REGIONAL ECONOMIC BENEFITS OF AIR SERVICES VERSUS THE ENVIRONMENTAL COST OF EMISSIONS

THE CASE OF LONDON CITY AIRPORT AND NEWQUAY CORNWALL AIRPORT

Thesis submitted for the award
of Doctor of Philosophy by
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April 2010

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ACKNOWLEDGEMENTS

The author would like to thank a number of people and their organisations for help given during the research work. In particular I would like to thank Mr Richard Gooding Chief Executive, London City Airport and both his support and airport staff. Also Mr Chris Cain, Director Cornwall Airports, and both his support and airport staff. At both airports the staff were most helpful and friendly.

A number of aircraft manufacturers, in particular Bombardier Aerospace Regional Aircraft and Fokker Services B V, were helpful in providing basic performance data for the different aircraft types operating from and to London City Airport and Newquay Cornwall Airport. I would like to thank Mr Nelson Court for his help and patience with analysis of the aircraft performance data to produce the detailed fuel burn figures for the various aircraft types. Also my thanks go to Patricia Shearman for her support and for her help over many hours interviewing at LCY and NQY.

Finally I would like to thank Professor Roger Wootton, City University for his patience, direction and ideas provided throughout the research time.

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SYNOPSIS

This study examines the relationship between the economic benefit of specific air services and the perceived cost of the carbon dioxide emissions from the aircraft operating the services. Initially a review is made of the basic evidence of climate change and air transport's contribution to it. This is to help put the conclusions of the study into the relevant context. As well as determining air transport's contribution to global warming, the study also considers the current and likely future taxation of air travel from the UK and the importance of air services to the World and specifically to the UK. These assessments are in macro terms.

In order to obtain the necessary data to determine the relationship between the perceived cost of the CO_2 produced and the economic value of the air services, research has been carried out at two UK airports – London City Airport, predominantly used by business travellers and Newquay, Cornwall Airport predominantly used by leisure travellers. Passengers were interviewed to obtain data relating to the benefit of their travel. The data was extrapolated for a full year and compared with the amount of CO_2 produced by the aircraft operating the air services from and to the two airports in the same year. Forecasts of the cost of the cost of CO_2 were used leading to a ratio of economic benefit to CO_2 cost.

The results suggest a significantly greater economic value and this, plus the qualitative assessment of the value of air transport, provide evidence to question plans for increased taxation of air transport. The study then uses a further survey to assess this conclusion in the context of global warming. Consideration is given to air transport's catalytic role as an enabler for business development leading to conclusions that economic damage would result from increased taxation. This proves the research hypothesis.

PART I

INTRODUCTION

Section 1 Research Details

Section 2 The Methodology Applied

SECTION 1
RESEARCH DETAILS

THE SCOPE OF THE RESEARCH

Hypothesis

Research work has been undertaken in order to prove or disprove the following hypothesis:

> ***"That the economic cost of Government environmental measures which are aimed at reducing demand for air travel, would be considerable and damaging to the economy. That such action would be serious for regional economies and serious for the elements of the air transport industry involved."***

> This is considered by determining the regional economic benefits of specific air services and comparing these with the perceived cost of aircraft emissions of CO_2 - as shown by examination of air transport services operated from and to London City Airport and from and to Newquay Cornwall Airport. Assessment of the economic benefit includes catalytic benefit using the value of travellers' time saved.

The study therefore involves research being carried out to determine the relationship at a regional economic level, between:

a. the economic benefits that arise from the existence of air services to and from the specifically selected airports and
b. the perceived cost of the emissions, primarily carbon dioxide (CO_2), which are produced by the aircraft operating those services.

Definitions

The following terms and phrases used in the hypothesis section above are defined in order to establish the boundaries for the research work:

- *"..economic cost.."* and *".damaging to the economy."* While the study examines and draws conclusions from existing research on the value of air transport for the national UK economy, this study uses original research at a regional and micro economic level. Economic cost is therefore described as a worsening of a regional economy in terms of a reduced level of business activity and the consequent effects of this. If this were to occur across other regions of the UK, then the consequences would be significant and therefore serious

- "*.. serious for the elements of the air transport industry...*" The seriousness includes the cessation of air services on a specific route altogether and/or a reduction in the number of services operated on a specific route. This implies reduced employment by airlines and airport companies.
- "*... of Government environmental measures..*" The UK Government has committed to reducing CO_2 emissions to below 1990 levels by 2010. The UK Government in conjunction with the European Union (EU) proposes to apply Emissions Trading to air transport which is likely to add considerable cost to airlines and consequently to airline passengers. At the same time the Air Passenger Duty (APD) tax has been progressively increased and discussion has been initiated through a Government White Paper concerning the need to further increase such taxation in order to drive down passenger demand. The thinking is that in this way airlines would be forced to significantly reduce their operations thereby reducing CO_2 emissions. The APD level for 2007 will be used as the baseline.
- "*..economic benefits of specific air services..*" economic activity arising firstly from employment associated with the provision of the air services and secondly from increased productivity from business travellers as a result of their use of air services – that is the catalytic benefit, and from their expenditure in the region as visitors. Thirdly, from increased tourist numbers and other non-business travellers and consequently their expenditure as visitors. The catalytic benefit is based on the value of travellers' time saved.
- "*..perceived cost of aircraft emissions..*" The introduction of Emissions Trading Schemes has involved the creation of Carbon Markets. It is therefore possible to put a cost to the amount of CO_2 produced by the airline operations on the routes studied. While this cost is at present relatively low, forecasts of future levels have also been applied.

- *"...elements of the air transport industry involved."* The main elements of the industry are airlines and airports plus air traffic services and navigation service providers, travel agents and aircraft manufacturers.

THE PURPOSE OF THE RESEARCH

The purpose of the study is firstly to determine the value of specific air services to and from two selected airports, in terms of the economic benefits for the surrounding region including their contribution to economic growth. Secondly to determine the amounts of CO_2 produced by the air services involved, then to quantify the cost of these based upon the current and forecast market prices of CO_2. Thirdly to consider whether the economic benefit derived from the air services is significant when compared with the artificially constructed cost of CO_2. This cost is based upon the various forecasts developed for CO_2 limiting schemes such as the EU Emissions Trading Scheme (ETS).

Fourthly, to examine the possible impact of the government measures to reduce the demand for air transport for environmental reasons. The final purpose of the study is to draw conclusions from the research work carried out.

In assessing part of the economic benefit of the specific air services the research work will provide quantified data based on interviews with passengers travelling on these services. Also the work will cover analyses of employment data for the airlines, airport companies and associated businesses operating at the airports that are used in the study. The information has been extrapolated to cover a year of air services.

The research work will also provide quantified information based on aircraft manufacturers' data on aircraft performance. This enables calculation to be made of the total fuel burnt in a year by the aircraft operating the schedules to and from the airports concerned. The amount of CO_2 created by the operation of these services can then be determined.

The research work has focussed on two airports:

- London City Airport (LCY) which is predominantly but not solely, used by people travelling for business purposes

- Newquay Cornwall Airport (NQY) which is predominantly but not solely, used by people travelling for leisure and non-business purposes

RELATED LITERATURE

A review has been made of related literature to examine the work that has been undertaken in this field and to establish what has not been fully covered. Appendix A sets out the review. The conclusion was that no studies directly similar to this one have already been undertaken.

ORIGINAL RESEARCH

The study has involved considerable original research including:

1. Examination and calculation of the CO_2 emissions for different aircraft types operated by different airlines and operating from specific airports.
2. Calculation of the cost of CO_2 emissions from different aircraft types operating scheduled services from specific airports.
3. Examination and calculation of the benefits of air transport at a regional level using air passenger surveys at specific airports to help in establishing the total sum of the benefits of the air services.
4. Use of productivity benefits gained by passengers travelling for business purposes, as a result of time saved when travelling by air transport rather than by surface transport. This has been used as the basis for calculation of the catalytic benefit of air services.
5. Determination of the total potential impact of increased taxation and the application of the EU Emissions Trading Scheme.
6. Development and application of a socio-political factor to reflect the value of a more isolated regional airport – in this case Newquay Cornwall Airport.
7. Calculation of the relationship between the cost of the CO_2 emissions arising from the operation of a scheduled network of air services and the value of the economic benefits obtained as a result of the operation of the scheduled network.
8. Use of elasticity co-efficients to estimate the possible effects on demand of price increases for air journeys arising from specific increases in forms of taxation for air travel (Air Passenger Duty and Emissions Trading Scheme

costs). The elasticity co-efficients are derived from the surveys carried out for this study supported by existing work in this field.

9. Determination of the possible effects on the regional economies involved, of the increase in air fares arising from the increases in forms of taxation for air travel if as a result, air traffic declines and air services are reduced or terminated.
10. Determination of the possible effects on the airports and on the airlines operating the air services, arising from the increase in air fares due to the increases in forms of taxation for air travel.
11. Development of models for use by airport and airline companies to assist in assessing their environmental position together with a proposed assessment scale.
12. Assessment of the potential severity of climate change using a straw poll. This was carried out in order to obtain a clear position against which the government policy could be assessed.

RESEARCH TECHNIQUES AND STUDY OVERVIEW

Research Techniques

In order to fulfil the purpose of the study, standard research techniques have been used including:

- desk top analyses of existing data
- review of existing literature on the topics involved
- market research interviews with airline passengers, leading to analysis and production of quantified data concerning economic benefits
- market research interviews with airline passengers leading to assessments of responses to fares increases due to increased taxation
- interviews with relevant parties to develop qualitative and quantative information covering global warming, economic benefits of air services, aircraft engine emissions, government environmental considerations and future carbon market pricing
- analyses of aircraft performance data to produce detailed emissions information

Study Overview

In order to prove or disprove the hypothesis it was found to be necessary to:

- carry out detailed analysis of the research data collected. The methodology used for various stages of the work is described in Section 2.
- describe some of the current evidence showing that a serious environmental problem exists. This is covered in Section 3.
- provide factual evidence that air transport is part of the cause of the environmental problem. This is also covered in Section 3.
- quote evidence that governments (UK and EU) were seeking to reduce or limit the growth of air transport. This point is also covered in Section 3.
- describe the relevance and value of air transport. This is covered in Section 4.
- consider whether air transport is really important and useful regionally, nationally and globally. Also covered in Section 4.
- establish the amount of planned and likely future increases in air fares arising from increased taxation (APD) and the introduction of the EU ETS. This is covered in Section 3.
- examine the economic benefits that are claimed for air transport. This is described in macro terms in Section 5.
- produce and quantify evidence of the economic benefits arising at regional levels from the operation of air transport services to the specific airports. This is covered in Section 6.
- produce and quantify details of the amount of CO_2 produced by the operation of the air services from and to the specific regional locations. This is covered in Section 7.
- establish the cost of CO_2 emissions and compare this with the value of the assessed economic benefits. Establish the relationship between these. This is also covered in Section 7.
- examine market elasticities to determine the likely effect of increases in various forms of government taxation on the regional air transport services examined.. This is covered in Section 8.
- determine the potential loss of business and leisure traffic on the routes concerned and establish the likely impact on airport and airline profitability to provide a guide to the continued viability of some of the air services. This is also covered in Section 8.

- produce and quantify an assessment of the potential severity of climate change and analyse the implications of the assessment for air transport so far as this study is concerned. This is particularly relevant so far as the economies of the regions around the airports used in the study, are concerned. This is covered in Section 11.
- determine the possible impact on the regional economies around LCY and NQY, of the potential loss of business and leisure traffic on their air services. This is given in Section 11.
- draw conclusions. These are given in Section 12.

The report is arranged in five parts:

i. I Introduction (Sections 1 – 2)
ii. II The Environmental and Air Transport Cases (Sections 3 – 5)
iii. III Research Analysis and Evaluation (Sections 6 – 11)
iv. IV Summary and Conclusions (Section 12)
v. V Appendices (A – O)

The structure of the report initially examines the environmental aspects involved, particularly focussing on the contribution of air transport to global warming through the emission of greenhouse gasses. This is necessary in order to understand the problem of aircraft emissions. Consideration is given to the various reports on the amount of CO_2 produced by air transport annually and to the current views on the extent of aircraft emissions. This includes the contribution of vapour trails and the true value of overall radiative forcing. The status of various major studies and agreements are considered, including Kyoto, Bali, Copenhagen, IPCC (the United Nation's Intergovernmental Panel on Climate Change), the Stern Report, UK Committee on Climate Change and various papers by the UK Department for Transport and Oxford Economic Forecasting. The UK Government's position on emissions targets and its plans for increasing taxation to limit demand for air transport are then examined.

The shape and size of the UK air transport industry is described in order to understand the possible effects of reducing air transport services. This is followed by consideration of existing research work on the macro economic benefits of air transport for the UK economy. This leads to consideration of just how important air transport really is. If this is considered against a potential scenario of much of present day coastal areas being flooded by the end of this century, then clearly little else can be as important as trying to solve this problem. However, there are many other considerations. Can air transport be sustained and still radically reduce its carbon footprint? What are the effects on the community – commercially, socially, politically and economically of significantly reducing the demand for air transport? What are the effects on the community if the fall in demand leads to the reduction or cessation of the air services? Can some levels of air transport activity be justified on economic benefit grounds?

Regional and micro economic considerations are then introduced leading to the focus of the study on London City Airport and Newquay Cornwall Airport with details of the business, tourism and social travel markets and the airline operations and schedules. Details are given of the research survey carried out with airline passengers to develop qualitative "pictures" and quantified analyses of the economic benefits arising from the existence of the air services. Using annual traffic data for the routes studied, the survey results are extrapolated to produce annual assessments.

Calculation is then made of the total aircraft fuel burn for the year for the air services operated to and from the airports studied and the subsequent amounts of CO_2 produced. Consideration is given to the use of multipliers to reflect the full radiative forcing effect.

Using current and forecast market costs for CO_2 the relationship between the annual economic benefit arising from the operation of the air services on the routes studied and the cost of the CO_2 produced, is examined. How close is this relationship? Would economic benefit need to increase to match the CO_2 cost or conversely how much might CO_2 need to cost in order to match the level of economic benefit?

Using the research survey responses, consideration is given to the demand elasticity of the different market segments identified in the surveys. This is then applied to the possible impact of further taxation on airline traffic volumes, service frequency and service viability. The term "taxation" has been used in this study to cover both the

Air Passenger Duty tax and the Emissions Trading Scheme costs. If such taxation is being introduced or increased in an attempt to limit or reduce market demand for air services, then would such a government policy be effective? If so what might the corresponding effect be on the regional economies studied and on the air transport companies involved?

The final section of the study report presents a summary of each section and the conclusions which seek to answer the initial hypothesis.

SECTION 2

THE METHODOLOGY APPLIED

SUMMARY STATEMENT

The methodology applied to prove or disprove the hypothesis follows logically through each stage of the research and covers:

- Determination of the economic benefits arising from the operation of air services from/to London City Airport (LCY) and Newquay Cornwall Airport (NQY)
- Calculation of a socio-political factor for NQY as an additional benefit. This was not found to be relevant for LCY
- Calculation of the amount of CO_2 created from the operation of the air services from/to LCY and NQY
- Calculation of the relationship between the economic benefit and the amount of CO_2 created, as a result of the operation of the air services from/to LCY and NQY
- Determination of the average fares appropriate to the routes studied from LCY and NQY
- Calculation of the possible level of air fares increases arising from changes to the UK Air Passenger Duty (APD) and to the introduction of the EU Emissions Trading Scheme (ETS) on routes from/to LCY and NQY
- Use of Demand Elasticity co-efficients to enable calculation of the possible impact on airline traffic of the fares increases arising from the APD increases and from the implementation of ETS
- Use of Airline Operating Ratios to determine the possible effect on airline actions, revenues, costs and results, of traffic decline due to the fares increases arising from APD increases and from the implementation of ETS
- Assessment for study purposes only, of the possible severity of climate change facing the Earth.

- Calculation and assessment of the possible effect on regional economies of the fares increases arising from the APD increases and from ETS

The methodology used for each of these is described below. In order to provide a logical flow through the report some of the details following are repeated at the point in the report where they are relevant.

Detailed calculations and results for some of the points described below are provided in the Appendices.

METHODOLOGY DESCRIPTIONS

1 Determination of the regional economic benefits arising from the operation of air services from/to LCY and NQY

Determination of the economic benefit arising from the operation of air services from/to LCY and NQY has been achieved by:

- Collecting data covering the number of employees in each work category/grade. These were obtained from the airport companies and from other employers at each airport
- Collecting data covering salary levels for each grade, again obtained from the airport companies and from other employers at each airport. The financial benefit from direct employment was then calculated
- Use of multipliers taken from other relevant studies (including Oxford Economic Forecasting) which enabled calculation of the level of financial benefit from indirect (multiplier of 0.89 applied) and induced (0.25 applied) employment.
- Collecting data on the number of passengers travelling from/to the two airports in full year 2008 (completed after the end of the year)
- Carrying out a passenger survey with interviews at each airport using a detailed questionnaire. This formed a major part of the research work enabling a number of points to be established. These included for example, the split of passenger traffic between business and leisure/vfr

(Visiting Friends and Relatives) which was subsequently verified by other studies

- Using the survey analyses to determine the catalytic benefit to the region from business travellers' activities when travelling from/to each airport. This involved questions to ascertain the time saved by use of air travel rather than surface travel and the stated value of that time saved. To obtain the latter, respondents were shown a card with a range of money values and asked to choose which one best matched their company daily call-out rate or their salary plus expenses per day. With this method almost all respondents were willing to answer these questions. The number of passengers travelling on business in 2008 was then multiplied by the average time saved and this was multiplied by the weighted average value per day to obtain an estimated yearly benefit. The result is termed "BATV – Business Air Travel Value" in this report.
- Using the survey analyses to establish the local expenditure made by inbound passengers during their stay. Separate assessments were made for business and leisure/vfr travellers. Respondents were shown a card with a range of money values and asked to choose which one best matched their expenditure. The number of passengers travelling inbound (that is, originating elsewhere) to each airport on business and leisure/vfr categories in 2008 was then multiplied by the weighted average expenditure for each category to obtain an estimated yearly benefit
- Calculating, in the case of Newquay Cornwall only, an additional benefit to reflect the socio-political problems arising from the relative isolation of Cornwall. (See Point 2)
- The money values established from all the points above were then summed to produce the total Economic Benefit for each airport.

2 Calculation of the socio-political factor for NQY as an additional benefit.

- It was claimed during the study, that many problems – social, economic and even political, would increase significantly if NQY airport was closed. The key link was seen to be to London which, when travelling by road, needs a time allowance of up to 6 hours. The air route was described as Cornwall's umbilical cord providing vital links for the region for social, economic, medical etc reasons. An additional benefit was therefore calculated for NQY.

- However, it was evident that services to London alone would not be sufficient to support the infrastructure of the airport but without the London services it was likely that no air services would be available to/from the Newquay area.
- Therefore the socio-political benefit was derived by taking the number of all the passengers (2008) originating in Cornwall multiplied by the average one-way fare on the routes from NQY. This therefore represented, as an absolute minimum, the value of the routes in terms of the number of people in Cornwall wanting or needing to travel by air, primarily to London and able to afford the price of the air journey.

3 Calculation of the amount of CO_2 created from the operation of the air services from/to LCY and NQY

This was derived from the schedule of services operated by each airline from/to LCY and NQY in 2008, as follows:

- The sector distance in kilometres (kms) for each route was derived from the Great Circle distance (taken from the website Great Circle Mapper http://gc.kls2.com) plus an additional 10% in order to provide a realistic track distance
- As all the routes were shorthaul and many operated by turboprop aircraft, a straight-line formula was applied to calculate the sector and roundtrip fuel burn in kilograms (kgs). The formula was:
    - ((Constant A * Sector Distance) + Constant B) for the roundtrip. The constants were based on analyses of the specific aircraft operating and their performance data
    - The basic aircraft operating data, aircraft performance and fuel consumption data were obtained from either the operating airline or from the aircraft manufacturer.

- The formula used was developed by British Airways for fleet evaluation purposes

- The fuel burn for each one-way route and aircraft type was then converted into tonnes and multiplied by 3.151 (the number of tonnes of CO_2 created from burning one tonne of kerosene) and multiplied by two, to produce the amount of CO_2 created for each roundtrip service. Given the short distances involved doubling the one-way to obtain the roundtrip amount of CO_2 was seen to be acceptable. This was then multiplied by the number of frequencies in each season in 2008 (i.e. Jan-Mar: 13 weeks/ Apr-Oct: 30 weeks/ Nov-Dec: 9 weeks) to produce the total amount of CO_2 created on each route. All routes were then summed.
- The UN IPCC work and other studies - although not supported by all scientists, suggest that aircraft generate more global warming impact because emissions are produced at altitude and because aircraft produce additional greenhouse gasses. In order to reflect the full radiative forcing level of aircraft emissions, an examination of various studies was used which showed that the suggested multipliers to incorporate this, ranged from 1.1 to 4.0. The most commonly quoted multiplier was found to be 2.7. This was therefore used in this study and applied to the route totals of CO_2 and to the summation in order to provide an additional assessment of the impact of air services from and to LCY and NQY. However, it should be noted that the application of a multiplier does not form part of the EU Emissions Trading Scheme. It is therefore accepted that applying a multiplier to this study is to the disadvantage of air transport.

4 Calculation of the relationship between the economic benefit and the amount, in money terms, of CO_2 created as a result of the operation of the air services from/to LCY and NQY

In order to calculate the relationship between the benefit and the perceived cost of CO_2 the following steps were applied:

- The economic benefit was already calculated in financial terms for each airport (points 1and 2 above)

- The amount of CO_2 created by the air services from/to LCY and NQY was already calculated (point 3 above)
- The cost of CO_2 was obtained through examination of current and forecast prices per tonne. These varied considerably, for example, current (2009/10), carbon market rates were around £13/tonne, whereas the Stern Report used £57 while DfT used $24.7. Because of the many variations in both current and forecast prices, two cost levels were used for this study - £25 and £57 per tonne, both representative of possible future levels. The cost of the CO_2 created by the operations at each airport was therefore calculated using these two forecast levels – £25 and £57 per tonne. The resulting costs were also multiplied by 2.7 to allow for the full radiative forcing effect
- The absolute money values of the economic benefit and the cost of CO_2 were then compared and calculation made of the price that CO_2 would need to be in order to match the economic benefit. The 2.7 multiplier was also applied to this calculation.
- An Environmental Ratio (ER) was established by dividing the economic benefit by the CO_2 cost. Criteria were set out to aid assessment of the ratio in order to establish the airport's environmental position.
- A number of Sensitivity Tests were applied.

5 Determination of the average fares appropriate to the routes studied from LCY and NQY

- Simple averages of the fares on a representative range of routes were used to give separate fares for business and economy classes for both airports.
- Fares were further categorised into those for routes less than, and those for more than, 500kms

6 Calculation of the possible level of air fares increases arising from changes to the UK Air Passenger Duty (APD) and to the introduction of the EU Emissions Trading Scheme (ETS) on routes from/to LCY and NQY

The APD increases are well documented and are described in the study but the possible cost per passenger for the ETS costs remains very uncertain and hence a range of possible costs has been used. The following steps were applied:

- It was assumed that the cost of the ETS would be passed on to customers in terms of a "per passenger charge".
- Analyses of various studies and reports were used to establish the possible "Lowest likely" and the "Highest likely" ETS charge per passenger. These were based on EC reports, DfT papers, Budapest Conference papers and a recent Merrill Lynch report. This range of costs was added to the increases in APD to give the possible total increase in fares. This excluded any airline administrative costs. The range of ETS +APD costs, for example for shorthaul economy fares, extended from £4.80 to £102.
- Because of this wide range, a number of possible levels of fares increases were applied in the research carried out to assess the impact on demand. These levels were £10, £20, £50 and £80
- However, in assessing the percentage increase that each of these increases represents, it was necessary to take general cost inflation into account since previous studies by the author had found that relatively small increases in air fares which were in line with inflation levels, were generally seen to be acceptable by the travelling public.
- In order to take account of inflation, the 2008 RPI level of 1.3% was considered but as this included some abnormal elements (such as the low mortgage interest rates) which exerted a strong downward effect, an "artificial" level of twice RPI, that is 2.6%, was seen to be more realistic. This level was subtracted from each of the fares increase percentage figures to provide an adjusted increase. These adjusted increases were then used for the elasticity calculations.

7 Use of Demand Elasticity co-efficients to enable calculation of the possible impact on airline traffic of the fares increases arising from the APD increases and from the implementation of ETS.

In order to determine the possible impact of the fares increases, the following steps were applied:

- Use was made of the passenger survey responses to obtain demand elasticity data in response to price changes. Respondents were asked questions that sought their reactions to fares increases. This led to different co-efficients for each airport and also different co-efficients for business and leisure/vfr passengers. The results were tested against a number of other studies on airline passenger demand elasticity and were found to be entirely representative
- The next step involved taking the average fares (point 5 above) and the possible increases from APD and ETS (point 6 above) as adjusted to reflect inflation, to assess the impact on traffic levels using the elasticity formula:

$$\text{Elasticity} = \frac{\text{\% change in Traffic}}{\text{\% change in Price}}$$

- The resulting matrix indicated the possible percentage decline in traffic for each airport – and separately for each market segment, that is business and leisure/vfr segments. The decline was calculated according to the different levels of fares increases - £10, £20, £50 and £80 (point 6 above) and according to route distance i.e. less than or more than 500kms.

8 Use of Airline Operating Ratios to determine the possible effect on airline actions, revenues, costs and results, of traffic decline due to the fares increases arising from APD increases and from the implementation of ETS

The effect on airline actions, revenues, costs and results was determined using Route Operating Ratios which were developed as follows.

- Operating Ratios (ORs) in index terms were used as a basis for the calculations i.e.

  $$\frac{\text{Route revenue}}{\text{Route costs}} \times 100$$

- ORs obviously vary by route and according to traffic mix. Hence two OR levels were used for the study based on information provided by airline staff with experience of the routes concerned. These were:
  - LCY routes 104 and 108
  - NQY routes 102 and 108

  These are conservative, with few routes higher but many routes lower. However, these levels were seen to be realistic for this work. For example, using index terms and the initial LCY OR of 104 means:

  $$\frac{\text{Revenue} = 100}{\text{Cost} = 96} \times 100 = 104$$

- The revenue decline is directly related to the traffic decline (point 7 above) but the loss of revenue has been calculated according to the proportions of business and leisure/vfr traffic from/to each airport and the percentage loss of traffic for each segment. For example, 60% of LCY passengers are travelling for business purposes and 40% for leisure or vfr reasons. The loss of traffic as calculated in point 7 above for a fares increase of £20 on a route less than 500km, is -0.6% for business travellers and -11.8% for leisure/vfr passengers. These are then weighted to give a weighted loss of revenue for the LCY routes of less than 500km of -5.0%
- The first step in re-calculating ORs that reflect the loss of revenue from fares increases due to APD and ETS can then be taken. Using the OR calculation above:

  $$\frac{\text{Revenue} = 95 \text{ (i.e. } 100 - 5.0)}{\text{Cost} = 96} \times 100 = \text{OR } 99.0$$

  The resulting ORs for this stage of the calculation, vary according to less than or more than, 500kms and also according to the range of the fares increases.

