



Aviation in a sustainable world

## People Issues: Incorporating Passenger Expectation and Airline Business Models Workshop



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## About Omega

Omega is a one-stop-shop providing impartial world-class academic expertise on the environmental issues facing aviation to the wider aviation sector, Government, NGO's and society as a whole. Its aim is independent knowledge transfer work and innovative solutions for a greener aviation future. Omega's areas of expertise include climate change, local air quality, noise, aircraft systems, aircraft operations, alternative fuels, demand and mitigation policies.

Omega draws together world-class research from nine major UK universities. It is led by Manchester Metropolitan University with Cambridge and Cranfield. Other partners are Leeds, Loughborough, Oxford, Reading, Sheffield and Southampton.

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## Executive Summary

The environmental impact of the provision of goods and services has become a high profile issue gaining much news coverage and there are indications in some sectors that environmental concerns are starting to affect customer choice and behaviour; thus environmental performance improvement has become an area of competitive advantage as well as a means of cost and impact reduction. As yet there has been little systematic analysis of how these changing attitudes might affect the nature, quality and quantity of air transport services, or indeed the willingness and capacity of airlines to make changes to service provisions to achieve carbon efficiencies to the potential detriment of customer convenience or to airport or in-flight service standards.

If airlines are to rise to the challenge of providing more carbon-efficient services<sup>1</sup> then an understanding how the public perceives the environment as a factor affecting travel choice or service level is fundamental to success. Responding to changing market demand is becoming critical for the aviation industry. Consequently this scoping study aimed to:

- Establish the nature and extent of public engagement with aviation sustainability issues, the willingness of the general public to pay for, or to forego convenience or service levels in order to reduce aviation climate change impacts.
- Catalogue recent airline initiatives to improve carbon performance of their services.
- Engage in a dialogue with industry actors, academics, policy-makers and NGOs in order to establish the potential for further reductions in CO<sub>2</sub> emissions and the implications for existing service provision and business practices.

The review of previous passenger attitude surveys<sup>2</sup> undertaken through this study revealed a very mixed picture; with air passengers clearly concerned about climate change and aware of the contribution made by flying (at least in terms of the causal link if not the full scale of the contribution). However, passengers generally look to other parties to solve the problem (e.g. government, airlines), rather than to changes in their own behaviour. Thus, there is a reluctance to reduce flying, especially for leisure, and a belief that others can solve the problem by making the service more efficient. There is willingness among some passengers to pay more for more environmentally-friendly services and/or to mitigate the consequences

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<sup>1</sup> Carbon efficiencies of goods and services are usually expressed in tonnes of CO<sub>2</sub> per unit of output. Most commonly for aviation either revenue passenger kilometres (RPK) or revenue tonne kilometres (RTK) are used to define units of air transport services. However with respect to the type of service changes discussed here, more specific units of service are sometime more appropriate such as per seat or per meal served. Whatever unit is used it is important to recognise that improvements in efficiency do not necessarily lead to reductions in overall CO<sub>2</sub> emissions; this will depend on the extent to which efficiency improvements compensate for any growth in service output.

<sup>2</sup> The original intention was to incorporate the results of a supplement to the CAA passenger survey during 2008; designed to establish passenger understanding of aviation and climate change issues and willingness to change their expectations and behaviours to mitigate GHG emissions. Unfortunately, due to the timing of the grant award this was not possible. Nevertheless, dialogue between the CAA survey team, Omega stakeholders and CATE staff continued and has informed survey questions now in their second round of revision. Thus, a supplement to the main CAA survey will be included during 2009; this represents an achievement on the original aim and is further discussed in the CAA workshop presentation summarised in section 4.3

of flying through offsetting. What is unclear is whether this willingness to pay extends to forgoing traditional service elements to enhance environmental performance.

It is hardly surprising therefore that until recently the initiatives pursued by airlines to improve carbon efficiencies have largely been devoted to modifications that have little/no impact on the passenger experience. The workshop, conducted as part of this study to discuss current and future airline carbon saving options in the light of changing passenger concerns about climate change, demonstrated that if airlines are to introduce more radical changes then they will have to be convinced of the environmental benefits and also passenger acceptance of the service adjustments. This will require educating consumers as to the extent of environmental benefits if expressed attitudes are to be translated into behavioural changes and acceptance of change.

The core conclusions that emerge from this study are that:

- Airlines will continue to pursue incremental changes to service delivery where the benefits are evident (e.g. in fuel savings and GHG emissions reductions) and not seen to conflict with passenger expectations of service. For a more detailed breakdown of the efforts to date and the links to specific business models please see Mason and Miyoshi, 2009.
- More rigorous monitoring of resource use in some areas could assist in tailoring supply to passenger demand on specific routes (e.g. water and duty free). The potential to reduce water carriage in this way is thought to be quite considerable.
- Awareness raising among pilots of the financial and environmental consequences of fuel contingency exceedances could yield significant benefits whilst not compromising legitimate pilot concerns for and primary duty to ensure safety.
- In some areas opportunities to reduce weight have reached the limit allowed by regulation (especially among LCCs), for example, air crew numbers and seating space allowances.
- Passengers need to be educated as to the relative impact of flying compared to other GHG generating activities and to the significance of specific and more fundamental changes in service delivery if more radical changes to improve efficiencies are to be considered by airlines (e.g. use of slower aircraft, optimised stage lengths, reduced frequency of services to enhance load factors).
- Passenger surveys suggest there is little appetite for behavioural changes that could reduce demand for air services such as willingness to take fewer longer overseas holidays or to holiday in the UK.

Consequently, future work could usefully focus on:

- Systematic dissemination of emerging best practice in terms of carbon efficiency improvement initiatives, this could be coordinated through organisations such as BATA, IATA and ACI.
- More comprehensive and systematic analysis of the link between passenger attitudes and behaviour with a particular focus of passengers' willingness to pay for and/or forego service elements that can influence carbon emissions. This could inform the

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development of air service options and any requirement for educating travellers as to the environmental benefits of given courses of action.

- Enhanced environmental training for pilots to raise awareness and encourage more proactive responses to environmental improvement initiatives.

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## 1.0 Introduction

This report presents the findings of an Omega scoping study designed to explore the short-term potential of incremental changes in air services to contribute to longer-term efforts to improve the carbon efficiency<sup>3</sup> of air transport. This included a review of surveys of public (and passenger) attitudes to climate change and aviation<sup>4</sup> and of the actions currently being taken by airlines to improve the carbon efficiency of their service delivery. These activities were undertaken to inform an Omega workshop, hosted by Manchester Metropolitan University (MMU) and Cranfield University. The workshop focussed on two key areas of research:

1. The nature and extent of the public's regard for environmental issues and how perceptions affect customer choice over air transport services.
2. Current understanding of the ramifications of diversified market business models on the environment.

Presentations from academic, business, and Non Governmental Organisation (NGO) representatives demonstrated some of the key issues and in particular examined: the willingness of passengers to accept changes in air transport services designed to improve carbon efficiency; how pricing, operational practices, and the structure of the airline industry influence environmental performance; and the extent to which further carbon dioxide emissions reduction options require changes to business models. Thus, discussion focussed on:

- What we know about customer attitudes to aviation and climate change,
- The implications of these attitudes for the services offered by airlines, and
- How airlines can find new 'low carbon' and 'climate friendly' commercial opportunities.

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<sup>3</sup> Carbon efficiencies of goods and services are usually expressed in tonnes of CO<sub>2</sub> per unit of output. Most commonly for aviation either revenue passenger kilometres (RPK) or revenue tonne kilometres (RTK) are used to define units of air transport services. However with respect to the type of service changes discussed here, more specific units of service are sometime more appropriate such as per seat or per meal served. Whatever unit is used it is important to recognise that improvements in efficiency do not necessarily lead to reductions in overall CO<sub>2</sub> emissions; this will depend on the extent to which efficiency improvements compensate for any growth in service output.

