national emissions accounts. Countries outside the EU, notably the US, show few signs of supporting a global extension of the ETS or the incorporation of international aviation into national carbon accounts. While there are a number of taxation and regulatory mechanisms available to the UK government as a national response to emissions reduction, any unilateral action on taxation might prompt some airlines to move operations offshore, and may lead to difficulties with prevailing global aviation agreements.

Airlines take differing views of the ETS and its impacts. At this point, it is also difficult to assess these impacts in terms of any reduction benefits derived from including aviation in the scheme. What is clear is that supporting an EU-wide programme is desirable, although the ETS will only cover commercial flights within the EU from 2011, and all

Efficient flying: keeping emissions low at 35,000 feet

How a plane is used in addition to the efficiency of the aircraft itself will largely determine the fuel and emissions efficiency of a flight. Newer aircraft tend to be more efficient than older ones, but this is not the only criteria on which efficiency calculations are based.

Seating The number of seats on a plane will determine its maximum passenger load and, assuming a constant average load factor, the plane with the most seats will deliver the lowest per flown seat emissions, even allowing for incremental fuel weight and usage for the flight. Maximising seat capacity ensures the total emissions of each flight are divided among the largest number of passengers. The underlying reason for the favourable per flown seat emissions of low-cost carriers is not just their high load factor, but also that passenger seating is maximised, enabling more passengers to travel on each flight.

Direct vs indirect The importance of direct flights relates not just to distance flown, but the need for two landing and takeoff cycles (LTOs) in one journey. The LTO requires a large amount of fuel for this part of any flight and the use of direct flights between two points ensures that less fuel is used and thus fewer emissions are created. The use of point to point travel as opposed to hub and spoke (a system in which flights from a number of points arrive at, then leave from, one common point) helps to reduce emissions.

Load factor An airline with a low load factor on a route will create higher per seat emissions than a competitor with similar aircraft and seating capacity. The total flight emissions are divided among fewer passengers.

Engine type, altitude, air traffic control, cargo weight and a range of other factors will also help to determine actual emissions per flight. Many of the factors affecting fuel consumption cannot be determined easily, and in many cases are factors over which consumer purchasing may have less effect than routing, seating and load factor.

Case study: the Airbus A380

The new Airbus A380 has been designed to improve fuel efficiency per seat for long-haul flights. It can carry more passengers than any other commercial aircraft and this delivers greater fuel efficiency and emissions per seat. The actual benefits will depend on the number of seats on board and load factor. If the plane is configured for upwards of 500 passengers it will clearly deliver a better per passenger performance than if it is mainly configured for first and business class travel with, for example, 300 to 400 seats.

In addition, the A380 is designed for long-haul point to point travel, which may require an increase in short-haul flights to those large airports from which the A380 will predominantly operate. The A380 may be the most efficient long-haul aircraft per passenger seat, but it will not really be possible to assess its full benefits until it has commenced operations with a number of airlines and seating configuration, load factor and the downstream effect on short-haul flights has been assessed. This represents the challenge for efficiency-based purchasing, and also highlights the need for fuel usage reporting so that a choice to be made and real benefits and performance assessed in the light of actual data rather than anticipated benefits.

flights to and from the EU starting in 2012. In the meantime, the government needs to focus on those areas where it can make a difference.

Charges based on aircraft utilisation — that is, aircraft type, the distance flown and the number of passengers carried — would be an incentive for greater energy efficiency. They would also provide a simple mechanism for assessing the carbon cost of aviation in the interim period before aviation is included in the ETS.

Single European Sky Today's system of air traffic control is estimated to generate an additional 12 million tonnes of carbon emissions annually — more than four years' worth of domestic UK aviation. The IPCC suggest that the benefit from more efficient air traffic control could be between 6-12 per cent of total annual aviation emissions.

The 'Single European Sky' is an initiative to restructure European airspace use to reduce flying time and so improve air traffic efficiency. The initiative enjoys support from both the aviation industry and scientists. Given the UK government's aspirations to be a leader in global climate change action, promoting the Single European Sky as a priority would be logical and desirable.

Limiting airport expansion The government should avoid expansion of UK airports until the full environmental cost of aviation is borne by the industry and passengers This is the approach recommended by the 2006 Eddington Transport Study, put together for the UK government by former BA chief Sir Rod Eddington.

References

1. IPCC (1999) *Special Report: Aviation and the global atmosphere*. IPCC, Geneva. This figure will have increased since 1999. The 1.6 per cent figure is for aviation as a percentage of global greenhouse gas emissions, and not just CO_2. The aviation CO_2 figure as a percentage of total CO_2 emissions from human sources is 2 per cent. See www.ipcc.ch.

2. IATA (2007) The 2 per cent figure relates only to total global CO_2 emissions and not total greenhouse gas emissions. See www.iata.org.

3. 2nd Aviation and Environment Summit (2006).

4. WTO (2006). See www.world-tourism.org.

5. FAA (2005). See www.faa.gov.

6. DEFRA Fuel Conversion Factors June (2007). See www.defra.gov.uk/environment.

7. DEFRA Air Passenger Transport Conversion Factors (2007). See www.defra.gov.uk/environment.

8. Kimber, H. (2007) *Taking Responsibility for the Impact of Aviation Emissions*. The Carbon Consultancy/IIED, Swindon/ London.

9. Part of the difference in reported emissions is down to radiative forcing, a measure of the impact of a change in atmospheric composition on climate. The total warming effect of CO_2 emissions from aircraft in flight is 2.7 times greater than the effect of these emissions alone. Aircraft also produce water vapour and particles as 'contrails' that trap heat. There are considerable uncertainties in the science, however, so this issue is only touched on here.

10. Reid, H. and Roe, D. (2007) *The Trouble with Travel and Trees*. IIED Sustainable Development Opinion. IIED, London.

11. This figure was calculated by taking total air passenger movements, CO_2 per kilogram of baggage as an emissions value modelled over a Boeing 737-500 by the University of Manchester for The Carbon Consultancy. The number of flights as an equivalent from London to Malaga uses DEFRA per seat values based on distance flown and assumes DEFRA 737-400 capacity at 75 per cent load factor.

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