- However, airlines will respond to the traffic loss in order to avoid the route losing money, by offering promotional and hence lower, fares and by reducing costs. Discounting fares reduces yield which may mean less revenue. However, if the discounting is effective then more sales will result to balance out the lower yield.
- This may or may not be productive and therefore this study has focussed on the second step in re-calculating the ORs, which considers possible reductions in route costs. The following rules have been used, based on the proportions of Direct, Indirect and Fixed costs appropriate for shorthaul airline operations.
  - Where traffic loss reduces passenger load factors to around 60% but the service frequency is maintained, a small decrease in route total costs is assumed to arise. This is simply due to the lower number of passengers. The decrease applied, based on discussions with airline managers, is 5%
  - Where service frequency cannot be maintained and a limited reduction takes place, route total costs are reduced by two-thirds of the percentage reduction in frequency. For example, if frequency is reduced from daily to 5 services per week (29%), the cost reduction is 66.67% of 29% = 19%
  - Where service frequency is radically affected and services are reduced by half or more, the cost reduction is 75% of the percentage frequency reduction

The resulting ORs therefore take into account both revenue decline and cost reductions, and vary according to less than or more than, 500kms and also according to the range of the fares increases.

9 Assessment for study purposes only, of the possible severity of climate change facing the Earth.

Considerable uncertainty continues to surround the topic of "climate change" with many reputable scientists advancing conflicting views, theories and solutions. Making some assessment of the possible severity of climate change was found to be necessary for this study since it became clear that the economic benefits of air transport far exceeded the perceived cost of CO_2 emissions. However, to then suggest that air travel should not be "priced out" would be unrealistic if the possible severity of climate change was such that life as we know it today would become impossible. Clearly in such circumstances air transport, like everything else, would have to accept radical change or even largely cease.

- A "Climate Change Severity Scale" – CCSS was developed from 0 (representing climate change is not happening) to 10 (the world as we know it will come to an end with wars, food and resource shortages, mass migration and economic hyperdeflation). This was sent out as a **straw poll** in order to gauge current opinions and around sixty of the survey forms were returned. A straw poll is not based on random population selection and therefore cannot be described as fully representative. It is however, adequate for the purposes of this study.

- The assessment result would be categorised into three levels as follows:
  a. If the resulting opinion indicated a scale level of 4 or less i.e. situation not serious or
  b. If the resulting opinion indicated a scale level of 5 to 7.5 i.e. the problem is real, serious, but can be solved without changing life as we know it or
  c. If the resulting opinion indicated a scale level of 8 to 10 i.e. the world as we know it will change drastically

- If the resulting opinion indicated either of the first two levels given above, then a case can be made for arguing that the economic benefits of air transport require special consideration. If the resulting opinion indicated the third level above then in spite of the economic benefits, air transport would need to accept radical change – as would all business activities.

10 Assessment of the economic implications of the possible impact on regional GDP levels arising from the fares increases from APD increases and from ETS

- The methodology as set out in point 8, was used to determine the level of possible reduction of air services from/to LCY and NQY arising from the fares increases from APD increases and from ETS
- Estimates were then made of the potential reductions in the regional GDP levels for Cornwall and East London based on the possible reduction in air services. Note that both airports are in deprived areas with Cornwall receiving EU support aid.
- The Stern report suggested that economies would experience some downturn due to the necessary measures taken to reduce CO_2 emissions. Assuming that this is correct it would be likely to lead to deflation which in turn would lead to government action to counteract the position
- The Climate Change Severity Scale straw poll results (described in point 9) were then used to help put the conclusions of the impact of the fares increases on the regional economies into perspective.

PART II

THE ENVIRONMENTAL AND AIR TRANSPORT CASES

Section 3 The Environmental Background and Concerns

Section 4 The Air Transport Case and Position

Section 5 Consideration of the Macro-Economic Benefits of Air Transport Services

SECTION 3

THE ENVIRONMENTAL BACKGROUND AND CONCERNS

GLOBAL WARMING AND GREENHOUSE GASSES

Environmentalists are concerned that the global climate is changing with serious consequences. What is "global warming"? One definition states:

> *"Global warming is the increase in the average temperature of Earth's near-surface air and oceans since the mid-20th century and its projected continuation. Global surface temperature increased 0.74^{0}C between the start and the end of the 20th century. The Intergovernmental Panel on Climate Change (IPCC) concludes that most of the observed temperature increase was very likely caused by increasing concentrations of greenhouse gasses resulting from human activity such as fossil fuel burning and deforestation."*[1] *

It is estimated that some 26 billion tonnes of CO_2 are currently produced each year[2] – and this is claimed to be mainly due to human activities. At the same time, we are removing the planet's forests at an alarming rate while increasing temperatures are beginning to thaw the Russian tundra, potentially releasing millions of tonnes of methane, seriously worsening global warming. All activities leading to yet more Greenhouse Gasses (GHGs) are heavily criticised by the media and by some governments. This includes air transport which has been widely accused of being the cause now and even more in the future, of a lot of the world's CO_2. The Bishop of London in a newspaper interview [3] suggested that air travel was "a symptom of sin".

The problem is stated to be serious; in a recent press interview Professor Stephen Hawking [4] said that more resources should be put into developing our space exploration capability, because he felt that the planet as we know it now, could not be sustained for much more than another hundred years.

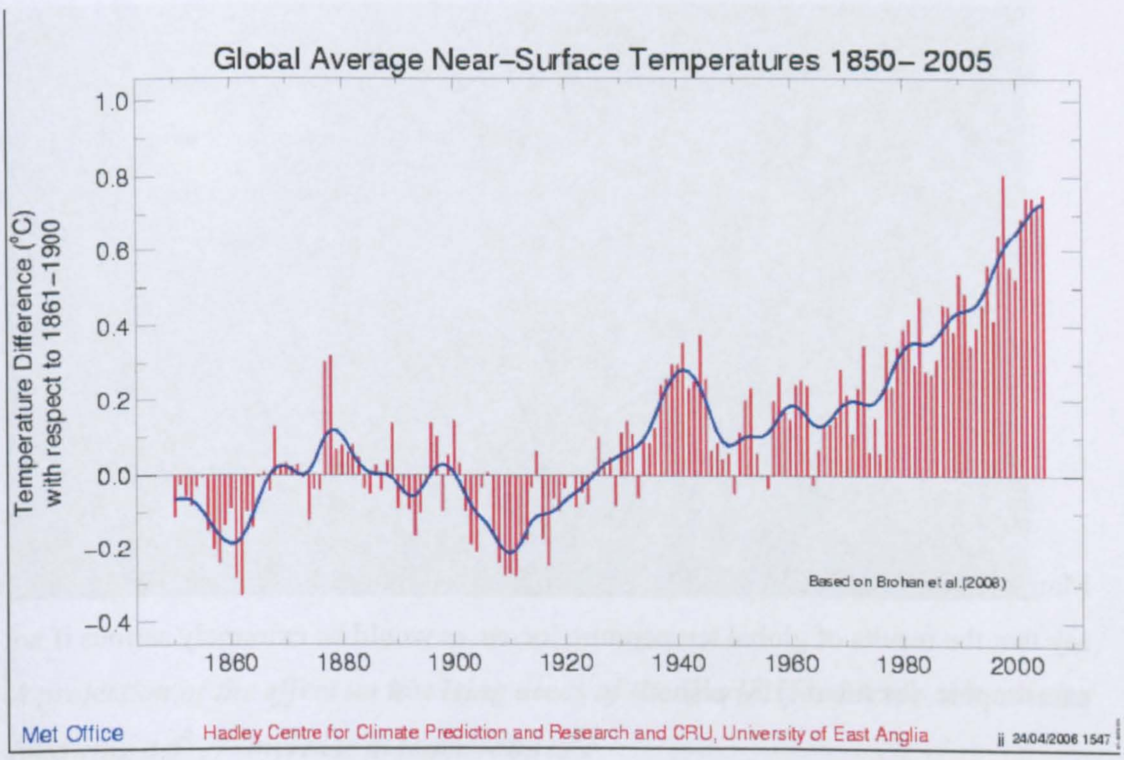
**** All references are listed at the end of each section***

So what are the real facts behind the media hype? Is air transport really responsible for a lot of the world's annual CO_2 production? If it is responsible, what action is being taken to address the situation?

Background

There is clear evidence that the temperature of our planet has increased over the past two centuries and it appears to be continuing to do so. Diagram 3-1 below [5] sets out the recent historical trend over the past one hundred and fifty years. Such trends and subsequent projections have given rise to environmental movements across the world urging politicians and citizens to take action to reverse the rising temperature trend. And yet, there is ample evidence that the planet has experienced hot periods many times before during its history, particularly during the Mesozoic Period (540-240 million years ago). The difference now is that human beings dominate the earth and the anthropogenic effect is therefore widely considered to be the cause of this rise in temperature.

Diagram 3-1: **Global Average Temperatures 1850-2005**



"Planet could be over in 50 years" screamed a national newspaper headline [6] claiming that politicians were not doing enough to persuade people in large-scale polluting countries to change their ways. The response from some has simply been to suggest that a relatively small increase in temperature might not be unwelcome. However, this point cannot be taken seriously since even relatively small increases could, it is claimed, have serious repercussions which could be catastrophic. Not necessarily catastrophic for the planet that is, but for those on it. Some of the projections suggested are shown in Table 3-1 [7]. Similar projections are given in the Stern Report[29] commissioned by the UK Government to examine the economics of climate change.

Table 3-1: **Possible Effects of Global Warming**

An increase in global temperatures of degrees Centigrade	*Effect*
1	*Ice caps would melt, particularly at the North Pole with a consequent rise in sea levels*
2	*More extreme weather would occur: hurricanes, hot and cold spells, drought and flooding*
3	*The increasing rise in sea level would cause loss of low lying areas leading to mass movement of people to higher ground*
4	*Serious crop failures would occur leading to food shortages and starvation in many parts of the world. Many animal species would become extinct.*

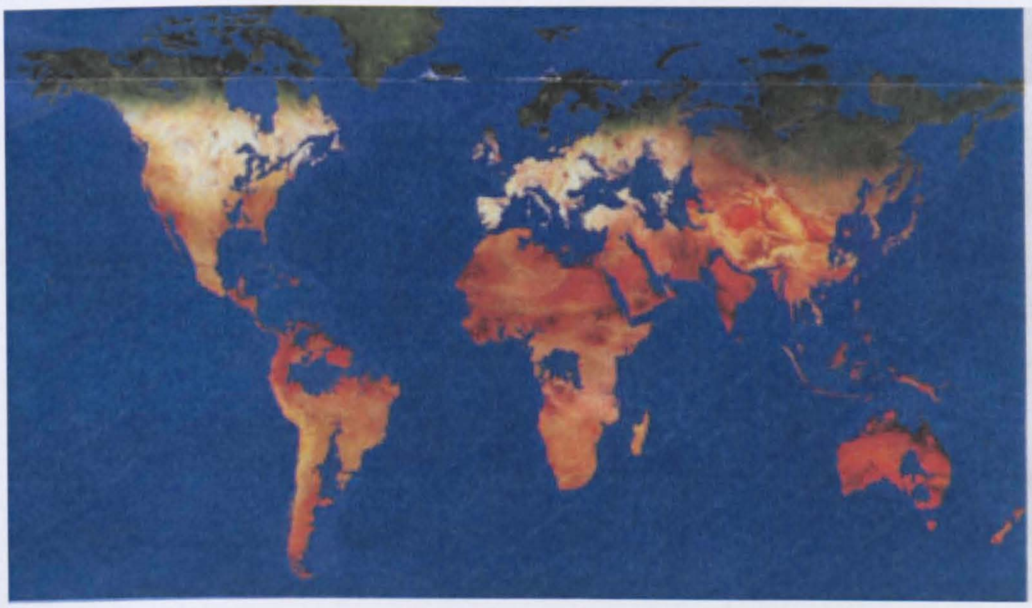
Many authors claim even more dire consequences although it is probably sufficient to say that the results of global temperature increases would be extremely serious if not catastrophic, for life on this planet.

Increasing understanding of the complex issues involved suggests that parts of our food chain could be under threat. The Monaco Declaration[8] states that absorption by our oceans of increased amounts of CO_2 is leading to a serious rise in the acidity levels that may threaten the survival of coral reefs, shellfish and marine food generally.

One forecast of the serious results of global warming is given in Diagram 3-2 below[9] which shows what the world might be like if sea levels were to rise in the wake of a temperature increase of more than five degrees sometime up to 2100. While this amount is probably at the extreme end it is clear that if this were to happen, many parts of the World would be lost including many coastal areas which currently support large populations. One calculation based on similar lines and quoted in the BBC's Focus magazine[10] suggests that if the icecaps at both north and south poles were to melt then global sea levels would rise by about 68 metres.

Another view is given by James Lovelock[11] who believes that we are already too late to solve the global warming problem and suggests "Our goal now is to survive and to live in a way that gives evolution beyond us the best chance."

Diagram 3-2: **The Effect of Global Warming by 2100**



A projection of the effect on low lying areas of the World, if sea levels were to rise following a 5^0 -7^0 increase in temperatures[9].

Conflicting Views

However, the general public is faced with conflicting views often widely stated in media reports. For example, a US academic Richard Lindzen Professor of Atmospheric Sciences at Massachusetts Institute of Technology states[12] that "What we see is that the very foundation of the issue of global warming is wrong." In his evidence to support this he accepts that "... CO_2 is increasing, but that that does not constitute climate change per se."

On the other hand one media commentator[13] M McCarthy of the Independent Newspaper, suggests that climate change will be so serious that wars and mass migration of people will occur as low lying areas become flooded by rising sea levels and other areas become increasingly desertified. He also suggests that mankind has caused the problem and that apart from inevitable human suffering 10% of animal species are at risk of extinction for every 1^0C rise in the global mean temperature.

An American futurologist, Paul Saffo[14] who is sceptical of many proposed solutions rather than of the problem, likened climate change to a battle between "Druids" who wanted to turn the clock back and force mankind to significantly reduce the quality of life and "Engineers" who could solve the problem given enough resources.

An English court[15] ruled in 2009 that "Environmentalism" and belief in man-made climate change constituted beliefs comparable to religious and philosophical beliefs. The UK Institute of Civil Engineers – ICE produced a report[16] in 2009 suggesting that air travel will reduce by half over the next thirty years as it becomes socially unacceptable due to environmental considerations.

What are the causes of Global Warming?

However, the trend of increasing temperatures and the seriousness of the potential consequences are generally accepted by scientists across the world. But while the anthropogenic effect is accepted as the cause by the majority of scientists, there remain other views. This point may be relevant to this study and therefore this aspect is briefly covered.

The majority view accepts evidence that the amount of GHGs, in Earth's atmosphere has increased significantly over the past two hundred years.

The principal GHGs and their concentration in terms of parts per million – ppm, (the number in every million molecules in the air) are given in Table 3-2 below[17]:

Table 3-2: **The principal Greenhouse Gasses**

GHG	% OF TOTAL	CONCENTRATION (ppm)
Carbon dioxide – CO_2	53	380.00
Methane – CH_4	17	1.80
Ozone (tropospheric) - O_3	13	0.03
Nitrous Oxide - NOx	12	0.30
Chlorofluorocarbons - CFC	5	1.00
Water Vapour contrails	These vary with altitude, humidity and temperature levels.	

Source: *Various including IPCC Data Distribution Centre*

The Earth is warmed by the sun which in turn emits infrared radiation back into space allowing the planet to cool. However, the more cloud and GHGs in the atmosphere, the less the radiation escaping into space and the less the planet is able to cool. It is therefore the level of GHGs and their growth which are seen to be the primary cause of global warming.

The growth of CO_2, the main GHG, is illustrated [18] in Diagram 3-3 below.

Diagram 3-3: **Emissions of CO_2 from Fossil Fuel burning 1850-2000**

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This dramatically shows that the level of CO_2 has increased enormously since the middle of the nineteenth century which is generally regarded as the period when the Industrial Revolution really began to grow. At that time mankind began intensive use of fossil fuels – initially coal, but later oil and natural gas, to increase the level of industrial activity. Burning these, which were originally created from the fossilisation process of vegetation, releases CO_2. One writer [19] states "The amount of greenhouse gas we (mankind) add (to the atmosphere annually) is staggering – in carbon dioxide alone, the total is about

26,000,000,000 metric tonnes per year,

which is more than four metric tonnes per person per year." If you add the other gasses categorised as GHGs, then the annual figure, which is known as Carbon Dioxide equivalent or CO_2e, is 34 billion tonnes[88].

The correlation between the increasing levels of CO_2 and the growth of industrialisation is evident and generally sufficient for the majority of the scientists involved. It is certainly accepted by the UN IPCC [20]. The correlation has then been turned into a projection to consider the various possibilities based upon the Kyoto plan to reduce emissions from a 1990 baseline. This is illustrated in Diagram 3-4 below[21] and clearly shows how serious the position would be if we fail to act now.

Diagram 3-4: **Forecast of CO_2 Emissions to 2100**

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This forecast rise in CO_2 concentration by 2100 if the World adopts a "business as usual" approach is clearly dramatic and emphasises the urgency of finding solutions to the global warming problem. Such an increased level would be likely to result in a rise in sea levels such as that depicted earlier. Whether it is air transport or energy production or any other CO_2 producer, it is clearly obvious that action needs to be taken by all polluters to drastically reduce CO_2 emissions. If any significant CO_2 polluter fails to act, it will obviously be critical for mankind.

However, some scientists are less certain that the cause of the increasing levels of CO_2 is anthropogenic. An Australian geologist[22] questions the anthropogenic cause, suggesting that carbon emissions in the atmosphere mainly come from volcanoes and that global warming was simply the result of solar cycles

Another theory [23] advanced by Danish scientist Henrik Svensmark suggests that the earth has warmed up many times in the past and that these occasions have coincided with periods of greater activity from the Sun. The normal magnetic activity arising from the Sun's solar flares protects the Earth from an excessive level of cosmic rays penetrating the Earth's atmosphere. The theory advanced suggests that less sunspot activity leads to more cosmic rays reaching Earth which in turn leads to the creation of more low level clouds which help to keep the planet cool. Conversely, more sunspot activity leads to less cosmic rays reaching Earth, less low cloud formation which allows a greater amount of higher cloud formation and therefore increased warming.

During the 20th century the Sun's sunspot activity and magnetic shield more than doubled in strength, reducing the level of cosmic ray penetration and hence the amount of lower clouds. Svensmark claims that such occurrence would account for a high proportion of the global warming currently being experienced. CERN (Centre for European Nuclear Research) will conduct an experiment in 2010 called "CLOUD"[24] that should prove or disprove the role of the Sun's magnetic shield in current global warming.

However, while accepting that the scientific evidence of the cause of climate change is not wholly proven, this research work is not concerned with the validity of the conflicting views. Nevertheless, one of the points advanced by supporters of the Cosmic Ray theory is that the efforts being made across the world to reduce the levels of GHGs are unlikely to affect global warming simply because the efforts are addressing the wrong cause. If this point was found to be true then all mankind's efforts to limit CO_2 growth through:

- use of alternative sources of energy – nuclear power, wind farms, solar power etc
- through the adoption of hybrid and electric cars
- through purchase of locally produced food to reduce distribution miles
- through stopping taking holidays away from home to reduce air travel

are unlikely to have much effect.

This argument would then suggest that the hypothesis forming the basis of this study is largely irrelevant. However, logical assessment of the anthropogenic cause of global warming versus the cause due to changes in sunspot and cosmic ray activity, suggests that this study in not irrelevant. If mankind accepted the latter cause and ceased action to reduce the levels of GHGs in the atmosphere on the grounds that such actions would have limited effect, then it might be too late if subsequently the anthropogenic cause was found to be correct. In other words, the argument advanced by environmentalists and some politicians must be correct; that is, that mankind cannot afford to wait and see – action has to be taken now. On these grounds this study is seen to be relevant.

Who produces all the additional carbon dioxide?

There is little argument about the contributors to the growing levels of the GHGs, especially CO_2, but the perceived extent to which each contributes, varies considerably. Table 3-3 below is derived from scientific reports, government papers and media reports concerning the global sources of CO_2.

Table 3-3: **Global sources of CO_2**

Global sources of CO_2	***Report Sources * Percentages quoted %***					
	1	***2***	***3***	***4***	***5***	***6***
Industry	33	16	42	19	16	14
Forestry	14	)	-	17	-	)
		) 24				) 35
Agriculture Land Use & Waste	18	)	4	16	24	)
Buildings	21	-	32	8	-	8
Transportation	14	18	22	13	18	14

Electricity generation & Heating	-	32	-	27	32	24
Other	-	10	-	-	10	5

* Report sources:

1: IEA World Energy Outlook 2004
2: Greener by Design study 2008
3: IPCC Report 2001
4: IPCC Working Group 2007
5. Rolls Royce RAeS Conference 2007
6. Stern Report on the Economics of Climate Change

Variations are clearly considerable. For example, the proportion of CO_2 produced by transportation varies from 13% to 22% - a variation of 70% over the lowest forecast. Note that these extremes are both from IPCC reports but in any case these serve to illustrate how much uncertainty exists over the science of climate change. Deforestation is one of the biggest contributors and yet the efforts to arrest this do not appear to be successful [25].

However, during one interview[26] that touched on the point of considerable uncertainty about this data, the comment was made that each industrial sector was working hard to reduce its emissions and therefore the precise proportions were not too important!

Significantly reducing deforestation is widely seen to be vital for helping the planet's natural absorption of CO_2. The booklet "Rain Forests – The Burning Issue" [27] produced by HRH Prince Charles has been distributed free of charge in an effort to increase public awareness of the seriousness of the problem.

CO_2 emission levels vary considerably by country with large producers influenced by population numbers. Table 3-4[28] shows selected countries to illustrate the wide variations across the world.

Table 3-4: **CO_2 Annual Emissions – selected countries**

	CO_2 total emissions (m tonnes)	CO_2 total emissions per head of population (m tonnes)
USA	1,600	5.3
China	1,600	1.2
W Europe	1,100	2.5
India	400	0.3
South Africa	115	2.4

Qatar	14	16.7

Source: BBC Focus magazine December 2009

The United States President, Barack Obama has accepted the need for the US to take action to reduce CO_2 emissions. In his State of the Union address in January 2010 the President emphasised that in helping to solve the problem he saw:

- many job opportunities within the US
- advanced research work that would aid other developments
- many new business start-up opportunities

Many therefore see substantial benefits arising from the measures necessary to reduce dependency on fossil fuels.

THE STATUS OF CURRENT AGREEMENTS AND MAJOR STUDIES

The Kyoto Protocol was signed in 1997 and entered into force internationally in 2005. More than 180 countries have ratified the Agreement. It requires developed countries to reduce GHG emissions to specific levels based upon 1990 levels. The Agreement provides for the use of a form of "cap and trade" system which develops a process by which developed countries can reduce their emissions towards their 1990 baseline level by 2012. Further reductions must then be achieved progressively to 2050. Different countries have adopted different approaches to achieve their targets with some, such as the EU, introducing a detailed Emissions Trading Scheme (ETS).

Under such schemes business companies in industries producing CO_2 are set limits on the amounts of CO_2 that they can produce each year. Such companies must then buy carbon credits if they exceed their quotas or buy credits through carbon offsetting schemes. They will generally be able to buy credits from other companies which have not reached their quotas. This can be done through carbon trading markets such as one established in London operated by Emissions Trading plc.

The UN Climate Change Conference held in Bali in December 2007 led to the Bali Roadmap. This is intended to provide long-term co-operative action to achieve global emissions reduction. Perhaps the most significant point about the Bali meeting was that the USA finally accepted some involvement and responsibility for emissions reduction.

The subject of global warming has generated enormous amounts of activity and also a large number of reports by government departments and many other interested parties and organisations. Some of these are described briefly in Appendix A. The IPCC continues to encourage research into contentious topics especially where scientific evidence is limited, including the understanding of the effect of aircraft contrails.

It is likely that the flow of papers from all sources will continue as each interested party seeks to gain acceptance of its theories and views. The amount of activity and the extreme positions often stated however, appear to reflect the lack of agreed scientific evidence on many aspects of global warming. For example, many statements and media reports would seem to reflect emotion and bias - both for and against the environmental view, rather than being scientifically based.

The UK Government commissioned a major review conducted by Lord Stern into the economics of climate change [29]. The report concluded that if global temperatures continued to rise, the cost to the world would amount to 5 – 20% of global GDP and that the basics of life – access to water, food production, health and the environment, would all be radically worsened. The report also concluded however, that if the world community took action now and adopted measures that would stabilise GHG concentrations, then the GDP cost could be reduced to around 1-2% and the threat to today's quality of life would be significantly reduced. While such concerted global action is difficult and faces enormous public and political opposition in some parts of the world, the precedent set by the successful global action to radically reduce the production of CFCs is impressive and shows what can be done. It was scientifically proved that CFCs were damaging the planet's protective ozone layer and this is now slowly rebuilding.

Various UK Government departments have produced papers covering the implications of implementing the Stern Report and relevant quotes are given further in this paper. Other interested parties have developed arguments to defend the position of various industries particularly those involved in GHG creation. Oxford Economic Forecasting (OEF) for example, has carried out extensive examination of the global economics of air transport in relation to global warming[30].

The United Nations Climate Change Summit held in Copenhagen in December 2009 was intended to extend the cap and trade approach to reducing GHG emissions. Little appeared to emerge from the meeting apart from promises but as one commentator suggested[31] the issue has become a trade-off topic involving global trade negotiations, exchange rates, reform of UN, reform of IMF and more. Attempts to create a global emissions trading scheme for airlines failed although ICAO is to consider the matter further and be responsible for taking action.

CONTRIBUTORS TO GLOBAL EMISSIONS

The UK's contribution

The emission of CO_2 and other GHGs into the atmosphere does not of course, recognise political boundaries. The UK Government estimates[32] that the amount of CO_2 produced as a result of human activities in the UK represents about 2% of the total global emissions. However, the Carbon Trust believes the figure to be 3% [33]. The difference in absolute terms is considerable which simply demonstrates the high degree of uncertainty that exists throughout the whole field.

The UK is fully committed to the Kyoto Treaty and to the EU's determination to meet its responsibilities for emissions' reductions[34]. The UK Government states[35] that GHG emissions from activity within the country's borders, fell by around 15% between 1990 and 2006. If emissions trading credits purchased through the EU ETS are included, the reduction in emissions amounts to 20%, considerably above the UK's Kyoto target of 12.5%. The UK's Climate Change Bill 2008 has the effect of legally committing the country to achieving CO_2 emission reductions over the 1990 level, of nearly 30% by 2020 and around 60% by 2050. The legislation provides the means of enforcement.

The Kyoto Treaty allows for the inclusion of domestic air transport in target setting for emission reductions and the UK's legislation embraces this. However, emissions from international air transport have not been included at any stage so far, simply because no agreement was reached at Kyoto or Bali on the methodology to be used to assign international air transport's emissions reductions to individual countries.