<sup>4</sup> The original intention was to incorporate the results of a supplement to the CAA passenger survey during 2008; designed to establish passenger understanding of aviation and climate change issues and willingness to change their expectations and behaviours to mitigate GHG emissions. Unfortunately, due to the timing of the grant award this was not possible. Nevertheless, dialogue between the CAA survey team, Omega stakeholders and CATE staff continued and has informed survey questions now in their second round of revision. Thus, a supplement to the main CAA survey will be included during 2009; this represents an achievement on the original aim and is further discussed in the CAA workshop presentation summarised in section 4.3

## 1.1 Rationale and Aims

The environmental impact of the provision of goods and services has become a high profile issue gaining much news coverage and there are indications in some sectors that environmental concerns are starting to affect customer choice and behaviour; thus environmental performance improvement has become a battleground over which industry actors are fighting for market share as well as a means of cost and impact reduction. As yet there has been little systematic analysis of how these changing attitudes might affect the nature, quality and quantity of air transport services, or indeed the willingness and capacity of airlines to make changes to service provisions to improve carbon efficiencies, even where this reduces customer choice or service provision.

If airlines are to rise to the challenge of providing less carbon-intensive services then understanding how the public perceives the environment as a factor affecting travel choice or service level is fundamental to success. Responding to changing market demand is becoming critical for the aviation industry. Consequently this Omega scoping study aimed to:

- Establish nature and extent of public engagement with aviation sustainability issues, the willingness to the general public to pay, or to forego convenience or service levels in order to reduce aviation climate change impacts.
- Catalogue recent airline initiatives to reduce the carbon intensity of their services.
- Engage in a dialogue with industry actors, academics, policy-makers and NGOs in order to establish the potential for further reductions in carbon dioxide emissions and the implications for existing service provision and business practices.

## 2.0 Public Attitudes to Aviation and Climate Change

The UK Government acknowledges the need to raise awareness of climate change and encourage the public to take account of the climatic consequences of their purchasing behaviour (DEFRA, 2006). Furthermore, environmental performance has become both a marketing issue and a goal within the business world: companies want to understand the public's perceptions of environmental performance and how this could influence their travel choices. This section summarises a series of recent surveys designed to establish public/passenger attitudes to climate change and the extent to which this affects behaviour.

### 2.1 Ipsos MORI for Commission for Integrated Transport (2007): Attitudes to aviation and climate change

#### *Rationale:*

Based upon findings of a three stage research process, the study aimed to gain insight into current and future flying behaviour, and evaluate how this links to passenger attitudes towards climate change.

#### *Methodology:*

The study consisted of:

1. Exploratory qualitative research in the form of discussion groups amongst leisure and business travellers and in-depth interviews with employees.
2. A public attitudes survey of participants, supplemented with samples of business flyers and people living near to airports (1190 participants overall).
3. A stakeholders meeting day which included members of the public, the aviation industry and environmental NGOs, to discuss the potential implications of the study for policy.

#### *Key findings:*

- The participants in the survey showed a growing awareness of the link between emissions and climate change – half of the participants were fairly concerned about the impact of flying. The participants did mention, however, that they felt that there was more scope for raising awareness and knowledge on the issue.
- The survey showed that although the participants would be receptive to certain policies to mitigate the impact of aviation's emissions, they would not be willing to for-go their foreign holidays altogether. Flying is considered as a good thing that the public are not willing to give up.
- In terms of responsibility, the onus of responsibility placed mainly on national and international organisations, with the government identified as a key institution to tackle the issue.

- The participants in the survey responded positively to policies which provided alternative means of transport to flying. However, they felt that significant changes were needed i.e. cheaper, faster, and so on.
- The participants were not very price sensitive to the cost of the flight for a main holiday and would be willing to pay more in the future. On average, people were willing to pay 10% more on the cost of the flight.
- There was an emphasis on the need for equitable policies, and variability in taxes and allowances was discussed as a possible policy option – although only if the revenue generated was spent on climate change mitigation.

## 2.2 Becken (2007): Tourists' perception of international air travel's impact on the global climate and potential climate change policies

### *Rationale:*

To explore tourist's knowledge and awareness of aviation's impact on the climate, their sense of personal responsibility and their reactions to specific climate change policies.

### *Methodology:*

Becken organised focus group sessions in New Zealand, where 3 policy options were discussed (this was a continuation of a previous study where 63 tourists were interviewed at Christchurch International Airport). The groups were typically sized at 5-10 participants and each focus group was structured to have 3 phases: climate and travel quiz, role play, and general discussion. In total, 32 tourists participated.

### *Key findings:*

- The focus groups highlighted that knowledge on climate change was very generic and there was a lack of knowledge on aspects of mitigation with very few tourists having an understanding of carbon 'compensation' or 'offsetting'.
- Although participants perceived that climate change was a massive problem, links were rarely made between their own behaviour and climate change.
- Freedom to travel was considered an integral part of peoples' lives, and a valued good.
- When accountability was discussed, the problem was perceived as a collective responsibility, and also largely seen as the responsibility of the government or international organisations. Furthermore, there was also an attitude that airlines should be accountable for the environmental damage caused by flying.
- The focus groups indicated that increasing the cost of flights would not prevent them from travelling.
- In terms of policies/mitigation schemes, the participants indicated that these should be simple. They concluded that voluntary schemes would be ineffective and unfair, and air travel taxes were considered a better solution (although they expressed fears that they would disproportionately affect the poorer members of society). A carbon budget for

each individual traveller was also considered as a viable option, although there was speculation on how it would be managed.

### 2.3 Energy Saving Trust (2008): Flying in the face of climate change: exploring the paradox of climate-concerned frequent flyers.

#### *Rationale:*

The UK's Energy Saving Trust (EST) considers it a paradox that a large majority of the frequent flyers (which they define as flying 3 or more times a year for leisure purposes) are not only often informed and concerned about climate change, but also take action in their lives to reduce their overall carbon footprint. Their study aimed to determine what it would take for these frequent flyers to reduce the climate impact of their flying behaviour.

#### *Methodology:*

Ensuring that a representative sample of the UK population was examined (2000 adults), the EST surveyed flyers and non-flyers on their attitudes to both climate change and flying. Additionally, focus-groups were conducted with those 'frequent flyers that care about the environment'<sup>5</sup> to establish their reasons for flying, and what would make them reduce the numbers of flights they take annually.

#### *Key findings – Climate change and flying:*

- The main motivation for flying for was to visit new places. The EST considers this an encouraging finding as new places can be discovered closer to home or without having to leave the country.
- When asked what actions the respondents preferred to undertake to reduce their carbon footprint, the most popular action was to recycle. In terms of flying, less than 10% of respondents preferred to take fewer flights (under 10% for long-haul, and under 10% for short-haul), and carbon offsetting for flights was the least preferred action. One explanation for this that the EST considered was a lack of awareness of the impact of aviation in comparison to other aspects of their lives, in terms of their overall carbon footprint.
- A considerable majority (89%) of those respondents who had flown in the last year did not feel guilty about it.
- Whilst understanding that the climatic impact of flying was worse than e.g. driving, the frequent-flyers surveyed admitted that they had limited knowledge when it came to understanding the actual climate impact of aviation.

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<sup>5</sup> Based on DEFRA A Framework for Pro-Environmental Behaviours Report, January 2008.

- Participants demonstrated a desire to pass the responsibility of aviation emissions onto a third party (e.g. some participants considered business travellers more responsible) rather than to accept personal responsibility.
- The EST concluded that their survey had demonstrated that raising awareness regarding the climatic impact/damage caused by flying was not enough to encourage flyers to make significant changes to their flying habits. Further education would be needed, which may have the potential to assist with gaining support for policies that address aviation-climate issues.