The European Union Position

However, the EU Parliament, Commission and the Council of Ministers have decided that all air transport should be included in emissions reduction targets and that it should be subject to ETS rules.[36] This would apply to all air services operating within and to and from the EU. This decision is leading to conflicts with other countries who dispute EU's right to enforce an ETS on foreign, i.e. non-EU, airlines [37]. The dissention was principally led by the US although the current administration appears to be more receptive to the objectives of ETS. While some non-EU airlines and/or their governments are likely to mount legal challenges to the EU plans, the EC does not expect such action to succeed, except perhaps to delay implementation[38]. The US Air Transport Association (ATA) with a consortium of US carriers commenced legal action against the EU at the end of 2009[39].

The EU's proposals mean that all airlines operating within, or to and from the EU must provide data based on their emissions in the period 2004-2006, to establish their 2012 level of CO_2 emissions (see Paragraph: EU Emissions Trading Scheme page 66). The scheme involves a "cap and trade" system covering some free allowances (85% of the baseline level) with an auction for the remainder. If airlines fail to meet their targets they must obtain credits from other companies with surplus credits, or alternatively by buying extra credits from carbon offsetting schemes. Such schemes must be EU authenticated.

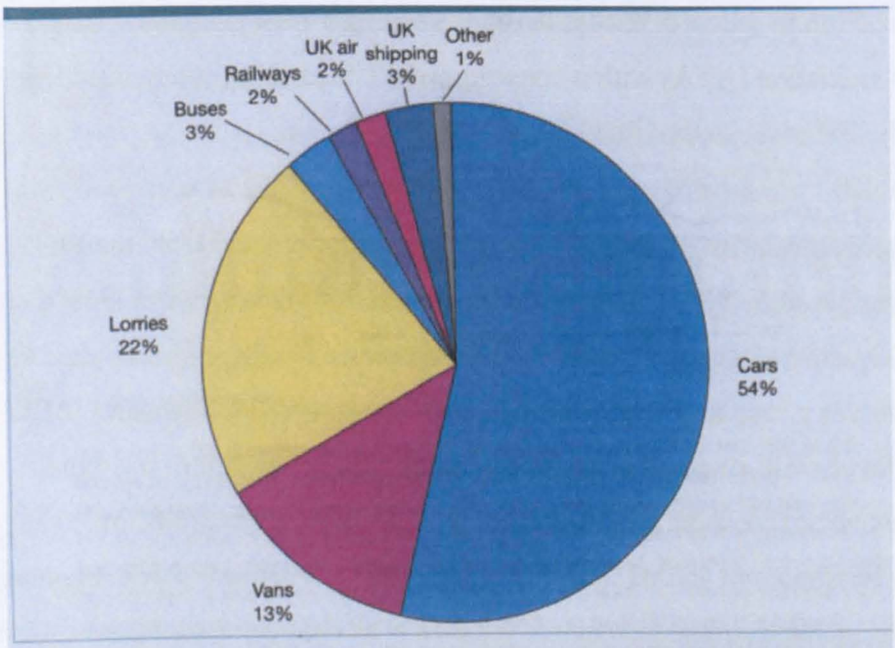
The permitted level of emissions produced by each airline is then progressively reduced until, for example, by 2020 perhaps only 30% of the 2012 historically based level is permitted free. Alternatively some are proposing that none should be permitted free by 2020. The air transport industry will need by then, to have developed engine technology and operational solutions that radically reduce aircraft emissions or airlines will have to continue to buy credits. The cost is likely to be high. The position concerning new carriers is still unclear. Some 3% of allowances are to be held for new start-up airlines although the lack of a historically based level may mean that they will need to purchase credits for 100% of their emissions. If this occurs then again it is likely to lead to legal challenges against the EU by other nations.

AIR TRANSPORT'S CO_2 EMISSIONS

Establishing the facts on emission levels

Air transport's contribution to global emissions of CO_2 is estimated to be between 2 – 3% of total emissions [40]. Estimates for the UK alone however, are more difficult to assess. Consideration of UK domestic transport gives a figure of 2% for aviation[41]

Diagram 3-5: **UK Domestic transport contributors to CO_2 emissions**



Source: *DfT Towards a Sustainable Transport System 2007*

This chart shows that 92% of UK domestic transport emissions are produced by road transport. Environmentalist groups claim that air transport produces far more CO_2 than a car but a better comparison may be between one airline in a year and the amount of CO_2 produced in a year by all road vehicles in a major city such as Leeds or Swindon. Conversely one writer[42] states that one flight from London to Dubai produces an amount of CO_2 equal to that produced by 18 average UK citizens in a year. Shipping is now seen to produce considerable amounts of CO_2. One source suggests that a typical cruise ship produces about the same amount of CO_2 as twelve thousand cars [43].

Rail transport has generally been regarded as environmentally efficient due to the high passenger capacity. However, this has been challenged by a study[44] for the UK DfT on the construction of a high speed rail link between London and Manchester. The study concluded that building and operating such rail links would lead to more CO_2 emissions than would be produced by the parallel air services. The greater efficiency of the train is offset by the construction emissions.

A further study was carried out by the Chartered Institute of Logistics and Transport[45] with a comparison of the CO_2 produced on London – Scotland routes by the Pendolino train and an Airbus A320. The study took into account the emissions involved in producing the power for the train services and showed that the A320 created about 40% less CO_2 per passenger kilometre than the train when the latter's power came from coal powered power stations but more than 50% more when the train's power came from a nuclear powered power station. When the current mix of UK's energy sources was considered the A320 produced about 10-15% more CO_2.

However, on the question of the size of air transport's UK emission level, other sources suggest that between 5 – 6.5%[46] of UK emissions are produced by air transport. This realistically takes into consideration all domestic and international airlines, both British and foreign, and this difference probably reflects the size of the UK air transport market. This is significant because of UK's:

- geographical position
- economic, financial and trade position in the world
- historic connections with the rest of the world
- tourist attractions

A sample of the number of scheduled airlines operating to and from a number of countries shown in Table 3-5 illustrates this point[47].

Table 3-5: **The number of scheduled airlines operating to a sample group of countries**

Germany	92	Sweden	42
Italy	78	Switzerland	64
Netherlands	70	UK	93
South Africa	38		

Source: Websites for Board of Airline Representatives (BAR) in each country.

With the total of international and domestic operations, forecasts made by the DfT [48] then suggest that growth in air transport demand will result in air transport being responsible for 10-12% of UK's total CO_2 emissions by 2030. The UK Committee on Climate Change in its Aviation Report[49] estimated that air transport would be responsible for 25% of UK's total emissions by 2060 although it accepted that it was possible that technological developments could improve the aviation position. However, the implication of such forecasts is that other polluters will significantly reduce their emissions but that air transport will continue to grow rapidly without succeeding to reduce its emissions.

Again on the other hand, a later report [50] suggests a higher current level of 6.3% leading to an estimate of 21% of UK's total emissions by 2050. The precise amount of CO_2 produced by air transport in the UK is rarely quoted, merely varying percentages. However, the Oxford Economic Forecasting report[51] in 2006 suggested that in 2000 all air transport in, to and from the UK, was responsible for the production of some 30 million tonnes of CO_2 out of a UK total estimated in that year to be 600 million. The UK Committee on Climate Change's Aviation Report[49] stated that air transport's CO_2 emissions in 2005 were 37.5 million tonnes – an increase of 5% per annum over the OEF 2000 level quoted above. This is roughly in line with air traffic growth in that period.

Other sources for example, Tyndall Centre for Climate Change Research [52] believe such forecasts to be considerably understated suggesting that as EU air passenger traffic has grown at around 6-7% per annum recently, EU air transport's emissions are therefore growing at 6% annually and are likely to increase by 25-60% between 2005 and 2012. It is clearly evident from the wide range that acceptable scientific evidence on such topics is sparse.

Aircraft emission facts

Aircraft emissions arise from the burning of kerosene. Aircraft require a high degree of oil refinement and use what is commercially known as Jet A-1 and Jet A (sold in the US).

However, initially the chemical process involved when kerosene is burnt is[53]:

$$2\ C_13H_{28} + 40\ O_2 = 26\ CO_2 + 28\ H_20$$

This means that burning one tonne of kerosene produces 3.172 tonnes of CO_2.

This changes slightly when the level of oil refinement to produce Jet A-1 or Jet A is considered. The standard value[20] used by airlines is 3.15 tonnes +/-0.01 of CO_2 per tonne of Jet A-1 burnt. After discussion this study has used 3.151 tonnes per tonne of Jet A-1 consumed.

The actual emissions of aircraft jet engines in normal operating conditions are[54]:

Table 3-6: **Aircraft Emissions**

	% of total emissions
▪ CO_2)	
▪ Water Vapour (H_2O) which in certain circumstances of temperature and altitude, produces contrails which may increase the formation of cirrus cloud)	8.0
▪ Nitric Oxide and Nitrogen Dioxide – collectively termed NOx. At ground level this worsens air quality around airports. At altitudes used by aircraft (up to approximately 40,000 feet) the emission of NOx leads to the formation of Ozone which at such heights acts as a GHG.	0.5
▪ Methane	0.1
▪ Soot and Sulphate particulates	0.1
▪ Normal atmospheric oxygen and nitrogen	91.3

Air Transport's total emissions

Climate scientists have determined that Earth's climate is influenced and changed by the amount of radiation received by the Earth and the amount of radiation released by the Earth and escaping into space. The resulting sum of positive and negative radiation is known as Radiative Forcing (RF) and can be measured to provide a Radiative Forcing Index (RFI). Greenhouse gasses provide a barrier which effectively reduces the amount of radiation escaping into space which in turn prevents the planet from cooling. As indicated in Table 3-6 aircraft produce GHG emissions but the effect of aircraft engine emissions is seen to be greater than simply arising from the amount of CO_2 emitted because the emissions are emitted directly into the stratosphere and because other GHGs are also emitted. The IPCC Report (1999)[55] estimated the total RF for air transport to be between 2 and 4 times greater than that from CO_2 alone. This would take into account both the altitude involved and the additional GHG emissions. However, while it is clearly important that the effects of air transport are properly assessed it is evident that much uncertainty exists.

The IPCC Aviation Group report[55] stated:

"Although the task of detecting climate change from all human activities is already difficult, detecting the aircraft-specific contribution to global climate change is not possible now and presents a serious challenge for the next century. Aircraft radiative forcing, like forcing from other individual sectors, is a small fraction of the whole anthropogenic climate forcing; about 4% today and by the year 2050 reaching 3-7%" ....(dependent upon different, stated scenarios).

A European Commission report, EC Trade-off Project[56] suggested an RFI or multiplier, of 2.0. The UK Department for Transport in its 2003 report [57] "Aviation and the Environment – using Economic Instruments" proposed a multiplier of 2.7 based on the earlier IPCC Aviation group Report and the 2002 Royal Commission report "The Environmental Effect of Civil Aircraft in Flight" [58]. However, the DfT's paper "Aviation emissions cost assessment 2008" [59] used a multiplier of 1.9 based on the most recent scientific evidence, although the report accepted the uncertainty involved and also considered a range of between 1 and 4. Clearly such a large range indicates the high degree of uncertainty involved in this aspect.

The multiplier level of 2.7 seems to be most widely quoted; consequently this figure has been used in this research in order to calculate air transport's total emissions arising from the air services operating to and from the airports used in this research. Sensitivity testing will be applied where relevant to any results, to reflect both higher and lower RFIs.

However, it is noted that the application of a multiplier does not yet form part of the EU Emissions Trading Scheme. It is therefore accepted that applying a multiplier to this study is to the disadvantage of air transport.

An immediate illustration of the significance of the use of this multiplier is as follows. Using the standard value formula quoted above and a multiplier of 2.7 suggests that burning one tonne of Jet A-1 fuel would in effect produce:

1 x 3.151 x 2.7 = 8.51 tonnes of GHG

The following table covering London-Newquay and London-Singapore, helps to put these figures into context to illustrate the size of the problem.

Table 3-7: **Aircraft Fuel burn and CO_2 Creation**

	LGW/STN–NQY -LGW/STN	LHR–SIN-LHR
Aircraft	B737-800/500	B747-400
Approx ow fuel - average tonnes	2.34	100.0
Flights per day - summer non-stop	2	6
Approx round-trip fuel per week- tonnes	65.5	8,400.0
CO_2 created per week - tonnes	206	26,500
CO_2 + multiplier 2.7 - tonnes per week	557	71,465

Source: Author

TAXATION SITUATION

Aircraft emissions can be classed in economic terms as an external cost which, it is argued, should be borne by the polluters – thus making the airlines internalise the cost. This can be done by taxation or by means of some other financial instrument.

In fact air travel has been subject to taxation for many years and from most countries across the World. Fifty years ago the tax was primarily charged to help governments to pay for airport, air traffic control and associated navigation services. Many or all of these organisations were, and many still are, owned by their governments. However, over time, the companies providing these services have been privatised in a number of countries and are no longer supported by the governments concerned. This applies to the UK. However, the tax, known as APD – Air Passenger Duty, on air travel has remained and the Government is frequently accused [60] of not using the revenue gained for the development of the air transport infrastructure. The tax has been frequently increased and it is now a legal requirement upon airlines that the taxes are included in their quoted air fares.

It is also accepted that air passengers have to pay additional charges and taxes to governments at the other end of the route. In the UK the airport companies also levy a charge – UK Passenger Service Charge (PSC) which varies by airport. In the case of London's Heathrow, operated by BAA the charge is £19.70 per passenger (2009) rising to £21.20 in 2010.

The UK Government had proposed that the APD should be replaced by a duty levied on each departing aircraft to be known as the "Aviation Duty". The intention, quoted in the Pre-Budget Report in 2007 [62], was to ensure "that aviation makes a greater contribution to covering its environmental costs while ensuring that a fair level of revenue continues to be raised by the sector in order to support public services." This plan was dropped in November 2008 following consultation, but instead the decision was taken to further increase APD. In 2010 the UK government has again proposed the introduction of a tax per plane. The current and future levels of APD [62] are given below:

Table 3-8: **UK Air Passenger Duty**

	Up to 2008	From: November 2009	November 2010

	Premium Classes (F/J)	Economy Class (Y)		F/J Classes	Y Class	F/J Classes	Y Class
	£	£	Distance from UK – miles	£	£	£	£
Europe	20	10	< 2,000	22	11	24	12
Longhaul	80	40	2,001 – 4,000	90	45	120	60
			4,001 – 6,000	110	50	150	75
			> 6,000	110	55	170	85

The increases for all classes for 2010 over 2008 are:

	%
Shorthaul routes	20.0
Longhaul to 4,000 miles	50.0
to 6,000 miles	87.5
> 6,000 miles	112.5

It is interesting to consider the annual value of APD and the following table reflects the total tax received[63] in 2008/09 and the APD charge at that time [64]. The passenger number breakdown between classes of travel is not regularly maintained so estimates have been made which are understood to provide realistic results.

Table 3-9: **Passenger Departures from the UK and Level\ of Taxes**

	APD £	Total tax £m
Passengers		
Est longhaul - Y	40	792
Est longhaul – F&J	80	345
Est EU – Y	10	579
Est EU – C	20	164
Total		£1,900 m

Source: UK Treasury Red Book data 2008; HM Revenue & Customs; interviews with airline managers.

In a recent report[65] the CAA estimated that the increased level of APD would produce an additional £1 billion per year. The International Air Transport Association – IATA, on behalf of all its members has condemned the planned increases in APD as "totally unfair"[66]. Singapore Airlines' UK General Manager told a reception for UK Members of Parliament that "the Government seemed bent on destroying Heathrow Airport as the hub of the World's airlines"[67].

In its review of APD, the UK Revenue & Customs Department ("Change to APD March 2009) estimated that some 0.4million tonnes of CO_2 would be saved following the planned APD increase. The review noted that other environmental benefits would also arise from reform of APD – lower NOx emissions, less noise and less congestion around airports, all due to fewer flights. A study carried out for the Airport Operators Association – AOA[68] suggested that the increases in APD alone would cause job losses in the wider economy which would significantly reduce Gross Value Added.

The UK Government considered imposing a tax on aviation fuel but international law based on Article 24 of the Chicago Convention of 1944[69], specifically prohibits such a tax on the grounds that the fuel is kept on board aircraft and consumed on international flights i.e. outside the airspace of an airline's country of registration. These terms have been further included in the many Air Services Agreements (also known as Bilateral Agreements) made by the UK with every other nation to control the operation of international services between the countries concerned. This point is considered further in Section 9.

DEPRESSING THE DEMAND FOR AIR TRANSPORT

It is reasonable to suggest, as many interested parties have,[70] that if air transport is to meet its environmental responsibilities then further expansion of air services should be limited. Legislation on such an objective would not be realistic or would be seen as highly contentious in countries that promote free trade, particularly with widely based shareholder ownership of many airlines. Consequently pricing is seen to be the right economic instrument[71] that should be used to achieve the objective. Pricing air fares is a commercial matter for the airlines concerned but taxation and the imposition of ETS are government regulatory matters. The UK Committee on Climate Change's Aviation Report[72] goes further and states that demand for air transport must be depressed. The report says "….deliberate policies to limit demand below its unconstrained level are therefore essential if the (UK) target is to be met."

Airlines claim[73] that the application of ETS to air transport will add a further significant cost for the airlines, so that together with the increased APD, the objective of depressing the demand for air transport services is likely to be met. Other European countries have also taken steps to limit air transport growth through new environmental taxes including Germany and the Netherlands although the latter was subsequently withdrawn.

Airlines faced with ETS costs and the increased APD, can either absorb the additional costs of the former or pass these on to their customers. Passengers will in any case pay the APD although airlines could reduce fares in compensation, especially in a competitive situation. However, few of the world's airlines appear to be highly profitable[74] (see Diagram 4-2 in Section 4) so it can be assumed that the additional costs will be mainly borne by the passengers. This is commensurate with government policy to restrict air transport growth by significantly increasing the cost of flying[48/77].

A small group of airlines and airport companies including Virgin Atlantic, British Airways, BAA and Air France-KLM set up Aviation Global Deal group[75] early in 2009 to urge that monies raised from any future global cap and trade schemes applicable to airlines be pumped back into initiatives to improve air transport's CO_2 emissions levels. Although this would seem to be a reasonable proposal it does not appear to have been accepted by any governments.

On the other hand there are some environmental lobby groups who do not believe that ETS is the right way forward anyway. The Friends of the Earth report[76] published in November 2009 called for ETS to be abolished as it was "unlikely to be effective and was financially dangerous".

However, the UK Committee on Climate Change's aviation report[77] is clear. Implementation of ETS plus APD increases are aimed at reducing air passenger growth to no more than 60% in the period from 2005 to 2050 – that is, an average of about 1.3% growth per annum. This report states that the position should be reviewed regularly and if the air transport industry succeeded in reducing emissions then the constraint on growth could be re-assessed. The industry is in fact forecasting growth of around 4-5% per annum for the next twenty years (See Section 4). Efforts to reduce or limit air passenger growth have legal and regulatory implications which are covered in Section 9.

The EU Emissions Trading Scheme

As mentioned earlier the EU ETS[78] will apply to all airlines flying within the EU and flying to and from the EU. It is based on CO_2 emissions and does not include any multipliers to cover the full radiative forcing aspects. Appendix B shows the current timescale for the implementation of the scheme to air transport. One EU-wide cap will be imposed based upon historical levels of emissions created in the 2004-2006 period. For 2012, the first full year, the cap will be set at 97% of this level. This will be reduced in 2013 to 95%. Individual airlines will be granted Aviation Allowances (AAs) based upon their level of Revenue Tonne Kilometre – RTK, production.

> ***RTKs are calculated from the number of passengers carried in weight terms, plus the weight of cargo carried, multiplied by the sector distances involved. The EC calculates the sector distance as Great Circle distance plus 95 kms.***

The approach used is that then 85% of their AAs will be granted free for existing airlines but the remaining 15% will be the subject of auctions which will be conducted by each EU member state. The proportion of the AAs subject to auctioning will be progressively reviewed by the EU – it is expected that the proportion will rise to 100% by 2020[79].

Airlines can buy EU credits from other airlines or from businesses with surplus credits, through the carbon exchange or they can purchase UN approved offset credits. However, over time the cost of carbon credits obtained through the carbon exchanges is expected to increase according to market demand conditions.

As stated ETS is to apply to all airlines that fly to, from or via EU and will be based on the RTKs produced by each airline, on the flights to, from or via EU. This presents a significant responsibility to the major EU carriers but also to the US carriers operating across the Atlantic. This has led to the decision by the US Air Transport Association of America – ATA[80] to file a suit against the EU. ATA is the US industry representation body and the filing is made on behalf of a number of US carriers including American Airlines, United Airlines and Continental Airlines. Their claim is that ETS violates the US – EU Air Services Agreement of 2007 and also the Kyoto Protocol.

For those airlines achieving cuts in their emissions through acquisition of newer, less polluting aircraft and by the adoption of more emissions-efficient operating procedures, it may be possible to avoid the need to buy credits. However, for some airlines the situation may be very different, even from the introduction of the scheme and it may prove extremely expensive[81]. In any case, as the level of free emissions is reduced over time all airlines will face a challenge, particularly as traffic growth forecasts (See Section 4) remain buoyant at present. So can airlines:

- continue to reduce CO_2 emissions through operational improvements by the airline itself and by airport and air traffic control organisations?
- plus aircraft and engine manufacturers, identify new technological solutions to reduce emissions?

A number of new initiatives that may improve the situation for aircraft and airlines are described in Section 4. However, for airlines with little success in reducing their emissions or for any new airlines, the position may be very different.

Calculating the cost of ETS

Partly because auctions are involved, precise costs for an airline – for acquiring credits and administering the scheme - are not yet fully established. A recent study by Merrill Lynch[79] found that the ETS scheme might cost all the airlines involved around $2.6 billion or €3bn. The study concluded that the cost per passenger for operations within the EU would be €1.5 for a LCC and €3.5 for a legacy carrier. These figures were based on relatively low auction costs but IATA in its press releases[81] has made similar estimates of the likely ***total*** cost for the industry. However, it is evident that the estimated costs continue to vary widely. Point Carbon[82] suggested that airlines collectively would face a €1bn carbon trading cost from introduction of ETS in 2012 with EU and US airlines facing the largest bill.

On the other hand a crude calculation for the industry as a whole can be made as follows:

Cost of ETS scheme	*Approx no. of passengers carried by airlines that operate to/from and within Europe*
€3bn	750m

= €4.00 (£3.55) per passenger

Source: Author

This suggests that the per-passenger charge – if it is charged to each passenger - might not be high.

A Journal of Air Transport Management paper[83] concluded that ETS would increase Lufthansa's cost by less that 1% but that a low cost carrier (LCC) such as Ryanair would experience a cost increase of about 3%. The point was made that this could adversely affect competition.

The widespread variation in ETS cost is emphasised by the estimate given by the UK Committee on Climate Change[84] that the CO_2 cost per tonne would be likely to rise to £200 by 2050. However, compounding the Stern Report figure of £57 from today for forty years produces a price close to £200. It has to be accepted that if this Committee's recommended policy is for air transport growth to be limited to about 1.3% per annum and that ETS plus APD are the instruments to achieve this, then the policy is not likely to be successful unless the cost to airlines and hence to passengers is high enough to depress demand. Consideration is given in Section 9 to possible scenarios if ETS plus APD are not found to be sufficient to depress passenger demand.

The following three tables and calculations provide illustrations of potential ETS costs.

1. The first table uses a cost per passenger based upon the marginal cost involved – that is, the cost of taking action to offset the CO_2 created by the air service. This has been estimated at UK£25 per passenger hour flown[85] (Budapest International Conference on Aviation Emissions: September 2008). The calculation that follows this table uses data from Table 3-7. The second table is based on the forecast cost per tonne of CO_2 given in the Stern report[86]

and the third is based on the approximate cost per passenger put forward in the Merrill Lynch[79] report.

Table 3-10: **Example of potential cost of airline initial ETS credit purchases based on marginal trading cost***

(For international journeys. Calculation covers the round trip – see note below)

Level of carbon credits needed by the operating airline**	100 Seat Aircraft (full) on a 2 hour flight = 4 hr round trip at £25 /hr = £100/pax (xx)		350 Seat Aircraft (full) on a 10 hour flight = 20 hr round trip at £25 /hr = £500/pax (xx)	
	Total ETS cost per round trip+ £	ETS Cost per pax rnd trip+ £	Total ETS cost per round trip+ £	ETS Cost per pax rnd trip+ £
15% of a/c pax	1,500	15.00	26,250	75.00
50% of a/c pax	5,000	50.00	87,500	250.00
100% of a/c pax	10,000	100.00	175,000	500.00

* Using the estimated initial marginal trading rate of £25 per passenger hour of flight[85]. This rate is likely to increase considerably over time.

(xx) Calculation is 100 passengers x 4 x25 = 10,000 divided by the proportion of the passengers for whom credits will be needed. The same calculation applies to the second example.

\+ ETS rules for all journeys are applied for the departing flight only. However, for the above calculation it is assumed that the destination country would also be levying a similar charge.

** Allowances are based on RTKs but for ease of illustration the calculations have been based on the number of passengers

Source: Author

2. Using figures based on data from Table 3-7 the amount of CO_2 produced for a four hour round trip flight with a shorthaul jet aircraft would be approximately 29.5 tonnes.

(The calculation is: 1hr one-way fuel = 2.34 tonnes x 4 for 4hr round trip = 9.36 x 3.151 = 29.5 tonnes of CO_2)

With 100 passengers on board (125 seats at 80% passenger load factor) CO_2 creation would be 0.295 tonnes per passenger. If the airline had to buy carbon credits for say, 15% of the passengers (i.e. it had 85% free allowances) at a cost of £57 per tonne this would cost £252 or £2.52 per passenger.

3. The second table - Table 3-11 below, uses this same method of calculation to show the cost using a forecast cost per tonne of CO_2 taken from the Stern Report[86] with different credit required levels and routes.

Table 3-11: **Example of potential cost of airline initial ETS credit purchases based on forecast cost of CO_2***
(For international journeys. Calculation covers the round trip – see note below)

Level of carbon credits needed by the operating airline**	100 Seat Aircraft (full) on a 2 hour flight = 4 hour round trip		350 Seat Aircraft (full) on a 10 hour flight = 20 hour round trip	
	Total cost	Cost per pax round trip + (xx)	Total cost	Cost per pax round trip + (xx)
	£	£	£	£
15% of a/c pax	252	2.52	4,177	11.93
50% of a/c pax	841	8.41	13,922	39.78
100% of a/c pax	1,682	16.82	27,844	79.55

* Based on the Stern Report forecast of US$85 (£57) per tonne of CO_2
(xx) ***The calculation is 29.5 tonnes of CO_2 x £57 x the proportion of credits required. The same calculation applies to the second example.***
\+ ETS rules for all journeys are applied for the departing flight only. However, for the above calculation it is assumed that the destination country would also be levying a similar charge.
** Allowances are based on RTKs but for ease of illustration the calculations have been based on the number of passengers

Source: Author

4. The final table is based on the approximate cost per passenger put forward in the report by Merrill Lynch[79].

Table 3-12: **Example of potential cost of airline initial ETS credit purchases based on Merrill Lynch report+**
(For international journeys. Calculation covers the round trip – see note below)

Lo Cost Carrier Average Cost per pax round trip +	Legacy Carrier Average Cost per pax round trip +

£	£
2.80	6.40

\+ ETS rules for all journeys are applied for the departing flight only. However, for the above calculation it is assumed that the destination country would also be levying a similar charge.

Source: Author derived from Merrill Lynch Report[79]

Clearly the variation between the three tables is considerable but airlines claim[87] that the charges likely to arise from auctioning some of the credits may prove to be even higher. Airlines are also claiming[87] that the set-up and annual administration costs will be considerable and will need to be factored into the overall ETS costs.

The cost of APD plus ETS

Assuming that the full APD is paid by the airline customers, then the additional cost per passenger of this, plus the ETS charge will provide total airline fares increases that might depress demand. Demand elasticity for airline passengers is discussed in Section 8 of this paper.

Table 3-13 below provides examples of the total potential impact on fares of APD and ETS charges together.

Table 3-13: **Total potential impact of increased taxation on selected routes. (NOTE this excludes any airline administration costs)**

ROUTE AIR FARES	APD 2010	APD INCREASE OVER 2008	POSSIBLE ETS CHARGE	TOTAL INCREASED CHARGE	% INCREASE IN FARE DUE TO APD INCREASE & ETS
Columns i	ii	iii	iv	v (iii + iv)	v/i as %
£	£	£	£	£	%
LON-ROM					
a 48	12	+2	d 2.80	4.80	10.0
			e 100.00	102.00	112.5
b 744	12	+2	d 2.80	4.80	0.6
			e 100.00	102.00	13.7
c 866	24	+4	d 2.80	6.80	0.8
			e 100.00	104.00	12.0
LON-JER					
a 63	12	+2	d 2.80	4.80	7.6
			e 100.00	102.00	61.8
b 376	12	+2	d 2.80	4.80	1.3

			e 100.00	102.00	27.1
c 442	24	+4	d 2.80	6.80	1.5
			e 100.00	104.00	23.5
LHR-SIN					
a 340	75	+35	d 12.00	47.00	13.8
			e 500.00	535.00	57.4
b 728	75	+35	d 12.00	47.00	6.5
			e 500.00	535.00	73.5
c 3,138	150	+70	d 12.00	82.00	2.6
			e 500.00	582.00	18.2

* Fares are quoted as at Jan 2009 on airline web sites

a = Lowest fare available eg LCC
b = Fully flexible economy
c = Business Class

d = Lowest likely ETS charge per pax with minimum number of credits needed
e = Probably the highest ETS charge per pax likely with maximum number of credits needed

Source:a,b,c = Internet + DfT ; e = Merrill Lynch; f = Budapest Conference on Aviation Emissions

The percentage increase in relation to the relevant fare for these example routes therefore ranges from 0.6% to 112.5%. Although only limited examples have been used the resulting increases are entirely indicative of the changes likely to arise across all routes.

REFERENCES, NOTES AND SOURCES

1 Wikipedia definitions of Global Warming

2 Climate Change – Rough Guide: Robert Henson September 2006

3 Rt Rev Richard Chartres Bishop of London, interview in The Sunday Times July 2006

4 Interview with Prof Stephen Hawking quoted in the Straits Times, Singapore. October 2008

5 From Hadley Centre for Climate Prediction & Research: presentation at RAeS Conference – Aviation and the Environment: State of Play. October 2007

6 Article in Cyprus Mail October 2006

7 Six degrees – Our future on a hotter planet: Mark Lynas, Harper Collins March 2008.

8 Monaco Declaration from the Second International Symposium on the Oceans in a High CO_2 World: Monaco October 2008

9 Climate change – Special Report: Sunday Times December 2007

10 BBC Focus magazine December 2009

11 The Vanishing Face of Gaia – A final warning. James Lovelock published by Allen lane 2009

12 Deconstructing Global Warming Presentation by Professor Lindzen, Professor of Atmospheric Sciences MIT September 2009

13 Article in The Independent newspaper by M McCarthy, Environment Editor Jun 2009

14 Paul Saffo article in Sunday Times October 2009

15 UK Court ruling at Employment Appeals Tribunal, Appeals Court England and Wales November 2009

16 Institute of Civil Engineers report on environmental issues November 2009

17 Various including IPCC – United Nations Intergovernmental Panel on Climate Change Data Distribution Centre

18 From Hadley Centre for Climate Prediction & Research: presentation at RAeS Conference – Aviation and the Environment: State of Play. October 2006

19 Climate Change – Rough Guide: Robert Henson September 2006

20 IPCC – United Nations Intergovernmental Panel on Climate Change – Working Group Report "The Physical Science Basis" 2007

21 From Hadley Centre for Climate Prediction & Research: presentation at RAeS Conference – Aviation and the Environment: State of Play. October 2006

22 Newspaper report on research project Daily Telegraph November 2009

23 The Chilling Stars: Henrik Svensmark & Nigel Calder Icon Books 2008

24 BBC Focus magazine August 2009

25 Taken from observations by the author during travels in Indonesia, Malaysia and Brazil

26 Discussion with former Chief Scientist, Gillette Company May 2008

27 Rain Forests – The Burning Issue. HRH Prince Charles. Produced by the Prince's Rainforests Project 2009

28 BBC Focus magazine December 2009

29 Stern Report: The Economics of Climate Change. HM Treasury October 2006

30 The Economic contribution of the Aviation Industry in the UK. Oxford Economic Forecasting. October 2006

31 Article by Professor Noreena Hertz, Judge Business School Cambridge reproduced in Sunday Times September 2009

32 Aviation and the Environment. DfT 2003

33 Carbon Trust advertisements Summer 2006

34 Moving to a global low carbon economy: implementing the Stern Review. HM Treasury 2007

35 Aviation Duty: a consultation HM Treasury January 2009

36 Various including EC website http:/ec.europe.eu/environment and DEFRA press statement

37 Omega Conference held at DfT London December 2008.

38 Verbal statement by EC speaker at the Omega Conference London December 2008

39 ABTN News report December 2009

40 The economic and social benefits of air transport. Air Transport Action Group 2008

41 Towards a sustainable transport system DfT 2007

42 The Final Call. Leo Hickman Transworld Publishers 2007

43 The Final Call. Leo Hickman Transworld Publishers 2007

44 Report by Booz Allen for UK DfT 2008

45 Chartered Institute of Logistics and Transport Focus document June 2009

46 Various sources including UK Air Passenger Demand and CO_2 forecasts. DfT 2003

47 Various websites for Board of Airline Representatives in selected countries

48 Aviation and the Environment. DfT 2003

49 UK Committee on Climate Change: Aviation Report – Meeting the UK Aviation Target – Options for reducing emissions to 2050. December 2009

50 Aviation Duty: a consultation. HM Treasury January 2008

51 The Economic contribution of the Aviation Industry in the UK. Oxford Economic Forecasting. October 2006

52 Centre for Climatic Change. Tyndall Report. www.tyndall.ac.uk

53 Chemistry for Dummies. Wiley Publishing 2003

54 Greener by Design Report 2006 Royal Aeronautical Society. Also, Plane Simple Truth. Aerospace Technology Publishing International Pty Ltd May 2008

55 Aviation and the Global Atmosphere. IPCC Special Report 1999

56 EC Trade-off Project. ec.europa.eu/environment

57 Aviation and the Environment: using economic instruments. DfT 2003

58 The environmental effects of civil aircraft. Royal Commission on Environmental Pollution 2002

59 Aviation emissions cost assessment. DfT 2008

60 W. Walsh speech at Third Aviation & Environment Summit Geneva April 2008 and other sources

61 Civil Aviation Authority (CAA) Report. Fares: Taxes, fees and charges added to air fares 1999 and subsequent updates

62 HM Treasury pre-budget report 2007

63 HM Treasury Red Book report 2008

64 HM Revenue & Customs www.hmrc.gov.uk

65 Recent trends in growth of UK air passenger demand. CAA January 2008

66 IATA Press Release June 2008

67 ABTN News report August 2008

68 Oxera Report for Airport Operators Association AOA, November 2009

69 Chicago Convention 1944 Article 24. Shawcross & Beaumont Butterworth Press 1951 and subsequent editions

70 Centre for Climatic Change. Tyndall Report. Also, Friends of the Earth "Plane Stupid" and Campaign for Climate Action

71 Aviation emissions cost assessment 2008. DfT 2008

72 UK Committee on Climate Change. Aviation Report: Meeting the UK Aviation Target – Options for reducing emissions to 2050. December 2009

73 British Airways News September 2009

74 Airline Business magazine August 2008

75ATI Report April 2009

76 Friends of the Earth Press release November 2009

77 UK Committee on Climate Change. Aviation Report: Meeting the UK Aviation Target – Options for reducing emissions to 2050. December 2009

78 Various including EC web site http://ec.europa.eu/environment

79 Aviation in the EU ETS. An incentive for efficiency. Report by Merrill Lynch 2008

80 ABTN News report December 2009

81 IATA Director General Press Conference September 2008

82 Aviation CO_2 Data Monitor. Point Carbon Aviation August 2009

83 Journal of Air Transport Management paper by J D Scheelhaase/ W G Grimme "Emission Trading for International Aviation – an estimation of the economic impact on selected European airlines" September 2007

84 UK Committee on Climate Change. Aviation Report: Meeting the UK Aviation Target – Options for reducing emissions to 2050. December 2009

85 Aviation, the Environment & Emissions Trading Conference. Budapest November 2008

86 Stern Report: The Economics of Climate Change. HM Treasury October 2006

87 Interview with a British Airways manager April 2007

88 Sustainable Energy – without the hot air. Prof D MacKay UIT Cambridge 2009

SECTION 4

THE AIR TRANSPORT CASE AND POSITION

THE ROLE OF AIR TRANSPORT

Around one hundred years ago air transport did not exist so its rise is seen as dramatic. Even fifty years ago air travel was generally perceived to be only for the "rich and famous" and the more adventurous. Even today, to many people across the world, air transport is simply irrelevant; it is only important to a minority of people, although even that is changing.

So in the early days of aviation travelling by air was seen as a "luxury" but today it is claimed[1] that for a very large number of people across the world it is now a necessity. Air transport is described as a "major global industry" involving many thousand airlines. Some 2.2 billion passengers were carried by air in 2007/08 and about 36 million tonnes of cargo. The graph below illustrates the rapid growth of air transport in revenue passenger kilometre terms.

Diagram 4-1: **The Growth of Air Transport**

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Source: Consultair Associates 2008 [2]

Total revenue earned by the whole air transport industry in 2007/08 was US$547billion[3], more than the GDP of Sweden or Belgium[4]. However, profitability for the whole industry has varied considerably with operating margins poor. Airline managements typically aim for around 10%[5] but the industry as a whole has not exceeded 7% in the past ten years as shown in Diagram 4-2. As traffic is forecast to drop by 3% in 2009 [6] it is unlikely that margins will improve for some time to come.

Diagram 4-2: **Airline Operating Margins** [3]

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The air transport industry's trade association IATA states in an Air Transport Action Group report that[7]:

- Aviation provides the only rapid worldwide transportation network which makes it essential for global business and tourism
- Over 40% of tourists now travel by air
- Air transport improves the quality of life by broadening people's leisure and cultural experiences
- Air transport provides access to remote areas where other modes are limited

However, it would seem to be globalisation that has made air transport an essential feature rather than a luxury one. In "The World is Flat" by Thomas Friedman[8], he uses many business case studies to show the extent to which globalisation has created an inter-connected world trading in goods and services – from production and mining to financial and tourism services and to criminal activities! Air transport provides an "enabling service" without which it is claimed globalisation could not function.

Similar facts were given in an Oxford Economic Forecasting report[9] commissioned by Airbus Industrie. The report states that air transport and travel and tourism are beneficial for developing countries, that air transport directly employs 3.5m people and contributes$425billion to global GDP.

The financial crisis of 2008 has critically illustrated the extent of inter-relationship of the World's financial markets. Hedge fund managers are not bound by national borders, they are only interested in opportunities. A recent cursory research in US departmental stores[10] found that clothing for sale had been imported from 35 different countries. Obviously such goods would travel to the US by container ship but the organisation, specification and contracting would involve considerable air travel. The Internet facilitates worldwide sourcing through b2b (business to business) of almost anything, but air travel may be involved to effect contracts, make inspection visits etc. Without such manufacturing orders the economies of many countries would be all the poorer.

A recent conversation by a US businessman (small local business company) with the author included the remark that the US' problems stemmed from "all these imports from China". Yet of course it is all these imports that have helped significantly to keep US shop prices low and fuel their economic expansion over recent years. Such examples are given simply to illustrate that globalisation is part of modern life. Globalisation is perceived to be beneficial for mankind and hence it is claimed that as it is a facilitator, air transport must also be beneficial.

JUST HOW IMPORTANT IS AIR TRANSPORT FOR THE WORLD AND FOR THE UK?

Assessing its importance to the World and to the UK today, in quantified terms, is obviously highly subjective and unlikely to be particularly useable. However, as environmentalists argue that air transport is damaging the environment and should be severely constrained it is reasonable that the case for air transport should also be considered.

The only plausible way of assessing this is to consider the extreme situation of the world without air transport services altogether. What effect would cessation of air services actually have? While this is obviously absurd and an unrealistic extreme it may help to put into context the many unquantifiable benefits claimed for air transport. No-one has really suggested such a cessation, in fact it is clear that the most widely proposed step is to limit the growth of air transport. Nevertheless the following analysis may help to illustrate the significance and importance of air transport.

Global considerations of a World without air transport

A number of points listed here can be considered and each one is examined briefly below.

- Can long distance business activity be conducted by means other than by air travel? That is, by telephone, fax, e-mail, teleconferencing etc.
- Some communities in isolated parts of the world rely on air transport services as surface transport links are poor or non-existent. What would happen to such communities without air links? Does it matter if some areas of a country – remote areas, islands or over water territories are less easily accessed?
- Since power struggles, rivalry, jealousy, extreme ambition and misunderstanding occur all too easily, such problems may lead to war and subsequent diplomacy and political bargaining. Would the world be a better or a worse place without rapid means of travel to help peacemakers in their work?
- Would it matter if air travel was not available in large countries such as the US or China or Russia or India or Brazil?
- Do we (i.e. those people that can afford it) have to travel abroad for our holidays?
- Does it matter if families who live far apart can only meet rarely?
- Do we have to have supplies of foodstuffs grown/produced outside our own country?
- Do we have to have supplies of "out-of-season" fruit and vegetables all year round?
- Is air transport really essential for imports and exports? Can and should, surface means of transport be substituted?
- Does it matter if international (and for larger countries, national) sporting events are limited or stopped?
- Do we really need up-to-the-minute global news coverage?
- Would the loss of "air mail" matter?

Considering each of these points in turn provides some of the answers.

Can business activity be conducted by means other than by air travel? That is, by telephone, fax, e-mail, teleconferencing etc.

Various forms of internet and intranet teleconferencing are ideal forms of communication for any inter-office needs. Such events should not need air journeys. However, negotiating contracts or making presentations to win business or any business functions requiring face-to-face contact are likely to continue to need air journeys if world trade is to continue.

Some communities in isolated parts of the world rely on air transport services as surface transport links are poor or non-existent.

Communities in areas such as Alaska or Siberia or central Brazil etc might prove to be less tenable without air services. If such communities exist because of the natural resources there, then the absence of air links might lead to the cost of the resources being increased. The main island of the Seychelles is some five days away from the African mainland by boat. Without air transport the country would be seriously isolated from the rest of the World[11].

New Zealand is not a large country and is relatively isolated in terms of travel from Europe or North America. Air services are therefore vital for the country's inclusion in world trade, in tourism and in world affairs. It is significant that Air New Zealand has been actively involved in trials of biofuels for its aircraft in order to reduce air transport's CO_2 emissions[12].

The National Geographic magazine in its 2009 special supplement entitled "Lift – 6.7 billion reasons to bring the World closer together" pointed out that there would be no future for the Inuit peoples of northern Canada without the availability of air transport.

Does it matter if some areas of a country – remote areas, islands or over water territories are less easily accessed?

The issues involved in this point are economic, social and political. Less easily accessed areas of a country may lead to less businesses locating to the area, less employment opportunities and therefore more unemployment creating economically depressed areas.

The population in such areas may have difficulty in accessing medical help, social services and educational facilities. History shows that remoteness of communities can lead to movements for political independence – especially, but not only, where different racial groups are involved. Examples include East Pakistan becoming Bangladesh and Timor becoming East Timor.

Because power struggles, rivalry, jealousy, extreme ambition and misunderstanding occur all too easily and this may lead to war and subsequent diplomacy and political bargaining. Would the world be a better or a worse place without rapid means of travel to help peacemakers in their work?

The world of politics and diplomacy is accustomed to air travel and it is likely that the world would not be a better place without air services. Greater understanding and co-operation between nations can be enhanced by an ability to meet and talk – air transport may help to provide the opportunity.

Would it matter if air travel was not available in large countries such as the US or China or Russia or India or Brazil?

It is hard to imagine such a scenario so far as the US is concerned. The Air Transport Association of America has estimated that on a busy day and at one moment in time, some 5,000 aircraft are in the air over the US. The country has developed its air services to the point where rail is little used for passenger travel beyond commuting distances – partly of course, because of the huge distances involved. "Without air transport the country would quickly become unmanageable" was the comment made by a US businessman in a conversation with the author. So far as the other large countries are concerned, they are in the process of developing their economies with air transport growing fast. Until 2008 China had experienced 10-20% growth in air passenger traffic per year for the past decade. Without air transport the opportunity for such developing countries to grow economically and prosper would seem to be severely threatened. Thomas Friedman's book "The World is Flat"[8] identified ten forces that have "flattened" the Earth in terms of creating an inter-connected world – commercially and socially. The ability to travel rapidly by air formed an essential part of this global change. The following quote by another author summarises this point:

"Aviation is a critical part of the US economy, providing for the movement of people and goods throughout the world, enabling the US's economic growth".[13]

Do we (i.e. those people that can afford it) have to travel abroad for our holidays?

Obviously the answer is "no". If the catastrophic predictions of global warming such as the wholesale loss of large areas of coastal land are maintained, then all efforts to prevent or moderate the impact are essential. However, if the World is going to succeed in avoiding such catastrophes, then other factors concerning this point must be considered. If people stop travelling abroad for holidays their loss is relatively small:

- Experience - especially for their children
- enjoyment of better weather
- cultural and social enlightenment
- physical exercise etc.
- relaxation through "re-charging batteries" and having a "change of scene"

Certainly some of these can be obtained at home and from an economic point of view this would be beneficial since holidaying abroad constitutes an export. Also holidaying at home would benefit local communities.

However, the position of the tourist receiving countries must also be considered. The proportion of national GDP contributed by inbound tourism for selected countries is given in Table 4-1[14].

Table 4-1: **GDP and Tourism- International**

Tourism receiving Countries	**Proportion of GDP from tourism[a] %**	**Proportion of tourist arrivals by air[b] %**	**Estimated proportion of GDP from air tourists[c]**
Spain	4.7	75 e	3.5
Cyprus	10.7	95 e	10.2
Greece	6.1	93	5.7
Thailand	7.1	85 e	6.0
Barbados	29.3	90	26.4
Tanzania	6.9	80 e	5.5

e= estimate

Source: a Nationmaster International Tourism. www.nationmaster.com and Wikipedia
b National tourism offices
c Derived directly from columns 2 and 3 although it is probable that visitors by air may spend more than visitors arriving by car etc.

Clearly the loss of tourists arriving by air would be catastrophic for many of these countries and other similar tourist receiving countries. The air transport industry sees this to be highly significant, as illustrated by this quote from the World Tourism Organisation website[15]:

> *"At the start of the new millennium, tourism is firmly established as the number-one industry in many countries and the fastest growing economic sector in terms of foreign exchange earnings and job creation. International tourism is the world's largest earner and an important factor in the balance of payments of most nations.*
>
> *Tourism has become one of the world's most important sources of employment. It stimulates enormous investment in infrastructure, most of which also helps to improve living conditions of local people. It provides governments with substantial tax revenues. Most new tourism jobs and business are created in developing countries, helping to equalise economic opportunities and keep rural residents from moving to overcrowded cities. Intercultural awareness and personal friendships fostered through tourism are a powerful force for improving international understanding and contributing to peace among all nations of the world."*

This is clearly an impressive statement but it is important to provide a balanced view. Many people now claim that the value of tourism is overstated and that its impact on the culture and the environment of the tourist destination can be devastating with a high long-term cost[16]. Such conflicting views need to be reconciled or at least taken into consideration.

Does it matter if families who live far apart can only meet rarely?

This is simply a matter of social and family cohesion following a sustained period of increased mobility over the past fifty years. It is not essential, merely desirable from a family unity point of view. Internet facilities including video telephone (Skype and other developments) may provide a substitute. Anecdotally, a friend used to travel from New Zealand to England every year to see her mother. She said that "using the telephone was simply not the same".

Do we have to have supplies of foodstuffs grown/produced outside our own country?
Do we have to have supplies of "out-of-season" fruit and vegetables all year round?
Is air transport really essential for imports and exports? Can and should, surface means of transport be substituted?

These issues are not important for those countries that are reasonably self sufficient for at least basic foodstuffs. Resulting "food-miles" are likely to be relatively low compared with the level arising from importing food. Most imported food travels by surface – rail, ship and truck, rather than air but such transport produces considerable quantities of CO_2 leading to claims[17] that all importation of food is undesirable and should be stopped. Air transport is generally used for perishable products such as fruit, vegetables and flowers. It may not be possible to grow some of these due to climatic conditions while others are imported during off seasons such as strawberries to the UK. We do not have to have such foods.

However, the relationship of trading nations is highly complex. The fruit and vegetables imported into the UK are often grown by farmers in lesser developed nations. Such imports reduce the need for greater levels of aid from the developed nations. Stopping such imports may result in putting farmers in Africa and many other areas of the world, out of business. A recent random survey[18], carried out in winter time, of fresh fruit and vegetables in a major UK supermarket that had been imported from outside Europe showed the following:

Table 4-2: **Sample of origin of Fruit & Vegetables sold in UK**

Origin	**Item**	**Origin**	**Item**
Kenya	Green beans	Brazil	Grapes
Peru	Asparagus	Morocco	Tomatoes
Argentina	Blueberries	USA	Strawberries
Egypt	Green beans	Mexico	Blackberries
USA	Lettuces		

Source: Author

While the supermarket may be able to justify such imports economically and in customer demand and choice terms, it is not surprising if environmentalists may be critical.

Does it matter if international (and for larger countries, national) sporting events are limited or stopped or if major cultural and music events become largely localised?

Obviously such considerations are less important if global warming radically changes the world as it is today. However, many sports – football, cricket, golf, tennis, rugby football, athletics, winter sports and many others create major business activities with many enthusiasts travelling abroad to enjoy their sport and with many fans travelling across the world to support their teams. Lectures[19] on air transport have suggested that air transport plays a role in bringing people across the world together, as they watch or participate in sport, concerts and cultural events. Emirates Airline was a co-sponsor for the 2006 Football World Cup and one of their advertisements at the time, stated that "We speak the language of football in five continents". Major sporting events contribute significantly to local economies as demonstrated by the size of budgets for events such as the Olympic Games.

It is not only fans and music followers that travel for such events; during the market research survey at London City Airport we interviewed a Road Team member of a pop group (Pendulum) who said that he travelled by air between 150 and 200 times a year!

Do we really need up-to-the-minute global news coverage?

The provision of up to the minute news coverage by all the major global news channels is probably not essential for most people. Certainly journalists and camera crews form a sizeable airline market and yet there are often local reporters who can disseminate the latest information. However, such current reporting is a feature of modern life and one that is extremely reliant on air transport.

Would the loss of "air mail" matter?

Without air transport mail could be sent by surface although for any intercontinental post this would be extremely slow. Today's use of electronic communication would clearly become the norm but the fact that post offices still use air mail suggests that the role remains significant.

UK Considerations

Some of the points above can be applied at national level. Air travel for tourism purposes is important for many areas of the UK as illustrated in the table below[20], particularly when the size of the regional GDP is considered.

Table 4-3: **GDP and Tourism - UK**

Region & GDP	**Tourism income proportion of regional GDP**	**Proportion of visitors arriving by air - %**	**Proportion of GDP from air tourists (approx)**	
Jersey ($3.6bn)	24	83	20%	$720m
Guernsey ($2.7bn)	11	75e	8	216m e
Isle of Man ($2.1bn)	14	80e	11	231m e
Cornwall ($6.0bn)	24	2	1	60m

e = estimate

Source: Internet and Author. Data for 2006 and 2007

Additionally air services are seen to be very important for social, political and business needs. During a recent survey conducted at Newquay Cornwall Airport, comments were made about the extent to which Cornwall would be "cut off without the airport link!". It is understood that such comments apply even more where islands are concerned.

The UK Government's view sometimes appears to be ambivalent. A newspaper report[21] quoted the Minister of Transport as saying "...we must carry on flying." He told his audience during a trip to Beijing that "... there's no necessary trade-off between a low carbon future and more or less transport".

THE SHAPE AND SIZE OF THE UK AIR TRANSPORT INDUSTRY TODAY

Who is involved in UK air transport?

There are many parts or elements of the air transport industry. Although all of these are inter-related, all the commercial companies involved are independently owned, many with stock market share holders. In the past the main elements were largely government owned organisations, although aero engine and aircraft component manufacturers have always been exceptions.

The various elements involved in UK air transport can be divided into a main group involved in the operation of air services and a support group regulating, facilitating and marketing air services.

Main Elements:

- Airlines
- Airports
- Air Traffic Services (ATS) / Air Traffic Control (ATC) / Air Navigation Service Providers (ANSP)
- Aircraft manufacturers – airframe, aero-engine and aircraft component manufacturers

Support elements:

- Government regulatory authorities – including Civil Aviation Authority (CAA), Department for Transport – DfT (Air Transport Directorate) Aircraft Accident Investigation Board (AAIB), Air Transport Users Committee (ATUC)
- Other Government authorities at international airport entry points to the UK: HM Revenue and Customs and the Home Office UK Border Agency together providing CIQ Facilitation Services – Customs, Immigration and Quarantine
- Travel Trade, that is Travel Agents, Tour Operators and other intermediaries. *This category will be involved in all other aspects of travel and tourism as well as air transport.*
- Industry bodies such as British Air Transport Association (BATA), Royal Aeronautical Society (RAeS), Association of British Travel Agents (ABTA), Board of Airline Representatives in UK (BARUK) British Airline Pilots Association (BALPA), Society of British Aerospace Companies (SBAC) and many more.

While air transport industry associations play a role in all air transport matters, many are not based in the UK. Such bodies include:

- International Air Transport Association (IATA) based in Montreal and Geneva
- Association of European Airlines (AEA) based in Brussels
- Low Fare Airlines Association (LFAA) based in Paris
- European Regional Airlines Association (ERA) covering all European regional carriers but is based in Surrey England

The International Civil Aviation Organisation (ICAO) is a United Nations agency based in Montreal providing a forum for governments for establishing the framework for global civil aviation. The UK is represented through the DfT with advice from the CAA.