*Key findings – Changing passenger behaviours:*

- The study revealed that for the participants, when identifying holiday destinations, flying was considered as a norm. There was a general opinion that the participants' own flying was justifiable. The EST considered that this suggests that a wholesale shift in consumer attitudes is needed for the environment to be factored into holiday decisions.
- The focus groups concluded that the popularity of flying was due to its speed, affordability and access to far-off destinations. Furthermore, there was the desire for excitement, although some felt that this could be met through transport such as the Eurostar. Nonetheless, the negatives of flying were also discussed. They included transfer hassle, fear of flying, cramped conditions, and long waiting times at airports (i.e. security and check-in).
- When the respondents were asked about the acceptability of alternative forms of transport to flying, the most common response was to travel abroad by rail, car or ferry. The option of not taking a holiday overseas, but instead participating in leisure activities closer to home was not popular, demonstrating that the public are not willing to forego their international holidays.
- Feedback from the focus groups showed that it would be more beneficial to encourage a switch from flights to alternative modes of transport for short-haul holidays and mini-breaks. For long-haul journeys (usually main holidays), changing to a nearer destination was considered a possible substitute.
- Further feedback demonstrated the need for reductions in the cost of holidaying in the UK, as well as travel to these domestic destinations.
- Making flights more expensive was not often cited as an influencing factor when changing flying behaviour.
- When presented with a number of ways to reduce the carbon footprint of flying, the most favourable option was to fly more energy efficient planes. The second most attractive option was automatic offsetting, possibly as it was deemed a fair option. The least attractive options included voluntary offsetting and raising the cost of flying. The EST considered the number of people interested in a personal carbon allowance (42%) to be an interesting finding.

## 2.4 Camcon (2008): Aviation Study

### *Rationale:*

The Camcon study aimed to examine public attitude to the UK's airport growth plans, what their concerns are, and how they may be allayed. Amongst other environmentally focused issues, the study aimed to examine whether public concern about the environment was enough to dissuade them from flying.

### *Methodology:*

Online market research agency YouGov conducted this nationwide survey of over 2000 people.

### *Key findings:*

- Although participants were worried about the impact of aviation on the environment, they are generally unwilling to change their travelling habits – only 22% of those respondents stated that their concerns had affected the number of flights they take.
- The responsibility for reducing aviation emissions was considered to be the airline operators' and manufactures'.
- Over half of the participants were unconcerned about proposals for airport expansion.
- Participants cited noise pollution, climate change, air quality and the impact on house prices as the source of their apprehension towards airport expansion.
- Female participants and those surveyed in the South of England were found to be more eco-conscious. Whereas participants in the East Midlands were found to be the least willing to alter their travelling behaviour.

## 2.5 Department for Transport (2008): Public experiences and attitudes towards air travel

### *Rationale:*

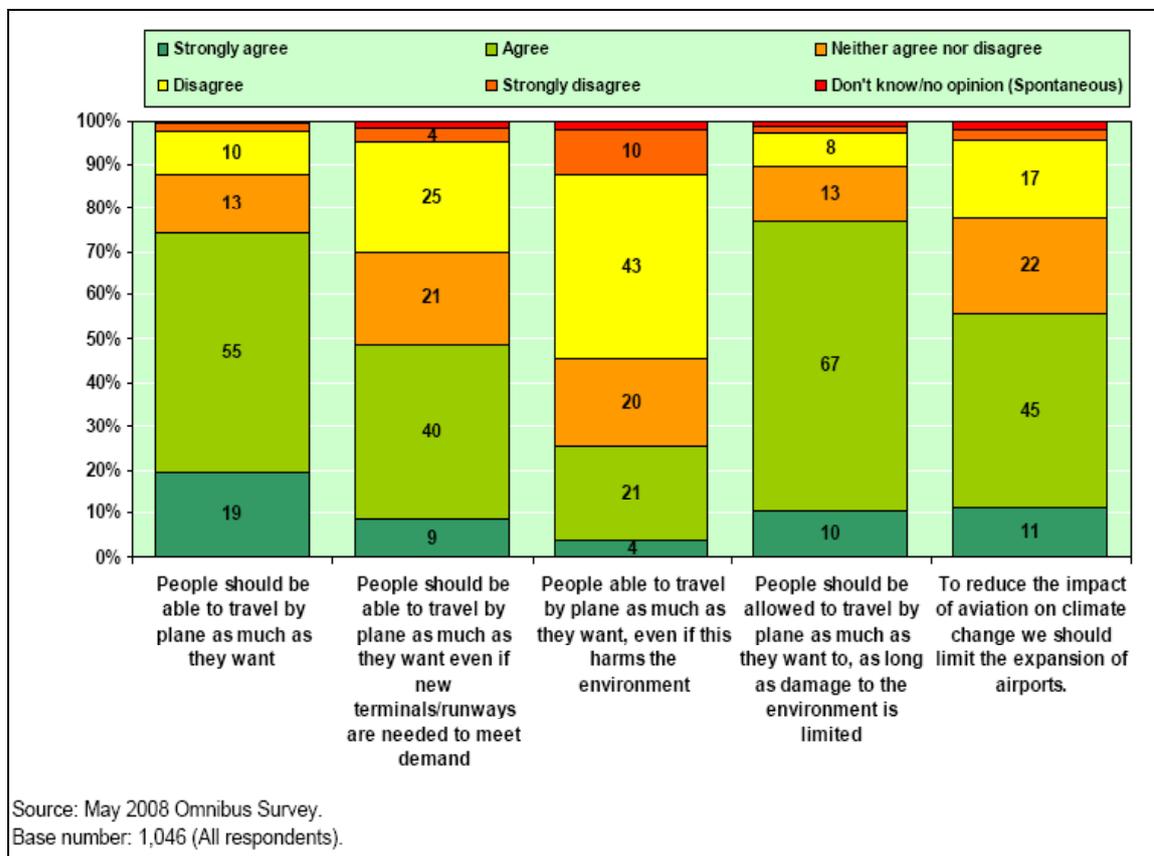
The Department for Transport (DfT) considers it important to understand the public's attitudes, perceptions and knowledge in relation to transport measures and therefore regularly runs surveys.

### *Methodology:*

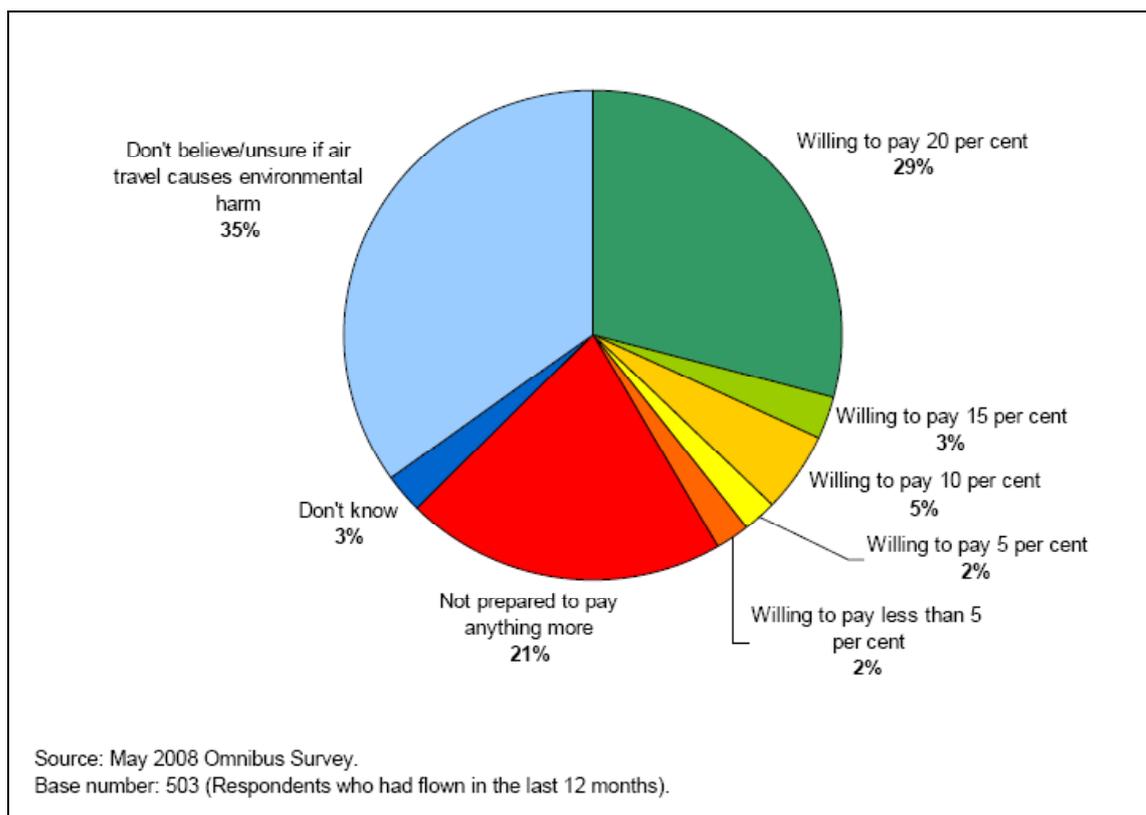
A module of questions on public attitudes and experiences towards air travel was included within the May 2008 Office of National Statistics Omnibus Survey. This followed on from the 2006 survey.