The industry is closely inter-related, particularly the main elements. It is not possible to run an airline unless airport, ATC and ANS facilities are available. There is little point in establishing an airport unless there are airlines (and customers) wanting to fly to it. Equally an aircraft manufacturing business will not survive unless there are airline customers for the products.

The UK CAA provides a number of essential services to facilitate the operation of air transport[22], including applying the UK legislation arising from the Chicago Convention 1944 which established the inter-government organisation ICAO - International Civil Aviation Organisation and the subsequent ICAO Annexes. These Annexes cover a number of aspects of civil aviation including air safety, aircraft noise, aircraft airworthiness, aircrew and aircraft engineers' licences, the carriage of dangerous goods, aircraft noise, airport facilitation etc all of which are enacted into UK law through the Air Navigation Orders[23]. The CAA also has an airline economic oversight role and a responsibility to monitor airport charges. The DfT has responsibility for negotiating international traffic rights to and from the UK and for overseeing the implementation of government policy on air transport[24].
The number of staff employed in the main elements of air transport in the UK is given in the table[25] below.

Table 4-4: **Air Transport Employment**

Air Transport Element		Number of staff employed
Airlines		82,000[a]
Airports	)	
ATS/ATC/ANSP	)	104,000[b]
Travel Agencies		82,000[d]
Aircraft & Aero engine Manufacturing		121,000[c]
Total		389,000

Source a CAA Annual Statistics 2007
b Airport Operators Association 2006
c Society of British Aerospace Companies 2006
d Oxford Economic Forecasting

An estimate[26] of the number of people employed in the support elements apart from the travel agencies, is approximately 10,000. Altogether the number of people in the UK employed directly, and in support of air transport[27] is therefore approximately 400,000.

The Shape and Size of the Airline and Airport Businesses in the UK

A number of features make the UK an important country in the World including:

- The position of the British Isles – on the north-western edge of Europe
- The size and importance of the UK economy
- The size and importance of London – the largest city in Europe with a major role as a World financial centre
- The culturally diverse nature of its population
- The importance of Britain as a major tourist receiving country and as a major source of tourists travelling overseas
- Its historic ties to many other countries across the World
- Its role as a major player in the European Union

All these features and others make the UK a significant country in world terms, which has led to the establishment of a comprehensive air transport network providing links throughout the country and to countries overseas, for economic, political, tourism and social reasons.

There are 16 airlines registered in the UK[28] (This number includes Ryanair which operates from UK but is registered in Ireland). Together they provide a range of air services given by – traditional (or legacy) airlines, low cost carriers (LCC or New Generation) and charter airlines. The latter are 8 tour operator airlines registered in the UK[29]. Of the total number of airlines only 3 operate intercontinental scheduled services. The size of each of these categories is given in Table 4-5 below[30]

Table 4-5: **Size of UK Airlines**

Airline type	Revenue £bn +	No. of pax	%	RTKs*	%
Traditional	16.3	43.6	24.2	159,034	44.7
LCC	5.4	94.2	52.3	90,875	25.5
Tour Operator	n/a	42.3	23.5	105,901	29.8
Total		180.1		355,810	

* RTKs = Revenue Tonne kilometres = the number of passengers and tonnes of cargo carried added together in weight terms and multiplied by the sum of the sector distances flown.

\+ Revenue in UK£ converted from US$ at $1.50 = £1

In addition to these UK registered airlines, there are 93 foreign carriers[31] including 21other EU airlines, operating to and from UK airports.

So far as aircraft noise and emissions are concerned the levels of these are largely related to the age of the aircraft operated. The aircraft and aero engine manufacturers advise that new technology has led to significant improvements although it is accepted that as a generalisation, the older the aircraft the noisier and more polluting it will be. Table 4-6[32] shows the main different aircraft types operated by UK registered airlines together with the year of first operation of the particular type.

Table 4-6: Main **aircraft types operated by UK Airlines**

Aircraft type and variant	No operated by UK airlines (2008)	Year of first operation
Airbus:A320 family	202	1987
A330/340	33	1994
ATR42/72	12	1995
Boeing: B737 series	152	1984+
B747 series	77	1971/1989
B757	99	1983
B767	43	1982
B777	45	1995
DH Dash 8 series	16	1984
Embraer RJ series	33	1996

Source: Flight International / Wikipedia

In an annual list of the World's airports[33] seven UK airports appear in the top150 in terms of revenue earned or the number of passengers carried which illustrates the size and importance of UK airports. The data for the main UK airports is shown in Table 4-7[33].

Table 4-7: **The size of UK Airports**

Airport	World ranking		Revenue £ m	No. of pax -m
London Heathrow	3	)		68.1
London Gatwick	25	)	5,310	35.2
London Stansted	50	)		23.8
Manchester	58		796	22.4
London Luton	132		*	10.0
Birmingham	135			9.6
Edinburgh	140		+	9.1
Glasgow	143		+	8.8

* Owned by Abertis plc and not shown separately in Abertis plc consolidated accounts

+ Owned by Ferrovia plc and not shown separately in Ferrovia plc consolidated accounts

Source: Airline Business June 2009

Air Fares

It is argued that air fares have been reduced dramatically in real terms over the past fifty years[34]. This is largely due to the steady improvement in aircraft and aero engine technology. In turn this has led to better aerodynamics and better engine fuel efficiency which has provided manufacturers with the technical ability to build larger aircraft with greater range capability. These technical improvements have produced lower costs per available tonne kilometre (ATK) – the total number of seats in passenger weight terms plus cargo capacity, multiplied by the sector distances flown in kilometres. This passenger and cargo capacity is therefore available for sale. Lower costs per ATK enable airlines operating the newer aircraft to offer lower fares and yet still be profitable.

The trend in air fares in terms of yield – revenue per revenue passenger kilometre (or miles in this illustration), is shown in Diagram 4-3[35] followed by a chart produced by the Australian Government[36] – Diagram 4-4, which illustrates the small extent to which air fares have increased over the past fifty years in comparison with other costs.

Diagram 4-3: **World Airline Yields**

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This chart[35] shows the steady reduction of airline yields and hence air fares, over the past forty years. The primary cause given by airline economists[37] is the lower operating costs arising from:

- improved aircraft technology
  - particularly aircraft engine developments
- larger size of today's aircraft
- greater range of today's aircraft
- economies of scale
- greater business and operating efficiency

Diagram 4-4: **Comparison of Cost Changes in Australia 1964-2002**

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The Australian diagram above provides an interesting comparison of the change in the cost of various items over the past forty years. It shows that the cost of a three bed-roomed house in Australia has increased by more than 4,000%, a four-door car by more than 1,300% and average earnings by more than 1,400%. In comparison the cost of an air fare for a Sydney to London journey has only increased by 92%.

An earlier study on air fares trends[38] carried out for IATA - the International Air Transport Association, concluded that air fares would continue to decline in real terms for as long as the most efficient airline could no longer reduce fares without becoming unprofitable. This is in line with economic theory for competitive pricing

However, while this may suggest that air fares were likely to continue to decline further, the position has changed considerably in recent years with many much lower fares. These have arisen as the growth of low cost carriers (LCCs) has been considerable. Such airlines operate domestically, within one country such as the USA or within a political union such as the EU or between countries that have agreed to permit LCC services on routes between their countries; South-east Asia is an example of this. Consequently LCC operations are not bound by restrictive Air Services Agreements, many of which still require that airlines file their intended fares on each international route with the governments at each end of the route.

LCCs use a different business model which provides an alternative form of air service as opposed to full service carriers (by definition, higher cost). LCCs generally provide little service, for example "no-frills" services or charge for any catering or checked baggage etc. Full service airlines – FSAs (commonly called legacy carriers) continue to operate international routes in most parts of the world and on the domestic routes of many countries. However, it would be reasonable to say that the difference in the US domestic market between the two types of airline is becoming smaller.

The difference between the two types of airline that is relevant to this study is their approach to pricing policy[38]. FSAs' pricing policy is based on maximising the availability of a range of fares through traditional means of distribution. This seeks to reach a wide range of market segments and involves:

- the provision of detailed prices for every route served, known as "published fares"
- the filing of fares for approval with governments at each end of the route, where such filing is still required under the relevant Air Services Agreement. These fares are then legally binding – at least in theory, although discounting frequently occurs by various means
- the provision of a range of fares including premium fares aimed at wealthy or business travellers who require greater privacy or flexible travel arrangements. These are first class, business class and fully flexible economy class fares. Nearly all the fares provided by FSAs are based upon a declining rate per kilometre over distance reflecting the curve of operating costs
- the provision of cheaper fares to increase demand. Such fares carry specific conditions and generally the lower the fare the more onerous the conditions. These include for example:
    - Minimum length of stay at the destination
    - Maximum length of stay at the destination
    - No cancellation or change of booking.
    - No refund
    - No re-routing
    - Advanced purchase (typically 30 days ahead)

- Passenger must stay over Saturday night before returning (this is to discourage business travellers from using the cheaper fare)

- covert discounting, which is increasingly overt in many parts of the world, carried out through the travel trade and business companies (in order to increase business and to maintain loyalty). Today, cheaper fares are readily available and therefore increasingly sold, through Internet web sites.

The FSAs' pricing policy could be described as "airline directed"[38] in that the published prices are put out into the market directly by the airline or through travel agents, and potential customers are able to see what they must pay if they wish to travel. These prices do not generally change other than over time, that is between seasons or years.

LCCs' pricing policy[38] is based upon the carriers' ability to vary pricing almost continuously enabling them to attract the market with very low prices and ultimately to maximise revenue. This involves:

- the promotion of low fares (often very low fares and even free) to attract market interest
- almost all bookings are made directly to the airline via the Internet
- almost continuous variation in price as the LCC sees the fluctuations in demand. This means that prices may be very low one day but considerably higher for the same seat the next day. Prior to the day of departure of a particular service the LCC fare may be extremely high if the flight is almost full or still very low if the flight is not full.

The LCCs pricing policy can be described as "market response driven" or simply that a LCC is a "market driver". At the same time, the carrier always endeavours to achieve a profit on every flight by balancing the low fares sold with higher levels sold later in the life of each flight.

It is relevant for this study to make some comparison of the one way fares applied by legacy and low cost carriers using shorthaul routes for the illustration[39]. This is because consideration will be given in Section 8 to the demand elasticity effects of the plans for increasing air travel taxes.

Table 4-8: **Comparative EU Air Fares**

ROUTE*	RYANAIR (FR) £ FLYBE (BE) £	BRITISH AIRWAYS (BA) LOWEST £	FLEXIBLE £
Barcelona (FR)	Free (Reus Airport)	127	637
Dublin (FR)	Free	61	404
Rome (FR)	Free (certain flights only)	123	613
Rome (FR)	22.50 (Ciampino)		
Madrid (FR)	26.80	68	616
Malta (FR)	25.80	101	570
Marseilles (FR)	Free	68	606
Milan (FR)	Free (Bergamo)	89	598
Oslo (FR)	Free (Torp)	95	626
Stockholm (FR)	26.85	77	604
Aberdeen (BE)	36.99	89	251
Inverness (BE)	31.99	105	231
Jersey (BE)	31.99	90	194
Newcastle (BE)	29.99	102	238

* Flights from London – FR from Stansted or Luton; BA from Heathrow or Gatwick. BE from Gatwick. All fares are one-way and include all taxes. The fares shown were for flights in October 2008 for bookings made two weeks prior to departure. All the fares were taken from the relevant carrier's web site

Note that destination airports used by FR were often not the main airports for the city concerned and these are indicated in brackets against the fare level.

These comparisons are relevant so far as the discussion of passenger or aircraft taxes are concerned. However, it is important to recognise that the fares charged by the LCCs may not reflect the true cost of the air journey. For example[40], some LCCs may receive "discounts" or subsidy payments from the destination city for each passenger brought to the destination – a practice initially outlawed by the European Commission in the case of Ryanair and Brussels–Charleroi but upheld on appeal by the European Court. Also some LCCs may receive preferential rates for landing or handling fees at certain airports, granted as an inducement to operate to the city concerned.

Many of the LCCs rely extensively on supplementary revenue where charges are levied for payments made by credit cards, for checked baggage, food and beverages on board, seat selection etc[41]. In some cases, the very low fares may involve early payment for flights booked many months ahead which may help to improve cash flow for the airline.

British Airways developed a Value Calculator to help prospective passengers make comparisons between their fares and charges and the charges made by LCCs.[42] The following table is based on the BA information.

Table 4-9: **Comparison of Airline travel charges**

	Ryanair £	Easyjet £	British Airways £
Telephone booking	Internet only	Internet only	10
Payment by debit card	10.00	2.95	nil
Payment by credit card	Not accepted	Not accepted	2%
Airport check-in	80.00	nil	nil
Priority boarding and seat selection	6.00-8.00	5.90	nil
Checked baggage – 15kgs	20.00	16.00	nil
- 23kgs	260.00	58.00	nil
> 1 pce	double	double	35 per piece*
Food & drink	2.00-9.00	2.00-7.00	nil

* £28 if arranged on-line in advance.
Source: Based on information from BA News plus the web site for each airline

WILL AIR TRAFFIC CONTINUE TO GROW?

The demand for air travel is seen to be heavily influenced by economic conditions. Business travel is strongly correlated with economic growth or recession while leisure travel is correlated with income levels, employment or unemployment and levels of disposable income. The diagram below illustrates the economic relationship for air travel[43].

Diagram 4-5: **Correlation between world GDP and air traffic (RTKs)**
Error! Objects cannot be created from editing field codes.

Forecasts for the industry carried out by the aircraft manufacturers Boeing Airplane Company and Airbus Industrie in conjunction with airlines, have produced consistently bullish projections. Diagram 4-6[44] shows a recent forecast based on the manufacturers' research.

Events such as the Gulf Wars, the 9-11 attack in New York, the SARS epidemic and the 2008 financial crisis all affected air travel demand, but the forecasts continue to show that the longer term trend is steadily upwards. Is this really sustainable or are there factors which may limit or restrict the continued growth? It is interesting to read a quote from a book which questions the need for air travel growth[45]. An Airbus Industrie spokesperson is reported as saying that "*.....climate change is not an element we factor in (to traffic forecasts). We see global aviation growth of 5 per cent a year. There is no constraint in that forecast because of governments' response to climate change.*"

Such a complacent view does not appear to be consistent with the current thinking of some governments or some airlines. However, the UK Committee on Climate Change's report[46] clearly states that the policy is to limit air traffic growth to 60% from 2005 to 2050 – averaging about 1.3% per annum. The report accepts that unconstrained demand would increase air traffic by about 200% by 2050 – averaging at around 5% per annum.

The possible constrained growth described above is inevitably in conflict with the forecasts of the industry. However, the industry claims that many initiatives are being taken which will significantly reduce the environmental impact of air travel thus allowing the continuing optimistic forecasts.

Diagram 4-6: **Long term airline passenger traffic forecast**

Error! Objects cannot be created from editing field codes.
Based on Boeing Current Market Forecast

Possible future air passenger numbers

The current forecasts suggest that the number of passengers will double about every fourteen or fifteen years. If this were to happen it would give the following passenger numbers:

Table 4-10: **Possible future air passenger numbers**

	Number of Passengers - billion
2007/08	2.2 (actual)
2021/22	4.4
2035/36	8.8

Source: Author based on forecasts from several sources

While such numbers appear dramatic, the way that the air transport industry counts its passengers needs to be taken into account. Each passenger sector counts as one passenger so that one person travelling every week of the year from London to Geneva on a Monday returning on Friday counts as 104 passengers. So the numbers in the table above will include many people travelling many times a year. Nevertheless the increase in the number of passengers represents a considerable increase in the amount of CO_2 created unless significant technical developments occur over the next twenty five years.

PLANNED AIR TRANSPORT AND AIRCRAFT DEVELOPMENTS

Many airlines and aircraft manufacturers, air traffic control organisations and airports – all representing various aspects of the air transport industry, are claiming[47] that aircraft and operational developments over the years ahead will significantly reduce the environmental pollution caused by aircraft. The current Director General of IATA has called for developments to eliminate CO_2 emissions from aircraft by 2050[48] although at present, this would seem to be unlikely to be achieved for aerodynamic reasons. More realistic targets were set by IATA in 2009[49] for the airline industry to be carbon neutral by 2020. In effect this means that improvements in emissions reduction will keep pace with air transport growth. The targets also include halving net CO_2 emissions by 2050 compared with 2005 and improving CO_2 efficiency by 1.5% a year to 2020.

However, other sources claim that improving the efficiency of aircraft is aerodynamically limited. Professor David McKay (a UK Government Advisor) claims[50] that the laws of physics impose fundamental limits. He states that "Planes have been fantastically optimised and there is no prospect of significant improvement in plane efficiency".

General Developments

However, it is clear that aircraft technology evolves and regular improvements are made but if a new aircraft is introduced with considerable technical innovations such as Boeing B787 or the Airbus A350XWB, it will take many years before such aircraft or newer still aircraft, are dominant in the world's airline fleet. Observations by the author supported by OAG data show that there are many aircraft operating today on US domestic routes that are more than thirty years old.

Many airlines are tackling the emissions problem seriously accepting that they must be, and must be seen to be, responsible organisations which accept their external costs. British Airways has advocated the inclusion of air transport in ETS for several years[51] and has introduced a comprehensive Carbon Offsetting scheme. BA states that in 2008 55,000 tonnes of CO_2 were offset by its customers[51]. The airline's web site provides a calculator for passengers to work out the cost of offsetting the emissions their prospective seat on a flight will create. Using this for a flight by the author with his wife in August 2009 from London Heathrow to Larnaca Cyprus, the calculator showed that 1.6 tonnes of CO_2 would be created as a footprint and that this could be offset by a payment of £16.40. The web site stated that the money would be passed to Morgan Stanley "who are experts in sourcing certified emissions reductions. (They) will use your payment to fund a portfolio of projects selected for our customers to support."

Most airlines have sought to reduce emissions – since this may involve reducing fuel consumption and lowering costs – and this is clearly desirable anyway. Singapore Airlines[52] has developed a detailed environmental policy supported by the company's Board. This involves:

- operation of a young, modern, environmentally efficient fleet of aircraft

- efficient fuel consumption management through better operating procedures, improved engine and airframe maintenance, better route planning and reduced aircraft operating weight
- use of continuous descent approaches (CDA) wherever permitted
- office renovations to incorporate environmentally friendly features and also use of hybrid ground transport

Other ways that airlines may seek to reduce CO_2 emissions include:

- increasing the passenger seats per aircraft. This can be achieved by use of larger aircraft and/or by increasing the seating configuration with less seat pitch. This might lead to the use of less aircraft to carry the same number of passengers
- increasing passenger load factors. It is evident that LCCs and charter operators achieve higher passenger load factors than the legacy carriers. However, the argument is made by Legacy Carrier airline managers that higher load factors mean less seat availability for late booking passengers who are usually the higher fare paying business travellers. But it is correct to say that higher load factors might lead to the need for less aircraft to carry the same number of passengers
- increasing aircraft utilisation. Increasing the number of hours flown per annum by the airline's fleet may lead to the need for less aircraft to operate the same commercial network of services.

Technical Developments

The technical developments envisaged by the industry that will reduce aircraft emissions include:

- more fuel efficient aircraft are being ordered and put into service. Boeing claim that only one-third of today's (2006) aircraft will still be flying by 2026 and yet the number of aircraft in operation will increase[53].
- studies to reduce drag and hence fuel burn through lower skin friction using hybrid laminar flow[54] plus new measures to achieve laminar flow wings
- increased use of winglets to reduce drag[55]

- silent aircraft project involving more efficient engines[56]
- wireless In-Flight Entertainment (IFE) systems significantly reducing wiring[57]
- increased aircraft range capability leading to elimination of intermediate stops[58]
- aircraft design change including blended wing bodies to reduce noise and fuel burn[57] plus new lighter and stronger composite materials
- engine design changes including unducted turbofan and open rotor engines[59]
- improvements in air traffic control procedures[60] including:
  - more direct routings and more effective Air Traffic Management procedures
  - reduced vertical separation minima (RVSM)
  - increased datalink communication between ATC and the cockpit
  - the progressive development of "free flight" in which voice contact between ATC and the cockpit will be by exception only; all other communication will be computerised[61]
  - introduction of more "Continuous Descent Approaches" (CDA) to eliminate aircraft stacking[62]
  - introduction by airlines in the Pacific Rim/Australasia regions of ASPIRE a joint endeavour by airlines, national ATCs and governments to reduce CO_2 emissions by improved flight planning[63]
- work on eliminating contrails:
  - by ATC adjusting aircraft heights when contrails observed, particularly during terminal area approaches
  - by use of microwave beams [64]
  - development of electro-active polymers for flow control to reduce aerodynamic drag and fuel consumption [65]

The European Union through ACARE - Advisory Council of Aeronautical Research in Europe, has set a number of targets[66] to be achieved by 2020. These include 50% lower CO_2 per passenger kilometre and 80% lower NOx.

The individual effect of each of these planned changes is not seen to be especially significant for example, fuel saving through engine improvements is forecast to reduce consumption by 1-2% per year[67]. However, although the total impact of all the initiatives is difficult to assess it would not seem unreasonable that the industry is claiming that these iniatives may move the industry towards the ACARE and even the IATA, targets.

Alternative Fuels for Aircraft

Another aspect of technical developments is the question of alternative fuels and fuel availability. Professor McKay[68] suggests that "Trying to reduce emissions from oil and gas is of secondary importance (to reducing emissions from coal) because supplies of both gas and oil are expected to decline over the next fifty years." This is significant when considering air transport's annual fuel requirement which one estimate gives as 85 billion gallons[69].

Although many other studies[70] also suggest that oil production has peaked and will decline steadily over the next fifty years, oil companies continue to state that reserves and forecast future discoveries[71] remain sufficient to meet future demand. However, it is clear that new finds – mainly deep sea and oil from shale, cost more to extract to the point where production may be limited by the price the market will bear. It has been suggested[72] that air transport is unlikely to be able to match the prices that other industries may be prepared to pay and this, plus air transport's CO_2 emissions problem, may bring the industry's long term reliance on fossil fuel into question regardless of environmental considerations.

Many companies, particularly in the USA, are researching hybrid and biofuel possibilities[73]. Sir Richard Branson has invested[74] in a Californian based company to develop isobutanol, a fuel derived from various sources including sugar. His airline Virgin Atlantic, has been active in successfully testing a hybrid of kerosene and biofuel in aircraft operation. UOP – a Honeywell Aircraft Engine Company subsidiary, claims[72] that such hybrids could produce 60-80% less CO_2 than kerosene. Boeing has made similar claims[75].

However, while fuel to power aircraft ***can*** be obtained from crops, the issue is much more complex and many experts are suggesting[76] that the commercial use of such fuels is many years ahead. The amount of land needed for some crop types would be considerable – one suggestion[77] being that an area the size of Belgium would need to be completely covered by such crops just to meet a year's fuel requirement for Air France/KLM! However, even more significant is that some of the potential crops would require good soil and so would replace food crops leading to scarcity and increases in food prices.

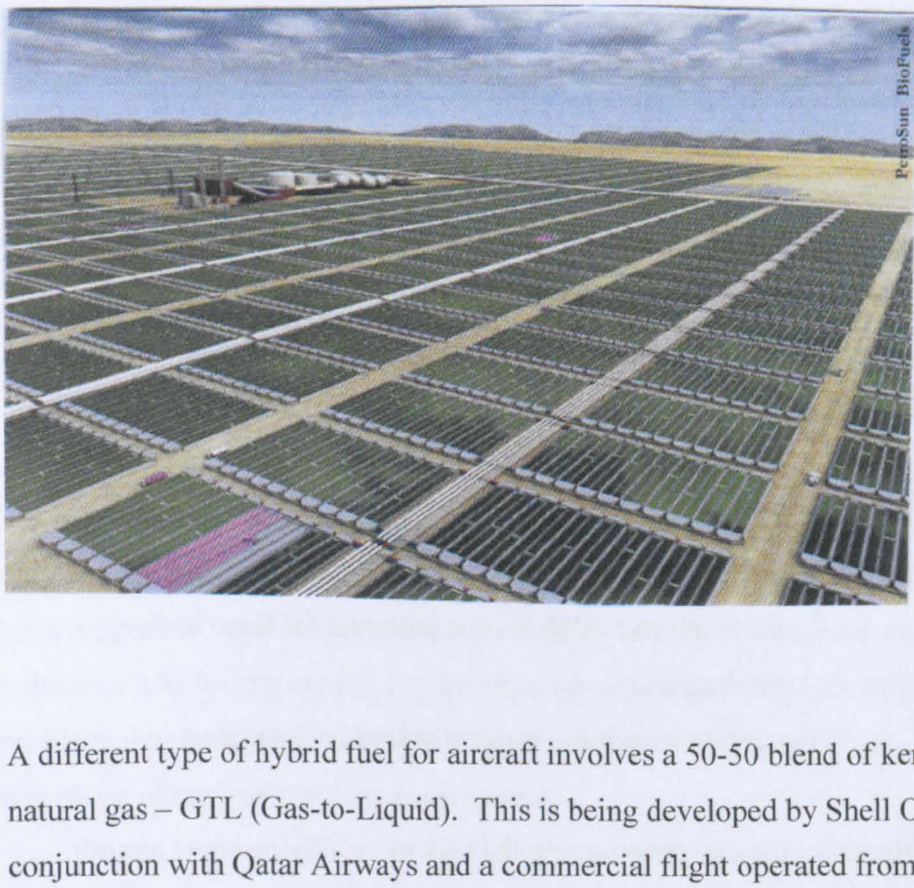
There are four main types of biofuel currently being researched[78]

1. Camalina - available now and can be grown with traditional agriculture
   - limited yield and maybe linked to grain market swings
2. Jatropha - available in 2-4 years and can grow in marginal land (that is, land not necessarily useable for food crops)
   - needs warm climate and at present cannot be harvested mechanically
3. Halophytes – available in 2-4 years and can grow in deserts and in salt water
   - cost may be higher than for other biofuels
4. Algae - available in 8-10 years and likely to have high productivity. Also has the potential for large scale production
   - economic refining process still to be developed

While these timescales may be encouraging the task of modifying some aircraft engines and the task of producing algae fuel on a commercial scale to meet air transport's needs, has to move such changes quite a few years ahead.

Research on fuel from algae – the last biofuel listed above, is increasing rapidly as aircraft manufacturers and airlines see the potential for a fuel from a source with high energy content and which can grow where nothing else will[79]. The following artist's concept Diagram 4-7, [80] of a future large scale algae farm in desert land emphasises the current trend in thinking on alternative fuels.

Picture 4-7: **Artists concept of a large scale algae farm**



A different type of hybrid fuel for aircraft involves a 50-50 blend of kerosene with natural gas – GTL (Gas-to-Liquid). This is being developed by Shell Oil Company in conjunction with Qatar Airways and a commercial flight operated from London Gatwick to Doha in October 2009 using this fuel[81]. The fuel is seen as a way of diversifying air transport's fuel supply, one which produces less CO_2 and less NOx (Nitrous Oxide). Lower levels of the latter would lead to improvements in local air quality around busy airports.

British Airways has recently announced[82] (February 2010) a joint venture with American company Solena Group to build and operate a plant to convert household waste material into a useable jet fuel. The plant will be constructed in East London and it is planned that the fuel will be used to operate all BA's services from LCY from 2014.

REFERENCES, NOTES AND SOURCES

1 The Economic and social benefits of air transport 2008. Air Transport Action Group April 2008

2 Consultair Associates updated 2008

3 Airline Business magazine August 2008

4 Wikipedia

5 British Airways News. Various editions including January 2009

6 Interview with IATA Director General. Flight International magazine January 2009

7 The Economic and social benefits of air transport 2008. Air Transport Action Group April 2008

8 The World is flat. Thomas Friedman Penguin Books 2006

9 Oxford Economic Forecasting; paper prepared for Airbus Industrie June 2009

10 Random survey by the Author: US Department stores

11 Discussion by the author with members of the Government of Seychelles 1982

12 Article on the use of Biofuels for aircraft. Daily Telegraph November 2009

13 Aviation and the Environment: A national Vision Statement. Framework for goals and recommended actions. Waitz et al MIT March 2008

14 Wikipedia/ Nationmaster International Tourism data/ National tourism offices websites

15 World Tourism Organisation (WTO) web site: www.world-tourism.org/about wto

16 The Final Call: Leo Hickman Eden project Books 2008

17 The Final Call: Leo Hickman Eden project Books 2008

18 Random survey by the author: Sainsbury's supermarket

19 Lectures by Philip Shearman to air transport students "State of the Industry Today" for City University, Singapore Airlines and others

20 Web sites for tourism data for Jersey, Guernsey, Isle of Man and Cornwall

21 Article in Daily Telegraph newspaper August 2009

22 Civil Aviation Authority web site: www.caa.co.uk

23 Civil Aviation Authority web site: www.caa.co.uk

24 Department for Transport Aviation Directorate web site: www.dft.gov.uk/aviation

25 CAA Annual Statistics 2007/ The Economic Contribution of the Aviation Industry in the UK: Oxford Economic Forecasting 2006/ Airport Operators Association 2006/ Society of British Aerospace Companies

26 Estimate made from discussions with aviation managers

27 The Economic Contribution of the Aviation Industry in the UK: Oxford Economic Forecasting 2006

28 CAA Statistics

29 CAA Statistics

30 Airline Business magazine August 2008

31 Board of Airline Representatives in UK (BARUK)

32 Flight International magazine / Wikipedia

33 Airline Business magazine June 2008

34 Current Market Outlook: Boeing Airplane Company / IATA World Air Transport Statistics

35 Based on data from Current Market Outlook: Boeing Airplane Company

36 Australian Comparative Price Index report: Australian Bureau of Statistics 2004

37 Consultair Associates pricing study 2006 (not publicly available)

38 Consultair Associates consultancy report for IATA 1997 (not publicly available)

39 Internet sites for various airlines

40 European Court ruling on EC v Ryanair December 2008

41 Low cost carriers' web sites

42 British Airways website and British Airways News June 2009

43 Air Transport Action Group. Geneva

44 Current Market Outlook: Boeing Airplane Company

45 The Final Call: Leo Hickman Eden project Books 2008

46 UK Committee on Climate Change Aviation Report. Meeting the UK Aviation Target – Options for reducing emissions to 2050. December 2009

47 Plane simple truth: Thomas. Norris, Creedy, Forbes-Smith, Pepper Aerospace Technical Publications 2006

48 Press release: IATA Director General Sr Bisignani April 2007

49 IATA Annual General Meeting report Kuala Lumpur July 2009

50 Sustainable Energy – without the hot air. Professor D McKay UIT Cambridge 2009

51 British Airways Annual Report (page50) 2008/09

52 Singapore Airlines Environment report 2008/09 published August 2009

53 Boeing/NASA study reported by R Faye et al 2001

54 Airbus tests with A320 study reported by E Coustols and V Schmidt 1989

55 Evaluation of NASA's programme for improving aircraft fuel efficiency. US National Research Council 1980

56 The Silent Aircraft Project: Joint study Cambridge University / MIT. http://silentaircraft.org

57 Royal Aeronautical Society report in Aerospace International March 2009

58 The Environmental cost implications of hub-hub versus hub bypass flight networks. P Morrell & C Lu. Cranfield University 2006

59 Easyjet press release and web site

60 Plane simple truth: Thomas. Norris, Creedy, Forbes-Smith, Pepper Aerospace Technical Publications 2006

61 Plane simple truth: Thomas, Norris, Creedy, Forbes-Smith, Pepper Aerospace Technical Publications 2006

62 British Airways Business Life September 2007

63 Singapore Airlines company news February 2010

64 Flight International November 2008

65 Information sheet Imperial College Department of Aeronautics

66 Greener by Design RaeS Annual Report 2007/08. April 2008

67 Plane simple truth: Thomas, Norris, Creedy, Forbes-Smith, Pepper Aerospace Technical Publications 2006

68 Sustainable Energy – without the hot air. Professor D McKay UIT Cambridge 2009

69 Article in Sunday Times newspaper November 2009

70 "Hubbert peak of Oil production" website. Also www.oilcrisis.com

71 Royal Dutch Shell Company plc website www.shell.com

72 City University MSc project by Christopher Smith "UK Airlines in the EU Emissions Trading Scheme" 2006

73 Biofuels and fuel Security. Chartered Institute of Logistics and Transport

74 Article in Sunday Times newspaper on Sir Richard Branson's investment in future energy sources August 2009

75 Article on The Environment. Flight International June 2009

76 Various speakers Royal Aeronautical Society Conference: Aviation and Climate Change. October 2006

77 Professor L R Wootton City University. Lecture on Sustainable Aviation March 2009

78 British Airways News article November 2009

79 Flight International magazine December 2009

80 Royal Aeronautical Society Aerospace International magazine March 2009

81 Qatar Airways Press release October 2009

82 British Airways News and Flight International reports February 2010

SECTION 5

CONSIDERATION OF THE MACRO-ECONOMIC BENEFITS OF AIR TRANSPORT SERVICES

INTRODUCTION

Air transport is a service industry and consequently generates economic benefit through its own direct activities as well as through indirect and support activities. These are quantifiable. However, as a service industry, it also acts as a facilitator or catalyst for the business activities conducted by those using or relying on air services for business or tourism purposes. This is difficult to quantify meaningfully at a macro level. The research for this study has however, sought to quantify this catalytic aspect at a more micro level.

However, considering the overall point of air travel, logic suggests that individual travellers and business companies must perceive economic value in the existence of air services since they are willing to pay for such services. That they do so, also suggests that they see their journeys as being necessary. The environmental lobby is urging that unnecessary air journeys should be avoided[1] – but the definition of "necessary" and "unnecessary" will obviously vary for almost all travellers and of course, also for all environmentalists!

THE ECONOMIC BENEFITS OF AIR TRANSPORT

Air transport is therefore seen to produce economic benefit through a number of features. Firstly, these relate to employment and secondly, so far as the users are concerned, to the benefits arising from their journeys which are possible due to the existence of air services.

1 Employment

- Direct employment by airlines, airport companies, air traffic control staff. See Section 4.
- Indirect employment (first category) by companies involved in the supply chain serving the air transport industry. This includes for example, companies supplying aircraft catering and aviation fuel, aircraft manufacturers and aircraft component manufacturers, suppliers for the airport retail outlets etc. This category also includes employment related to work generated by capital investment in the infrastructure required by airlines, airport companies, air traffic control etc.
- Indirect employment (second category) by companies involved as agencies securing airline revenue. These include travel agencies, tour operators, air cargo agents and freight forwarders.
- Induced employment which arises from demand for all goods and services created by those directly and indirectly employed in the air transport industry. The level of benefits arising is based upon the application of a "multiplier".

2 Benefits arising from the very existence of air travel services through:

- Catalytic benefit – this is defined as that arising in other businesses because of the facilitating role of air transport. For example, the existence of air transport services may help businesses to operate more efficiently and effectively and to compete more easily in overseas markets. As a result many companies locate at business parks close to a major airport.
- Business travellers - both inbound and outbound
- Tourist travellers inbound (but not outbound since that will merely assist the economy of somewhere else)
- Passengers travelling for other purposes – visiting friends and relatives (vfr), students attending universities, medical trips etc.
- Air cargo facilities for servicing both imports and exports
- Some additional services provide political (in the administrative sense) and social benefits. For example, the air services to the Scottish Hebrides,

Shetland Islands, the Isle of Man, and the Channel Islands and also to Cornwall.

In all these cases air transport is a facilitator and it has to be accepted that other forms of transport – that is surface transport, could provide the service required. It is then that the time saved by the use of air transport rather than surface transport becomes important and this study uses this measure as an indication of the value of the benefits of this aspect of air transport (see Section 6).

However, this section initially examines the claims for global benefits and then considers the UK position at a macro level. These points help to establish the overall size of the air transport industry in economic benefit terms. This analysis of necessity, uses existing data from recent reports commissioned by IATA and by the UK Government as well as using data provided by different UK Government departments.

This is followed in Section 6 by specific economic benefit details relating to the research work carried out at two UK airports as part of this study – London City Airport (LCY) and Newquay Cornwall Airport (NQY).

- LCY air services typically serve markets which are predominantly based on business traffic, both inbound and outbound
- NQY air services typically serve markets which are inbound tourists, a small business element and outbound travel by Cornish residents

These airports and their catchment areas therefore provide a more micro level opportunity for study, based on the economic benefits for the regions concerned.

ECONOMIC BENEFIT OF AIR TRANSPORT GLOBALLY

The Air Transport Action Group of IATA (ATAG) in its 2008 report on "The economic and social benefits of air transport"[2] sets out the following points:

- Air transport facilitates world trade, helping countries participate in the global economy by increasing access to international markets and allowing globalisation of production
- The total value of goods transported by air represents 35% of all international trade
- The air transport industry generates 32 million jobs globally including some 5.5 million directly employed, 6.3 million indirectly, 2.9 million through induced employment and 17.1 million through air transport's catalytic impact on tourism
- Air transport's global economic impact is estimated at US$3,560 billion equivalent to 7.5% of world GDP
- Air transport improves productivity by encouraging investment and innovation
- Internet portals facilitate global tendering for business contracts many of which would not be possible without air services to assist with face-to-face negotiations etc.
- Tourism is the mainstay of many countries' economies with air transport providing the essential link
- Air travel increases understanding of different cultures and nationalities which facilitates closer international integration

It is also claimed by the industry that recent technical improvements have enhanced the value of air transport. For example it is stated that it is now possible to fly between almost every main city in the world and that with the very long range aircraft flying today it is possible to fly non-stop between almost all major cities across the world. One example given is Singapore Airline's regular non-stop flight from Singapore to New York (Newark) which takes around 18.5 hours and covers about 15,000 kilometres.

BENEFITS OF AIR TRANSPORT TO THE UK ECONOMY

In its White Paper "The Future of Air Transport" published in 2003[3], the Government accepted the economic importance of air transport to the UK saying:

> *"Britain's economy is in turn increasingly dependent on air travel. One third of our visible exports, by value, now go by air. Exports of services, which depend on the ability to travel by air, make up a further eight per cent of our*

national income. Around 25 million foreign visitors a year contribute to a tourist industry that directly supports more than two million jobs; two thirds of these visitors come by air. Businesses coming to Britain are attracted by our good air links, and airports are a magnet for other forms of development. In an increasingly competitive global marketplace, Britain's continuing success as a place in which to invest and do business depends crucially on the strength of our international transport links."

Employment

The Oxford Economic Forecasting (OEF) report[4] issued in October 2006 was commissioned by the Department for Transport, Visit Britain and various organisations from different areas of the air transport industry. The findings based on 2004 data (see table 4-4), include the following:

Table 5-1: **Direct employment in the UK air transport industry**

Direct employment in air transport	186,000
Aerospace industry	121,000
Travel agencies and tour operators	82,000
Direct support	10,000
Total	399,000

Table 5-2: **Indirect and Induced employment supported by the Air Transport industry**[4] (based on OEF data)

Supply chain - Indirect	167,000
Induced employment	88,000
Total	255,000

This gives a total of 654,000 people employed as a result of air transport services. A more recent study[5] based on 2007 data generally confirms the OEF data while increasing the overall contribution of air transport to the UK economy.

UK Gross Domestic Product

As mentioned earlier, quantifying the benefits arising simply from the existence of air transport services is difficult and this aspect was not quantified in the OEF report. However, this aspect is covered in the regional analyses in this study (see Section 6).

OEF assessed the overall impact of air transport on the UK economy in GDP terms. Their report did comment that the UK National Accounts statistics do not have a specific category that corresponds to the air transport industry. Their assessment therefore was based on the recorded output of airlines and related organisations plus Annual Business Inquiry data for those organisations providing supporting activities. It was also based upon an estimate for the remainder of the industry using data for similar categories. This produces a total value added for the UK GDP as follows.

Table 5-3: **Value Added for the Air Transport Industry** OEF[4]

	£ billion
The output of airlines and associated direct organisations	6.5
Companies providing main supporting activities	3.4
Other supporting companies	1.5
Sub-Total	11.4
Aerospace	5.3
Total	16.7

The result of £11.4 billion for airlines, airports and other support businesses for 2004 represents 1.1% of the UK GDP. Aerospace represents a further 0.5%, giving a total of 1.6% of UK GDP for the industry overall – significant, but it could be argued that this size is hardly vital!

Contribution to the UK Accounts

Some profit data is available for UK airlines and airports as shown in Table 5-4. The major airport group BAA, has been sold and now faces partial break up. The results are shown for 2004 in line with some of the other tables but with more recent data in addition.

Table 5-4: **Contribution to the UK Accounts**[4]

	Major UK Airlines 2004	Major UK Airports 2004/05
Profit before tax - £m 2004	676	693
2008	(253)*	952

* this includes the result for British Airways of (£455m)
Source for 2008 data: Airlines – CAA statistics; Airports – Airline Business

The contribution of Air Transport to the UK Public Finances[4] has been calculated for 2004/05

Table 5-5: **Contribution to the UK Public Finances**

	£m
Income tax	1,410
National Insurance contributions	863
Corporation tax	377
Air Passenger Duty – APD	900
Total contribution to the UK Exchequer	3,550m

Air transport contributes to the UK Balance of Payments[4] although the data for 2004 shows that the net result was a Balance of Payments **deficit** in air transport services of around £3.3billion.

Table 5-6: **Air transport's contribution to the UK Balance of Payments**

		£ billion
Airlines and Airports	: Exports	6.9
	: Imports	10.2
Balance		- 3.3

The negative balance is due firstly to the greater number of UK citizens travelling abroad compared with the number of visiting foreigners and secondly to the excess of imports over exports moving by air.

Data for the Aerospace element for 2004 was not available although it is significant that nearly 90% of UK Aerospace's output was exported, clearly making the sector a strong contributor to the overall Balance of Payments.

Investment in Air Transport and Aerospace

The industry's level of investment is seen by OEF in its report to be particularly high, although some doubts exist about the accuracy of some of the data. The total investment during the period from 2000 to 2004 represents around 3.5% of the total UK business investment.

Table 5-7: **Investment in Air Transport and Aerospace[4]**

	2000-2004 Annual average £m

Airlines	21,190
Airports	5,965
Aerospace	2,675
Total	29,830

Assessment of the overall economic contribution of air transport to the UK Economy

Environmentalists would reasonably suggest that such contributions as given above, including:

the UK GDP of 1.6% and

the deficit on Balance of Payments of –£3.3bn

are not highly significant and beneficial and certainly not vital for the economic survival of the country given the importance of seizing all opportunities for reducing CO_2 emissions.

While such a view may be understandable, air transport's emissions (by all airlines - UK registered and foreign, airlines - operating to/from and within the UK – see Section 3) are estimated to represent somewhere between 5% and 6.3% of the UK's total emissions, which in turn_are only estimated to be 2% of total global emissions.

> ***This means that the total cessation of <u>all</u> air transport to/from and within the UK would only remove about 0.13% of global emissions. This appears to be a negligible figure.***

On the other hand, if a multiplier of 2.7 is applied to reflect the full RF – the greater impact of emissions at altitude, as well as the additional GHGs produced by aircraft engines, then air transport's contribution to the UK total, artificially increases to between 13.5% and 17.0%. That would make UK air transport's contribution to global emissions representative of a figure somewhere between 0.2% and 0.34%.

> *The term "artificially" is used here since the amount of CO_2 does not increase by application of the multiplier, merely that the effect the emissions produced at altitude is estimated to be significantly greater (see Section 3).*

Although air transport's contribution to the UK GDP is relatively small, the Government in its Consultation document[6] (Aviation Duty: a Consultation. 2008) gave clear support for maintaining the industry. Paragraph 1.11 stated:

> *"The Government remains committed to supporting the sustainable growth of the aviation industry, as it makes an important contribution to the UK economy. It is recognised that the industry directly supports around 200,000 jobs and indirectly up to three times as many. One fifth of all international air passengers in the world are on flights to or from a UK airport, and in 2005 some 228 million passengers passed through UK airports. All the evidence suggests that the growth in the popularity and importance of air travel is set to continue over the next thirty years."*

It is also relevant that the economic considerations above do not give any measure for the catalytic benefits which are considered below.

Catalytic contribution of Air Transport to the UK economy

Although it is difficult to provide detailed assessments of the catalytic contribution of air transport on a total UK basis, it is possible to consider the various elements involved.

1. The importance of Tourism. The OEF report[7] stated that in 2005 the sector generated approximately £47 billion of output or nearly 4% of GDP. Over one million jobs are directly involved in this activity. Employment in all tourism related activities suggests that over 2.5 million people are involved – although this includes all restaurants, bars, and sports activities etc – a much wider definition.
   Note that these figures represent tourism by all modes of transport (although nearly 75% of international visitors to the UK arrive by air) and they also include business travellers.

2. Trade Support – passenger travel. A comprehensive air network with good connections increases the business person's efficiency in accessing overseas clients and obviously saves time compared with using surface transport. As

part of the research work, use has been made of the proportion of business travellers travelling by air from/to or within the UK – see Table 5-8 below.

Table 5-8: **Proportion of Business Travellers by air**[8]

Number of air travellers – m through London Airports	**% travelling on business (average)**	**Estimated number of business travellers through London Airports**
142m	31.0%	44.0m

Source: Airline Business June 2008 and York Aviation planning document paper for LCY 2006

3. Trade support – air cargo: exports and imports. The UK has always been a trading nation and today air transport plays a leading role: 55% (by value) of UK exports of manufactured goods to countries outside EU were carried by air in 2005[7]. The total value of trade carried by air in 2005[7] was:

Table 5- 9: **Value of Trade by Air 2005** (Adapted from OEF)

	£ billion
Exports	62.7
Imports	59.6

4. Business location. Many businesses cite air transport links as being an increasingly important factor in considering location of factories and offices. This is to facilitate travelling to clients, customers and markets both overseas and within the UK and conversely to facilitate visitors travelling to visit the company.[9]

REFERENCES, NOTES AND SOURCES

1 Why we must give up flying. Article in Daily Telegraph July 2006

2 The Economic and social benefits of air transport 2008. ATAG Geneva April 2008

3 The Future of Air Transport. DfT 2003

4 The Economic contribution of the aviation industry in the UK. Oxford Economic Forecasting October 2006

5 Study by Oxera for Airport Operators Association: What is the contribution of aviation to the UK economy. November 2009

6 Aviation Duty: A consultation. HM Treasury January 2008

7 The Economic contribution of the aviation industry in the UK. Oxford Economic Forecasting October 2006

8 Socio-Economic impact on London City Airport. York Aviation Consulting Group 2006- 2007 and Airline Business June 2008.

9 The Economic contribution of the aviation industry in the UK. Oxford Economic Forecasting October 2006

PART III

RESEARCH ANALYSIS & EVALUATION

Section 6 Consideration of the Regional Economic Benefits of Air Transport Services

Section 7 Relationship between the Economic Benefits of Air Transport Services and the Resulting Levels of Carbon Dioxide Emissions

Section 8 Air Transport Market Elasticity and the Assessment of the Impact of further Taxation on Air Transport Services

Section 9 Regulatory and Legal Aspects

Section 10 Further Application of selected parts of the Study Methodology

Section 11 Assessment of the case for Air Transport

SECTION 6

CONSIDERATION OF THE REGIONAL ECONOMIC BENEFITS OF AIR TRANSPORT SERVICES

INTRODUCTION

Research was carried out for this study at a secondary London airport – London City Airport (LCY) and at a UK regional airport – Newquay, Cornwall (NQY). This has enabled analyses to be made of the more micro level economic benefits arising in the areas around a major business travellers' airport and a significant leisure travellers' airport. With very different market profiles these two airports were seen to be appropriate for understanding the regional economic implications of the fares increases arising from APD increases and from the introduction of the EU's ETS.

LONDON CITY AIRPORT

London City Airport (LCY) was opened in 1987 primarily for short take-off and landing aircraft. It serves a concentrated catchment area of central and east London and, in particular, the City of London financial centre – the primary reason for establishing the airport. The growth of the airport services was accelerated by the shift of many City companies to the Canary Wharf area and also by the opening in December 2005, of the extension of the Docklands Light Railway to provide direct train access to and from the airport. Train time from LCY to Canary Wharf is ten minutes and to the City area (Bank Station) is twenty minutes.

The airport's single runway is sited on a former dock area and it is surrounded by narrow strips of water. The airport is in the heart of an area of factories, hotels and residential housing within a number of London boroughs:

Newham	Barking & Dagenham
Tower Hamlets	Bexley
Greenwich	Hackney

The government White Paper "The Future of Air Transport"[1] noted that smaller airports such as LCY had a valuable role in meeting local demand and contributing to regional economic development:

> *"Airports are an important focus for the development of local and regional economies. They attract business and generate employment and open up wider markets. They can provide an important impetus to regeneration and a focus for new commercial and industrial development."*

LCY is an unusual single runway airport as the photo below shows.

Picture 6-1: **London City Airport**

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In 2008 3.3 million passengers travelled through LCY[2]. *(Note that this figure is based on the sum of passengers departing on flights from LCY added to the number of passengers arriving on flights at the airport. This is the method used by airlines to count the number of passengers carried. This is known as Sector Passengers counted, the number being described as equivalent one-way passengers)*
Ten airlines served 34 different destinations and there were more than 70,000 aircraft movements[2].

Employment

The airport provides a variety of employment opportunities, mainly but not all, in the air transport industry. The airport operating company – London City Airport plc is the largest single employer and has adopted a policy of employing people wherever possible, that live in the local area. As a result around 80% of those employed at LCY[3] live in the immediately surrounding boroughs. This level increases if the British Airways crew base is excluded. It has also followed a strong philosophy towards maintaining good relations with its neighbours – local residents and nearby business companies. An "open-day" is held annually when local residents and families of airport staff are invited to "come and see how the airport works"[3].

Employment is provided by:

1. Airlines
    a. Passenger and cargo ground handling
    b. Station administration
    c. Pilots) a crew base is located at LCY to
    d. Cabin crew) operate British Airways' services
2. the Airport company
    a. Passenger and cargo ground handling
    b. Airfield Operations
    c. Security
    d. Air Traffic Control
    e. Management and administrative staff
3. HM Customs and Home Office Immigration
4. Support services – sited on airport
    a. Car hire companies
    b. Restaurants / coffee shops – landside and airside
    c. Shops – landside and airside
5. In addition non-dedicated services are provided by Metropolitan Police and by London Taxis (non-dedicated simply means different police officers and different taxi drivers will be allocated to work at LCY on different occasions). Although this category serves all other areas of London as well as LCY, the numbers used in the study calculations reflect the number that would not be employed without the need to service LCY.
6. Support services – sited off airport
    a. Aircraft catering
    b. Terminal and office cleaning

In summer 2008 ten airlines served LCY[4], operating the following routes, aircraft types and frequencies. Generally the more airlines operating or the more frequencies provided, the greater the job opportunities.

Table 6-1: **LCY Airlines, routes and aircraft types**

AIRLINE	ROUTES AND WEEKLY FREQUENCY*	AIRCRAFT TYPE
Air France	Dublin (29); Dundee (23); Edinburgh (38); Eindhoven (12); Geneva (22); Nice (7); Paris – CDG (42); Strasbourg (17); Zurich (24)	Dornier 328-100 /BAe 146/ Avro RJ
Air One	Milan Linate (12)	Avro RJ70
Austrian	Vienna (10)	CRJ700
British Airways	Amsterdam (21); Barcelona (6); Dublin (16) Edinburgh (40); Frankfurt (16); Glasgow (23); Madrid (11); Nice (7); Warsaw (6); Zurich (28)	Avro RJ100
KLM	Amsterdam (40)	Fokker 50
Lufthansa	Berlin (12); Düsseldorf (18); Frankfurt (28); Hamburg (11); Munich (22); Stuttgart (5)	ATR42 / RJ85 /BAe 146-300 /Dash8-300
Luxair	Luxembourg (22)	Embraer RJ
SAS	Copenhagen (11); Oslo (11); Stockholm (11)	Dash8-400 AvroRJ70
Swiss Int.	Basel (12); Geneva (43); Zurich (47)	AvroRJ100
VLM	Amsterdam (67); Antwerp (28); Brussels (16); Groningen (6); Isle of Man (6); Jersey (6); Luxembourg (17); Manchester (37); Rotterdam (75)	Fokker 50

* Based on Summer schedules 2008 published by London City Airport (Note that in 2009 VLM was taken over by AF-KLM and BA introduced an Airbus A318 service to New York JFK.)

The following data have been obtained from the LCY Airport company[5] and from other employers showing the various categories, numbers and average remuneration levels during summer 2008. Full details are given in Appendix K.

Table 6-2: **Direct employment at LCY**

Categories	Numbers employed	Average annual remuneration £
Airlines	310	35,000
LCY company	470	30,000
CIQ	180	30,000
Air Traffic Control	40	40,000
Concessionaires, car hire, Maintenance	1,060	20,000
Other eg taxi, police	50 est	35,000
Sub-total	2,110	Annual total = £54.9m

Notes: Remuneration details derived from recruitment web sites and discussions on site

The existence and operation of the airport leads to additional employment:

- Indirect employment – in the chain of suppliers of goods and services to the airport activities

- Induced employment – generated by the spending of incomes earned in the direct and indirect activities

The multiplier to reflect these additional employment levels has been developed from existing work as shown in Table 6-3..

Table 6-3: **Multipliers**[6]

	Indirect	Induced
OEF study	0.89 – 1.38	0.25
York Aviation Consulting	0.19	0.10
ACI	Combined 2.1	

Following discussions with the airport company the lower level used by OEF (0.89) for indirect employment and 0.25 for induced employment have been used for this study. Since many of the jobs involved are relatively low skilled tasks the average remuneration for the Concessionaires category under Direct Employment has been applied for both Indirect and Induced employment..

Table 6-4: **Indirect employment**

Categories	Numbers employed	Annual remuneration £m
Indirect employment (i.e. Direct 2,110 x 0.89)	1,878	37.6

General expenditure by both direct and indirect employees leads to a level of induced employment. The multiplier to be used for this calculation[6] is as described above.