*Key findings:*

- Two thirds of respondents agreed that air travel harms the environment, but they also generally felt that people have a right to travel by plane as much as they like, although not necessarily to the complete detriment of the environment, as Figure 1 demonstrates.
- Only 1% of participants gave environmental concerns as a reason for reducing the number of flights they took.
- Over 40% of respondents said they would be willing to pay more for air travel to reflect its environmental impacts – this included 29% who would be willing to pay an additional 20% on the price. However, support reduced where this increase in cost was more substantial, making air travel much more expensive. Figure 2 demonstrates the willingness of participants to pay for the environmental damage of flying.



**Figure 1: Attitudes towards environmental impacts of travel (DfT, 2008)**



**Figure 2: Willingness to pay more for air travel to reflect environmental harm (DfT, 2008).**

## 2.6 Conclusion from Public Surveys

When comparing the surveys with one another, there are considerable similarities in some key findings. It was generally concluded that the public have some understanding about climate change (although this could be generic), and that some even understand the link between flying and climate change. This is corroborated by results of a previous Omega study examining passenger attitudes to offsetting where approximately 80% of the 500 passengers questioned acknowledged that climate change was a genuine threat and that air travel has an influence on climate (see Hooper *et al*, 2008). However, this knowledge rarely manifests itself in changes to behaviour such as reducing the number of flights taken by the individual. Again this was reflected in the Omega offsetting survey where nearly 90% of passengers stated that their attitude towards air transport and climate change did not influence their choices about flying. In general, attitudes to flying confirmed that it was viewed as a valued asset which respondents would be unwilling to forego.

The surveys demonstrated a degree of consensus when investigating who should be made accountable/responsible for emissions. Whilst some respondents concede that a certain level of personal accountability was required, in many cases the onus of responsibility was placed on government, national and international organisations, airline operators and manufacturers. These actors were also identified as being primarily responsible for offsetting

the climate impacts of flying by the respondents to the Omega offsetting survey where only 15% of passengers believed that the individual should be responsible for offsetting.

When evaluating possible policy options to mitigate aviation emissions, it was interesting to see that a considerable number of participants across the surveys would be willing to pay more for their flight (in some cases up to 20% more on the fare) if this resulted in improved environmental performance. Other mitigation tools that appealed to the participants were automatic offsetting, taxes, and personal carbon allowances. It was made clear that it was important to the participants that the options were equitable, and not unfairly detrimental to any sector of society. Alternatives to flying were also considered, and often positively received; although overseas holidays were generally regarded as sacrosanct. Furthermore, participants believed that considerable improvements to the current alternatives to overseas holidays would be required to convince them to make the change from flying. However, the review of passenger surveys revealed an absence of a systematic attempt to establish the willingness of passengers to accept more marginal changes to air service provisions intended to enhance carbon efficiencies. It is this gap in understanding that the supplement to the CAA survey, instigated as part of this project, is designed to address – please see section 4.3 for more details.

### 3.0 Airline Actions to Reduce Climate Change Impacts

Traditionally, the public and sector-specific debate on the environmental impacts associated with aviation has focussed primarily on the spatially discrete consequences of aviation activities confined to airport localities, such as noise, local air quality, water pollution and waste. However, the landscape has changed dramatically only very recently as wider scientific consensus has been reached over the causes and consequences of global warming resulting in a political mandate for change. The urgency and legitimacy of the need for substantial changes to de-couple economic growth from climate change were persuasively outlined in the 2007 Stern Report. Here, the Chief Economist of the World Bank, confirmed that climate change is a serious global threat by suggesting that the major risks posed to global economic and social activity were “on a scale similar to those associated with the great wars and the economic depression of the first half of the 20<sup>th</sup> Century” (Stern, 2007). Stern went on to conclude that if the worst effects of climate change are to be avoided then urgent action is required by governments, businesses and individuals. But this is not a ‘doom and gloom’ scenario as these changes are identified as bringing huge opportunities and thus regarded as compatible with economic growth.

Core actions to reduce climate change emissions as identified by Stern (2007) include:

- Carbon pricing such that people face the full social costs of their actions
- Technology policy to develop more efficient products and service and thereby shift to a low-carbon economy
- Engagement of the public with the urgency for change, thereby influencing individual behaviour.

The imperative for absolute reductions in greenhouse gas (GHG) emissions combined with a recognition that, whilst still relatively small (2-3% globally – IPCC, 1999) the historic and predicted growth of aviation climate change emissions is at odds with absolute emissions reduction target. This has meant that the contribution to climate change from aviation has been a central focus for policy-makers and pressure groups. This has implications for the sector through:

- The potential impact on the cost of travel
- The need for, and investment associated with, securing step-changes in the carbon-performance of engine and airframe technology
- Regulatory responses affecting demand and influenced by changes in public attitudes.

The aviation industry has not been slow to respond to these challenges nor the rising costs of aviation fuel, and has set itself demanding targets for improvements in technology and operational efficiencies. For example, in 2001 the Advisory Council for Aeronautics Research in Europe (ACARE) outlined its vision for 2020, which included the following targets:

- A 50% cut in CO<sub>2</sub> emissions for new aircraft entering service in 2020 relative to 2000 performance.
- An 80% cut in NO<sub>x</sub> emissions for new aircraft entering service in 2020 relative to 2000 performance.
- To make substantial reductions in the environmental impact associated with the manufacture, maintenance and disposal of aircraft.

These commitments have been reinforced by the International Air transport Association (IATA, 2008), which has set an objective for carbon-neutral growth from 2020 and a vision of carbon-free flight by 2050. The position taken by these organisations represents a significant change in the language used by the aviation industry and recognition of the magnitude of the threats posed by climate change and future predicted increases in oil prices. Massive funding in R&D will be necessary to deliver the requisite changes to airframe and engine technologies and to zero-carbon fuel central to these targeted emission reductions. However, in the meantime it is incumbent upon all aviation actors to seek to improve carbon-efficiencies wherever possible such that absolute growth in aviation emissions is reduced in the short-term.

A number of airline business practices associated with customer convenience (increased service frequency/competition leading to lower load factors than they would be otherwise), and on-board customer service (space usage and service offerings) add to aviation's contribution to climate change. For example, 1-2% of CO<sub>2</sub> emissions from aviation result from the fuel consumption associated with customer service considerations such as catering and in-flight entertainment (IPCC, 1999). Airlines are beginning to introduce a range of initiatives designed to reduce weight, fuel consumption and emissions associated with a given service delivery. Table 1 illustrates a wide variety of initiatives undertaken in pursuit of both carbon and economic savings.

Airline / Source	Carbon Reduction Initiative	Carbon / Economic Savings
<b>Air Canada, Jazz</b> (BBC, 2008a)	<ul style="list-style-type: none"> <li>▪ Removing life vests from all its planes. Regulations allow use of flotation devices within 50 miles of shore. Passengers will use seat cushions instead.</li> </ul>	Reduce aircraft weight by 23kg (50 pounds).
<b>Air France – KLM Group</b> (2008)	<ul style="list-style-type: none"> <li>▪ Reduced the weight of trolleys from 29 kg to 23 kg, of galley containers from 3.6 to 2.7 kg, drawers from 0.8 to 0.5 kg, glass trays from 1.0 to 0.5 kg</li> <li>▪ Reduced the amount of paper carried on board with the switch to digital technical documentation.</li> <li>▪ Purchased 3,800 lightweight baggage containers resulting in a 22 kg reduction per container, from 87 to 65 kg.</li> </ul>	Reducing the load by 1 tonne on a long-haul flight saves 300 to 400 kg of fuel.