Table 6-5: **Induced employment**

Sum of Direct and Indirect employment	Multiplier	Induced employment	Induced annual remuneration £m
3,988	0.25	997	19.9

The figures from Tables 6-2, 6-4 and 6-5 above form the first part of the assessment of the economic value generated by the airport.

The London City Airport Role

A passenger survey was carried out during August 2008 as part of this research work, to assist in determining the economic benefit arising from the airport's existence. This particularly helped to determine the catalytic benefit arising for the airport from the benefits enjoyed by those using the air services for business travel purposes. The Direct, Indirect and Induced employment estimates above are readily quantifiable but the catalytic impact arising from the benefits experienced by those using the air services, is harder to quantify. However, as stated in Section 5 the measure of the value of the time saved by using air services has been used for this purpose.

It is not surprising that catalytic benefits are increasingly seen to be important in determining the economic impact of airports. This is because many business journeys and consequently much business growth might not occur without the availability of air services. This point is validated by the results of the research questionnaire carried out at LCY as described below.

The catalytic economic benefit assessed through the passenger survey was specifically in terms of the reasons for travel and the financial value expected to be derived. This was seen to result from the time saved by the passenger using air transport for his/her journey rather than surface transport. This is relevant to business passengers both starting their journey from LCY as well as those returning home.

At the same time the survey was used to establish on a sample basis the proportions of holiday and vfr passengers visiting the London region through LCY. Their length of stay – number of days, and expenditure were identified. On the other hand although outbound leisure travellers using LCY were included in the survey for other reasons, their expenditure on holiday does not benefit the London region. A copy of the Questionnaire used for the survey is given in Appendix C and the detailed report of the analysis of the Questionnaire responses is given in Appendix D.

The following points summarise the key results arising from the survey.

> *1 Some 51% of the 181 passengers* interviewed in the survey were business travellers. This is a lower proportion** than experienced in other LCY surveys, simply reflecting the time of year used – August.*

* The sample of passengers interviewed is small in relation to the total number of passengers. However, it is statistically significant in relation to the number interviewed in each of the main market segments and also in relation to the number of destinations covered (60%) and in relation to the number of different airlines covered (100%).

**A recent survey carried out at LCY [7] as part of work connected with planning applications for the expansion of the airport; found that 64% of the passengers using the airport were travelling for business purposes. This level was contrasted with other London airports:

Table 6-6: **Proportion of business travellers at London Airports**

London Airports	Percentage of passengers travelling on business
London City	64
Heathrow	44
Luton	20
Stansted	18
Gatwick	17

Source: York Aviation

In view of these data, a level of 60% of LCY passengers travelling for business purposes has been used for the research work calculations. This reflects a realistic level for the peak summer and the rest of the year. Consequently a level of 40% has been used for leisure/vfr travellers.

2 The business passengers from and to LCY were generally frequent travellers with more than 20% making more than 21 trips a year. Some 86% of the business passengers were travelling alone as were over 60% of the leisure and "visiting friends and relatives" (vfr) passengers.

3 Nearly 70% of the business travellers were returning home, leaving 30% making an outward journey. On the other hand over 70% of the leisure/vfr travellers were making their outward journey.

4 Over 70% of the business passengers were travelling for one or two days only with nearly 40% travelling out and back in the day. For the leisure and vfr passengers nearly 65% were travelling for 4 days or more.

5 The weighted average length of stay in the UK was 2.1days for the business travellers now returning home, and 6.9 days for the leisure passengers.
6 The amount spent per person on accommodation, meals, transport, leisure activities etc in the UK, by returning business travellers was £374 but was £465 per person for the leisure travellers.

7 Business passengers were asked why they were using air travel rather than surface transport. Some 97% gave time saving as the reason with nearly 68% stating that up to one day would be saved. They were asked to put a money value to the time saved in terms of a company call-out rate or salary plus expenses per day. Nearly all respondents were willing to answer and the weighted average value per day was £914.

8 When asked if no air services were available to their destination would they still make the journey, nearly 60% said yes. Of the remainder, more than 70% stated that they would use teleconferencing as a substitute. However, many of these still preferred the air journey and the face-to-face contact, assuming that this was available.

9 Respondents were asked about a fares increase due to the imposition of government and/or environmental taxes and whether they would still travel by air. Even with an effective doubling of the fare 44% of business travellers said "yes" but only 16% of the leisure passengers.

10 Approximate measures of price elasticity were made which suggested that faced with a doubling of the total air fare, the business travellers' demand was strongly inelastic(-0.4) while the leisure and vfr travellers' demand was elastic (-1.2) although only moderately so.

The information derived from the survey has then been applied to the total traffic using LCY[8] in 2008. The estimated average time saved by the business traveller and the value then put on that time, has been used as an indication of the value put on their journey, so far as their business company was concerned. This is termed "Business Air Travel Value" – BATV, and this has been used as a realistic measure of the benefit arising for the business traveller from the existence of LCY airport.

The rationale for this approach is that a businessperson based in London and travelling away will be doing so to benefit his/her company which in turn benefits the local economy. Increasing their productivity by using air transport therefore improves the economy to the extent of the value of the productivity gain. The businessperson travelling to London will improve their own company which is away from London but will also enhance the local economy in London through contracts, servicing etc.

Table 6-7: **Business Air Travel Value – LCY**

a.LCY total passengers		3.27m
b. Proportion of business travellers – 60%*	=	1.96m
c. Average time saved using air travel		1.33 days
d. Stated value per day		£914
e. Journey value per pax (c x d)	=	£1,216
f. Total BATV for year (e x b)		£2,383m

* based on adjusted survey results – see page 106 above.

The survey identified the inbound business travellers' length of stay and expenditure while in the UK. However, consideration has been given to the point that 59% of the business travellers stated that they would still have made their journey even if air services were not available –ie they would use surface transport. Therefore in assessing the benefit of expenditure in the UK by visitors, only the proportion of travellers has been used that would not have travelled if air services were not available.

Table 6-8: **Inbound business travellers' expenditure in UK - LCY**

a.LCY total business travellers	1.96m
b. Proportion of inbound business travellers*	0.544m
c. Average length of stay – days	2.1
d..Expenditure per pax	£374

e. Total business visitor expenditure for year (b x d)	£203.4m

*The proportion is 68% but only 40.9% of these would not have visited without the availability of air services hence the proportion used is 40.9% of 68.0 = .27.8%

The survey information has been used to determine the number of leisure travellers visiting the UK using LCY air services and also those travellers visiting friends or relatives. These passengers were interviewed as they returned home and the survey identified their length of stay and expenditure while in the UK.

Table 6-9: **Inbound leisure and vfr passenger's expenditure in UK**

a. LCY total leisure/vfr travellers	1.32m
b. Number of inbound leisure/vfr travellers*	0.375m
c. Average length of stay – days	6.9
d. Expenditure	£465
e. Total leisure visitor expenditure for year (b x d)	£174.4m

* Based on adjusted survey results – see points following Table 6-6 above giving 40% of which 28.4% were inbound passengers.

Economic benefit summary

With the employment data and the information derived from the survey it is possible to develop the assessed economic benefit arising from the existence of LCY. The data relate to 2008.

Table 6-10: **Economic benefit – LCY**

	£m
Direct employment	54.9
Indirect employment	37.6
Induced employment	19.9
BATV – catalytic benefit	2,383.0
Business visitor expenditure	203.4
Leisure/vfr traveller expenditure	174.4
Air cargo	-
Non- quantified benefits (see paragraph below)	-
Total	2,873.2m

In assessing the overall economic benefit and its relationship to the cost of the CO_2 created, sensitivity tests have been carried out using a number of alternative levels including lower BATV levels – see Section 7.

The benefit which could be assigned to LCY arising from businesses locating nearby is difficult to assess. Work done by York Aviation in 2005[9] did not quantify such benefits but summarised them as follows. LCY's existence, the report suggested, would lead to:

- new investment from outside the area, and especially overseas companies
- the retention of existing companies in the area
- the expansion of existing companies, possibly in the face of competition with other areas
- the promotion of export opportunities for companies located in the area by the provision of passenger and cargo links to key markets
- the enhancement of the competitiveness of the local economy and the companies in it through the airport's increasingly wide network of services
- the decision of mobile workers to locate their homes in the area
- the attraction of more visitors and businesses due to the location of Excel – now London's major exhibition centre, only a few minutes from the airport. The existence of LCY was one factor in the location decision for Excel so that a symbiotic relationship has been formed.

None of these additional benefits have been quantified although some recognition will be credited to the airport in the final assessment of the economic benefits measured against the perceived cost of CO_2 emissions –see Section 7.

Similarly no additional benefits have been quantified for air cargo. Although some cargo is carried on services from/to LCY, the amount is small and the aircraft involved are not claimed to be ideal for cargo carriage. All loading is "loose" – that is, not containerised, which does not facilitate short turn-round times.

NEWQUAY CORNWALL AIRPORT - NQY

Located on the coast in the North Cornwall region the commercial airport of NQY has been established on the site of the former RAF airfield – St Mawgan. As a result the airport possesses a long runway of 2,745 metres. The airport is run by Cornwall Airports Ltd and serves north, west and south Cornwall with Plymouth serving the remaining areas. Newquay is a major surfing location and has become a very popular destination justifying air services. These are mainly UK regional services for inbound visitors although a small number of charter services are operated for Cornish outbound tourists.

Picture 6-2: **Newquay Airport**

In 2008 0.7m passengers travelled from and to NQY[10]. *(Note that this figure is based on the sum of passengers departing on flights from NQY added to the number of passengers arriving on flights at the airport. This is the method used by airlines to count the number of passengers carried. This is known as Sector Passengers counted, the number being described as equivalent one-way passengers)*

Five main operators served the airport flying to ten different destinations in the UK and the Republic of Ireland. A number of charter services were also operated.

Employment

The airport provides a variety of employment opportunities, mainly but not all in the air transport industry. The airport operating company – Cornwall Airports Ltd, is the largest single employer on the airport and nearly all employees live in the local area.

Employment is provided by:

1. Airlines
    - a Passenger and cargo ground handling
    - b Station administration
    - c. Pilots) a crew base is located at NQY to
    - d. Cabin crew) operate Southwest Airways' services
2. the Airport company
    - e. Passenger and cargo ground handling
    - f. Airfield Operations
    - g. Security
    - h. Air Traffic Control
    - i. Management and administrative staff
1. HM Customs and Home Office Immigration
2. Support services – sited on airport
    - j. Car hire companies
    - k. Restaurants / coffee shops – landside and airside
    - l. Shops – landside and airside
3. In addition non-dedicated services e g taxi services. Although this category serves other areas of north west Cornwall as well as NQY, the numbers used in the study calculations reflect the number that would not be employed without the need to service NQY.
6. Support services – sited off airport
    - m. Aircraft catering
    - n. Terminal and office cleaning

In 2008 five airlines served NQY[11], operating the following routes, aircraft types and frequencies. Generally the more airlines operating or the more frequencies provided, the greater the job opportunities.

Table 6-11: **NQY Airlines, routes and aircraft types**

AIRLINE	ROUTES AND WEEKLY FREQUENCY*	AIRCRAFT TYPE
Air Southwest	Bristol (12); London – LGW (22) Dublin (7) Leeds/Bradford (13); Manchester (12) Cork (6); Glasgow (7); Newcastle (7) Grenoble (1 – Winter only))	Dash8-300
Ryanair	London – STD (7)	B737-800
BMI baby	Manchester (7)	B737-300
British Airways	London –LGW (7)	B737-500
Flybe	Belfast City (1); Edinburgh (5)	Dash8-400

* Based on Summer schedules 2008 published by NQY

The following data have been obtained from the NQY Airport company[12] showing the various categories, numbers and average salary levels during summer 2008. Full details are given in Appendix K.

Table 6-12: **Direct Employment**

Categories	Numbers employed	Average annual remuneration £	Total remuneration £m
Staff employed by airport company, airlines etc at NQY airport	232	16,000	3.71

The multipliers shown in Table 6-3 have also been used for NQY except that the upper level of the OEF study figures for Indirect Employment have been used due to the high level of tourism in the area surrounding NQY. The OEF multiplier level of 0.25 has been used for Induced Employment. These levels represent averages and were used by OEF across the UK.

Table 6-13: **Indirect Employment[12] and sum of Direct and Indirect Employment**

Categories	Numbers employed	Average annual remuneration	Total remuneration -£m
Staff employed by suppliers, servicing companies, maintenance companies etc not based at NQY airport [Multiplier of 1.38 applied]	320	16,000	5.12
Total Direct and Indirect employment	552	16,000	8.83

General expenditure by these employees leads to a level of induced employment.

Table 6-14: **Induced Employment**

Sum of Direct and Indirect employment	Multiplier	Average remuneration £	Annual remuneration - £m
552	0.25	16,000	2.21

The final figures above (Tables 6-12, 6-13 and 6-14) form the first part of the assessment of the economic value of the airport.

The NQY Role

A passenger survey was carried out during October 2008 as part of this research work, to assist in determining the economic benefit arising from the airport's existence. This particularly helped to determine the catalytic benefit arising from the benefits experienced by those using the air services. The points in the section **"The LCY Role"** (see page 133) concerning the catalytic benefit apply equally to the study work for NQY. The same questionnaire, as given in Appendix C, was used for the passenger survey in NQY and the detailed report of the analysis of the NQY responses is given in Appendix E.

The following points summarise the key results arising from the survey:

1 Some 40% of the 131 passengers interviewed in the survey were business travellers. This is a similar proportion to that experienced in other NQY surveys[10]. Some 58% of the business travellers started their journey from NQY.*

* The sample of passengers interviewed is small in relation to the total number of passengers. However, it is statistically significant in relation to the number interviewed in each of the main market segments and also in relation to the number of destinations covered (63%) and in relation to the number of different airlines covered (83%).

2 The business passengers from NQY were moderately frequent travellers with more than 20% making more than 15 trips a year. Some 80% of the business passengers were travelling alone as were over 45% of the leisure and "visiting friends and relatives" (vfr) passengers.

3 Nearly 58% of the business travellers were on their outward journey compared with only 43% in the case of the leisure/vfr travellers.

4 Fifty percent of the business passengers were travelling for one or two days with over 20% travelling out and back in the day. For the leisure and vfr passengers nearly 70% were travelling for 4 days or more.

5 The weighted average length of trip for the business travellers returning home was 3.5 days.

6 The weighted average length of stay in Cornwall for the leisure and vfr travellers now returning home was 10.5 days..

7 The amount spent per person on accommodation, meals, transport, leisure activities etc in Cornwall, by business travellers returning home was £261 but was £349 per person for the leisure travellers.

8 Business passengers were asked why they were using air travel rather than surface transport. Some 90% gave time saving as the reason with over 70% stating that up to one day would be saved. They were asked to put a money value to the time saved in terms of a company call-out rate or salary plus expenses per day. Nearly all respondents were willing to answer (94%) and the weighted average value per day was £576.

9 When asked if no air services were available to their destination would they still make the journey, nearly 90% said yes. Of the remainder, most of the business travellers stated that they would simply not pursue the business – representing a potential loss for the Cornish economy.

10 Respondents were asked about a fares increase due to the imposition of government and/or environmental taxes and whether they would still travel by air. With an effective doubling of the fare 27% of business travellers said "yes" but only 8% of the leisure passengers. Over 60% of the business travellers said that they would travel less if the effective fare was doubled – again suggesting a potential threat to the Cornish economy.

11 Approximate measures of price elasticity were made which suggested that the business travellers' demand was strongly inelastic (-0.4) while the leisure and vfr travellers' demand was significantly elastic (-1.5).

The information derived from the survey has then been applied to the total traffic using NQY[13] in 2008. The estimated average time saved by the business traveller and the value then put on that time, has been used as an indication of the value put on their journey, so far as their business company was concerned. This BATV -"Business air travel value" as described earlier, has been used as a realistic measure of the benefit arising for the business traveller from the existence of NQY airport.

Table 6-15: **Business Air Travel Value – NQY**

a.NQY total passengers 2008	700,000
b. Proportion and number of business travellers	40% = 280,000
c. Average time saved using air travel	1.2 days
d. Stated value per day	£576
e. Journey value per pax (c x d)	£691
f. Total BATV for year (b x e)	£193.5m

The survey identified the inbound business travellers' length of stay and expenditure while in the Cornwall region.

Table 6-16: **Inbound business travellers' expenditure in Cornwall**

a. NQY total business travellers	280,000
b. Proportion of inbound business travellers – 42.3%	118,440
c. Average length of stay – days	3.5
d. Expenditure per pax	£261
e. Total business visitor expenditure for year (b x d)	£30.9m

Note that in the calculations for this benefit for LCY only the proportion of inbound business travellers who stated that they would not have travelled to London if no air services existed was used. However, in the case of NQY all the inbound business travellers have been used in the calculations. This is simply because nearly all of the air services were domestic within the UK and surface transport could easily have been used but was not. In the case of LCY the majority of services involved cross channel travel. If, in the case of NQY, only the proportion (11.5%) that would not have travelled is used, the Business Visitor Expenditure would be reduced to £5.1m. The latter figure has been taken into account in the Sensitivity tests given in Section 7.

The existence of an airport has often led to business companies locating close by for ease of travel and use of air freight. However, only a few businesses are located in the area around NQY and these were mainly there before the airport started to expand in the late 1990's. NQY is seen more as a tourist receiving airport which in turn helps to support the north, south and west Cornwall tourism industry. Consequently no quantified allowance has been made so far as businesses location is concerned.

The survey information has been used to determine the number of leisure travellers visiting Cornwall using NQY air services and also those travellers visiting friends or relatives. These passengers were interviewed as they returned home and the survey identified their length of stay and expenditure while in the region.

Table 6-17: **Leisure and vfr passenger's expenditure in Cornwall**

a. Proportion of leisure travellers – holiday and vfr - 60.3%	= 422,000
b. Proportion of these that were inbound visitors - 57.0%	= 240,600
c. Weighted average length of stay - days	10.5
d. Expenditure per pax	£349
e. Total leisure visitor expenditure for year (b x d)	£84.0m

Note that in the calculations for this benefit for LCY only the proportion of inbound leisure/vfr travellers who stated that they would not have travelled to London if no air services existed was used. However, in the case of NQY all the inbound leisure/vfr travellers have been used in the calculations. This is simply because nearly all of the air services were domestic within the UK and surface transport could easily have been used but was not. In the case of LCY the majority of services involved cross channel travel. If, in the case of NQY, only the proportion (27.8%) that would not have travelled is used, the Leisure/vfr Visitor Expenditure would be reduced to £23.3m. The latter figure has been taken into account in the Sensitivity tests given in Section 7.

Socio-political Factor

However, to a much greater extent than LCY, there are a number of economic, social and political benefits arising from the existence of NQY's airport. While road and rail links are adequate, journey times to major cities – Bristol, London etc are quite long. Roads in summer are frequently very congested. During the survey a significant number of respondents made unsolicited comments about the importance of NQY airport, several suggesting that it was "vital" for the community. Some business travellers were particularly vocal, including one – a London City venture capitalist – who stated that he would not live in Cornwall if NQY Airport did not operate.

It therefore appears that:

- business activity is enhanced simply because of the existence of NQY airport
- some business people and others, only live in the region because of the existence of the airport
- urgent non-business travel from Cornwall to major cities such as London, for example for medical treatment, is made possible because of the existence of the airport
- some business companies are valuing the Cornish location, as research shows that more flexible work practices are often applied to the benefit of staff as well as for company productivity[14] [Cornwall Enterprise Project conducted by Henley Business School 2008]
- maintaining air links to and from Cornwall is important in terms of encouraging continued economic development of the region which provides a political dimension for supporting the airport.

Such points had been previously emphasised in an interview with the Airports Development Director Cornwall Airports[15].

In view of these points and the qualitative evidence gained from the survey, consideration was given to a "socio-political" factor to represent the added economic benefit that is seen to arise because of the existence of NQY. The arguments in support of such an additional factor are:

1. Cornwall is relatively remote. A car journey would take some 4 to 5 hours but an allowance of 6 hours would be realistic to allow for congestion and breaks. Rail services take similar total journey time.
2. Residents of Cornwall may want access to a greater number of services than are available locally, for example, medical, financial, cultural, social, educational etc some involving urgency. London clearly provides all such services and is seen to be the major "services" destination
3. Therefore the existence of NQY airport enables air services to be provided to London and such services act as "an umbilical cord" between Cornwall and London. Simply because of the relative remoteness it is sound to have such a cord or link:
    a. for economic reasons for employment and business development
    b. for social and visiting friends and relatives, reasons

c. for medical and personal reasons

d. and even for political reasons to assist inclusiveness

4. Without the air services the remoteness would be increased, business activity would decline and the quality of life in Cornwall for many Cornish residents, would be lessened.
5. What is then the value of this cord? After much discussion this was initially assessed by using the number of people wanting and able to use the link from NQY to London in a year multiplied by the average fare on the route. The average fare was used as it represented what people were prepared to pay. This produce a further benefit of £4.0m (1.2% of the total) which was regarded as an understatement of the value of NQY
6. However, there are other routes served from NQY but these routes only arose once the airport and the "umbilical" link to London was established. Increasing utilisation of the airport facilities is economically sound and provides more potential economic benefit for the region..
7. Therefore the benefit has been based on all the routes from NQY resulting in the following:

Table 6-18: **Socio-political Factor**

Total number of passengers from/to NQY	= 700,000 (equivalent one-ways)
Originating from NQY – 43%	= 301,000
Average one-way fare	= £35*
Socio-political factor benefit	= £10.54m

*Including some very low fares by Ryanair that may be involved and Flybe without in this case, any account of the additional charges.

The benefit figure of £4.0m for NQY-London alone (point 5 above) has been taken into account in the Sensitivity tests given in Section 7.

It is worth noting that an organisation may pay a mileage rate of say, £0.32 per mile for employees using their own car for work purposes. London to Newquay round trip would then cost nearly £200 plus the car's CO_2 emissions.

Economic benefit summary

With the employment data and the information derived from the survey it is possible to develop the assessed economic benefit arising from the existence of NQY. The data relate to 2008.

Table 6-19: **Economic benefit - NQY**

	£m
Direct employment	3.71
Indirect employment	5.12
Induced employment	2.21
BATV	193.50
Business visitor expenditure	30.91
Leisure & vfr traveller expenditure	84.00
Air cargo (see note below)	-
Socio-political factor	10.54
Non- quantified benefits (see earlier paragraph)	-
Total	£329.99m

No additional benefit has been given for the carriage of cargo. Although some cargo is carried – mainly small, urgent items, the amount is small and some of the aircraft types used are not seen to be ideal for cargo operations anyway. This is realistic given the UK regional nature of the route structure. Surface transport is seen to be more appropriate and significantly cheaper.

REFERENCES, NOTES AND SOURCES

1 The Future of Air Transport. DfT 2003

2 www.londoncityairport.com

3 Community and Environment Report 2007. London City Airport Ltd. Annual company accounts and various LCY documentation

4 Timetable for LCY produced by the London City Airport plc

5 Discussions and documentation from LCY

6 The Economic Contribution of the Aviation Industry in the UK. Oxford Economic Forecasting. October 2006. Also London City Airport Planning Study York Aviation 2007. Also The Social and Economic Impact of Airports in Europe. Airports Council International (ACI) and York Aviation January 2004

7 Socio-Economic impact on London City Airport. York Aviation Consulting Group 2006-2007

8 www.londoncityairport.com

9 Socio-Economic impact on London City Airport. York Aviation Consulting Group 2006- 2007

10 Newquay Cornwall Airport Ltd Development Plan November 2008

11 Newquay Cornwall Airport daily "Mayfly" and airline timetables 2008

12 Interview Mr C Cain Project Director Newquay Cornwall Airport June 2007 and local discussions at the airport

13 Newquay Cornwall Airport Ltd Press release January 2009

14 Henley Business School study. Cornwall Enterprise project 2008

15 Interview Mr C Cain Project Director Newquay Cornwall Airport June 2007

SECTION 7

RELATIONSHIP BETWEEN THE ECONOMIC BENEFITS OF AIR TRANSPORT SERVICES AND THE RESULTING LEVELS OF CARBON DIOXIDE EMISSIONS

INTRODUCTION

Section 3 of this research paper outlined the climate change issues and emphasised the gravity of the situation facing the world. Sections 5 and 6 have covered the economic benefits claimed, and found to arise from the operation of air transport services.
This section brings together the economic benefits and the environmental costs of operating air services in terms of aircraft engine emissions, using the work and the surveys carried out at LCY and NQY airports as a basis.

In order to do this the following calculations were made:

- the aircraft fuel burn and consequent CO_2 production from the operation of the services to and from LCY and NQY in a full year -(2008)
- the annual economic benefit arising at LCY and NQY using the economic benefit summaries from Section 6 which were extrapolated for a full year (2008) .

CALCULATION OF AIRCRAFT FUEL BURN AND CARBON DIOXIDE (CO_2) PRODUCTION

Methodology

Data on aircraft fuel burn used for this study have been developed from a number of sources:

- Aircraft manufacturers
- Analysis of specific aircraft operating and performance manuals
- Formulae available to the author (as part of Consultair Associates' work) used in aircraft studies which are derived from aircraft performance data

The fuel burn for each specific aircraft type has been calculated in terms of fuel burn per kilometre. Basic data have been obtained from the Aircraft Operating Manuals of the various aircraft types operating from/to LCY and NQY. These were already available from airline sources or have been provided by the aircraft manufacturer. Samples of the basic data for the Bombardier Dash 8-400 and for the Fokker 50 are shown as examples, in Appendix F.

The formulae considered for the calculation of fuel burn for different aircraft types have been derived from the basic data as described above, which is based upon the actual performance of fuel consumption for the relevant aircraft types. Two basic formulae were initially used:

> For larger jet aircraft particularly on longer routes:
> =(EXP((Distance + Constant C)/Constant A)-1)*Constant B
>
> For smaller jets and turboprop aircraft:
> =(Constant A * Distance) + Constant B

The exponential calculation was at first seen to be appropriate for all the jet aircraft as the height at which the aircraft operates and therefore climbs to, and the significant reduction in the weight of the aircraft as fuel is consumed, all lead to a reducing fuel consumption per kilometre as distance is covered. The second formula more closely reflects a straight line calculation for a constant fuel consumption level. However, after analysing the data using both methods, it was concluded that the shorthaul nature of the routes concerned meant that the difference between use of the two formulae was very little. Using one formula throughout was more practical and hence the "straight line" formula was adopted. This gave an end result which was approximately 2% higher in terms of fuel burn.

The constants used cover the parts of the flight which are independent of the distance flown. These are engine start-up, taxi out, take-off run, initial climb (usually to 1500 feet), final approach (again usually from 1500 feet) landing run and taxi in. The fuel flow for the main part of the flight and hence consumption is dependent upon the distance flown. Formulae used for aircraft evaluation will vary slightly in terms of fuel burn although all are likely to produce answers to within + or – 2%. This has been taken into account in the sensitivity tests set out at the end of this section.

The sector distances for each route operated from and to the two airports have been obtained by initially using the website Great Circle Mapper[1] and these are shown in Appendix I. This provides Great Circle distances but then a further 10% has been added to reflect the additional distance flown on any flight between two points, in order to comply with Air Traffic Control requirements. This is based on actual performance and is regularly applied by airlines as a general rule.