<b>American Airlines</b> (AMR Corporation, 2007)	<ul style="list-style-type: none"> <li>▪ Cleaning the turbines that power the fleet so they run more efficiently.</li> <li>▪ For three years, a program has been in place to test efficiencies gained from running high pressure water through engines every six months.</li> </ul>	The program has saved 4.7 million gallons of fuel across the fleet over three years.
<b>British Airways</b> (2008)	<ul style="list-style-type: none"> <li>▪ Fitted new, lightweight seats on some of their short haul planes.</li> </ul>	The Boeing 747 was made 200 kg lighter.
<b>Brussels Airlines</b> (BBC, 2008b)	<ul style="list-style-type: none"> <li>▪ Slowing speeds by about 10km/h.</li> </ul>	Would cut annual fleet fuel bill by £800,000. The initiative would add 1 or 2 minutes to flight times.
<b>China Southern Airlines</b> (Watts, 2006)	<ul style="list-style-type: none"> <li>▪ Encouraging passengers to use the toilet before they board flights as a way of saving energy – a single flush at 30,000 feet uses a litre of fuel.</li> </ul>	Reducing the human waste in an average aircraft's tank would save £3 million per year.
<b>International Civil Aviation Organisation (ICAO)</b> (Viscotchi, 2006)	<ul style="list-style-type: none"> <li>▪ Keep operating items to minimum (no extra water, paperless cockpit, consumables for 1 flight only).</li> <li>▪ Usage of light carpet (up to 125 lbs).</li> <li>▪ Usage of Chromate free paint (up to 150lbs).</li> </ul>	No information available.
<b>Japan Airlines</b> (undated)	<ul style="list-style-type: none"> <li>▪ Flying eco-friendly unpainted cargo aircraft since 1992.</li> </ul>	Aircraft is 150kg lighter when exterior is not painted.
<b>Japan Airlines</b> (2007)	<ul style="list-style-type: none"> <li>▪ Lightweight porcelain tableware, 20% lighter, in First and Business classes.</li> <li>▪ Streamlining the spoons and forks: weight reduction of 2 grams per unit.</li> <li>▪ The amount of water in the water tank in the cargo compartment has been adjusted.</li> <li>▪ Use of Twintex instead of aluminium alloy in the side panels of the containers = weight reductions of 26 kg per unit.</li> </ul> <p>The amount of fuel onboard is measured in 100-pound units rather than 1000 (450kg), more precise measures of fuel required, weight savings of approximately 400 kg.</p>	<p>JAL have achieved weight savings of up to 400kg on 747-400s and 300kg on 777s.</p> <p>By reducing the weight of each aircraft by 1 kg it is possible to cut CO2 emissions throughout the entire JAL Group by approximately 76 tons per year.</p>
<b>Jet Blue Airways</b> (2008)	<ul style="list-style-type: none"> <li>▪ Eliminated disposable headsets and is encouraging customers to bring their own.</li> <li>▪ They are also saving paper by not offering an in-flight magazine.</li> </ul>	No information available.
<b>Jetstar - Qantas Group</b> (Qantas, 2008)	<ul style="list-style-type: none"> <li>▪ Offers a new fare that provides customers with the option to travel with only carry-on baggage for a cheaper price, reducing the operating weight of aircraft and thus reducing fuel requirements.</li> </ul>	No information available.
<b>Thomson Fly</b> (Thomson, undated)	<ul style="list-style-type: none"> <li>▪ High density seat configurations, improved by the installation of new 'thin' leather seats and high occupancy combine to provide a lower emission rate per passenger than a comparable scheduled flight.</li> <li>▪ Cabin crew use small handheld display units to replace volumes of manuals and paperwork. Pilot's laptops give them access to route and weather update and the latest</li> </ul>	Thomsonfly is 50% more fuel efficient than 30 years ago.

	safety and technical information.	
<b>Virgin Atlantic</b> (Guardian, 2008)	<ul style="list-style-type: none"> <li>▪ Replaced glossy magazines with increased in-flight entertainment systems</li> <li>▪ Considering cutting back on the newspapers, trimming meal trays and duvets, and taking empty champagne bottles off before flights depart.</li> </ul>	This will save \$43,000 per plane each year.

**Table 1: Examples of initiatives undertaken by airlines to reduce carbon emissions.**

The examples listed in Table 1 demonstrate the efforts being made by airlines to make incremental changes to improve fuel efficiency, resulting in reduced operational costs and GHG emissions; the compatibility of commercial and environmental objectives has no doubt stimulated these actions. However, this raises the question as to what is the limit of these business-environment win-win opportunities. The review of passenger attitudes suggests that whilst some passengers may be willing to pay more for air services, climate change concerns have yet to impact upon demand. At the periphery there is no definitive indication of the willingness of passengers to accept, for example, reduced service levels if this leads to more carbon-efficient air transport. Furthermore, given that airline initiatives to reduce weight and enhance emissions to date have not compromised existing service standards; what is the potential for further reductions and indeed do these options vary for different types of service provider (i.e. network carriers and low cost airlines)? It was a desire to investigate these questions that gave rise to the Passenger Expectation and Business Models Seminar summarised below.

## 4.0 Outline of Workshop Presentations

The Passenger Expectations and Business Models workshop, hosted by Manchester Metropolitan University (MMU) and Cranfield University, was held at the BERR Conference Centre on 4<sup>th</sup> December 2008. Presentations from academic, business, and NGO representatives examined: the willingness of passengers to accept changes in air transport services designed to improve carbon efficiency; how pricing, operational practices, and the structure of the airline industry influence environmental performance; and the extent to which further carbon savings options require changes to business practices. The presentations and discussion are summarised below.

### 4.1 Climate Change and Passenger Behaviour – Paul Hooper, CATE & Omega

There is now a consensus that climate change is occurring, to an extent that may prove dangerous in the near future. In pursuit of mitigation against such dangerous climate change, the EU has set the target to limit mean global surface temperature increases to 2°C above 1990 levels. However, one obstacle to meeting this target is the projected growth of the aviation industry which is predicted to continue to increase by 4% pa well into the next decade (ATAG, 2000).

Aviation and climate change concerns are gaining momentum. First, it is a sector which has until recently been mainly ignored as far as emissions targets and reductions are concerned; secondly, it produces a number of GHG's, which, in combination, have a predicted radiative forcing of almost 2 times that of carbon dioxide (derived from data found in Sausen *et al*, 2005); thirdly it is politically difficult to address as it spans numerous countries/jurisdictions etc; and finally as it has many benefits – some of which are globally relevant. Benefits include:

- The creation of direct and indirect employment
- Expansion of world trade
- Inward investment
- Opportunities for tourism and education
- Cultural development and support for a multi-cultural society

Nonetheless, despite these benefits, the climatic implications of aviation cannot be ignored. Therefore, there is the requirement to bring together the expectations and requirements of air travel, airlines' capacity to change, and the environment. Mitigating against the climatic impacts of aviation will have a number of implications:

- *An emphasis on commitment to continued eco-efficiency improvement:* including technology enhancement, operational and business practice changes, and optimising modal mix to minimise the GHG emissions from a given journey.

- *The demonstration of efforts being made to reduce absolute increases in environmental impacts:* including a systematic approach to environmental management, regular and transparent corporate reporting, as well as stimulating competition through improving environmental performance.
- *The requirement to address environmental limits through:* step changes in technology, reduction in demand for travel, and the deciding upon the acceptable levels of increases in social and environmental impacts.

In terms of the technological advances/improvements, commitments are already being made by some. ACARE (Advisory Council for Aeronautics Research in Europe) has already set targets to be reached by 2020 (relative to 2000 aircraft fleet):

1. 50% reduction in perceived noise
2. 50% reduction in CO<sub>2</sub> emissions
3. 80% reduction in NO<sub>x</sub> emissions

IATA (International Air Transport Association, 2008) has set an objective of carbon-neutral growth by 2020, and a vision for carbon free aviation within 50 years through engine, airframe, fuel and operational improvements. For operational improvements, commitments could include:

- Commitments to carbon neutrality/carbon management programmes for airports
- Air Traffic Management (ATM) improvements
- Landing take-off (LTO) cycle optimisation
- Weight reduction initiatives
- Increasing passenger load factors
- Route network development to better match demand and provision

A key question that requires answering is: How far can/should we go? Here there is a mandate to look for win-win opportunities, and there is a need to understand the wider dynamics/consequences of proposed solutions. Furthermore, there is a need to look to consumers to see what they are willing to change, what compromises are they willing to make? However, research has shown that there are mixed messages regarding passengers attitudes (see earlier summary in section 2).

#### 4.2 Passenger Attitudes Studies – Holly Preston, CATE & Omega

The growth of aviation in the UK is largely attributable to leisure flying; in 2006 57 million flights were for leisure in comparison to only 9.1 million flights for business (Energy Saving Trust, 2008). If the aviation industry is to tackle its climate change agenda effectively, its passengers will be a key factor in the success or failure of the mitigation tools the industry implements. Consequently, there is a need to understand the attitudes and habits of passengers, in particular those who fly for leisure, and as a result a number of passenger attitudes surveys have been undertaken in the recent years. This study reviews 5 surveys undertaken during 2007 and 2008.

As demonstrated in section 2 of this report, the surveys used a range of data collection methods which included focus groups, interviews, role plays and questionnaires; and ranged from 32 participants to over 2000. The focal point of these surveys was to determine passenger attitudes towards the relationship between air travel and climate change.

The key findings of these surveys revealed that:

- There is an acknowledgement that climate change is occurring and that air travel harms the environment, but there is confusion over what can/should be done about this.
- Despite the knowledge that climate change is happening, the majority of passengers are unwilling to alter travel habits at present to reduce the impact upon the environment.
- In general, concern for green issues has not affected the number of flights people take and, when planning a holiday, the environment is low on the agenda.
- Passengers believe that national and global institutions, as well as airline operators and manufacturers should mitigate the effect of transport emissions

In conclusion, flying is considered inherently valuable, especially due to its speed, affordability and access to remote destinations; and passengers feel they have a right to continue flying. Consequently, any attempt to encourage passengers to take personal responsibility for the adverse affects on the environmental created by their desire to travel will have to address customer attitudes, expectations and behaviour.

#### 4.3 CAA departing passenger survey and the environmental supplementary questions – Robert MacKenzie, CAA

The Civil Aviation Authority (CAA) conducts continuous surveys (regional cycles every 3-5 years) at London and Manchester airports, of departing passengers. The aim of the surveys is to obtain demographic information, points of origin and destination, journey purpose and frequency of air travel. In addition to this information, with the help of key researchers at Centre for Air Transport and the Environment (CATE), MMU, and in collaboration with Omega, the CAA has sought to incorporate environment-related questions into their passenger surveys, in order to determine passenger understanding of their impact upon the environment and their willingness to change their behaviour to help reduce the impact of air travel. Originally, CATE researchers suggested foci for questions should include: taking fewer flights; selecting more environmentally friendly airlines; contributing to offsetting programmes; giving up in-flight sales; duty-free collection on arrival; accepting less frequent services to enhance load-factors; and choosing to fly through a carbon-neutral airport. These questions were piloted in 2008 at Gatwick Airport; unfortunately, the feedback revealed difficulties in passenger comprehension and consequently responses were inconclusive. In response to the reactions to the pilot survey, the environmental questions have now been simplified and made more direct. The revised questions will be trialled

during January 2009 and added as supplements to the main survey of departing passengers in March 2009.

#### 4.4 Public Attitudes towards Aviation & Climate Change: An NGO's role - Cait Weston, AEF

Non-Governmental Organisations (NGOs) are taking part in a number of activities in order to demonstrate their views towards aviation and climate change. These include talking to politicians, providing information and comments for the media, advertising, demonstrations and direct action. The Aviation Environment Federation, in particular:

- Addresses all environmental impacts of aviation;
- Encourages politicians and regulators to lead and influence public attitudes; and
- Provides information to allow people to make changes in their own lives.

NGOs believe that the public needs to have a clear understanding of the science behind climate change and how their individual activities can affect the environment. The media focus on scientific uncertainty about climate change has been misleading and unhelpful; therefore NGOs have a common goal with the aviation industry to clarify the science. The use of advertisements to show how each individual can make a difference to climate change, for example choosing a bicycle over a car can encourage change on a personal level resulting in a much larger significance when adopted by the general public. The role of NGOs within aviation is therefore to educate the public on the scientifically proven effects of flying and influence travellers to use lower carbon alternatives available within the transportation industry or to use non-travelling options to meet communication needs (e.g. video-conferencing).

#### 4.5 The Impact of changes to market structure on carbon emissions – Keith Mason and Chikage Miyoshi, Cranfield University

As new technologies become available within the aviation industry, the impact of individual passenger's flights upon the environment and their contribution to climate change is reduced. Between 1996 and 2004 there was a three fold increase in the number of people travelling, but only a two fold increase in the amount of fuel used, enabled by a significant improvement in fuel efficiency. In addition to the contribution from improved technology, the average amount of CO<sub>2</sub> per passenger kilometre has also been reduced as a result of airlines increasing the load factors of their aircraft. However, the operational performance of each individual aircraft varies depending upon the type of aircraft, the load factor, the stage distance flown, the choice and frequency of the routes and the services provided (including cabin configuration, baggage allowance, catering and duty free sales, etc.). Thus, different carrier types and prevailing business models lead to inherently different carbon efficiencies and indeed may present different constraints to, and opportunities for, further

improvements<sup>6</sup>. However, all airlines have the ability to make changes to improve the performance of their aircraft and reduce their impact on the environment. Initiatives include:

- Increasing load factors
- Increasing seat density
- Reducing weight on board
- Changing to more efficient aircraft

Airlines have already begun making changes to aircraft to reduce the weight onboard, efforts include:

- Removing life vests
- Using lighter trolleys, cutlery, smaller bottles of wine, less glass and packaging, removing in-flight magazines
- Redesigning seats
- Using lighter carpet, less paint, paperless cockpit, carrying less water

Environmental concerns are beginning to affect consumer behaviour, but it is unknown as to whether travellers will readily accept lower standards of service on-board aircraft. However, the option of reducing passenger facilities on-board is one which can be adapted to, whereas increasing the price of flights to cover environmental taxes/fuel surcharges may significantly impact upon the demand for flights. Therefore, to ensure both the airlines and the environment benefit from on-board changes and any consequent increase in ticket price, awareness of climate change must be raised, with the aim to encourage public acceptance of any efforts to improve carbon efficiencies.

#### 4.6 [easyJet and the Environment – Chris Essex, easyJet](#)

easyJet believes that aviation may currently be responsible for 1.6% of global greenhouse gas emissions. Combined with the highly volatile price of oil, the Government's view that aviation is a soft target for taxation and the possibility of EU legislation directed at aviation emissions, it is considered that the sector is facing an array of environmental challenges. For air transport to have a sustainable future it must adapt to a carbon constrained world and utilise kerosene in the most efficient way and engage in the regulatory process to ensure environmental efficiency is incentivised and technology investments are made.

easyJet is Europe's fourth largest intra-European airline operating 165 aircraft that fly 43 million passengers per year across 400 routes from 103 airports, creating a carbon footprint of 3.7 million tonnes of CO<sub>2</sub>. The airline has an environmental code consisting of 3 promises to shareholders, employees and passengers:

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<sup>6</sup> For a more detailed presentation of this work please see Mason, K. and Miyoshi, C. (2009) *Airline Business Models and their Carbon Footprints*, Omega Report available at [www.omega.mmu.ac.uk](http://www.omega.mmu.ac.uk)

1. To be environmentally efficient in the air
2. To be environmentally efficient of the ground
3. To lead in shaping a greener future for aviation

Improvements in the efficiencies of current technology and investments in new technology are critical to ensuring a sustainable future for air transport. There are a number of opportunities available to allow airlines to improve their fuel consumption, including fleet replacement, operating procedures, engine performance monitoring and weight saving initiatives. Airlines could also invest in a greener future for aviation through the development of quieter and more fuel efficient fleets, such as the ecoJet concept proposed for use in 2015. Society cannot however, look at aviation in isolation, but must examine industry as a whole and determine how aviation plays its role in the environmental objective.

#### 4.7 Corporate Responsibility – Jonathon Counsell, British Airways

Aviation is an integral part of the global economy, but due to its negative impact on the environment the industry is poorly perceived by the general public. However, the transport sector produces fewer greenhouse gas emissions than both land use and power, and the emissions from aviation within the transport sector are much lower than those from road vehicles, 13% and 76% respectively (Stern, 2007).

The aims of BA's 'one destination' programme are to achieve responsible air travel to be accomplished through stakeholder dialogue, deliver a 50% net reduction in CO<sub>2</sub> by 2050, embed the environment within their business model, and to become publicly accountable for their environmental impact at a leadership level. At present BA have:

- Provided customers with a carbon offset scheme and information on how to fly responsibly
- A carbon benefit objective for all business cases and inclusion of sustainability opportunities in product development design briefs
- Invested in the environment at Heathrow's Terminal 5

In the future BA hopes to improve their environmental image through:

- Increasing the accessibility of their carbon offset scheme
- Using more sustainable products
- Integrating carbon into the key performance indicators in all aspects of the business
- Disclosing the carbon footprint of their supply chain

Low carbon and climate friendly commercial opportunities are becoming more available for the air transport industry and, once acknowledged and supported by all stakeholders, could influence the potential future growth of this sector.

## 5.0 Summary Discussion

Delegates were given the opportunity to discuss some of the issues raised in the presentations. Breaking into two groups, the main topics were:

- The public's willingness to accept change; and
- How services could be changed now and in the future.

The discussion highlighted that:

- Customers want the same service but with less impact upon the environment.
- Passengers are 'non-negotiable' when it comes to space as they do not want to feel cramped on board the aircraft.
- There is some willingness to pay for 'extras' such as enhanced leg-room.

The types of efficiency improvements underway or being considered by airlines related to making better use of the available space and reducing the weight of particular services/products include:

Variable	Full Service	Low cost carrier	Passenger Impact
<i>Seating Space</i>	Options to improve seat density through better configurations (e.g. in business class) are being exploited.	There is some margin for reduced space, but this would most likely require a monetary incentive.	Passengers are unwilling to forego space on long-haul. Regulatory limits are already being reached here by LCCs.
<i>Load factors</i>	There is the potential for better market intelligence to be used here. Also no refunds to passengers.	There is the potential for better market intelligence to be used here. Also no refunds to passengers.	Reduced flexibility might disproportionately impact on full-service carriers.
<i>Hold Space</i>	Carriers need to be encouraged to optimise freight carriage with passengers. Also lower weight pallets could realise fuel saving and/or enhance freight carriage.	Carriers need to be encouraged to optimise freight carriage with passengers. Also lower weight pallets could realise fuel saving and/or enhance freight carriage.	No impact.
<i>Baggage Weight</i>	Providing more generous allowances are core to full service offering.	Reduced and variable allowances and changes have already been introduced.	Allowance often linked to service levels. Passengers are less willing to forego allowances on long-haul
<i>Cabin Crew</i>	There may be some capacity to reduce crew numbers.	Most LCCs already operating at regulatory minimum.	Potential negative impact on service level.
<i>Paper Weight</i>	Shift from paper-based delivery of some	Shift from paper-based delivery of some	Possible implications for service levels and

	information to in-flight entertainment system (long-haul).	information to in-flight entertainment system (long-haul).	advertising revenues. Thus, airline data was considered most likely to be moved first.
<i>Food Weight</i>	This was thought not to be a significant contributor to weight. There is the potential to reduce the service on short-haul flights.	The service could be lowered to the option of buying food on board or carrying on from the terminal.	Food options linked to service level.
<i>Duty free</i>	Market analysis has allowed some airlines to tailor product range to particular routes with significance weight savings.	Market analysis has allowed some airlines to tailor product range to particular routes with significance weight savings.	Could impact on perceived service level. Potential conflict with cabin crew incentives.
<i>Drinks</i>	Choice is important here however, a shift from individual small bottles can save considerable weight.	Much has already been done by low-cost carriers in this area with optional services and the use of carry-ons.	Could impact on perceived service level.
<i>Water</i>	Water carried was often thought to be excessive and there is currently no monitoring of usage. Considerable potential for weight savings.	Water carried was often thought to be excessive and there is currently no monitoring of usage. Considerable potential for weight savings.	No impact, unless water ran out during flight, in which case it could result in re-routing. Monitoring required for tailored contingency.
<i>Fuel contingency</i>	Pilots thought to be very conservative here, understandably. Monitoring of contingency exceedances and costs of excess carriage used to educate pilots is yielding benefits.	Pilots thought to be very conservative here, understandably. Levels of contingency exceedances not clear.	No impact on service quality assuming contingencies are sufficient

**Table 2: Initiatives undertaken by airlines to reduce carbon emissions upon passengers discussed at the workshop**

A variety of changes to the modes of operation were identified, and their resulting climate and economic benefits discussed. These included:

- *Low and Slow*. Using existing technologies (economically advantageous), planes can fly lower and slower to save on fuel and therefore saving cost and produce fewer emissions. easyJet have adopted this at times and although there was not a considerable difference in the flight time (approximately 10 minutes), the amount of fuel consumed fell by 2-3%.

It was discussed however, that there may be noise implications and the question was raised as to how passengers would perceive the initiative. Furthermore, if flights were potentially lasting longer, then there may be the requirement to carry more water and supplies which could potentially offset any savings made.

- *Optimised stage lengths:* Tailoring stage lengths to maximise the efficiency of fuel burn is being considered (e.g. including extra re-fuelling stops to reduce on-board fuel weight). However, there may be limits imposed here due to local air quality (LAQ) implications and infrastructure capacities. Passengers would be disrupted and journeys would take longer.
- *E-flights:* In the future, e-flights could have considerable impact with the way services are managed. For example, services could be pre-booked before the flight so that no additional supplies/cargo/services are taken on-board. This could even go as far as having to specify whether or not you require the in-flight magazine. In terms of economic and climate benefits, it would mean that flights were tailored specifically to those who are travelling meaning no wastage (economically efficient) and weights would be optimised (potential fuel savings).

A range of other measures that would have little impact on passengers were also mentioned, such as the potential for mid-air fuelling, use of rails to reduce fuel burn in taxi, optimising maintenance regimes for fuel efficiency and penalising fuel tankering.

Overall, the discussions confirmed that airlines are willing and able to make changes to service delivery where there are no/marginal consequences for the passenger. However, given the mixed messages coming from passenger surveys regarding concerns for climate change and a lack of willingness to change behaviour, it is hardly surprising that airlines are taking a rather conservative line in their consideration of more dramatic shifts in service.

## 6.0 Conclusions

The climate change consequences of aviation have received substantial attention in recent years and resulted in high-profile commitments to improve the efficiency of air transport in the medium to long-term through investment in engine, airframe and air traffic management improvements. This Omega scoping study sought to explore the short-term potential of more incremental changes in air services to contribute to these efforts to improve carbon efficiencies.

The review of passenger attitude surveys revealed a very mixed picture; with air passengers clearly concerned about climate change and aware of the contribution made by flying (at least in terms of the causal link if not the full scale of the contribution). However, passengers generally look to other parties to solve the problem (e.g. government, airlines), rather than to changes in their own behaviour to address the issue of climate change. Thus, there is a reluctance to reduce flying, especially for leisure, and a belief that others can solve the problem by making the service more efficient. There is even willingness among some passengers to pay more for more environmentally-friendly services and/or to mitigate the consequences of flying through offsetting. What is unclear is whether this willingness to pay extends to forgoing traditional service elements to enhance environmental performance.

It is hardly surprising therefore that the initiatives pursued by airlines to reduce carbon intensities have so far largely been devoted to modifications that have little/no impact on the passenger experience. If airlines are to introduce more radical changes then they will have to be convinced of the environmental benefits and also passenger appetite for the service adjustments. This will require educating consumers as to the extent of environmental benefits if expressed attitudes are to be translated into behavioural changes.

Thus the core conclusions that emerge from this project are that:

- Airlines will continue to pursue incremental changes to service delivery where the benefits are evident (e.g. in fuel savings and GHG emissions reductions) and not seen to conflict with passenger expectations of service. For a more detailed breakdown of the efforts to date and the links to specific business models please see Mason and Miyoshi, 2009).
- More rigorous monitoring of resource and service use in some areas could assist in tailoring supply to passenger demand on specific routes (e.g. water and duty free). The potential to reduce water carriage in this way is thought to be quite considerable.
- Raising awareness among pilots of the financial and environmental consequences of fuel contingency exceedances could yield significant benefits whilst not compromising legitimate pilot concerns for safety.
- In some areas opportunities to reduce weight have reached the limit allowed by regulation (especially among LCCs), for example, air crew numbers and seating space allowances.

- Passengers need to be informed as to the relative impact of flying compared to other GHG generating activities and to the significance of specific changes in service delivery if more radical changes to improve efficiencies are to be considered by airlines (e.g. use of slower aircraft, optimised stage lengths, reduced frequency of services to enhance load factors).
- Passenger surveys suggest there is little appetite for behavioural changes that could reduce demand for air services such as willingness to take fewer longer overseas holidays or to holiday in the UK.

Consequently, future work could usefully focus on:

- Systematic dissemination of emerging best practice in terms of carbon efficiency improvement initiatives, this could be coordinated through organisations such as BATA, IATA and ACI.
- More comprehensive and systematic analysis of the link between passenger attitudes and behaviour with a particular focus of passengers' willingness to pay for and/or forego service elements that can influence carbon emissions. This could inform the development of air service options and any requirement for educating travellers as to the environmental benefits of given courses of action.
- Enhanced environmental training for pilots to raise awareness and encourage more proactive responses to environmental improvement initiatives.

## 7.0 References

**ACARE (2001)** *European Aeronautics: A 2020 Vision*. Available at: <http://www.acare4europe.org/html/documentation.asp>

**Air France – KLM Group (2008)** *Corporate Social Responsibility Report 2007-08*. Available at: [http://www.klm.com/travel/csr\\_en/images/AFKLM%20CSR-report-0708\\_ENG%20\(2\)\\_tcm256-128819.pdf](http://www.klm.com/travel/csr_en/images/AFKLM%20CSR-report-0708_ENG%20(2)_tcm256-128819.pdf).

**AMR Corporation (2007)** *2007 Environmental Responsibility Report*. Available at: <http://www.aa.com/content/images/amrcorp/amrerr.pdf>.

**ATAG (Air Transport Action Group) (2000)** *European Air Traffic Forecasts 1985-2015, IATA*. Available at: <http://www.atag.org/content/showpublications.asp?folderid=433&level1=4&level2=433&>.

**BBC (2008a)** *Airline life vests go to cut costs*. Available at: <http://news.bbc.co.uk/1/hi/world/americas/7586975.stm>.

**BBC (2008b)** *Airline flies lower to cut costs*. Available at: <http://news.bbc.co.uk/1/hi/world/europe/7363448.stm>

**Becken, S. (2007)** "Tourists' Perception of International Air Travel's Impact on the Global Climate and Potential Climate Change Policies" *Journal of Sustainable Tourism* 15 (4): 351 – 368.

**British Airways (BA) (2008)** *Measuring efficiency – flying smarter*. Available at: [http://www.britishairways.com/travel/csr-flying-smarter/public/en\\_gb](http://www.britishairways.com/travel/csr-flying-smarter/public/en_gb).

**Camcon (2008)** *Camcon Aviation Study Management Report*. Available online at: [http://www.camcontec.com/CamconManagementReport\\_FINAL.pdf](http://www.camcontec.com/CamconManagementReport_FINAL.pdf)

**DEFRA (2006)** *Climate Change: The UK Programme 2006*, CM6764. Available at: <http://www.defra.gov.uk/ENVIRONMENT/climatechange/uk/ukccp/index.htm>

**Department for Transport (2008)** *Public experiences of and attitudes to air travel*. Available online at: <http://www.dft.gov.uk/162259/162469/221412/221513/222322/airatt2008.pdf>

**Energy Saving Trust (2008)** *Flying in the face of climate change: exploring the paradox of climate concerned frequent flyers*. Available at: <http://www.energysavingtrust.org.uk/corporate/Global-Data/Publica?ons/Flying-in-the-face-of-climate-change-Exploring-the-paradox-ofclimate-concerned-frequent-flyers>.

**Guardian (2008)** *Airlines hope to keep a lid on emissions*. Available at: <http://observer.guardian.co.uk/shellenergy/story/0,,1793308,00.html>.

**Hooper, P., Daley, B., Preston, H. & Thomas, C. (2008)** *Final Omega Project Report: An Assessment of the Potential of Carbon Offset Schemes to Mitigate the Climate Change*

*Implications of Future Growth of UK Aviation.* Available at:  
<http://www.omega.mmu.ac.uk/using-carbon-off-setting-to-tackle-climate-change.htm>

**IATA (2008)** *IATA joins forces with Solar Impulse*, Press release Feb 18. Available online at:  
<http://www.iata.org/pressroom/pr/2008-02-18-02.htm>

**Intergovernmental Panel on Climate Change (IPCC) (1999)** *Aviation and the Global Atmosphere. A Special Report of IPCC Working Groups I and III*, ed. Penner, J.E., Lister, D.H., Griggs, D.J., Dokken, D.J., McFarland, M., Cambridge: Cambridge University Press.

**Ipsos MORI (2007)** *Attitudes to Aviation and Climate Change – Final Report*. Research for Commission for Integrated Transport. Available online at:  
<http://www.cfit.gov.uk/docs/2007/climatechange/pdf/2007climatechange-survey.pdf>

**Japan Airlines (JAL) (2007)** *CSR Report*. Available at:  
<http://www.jal.com/en/corporate/csr2007/pdf/all.pdf>.

**JAL (undated)** *Global warming: weight reduction*. Available at:  
[http://www.jal.com/en/environment/conservation/conservation02.html#q\\_003](http://www.jal.com/en/environment/conservation/conservation02.html#q_003).

**Jet Blue Airways (2008)** *Reducing our footprint*. Available at:  
<http://www.jetblue.com/green/footprint.asp>

**Mason, K. and Miyoshi, C. (2009)** *Airline Business Models and their Carbon Footprint*, Omega Project Report. Available at: <http://www.omega.mmu.ac.uk>

**Qantas (2008)** *Sustainability Report 2008*. Available at:  
<http://qantas.republicast3.com/Republicasts/Qantas%20Sustainability%20Report%202008/Qantas%20Sustainability%20Report%202008.pdf>.

**Sausen, R., Isaksen, I., Grewe, V., Hauglustaine, D., Lee, D.S., Myhre, G., Köhler, G.P., Schumann, U., Stordal, F. & Zerefos, C. (2005)** "Aviation radiative forcing in 2000: An update on IPCC(1999)" *Meteorologische Zeitschrift*, **14** (4): 555-561

**Stern, N. (2007)** *The economics of climate change: the Stern review*. Cambridge University Press, Cambridge, UK.

**Thomson (undated)** *Aircraft: sustainable aviation*. Available at:  
<http://destinations.thomson.co.uk/devolved/sustainable-tourism/tourism-transport.html>.

**Viscotchi, F. (2006)** *Aviation operational measures for fuel and emissions reduction workshop: Weight Management*. Available at:  
<http://www.icao.int/env/WorkshopFuelEmissions/Presentations/Viscotchi.pdf>.

**Watts, J. (2006)** *Skip the toilet, save the planet*. Available at:  
<http://www.guardian.co.uk/environment/2006/dec/01/travelsenvironmentalimpact.theairlineindustry>.