The formula result given in Section 3 for burning aircraft fuel – Jet A-1, of:

1 tonne of fuel burnt = 3.151 tonnes of CO_2

has been used together with the straight line formula described above which includes the sector distance. This enables calculation to be made of the amount of CO_2 produced per flight. This is then applied to the roundtrip and then to each route and the number of services operated on all the routes operated from and to LCY and NQY for the summer and winter schedules for the calendar year 2008 (see summer schedule details given in Section 6).

As stated in Section 3, a multiplier has been applied to the amounts of CO_2 calculated in this study to reflect the full estimate of radiative forcing contributed by aircraft to global warming. The multiplier level of 2.7 has been used as representative of the estimates made by IPCC[2] and others (See Section 3). While it is accepted that scientific evidence for this level of multiplier is inconclusive, studies being carried out currently[3] may show the level to be higher or lower and hence the level used, in the middle of the quoted range, is believed to be reasonably representative. Sensitivity analyses – given later in this section, will be applied to test the effect of using different levels.

Fuel consumption results

The detailed results setting out the annual fuel burn and the CO_2 then created for the flights to and from LCY are given in Appendix G and the same data for flights to and from NQY in Appendix H. However, in summary the data are:

Table 7-1: **Summary of aircraft fuel burn and CO_2 created by air services from and to LCY and NQY in 2008**

Flights to/from	Fuel burnt tonnes	CO_2 created tonnes – 2008 (at 3.151 tonnes per tonne Jet A-1 fuel burnt)	RFI created using 2.7 multiplier tonnes - 2008
LCY	168,999	532,516.30	1,437,794.00

NQY	13,056	41,140.20	111,078.60

ECONOMIC BENEFITS OF AIR SERVICES FROM AND TO LCY AND NQY

The information and data given in Section 6 described the various ways in which the economic benefits were assessed from the operation of air services from and to LCY and NQY. The detailed calculations are provided in Appendices J and K. The benefit tables are summarised below.

Table 7-2: **Summary of Economic Benefits – LCY and NQY**

	LCY £m	**NQY £m**
Direct employment	54.90	3.71
Indirect employment	37.60	5.12
Induced employment	19.90	2.21
BATV - catalytic	2,383.00	193.50
Business visitor expenditure	203.40	30.91
Leisure visitor expenditure	174.40	84.00
Air cargo	-	-
Socio-political	-	10.54
Total	**£2,873.20m**	**£329.99m**

No benefit has been given for the carriage of air cargo as the amount carried is limited. Also no benefit has been given for the location of business companies near to the airports concerned because of the availability of air services. No meaningful data could be obtained although some qualitative information was provided.

THE COST OF CARBON DIOXIDE

The approach put forward at the Kyoto Conference was for "cap and trade" to be used by those companies and organisations responsible for the production of emissions, specifically CO_2. The cost of a tonne of CO_2 is therefore variable and dependent upon market conditions. Current prices are low, partly as a result of high caps, and as a consequence of that, because few companies yet need to trade. This is likely to change and a number of forecasts have been made of possible costs per tonne which are given in table 7.3 below.

It is suggested[4] that many companies will not act to limit CO_2 until the ETS price is high enough to justify investment in appropriate equipment such as carbon capture facilities. A price of around $100 (£55-60) is seen to be sufficient to achieve this[4].

Table 7-3: **Comparative costs of CO_2**

Source	**Possible cost per tonne of CO_2** $	€	£
Department for Transport [4]	24.7		16.5
Stern Report forecast[5]			57
World Resources Institute [6]	20-100		14 - 71
European Climate Exchange[7]			
(Prices as at March 2009*)		12.0	11

* Since then prices have risen slowly and by July 2010 had reached €14.

This shows a considerable range. However, the main point of the "cap and trade" policy is for the cost of CO_2 to steadily increase under market pressures in order to force CO_2 producers to find ways of reducing the pollution. In view of this, forecast levels of UK£25 per tonne and UK£57 per tonne have been used in this study for assessing the relationship between the economic benefit arising and the perceived future cost of CO_2.

The UK Committee on Climate Change suggested in their Aviation Report[8] that the cost of CO_2 per tonne would be £200 by 2050. This figure has not been used in this study since inflation alone is likely to increase the cost per tonne to this level over the next forty years.

Combining the data in Table 7.1 with the price levels used for this study -£25 and £57 per tonne of CO_2, provides the level of CO_2 costs incurred by the operations from and to LCY and NQY.

Table 7.4: **Cost of CO_2 created by the operation of air services from/to LCY and NQY**

Flights to/from	**CO_2 created tonnes**	**Cost @ £25 per tonne £m**	**Cost @ £57 per tonne £m**	**RFI created 2.7 multiplier tonnes**	**Cost @ £25 per tonne £m**	**Cost @ £57 per tonne £m**
LCY	532,516	13.313	30.353	1,437,794	35.945	81.954

NQY	41.140	1.029	2.345	111,079	2.777	6.331

THE RELATIONSHIP BETWEEN THE CALCULATED ECONOMIC BENEFITS AND PERCEIVED COST OF CO_2 CREATED BY THE AIR SERVICES

Taking the summaries of the economic benefits arising from the air services operated from and to LCY and NQY as given in table 7-2 above, with the amounts of CO_2 created by the air services, we can start to identify the relationship. With the perceived cost of CO_2 as given in Table 7-4, it is possible to deduce the relationship between these two factors for the year under study - 2008. This is shown in the following tables:

Table 7-5: **Economic Benefit and the Cost of CO_2**

	Economic benefit £m	**Amount of CO_2 created tonnes**	**Cost of CO_2 £m @£25**	**@£57**	**Co_2 +RFI tonnes**	**Cost of RFI - £m @£25**	**@£57**
London City Airport	**£2,873.200**	532,516.30	£13.313	£30.353	1,437,794.0	£35.945	**£81.954**
Newquay Airport	**£329.990**	41,140.20	£1.029	£2.345	111,078.60	£2.777	**£6.331**

This shows that the economic benefit is greater than the perceived cost of the CO_2 produced as a result of operating the air services, including taking into account the higher level of CO_2 cost and the RFI multiplier.

Table 7-6: **CO_2 relationship to the Economic Benefit**

	Economic benefit £m	**CO_2 cost @ £25 per tonne as % of Economic benefit**	**RFI cost as % of Economic benefit**	**CO_2 cost @£57/tonne as % of benefit**	**RFI cost as % of benefit**
LCY	2,873.20	0.46	1.25	1.06	2.85
NQY	329.99	0.31	0.84	0.71	1.92

The following table shows what CO_2 would <u>need to cost</u> in order to match the level of economic benefit:

Table 7-7: **CO_2 price to match the Economic Benefit**

	CO_2 price to match the economic benefit £	**CO_2 +RFI price to match the economic benefit - £**

London City Airport	5,396 per tonne	1,999 per tonne
Newquay Airport	8,021 per tonne	2,971 per tonne

Assessing the results

While it is evident that the economic benefit exceeds the perceived cost of CO_2 for both airports and in all cases, the results need to be assessed in some meaningful way. The study has therefore developed an Environmental Ratio (ER) which may help to put the results into context in terms of the extent to which they are economically significant.

The ER can be calculated for a specific airport or for an individual airline route. The basis and the assessment criteria for the ERs are covered further in Section 10 and the methodology for producing ERs is detailed in Appendix N. The assessment is obtained simply by taking the ratio of the economic benefit divided by the cost of the CO_2 created by the flights operated either from and to the specific airport or on the individual airline route. Obviously the higher the resulting ratio the more economically significant is the airport or airline route. The results are then set against predetermined criteria.

Table 7-8: **Environmental Ratios - ER**

	Economic benefit £m	**CO_2 cost at £57/tonne £m**	**Airport ER**
LCY	2,873.2	30.35	94.7
NQY	330.0	2.35	140.7

The reason for the higher results for NQY reflects the large number of services from/to the airport operated by turboprop aircraft which generally produce less CO_2 emissions.

It is suggested that airport and airline managements may be interested to establish their "green credentials" by calculating airport or airline route ERs. However, criteria are needed to enable a full assessment to be made. The study suggests that the UK Civil Aviation Authority might be interested in assessing airport and airline route environmental credentials and therefore the following scale is put forward for assessing the results. This is initially stated here in order to help assess the results for LCY and NQY.

Table 7-9: **Suggested Criteria for Environmental Ratios***

ER Level	**Approval Action**
> 100	Strongly support
50 – 100	Support
25 – 50	Further economic justification required
< 25	Air service operations not supportable on economic benefit grounds

* See Section 10 for further consideration of the criteria and further examples.

So in the case of both the airports examined in the study, the results against these criteria show that the air services operated from and to LCY and NQY should be supported because of the significance of the level of economic benefits arising.

This aspect is considered further in Section 10.

SENSITIVITY TESTS

In order to test the research results a number of sensitivity analyses have been applied as shown below. Examination of the economic benefits established for each location shows that the level of BATV (Business Air Travel Value) is the most significant factor followed by the expenditure by the business travellers and then the expenditure by the leisure and visiting friends and relatives segment. Each of these factors are considered separately and then considered together.

Examination of the levels of CO_2 created shows that the rate of fuel burn and the RFI applied are the most significant factors. Each of these is considered separately and in the RFI case the multiplier level is considered both at a higher (4.0) and lower, level (1.2). In each case all other factors remain unchanged.

Table 7-10: **Sensitivity Tests**

A. If BATV was 10% or 25% lower what effect would this have?

Economic Benefit			Cost of	Cost of
Initial	-10%	-25%	CO_2	CO_2 +RFI

		on level of BATV		@£57/tonne	@£57/tonne
LCY	£2,873.20m	2,635m	2,277m	30.4m	82.0m
NQY	£329.99m	304.6m	282.0m	2.3m	6.3m

Result = No significant difference

B. If Leisure and vfr expenditure was lower by 10% or 20% what effect would this have?

	Economic Benefit			Cost of	Cost of
	Initial	-10%	-20%	CO_2	CO_2 +RFI
		on level of leisure expend		@£57/tonne	@£57/tonne
LCY	£2,873.20m	2,856m	2,838m	30.4m	82.0m
NQY	£329.99m	322m	314m	2.3m	6.3m

Result = No significant difference

C. Taking both A and B above together what effect would this have?

	Economic Benefit			Cost of	Cost of
	Initial	-10%	-25%*	CO_2	CO_2 +RFI
		on BATV & leisure expend		@£57/tonne	@£57/tonne
LCY	£2,873.20m	2,618m	2,242m	30.4m	82.0m
NQY	£329.99m	303m	266m	2.3m	6.3m

* -20% on leisure/vfr expenditure

Result = No significant difference

D. If fuel burn levels were 10 or 20% higher what effect would this have?

	Initial Economic Benefit	Cost of CO_2 @£57/ /tonne with fuel burn		Cost of CO_2 @£57 /tonne +RFI with fuel burn	
		+10%	+20%	+10%	+20%
LCY	£2,873.20m	£33.4m	36.5m	90.2m	98.4m
NQY	329.99m	£2.5m	2.8m	6.9m	7.6m

Result = No significant difference

E. If RFI level of 2.7 was increased to 4.0 what effect would this have? Or if the RFI multiplier was reduced to 1.2 what effect would this have?

	Initial Economic Benefit	Cost of CO_2 + RFI @£57/tonne		
		Initial	Multiplier = 4.0	Multiplier = 1.2
LCY	£2,873.20m	82.0m	121.4m	36.4m
NQY	£329.99m	6.3m	9.4m	2.8m

Result = No significant difference

F. Taking both C (with 25% reduction in BATV plus 20% reduction in leisure and vfr expenditure) and E (Multiplier at 4.0 only) together what effect would this have?

	Economic Benefit		Cost of CO_2 +RFI @£57/tonne	
	Initial	-25%*	Initial	Multiplier = 4.0
LCY	£2,873.20m	2,242m	82.0m	121.4m
NQY	£329.99m	266m	6.3m	9.4m

* -20% for leisure and vfr expenditure
Result = No significant difference

G. If the cost of CO_2 per tonne was increased to £80/tonne what effect would this have?

	Economic Benefit Initial	Cost of CO_2 Initial @£57	Cost of CO_2 @£80/tonne	Cost of CO_2 +RFI @£80 /tonne
LCY	£2,873.20m	30.4m	42.7m	115.2m
NQY	£329.99m	2.3m	3.2m	8.8m

Result = No significant difference

H. A number of alternative – lower, levels were described in the details concerning the economic benefit for NQY. The economic benefit is re-assessed below with only those business travellers who would not have travelled to NQY without air services included for their expenditure (£5.1m in place of £30.9m) and similarly for the leisure / vfr travellers (£23.3m in place of £84.0m). What would be the effect? Also if only NQY-London travellers and the route's average fare were applied in determining the socio-political factor (£4.0m in place of £10.54m) what would be the effect?

	Economic Benefit Iniitial	Revised Economic benefit	Cost of CO_2 + RFI @ £25	@£57 / tonne
NQY	£329.99m	£237.0m	£2.77m	£6.33m

Result = No significant difference

Consideration was given to reducing the BATV level by 50% but this would make no difference to the result and there appeared to be little justification for such a reduction.

Sensitivity test results

The results of the sensitivity tests show that even in the most extreme cases the levels of economic benefit considerably exceed the perceived cost of the CO_2 emitted as a result of the flights operating on the two routes. This applies equally with use of the highest price used (£57 per tonne) and with the 2.7 multiplier.

REFERENCES, NOTES AND SOURCES

1 Web site http://gc.kls2.com

2 IPCC – United Nations Intergovernmental Panel on Climate Change – Working Group Report "The Physical Science Basis" 2007

3 Radiation and Climate Group: Reading University in collaboration with Omega Project and Cambridge University 2008

4 Aviation emissions cost assessment 2008 Department for Transport 2008

5 Stern Report: The Economics of Climate Change. HM Treasury October 2006

6 World Resources Institute, Washington 2008

7 European Climate Exchange www.ecx.eu

8 UK Committee on Climate Change's Aviation Report. Meeting the UK Aviation Target – options for reducing emissions to 2050. December 2009

SECTION 8

AIR TRANSPORT MARKET ELASTICITY AND ASSESSMENT OF THE IMPACT OF FURTHER TAXATION ON AIR TRANSPORT SERVICES

AIR TRANSPORT MARKET DEMAND

The previous section showed that the economic benefit derived from the operation of air services from and to LCY and NQY considerably exceeded the perceived cost of the CO_2 created by the operation. While the contribution to the local economies is not highly significant it was seen to be sufficient to justify air transport's classification as "important for the local economy".

If that is the case then local authorities will want to continue to support the air services. Both Cornwall Council[1] and Newham and the other London boroughs around LCY have all confirmed[2] that they view their local airport as important.

Air transport demand elasticity

Section 3 set out the extent of taxation of air travel including APD and also an estimate of the ETS costs. This concluded that if these costs were all passed on to the passengers then this could add considerably to the passenger's fare. So what effect might this potential increase have on demand for the airlines' products? Airlines have used elasticity studies to examine fare changes in the past and so considerable literature exists. However, while these are of general use, precise measurement has always proved difficult. Appendix L lists a number of elasticities derived from studies over the past thirty years.

The questionnaire used at LCY and NQY included questions to elicit likely responses to fares increases. Passengers were asked about air fares increases of +10%, +50% and +100% arising from possible increased levels of taxation of air travel. The resulting elasticities were based on a sample over one week only but produced the following levels:

Table 8-1: **Elasticity Co-efficients**

London City Airport business travellers	-0.4

London City Airport leisure and vfr passengers	-1.2
Newquay business travellers	-0.4
Newquay leisure and vfr passengers	-1.5

Appendix L demonstrates wide variations simply because precise accuracy is difficult as demand elasticity will vary by time of day, day of week and month of year. However, all the data confirm that demand responds to changes in price. It is therefore realistic to use elasticity co-efficients to assess likely market response to the increase in fares due to the changes in taxation levels. As the levels in the table above are quite representative of all the measures arising from other, albeit more comprehensive studies, this study has therefore used the levels obtained from the surveys carried out at LCY and NQY.

Air travel taxation

Section 3 described the taxation currently applied to air journeys from and within the UK; that is Air Passenger Duty - APD and the likely cost of ETS for air passengers. In summary these are:

Table 8-2: **Summary of total potential impact of increased taxation.** (NOTE this excludes any airline administration costs). Short haul routes from UK.

Column 1	2	3	4
FUTURE APD UK £ (Nov 2010)	INCREASE OVER 2008 UK£	POSSIBLE ETS CHARGE UK£	POSSIBLE TOTAL INCREASE UK£
12 (a)	+2	2.80 (c) – 100 (d)	4.80 - 102
24 (b)	+4	2.80 (c) – 100 (d)	6.80 - 104

a = Economy fares
b = Business class fares
c = Lowest likely ETS charge per pax with minimum number of credits needed
d = Probably the highest ETS charge per pax likely with maximum number of credits needed

Source: Internet, DfT, Budapest Conference on Aviation Emissions, Merrill Lynch and the Author.

As described in Section 3 the percentage increase in relation to the fares used as examples, was found to range from 0.6% to 112.5%. In view of this considerable range, the analysis of the effect on demand has used a range of possible increases to encompass the levels shown in Column 4 of Table 8-2 above. These increase levels are:

£10 £20 £50 £80

The impact assessment therefore is based on these increases for both economy class and business class

Elasticity calculations

Using the elasticity co-efficient details from Table 8-1 above, the study can use the increase in air fares due to increased taxation and ETS in order to establish the potential fall in traffic. The formula is:

$$\text{Elasticity } \sum = \frac{\text{\% change in traffic volume}}{\text{\% change in price}}$$

However, for this we need to determine average fares from LCY and NQY as base line fares. This raises some difficulties and the range of one-way fares available on the Newquay – London route alone, illustrates the problem.

Table 8-3: **Comparative one-way air fares Newquay – London**[3]

Ryanair to Stansted	BA to Gatwick	Southwest Airways to Gatwick	Flybe to Gatwick
£nil*-upwards	£180 - 260	£29 - 163	£12 – 33*

* available at certain times only and under certain booking conditions. Additional charges are levied for some or all supplementary services such as carriage of checked baggage, personal check-in services and acceptance of credit cards for payment.

Overcoming this has been achieved by using specific routes from each location:

- taking the fully flexible fares as appropriate for business travellers
- taking the average of a selection of lower fares as appropriate for the leisure and vfr passengers
- the fares are net as most airlines no longer pay commission to agents in the UK.

The details involved in calculating the average fares are given in Appendix M with the following results:

Table 8-4: **Average Round-trip Fares from LCY and NQY.**

All shorthaul within Europe

From LCY:	Routes <500kms	Routes > 500kms	
Average business class fare	£500	£560	
Average leisure/vfr passenger fare	£161	£181	

From NQY:			
Average business class fare (est)	£300*	£450*	*(Estimated as few business class services available)
Average leisure/vfr passenger fare	£120	£230	

However, the level of general inflation needs to be taken into account when considering the effect of APD plus ETS increases. Earlier studies carried out by the author into airline price increases[4] found that small fares increases were generally accepted by passengers as "inevitable" particularly if these were close to RPI levels, and hence as a result, the fall in traffic was only small. In 2008 RPI was 1.3% which included some abnormal elements such as low mortgage interest rates, which exerted a strong downward effect. In order to counteract this for the purposes of this study, the RPI was artificially but realistically, doubled to 2.6%.

Therefore the increase in fares for the purpose of assessing demand elasticity has been adjusted to reflect the artificial inflation increase. Table 8-5 shows the levels of fares increases from the APD increases and ETS introduction, with percentages and with the increase percentage levels adjusted for inflation by subtracting the inflation increase of 2.6%. No negative adjustment – that is, reduction in fares was assumed. For example, the possible fares increase on routes from LCY of £10 on the average fare on the routes of less than 500 kms is 2%. This is adjusted for inflation by subtracting 2.6% and therefore leaving the fare unchanged.

Table 8-5: **Fares increases from increased APD plus ETS adjusted for inflation effect (-2.6%)**

Average RT Fares	Percentage of possible fares increase on average fares £10	£20	£50	£80
LCY				
Business fares (C)				
<500kms £500	2.0	4.0	10.0	16.0
Adjusted	***nil***	***1.4***	***7.4***	***13.4***
>500kms £560	1.8	3.6	8.9	14.3
Adjusted	***nil***	***1.0***	***6.3***	***11.7***
Leisure fares (Y)				
<500kms £161	6.2	12.4	31.1	49.7
Adjusted	***3.6***	***9.8***	***28.5***	***47.1***
>500kms £181	5.5	11.1	27.6	44.2
Adjusted	***2.9***	***8.5***	***25.0***	***41.6***
NQY				
Business fares (C)				
<500kms £300	3.3	6.7	16.7	26.7
Adjusted	***0.7***	***4.1***	***14.1***	***24.1***
>500kms £450	2.2	4.4	11.1	17.8
Adjusted	***nil***	***1.8***	***8.5***	***15.2***
Leisure fares (Y)*				
<500kms £120	8.3	16.7	41.7	66.7
Adjusted	***5.7***	***14.1***	***39.1***	***64.1***
>500kms £230	4.3	8.7	21.7	34.8
Adjusted	***1.7***	***6.1***	***19.1***	***32.2***

*Excluding Ryanair very low fares eg zero and close to zero, as additional charges are applied.

The following Table 8-6 illustrates the process then followed.

Table 8-6: **Illustration of the Calculation of Potential Traffic Loss**

LCY Business travel elasticity $\sum$ = -0.4
Average fare <500kms = £500
For increase of £20, new fare = £520 which = +4%

Using the details shown in Table 8-5 of the fares increases adjusted for inflation of 2.6% (i.e. for £20 the percentage increase is reduced from 4% to 1.4%. Therefore:

$\sum$ calculation is $-0.4 = \frac{x}{+1.4}$ $x = -0.6$

Potential traffic loss is therefore 0.6%

LCY Leisure traffic $\sum$ = -1.2
Average fare <500kms = £161
For increase of £20, new fare = £181 which = +12.4%

From Table 8-5 the percentage fares increase is reduced from +12.4 to +9.8 (i.e. adjusted by inflation level 2.6%) Therefore:

$$\sum \text{ is } -1.2 = \frac{x}{+9.8} \qquad x = -11.8$$

Potential traffic loss is therefore -11.8%

Calculating the traffic loss

Using the elasticity formula with the adjusted fares increases from Table 8-5 the potential loss of passenger traffic can then be determined as illustrated in Table 8-6. The results are as follows:

Table 8-7: **Calculated traffic loss from increased taxation**

From LCY:		% loss of traffic			
	Fares increase	+£10	+20	+50	+80
Business travellers: Routes	<500km	nil	-0.6	-3.0	-5.4
	>500km	nil	-0.4	-2.5	-4.7
Leisure/vfr passengers	<500km	-4.3	-11.8	-34.2	-56.5
	>500km	-3.5	-10.2	-30.0	-49.9
From NQY:					
Business travellers: Routes	<500km	-0.3	-1.6	-5.6	-9.6
	>500km	nil	-0.7	-3.4	-6.1
Leisure/vfr passengers	<500km	-8.6	-21.2	-58.7	Almost all at risk
Leisure/vfr passengers	>500km	-2.6	-9.2	-28.7	-48.3

The results suggest that relatively little business travel might be lost until significant increases start to occur, that is £50 and more. Leisure and vfr traffic would appear to decrease with even relatively small increases, that is £10 and more. The likely loss of leisure and vfr traffic when increases of £20 or more occur appears to be considerable. One source[5] quotes a UK DfT spokesperson as saying that the DfT model shows that once surcharges reach £75 then demand is heavily reduced, possibly to around half. The analysis above supports such a statement so far as leisure and vfr traffics are concerned.

However, in order to make further use of the potential loss of traffic in the business and leisure/vfr segments, it is necessary to combine the data - in this way an assessment can be made of the impact on the routes from each of the airports. This has been done by taking the split of traffic between business and leisure/vfr for each of the airports to obtain a weighted potential loss of traffic. The details are shown in Table 8-8

Table 8-8: **Calculation of Weighted Average Traffic Loss**

LCY		Loss of traffic		Proportions Bus/ Leisure	Weighted traffic loss
Fares increases		Business travellers	Leisure/vfr travellers	%	
Routes <500kms	£10	nil	-4.3	60/40	-1.73
	£20	-0.6	-11.8	60/40	-5.00
	£50	-3.0	-34.2	60/40	- 15.46
	£80	-5.4	- 56.5	60/40	- 25.82
Routes >500kms	£10	nil	-3.5	60/40	-1.39
	£20	-0.4	- 10.2	60/40	-4.32
	£50	- 2.5	-30.0	60/40	-13.51
	£80	- 4.7	-49.9	60/40	-22.78
NQY					
Routes <500kms	£10	-0.3	-8.6	40/60	-5.24
	£20	- 1.6	- 21.2	40/60	-13.35
	£50	- 5.6	- 58.7	40/60	-37.45
	£80	- 9.6	- 96.2	40/60	-61.55
Routes >500kms	£10	nil	- 2.6	40/60	-1.53
	£20	- 0.7	-9.2	40/60	-5.78
	£50	- 3.4	- 28.7	40/60	-18.55
	£80	- 6.1	- 48.3	40/60	-31.41

THE EFFECT OF PASSENGER TRAFFIC LOSS ON AIRPORTS

The effect of traffic loss is damaging for airport companies. While airlines are able to cease operations to an airport and possibly switch most of the resources involved to other routes, the airport company cannot do this. The threat of demand reduction through increased taxation is considerable, as the airport company is entirely reliant upon its customer airlines. If some of these chose to withdraw services the airport company will suffer.

Measures to reduce costs can be introduced with the objective of providing some reduction in airport charges to encourage the airline not to suspend services to the airport. Such action clearly worsens the airport company's financial position. Measures may be taken to encourage new airlines to start services to the airport but if these are unsuccessful then staff redundancy may well become necessary if the airport company is to survive. The positions of both LCY and NQY and their surrounding areas are specifically addressed in Section 11.

THE EFFECT OF PASSENGER TRAFFIC LOSS ON AIRLINES

The amount of passenger traffic lost for any given airline route impacts upon airline revenue, load factors and unit costs, which together will generally reduce profitability. The airline industry's profit margin levels were described in Section 4 as rarely above 4% over the past decade and currently negative. The effect therefore of increased taxation will worsen individual route results, but then consequently the overall airline results also because any reduction in route frequencies and/or the elimination of routes will have the effect of:

- reducing revenue
- creating surplus aircraft capacity
- creating surplus overhead costs

with the result that in all cases the airlines are likely to suffer further reductions in profitability.

The profit margin levels can be demonstrated using route Operating Ratios. These are calculated as:

$$\frac{\text{Revenue} \times 100}{\text{Costs}} = \text{OR (Operating Ratio)}$$

Clearly an OR in excess of 100 indicates a profitable route. In order to earn a return sufficient to sustain and develop the business, airline managements aim for levels around 110. However, CAA statistics for all UK carriers in 2008[6] showed total airline ORs of 101.2.

Examination of the data available[7] for the airlines that operate from/to LCY and NQY suggest Operating Ratios for these routes as being in the following ranges:

Table 8-9: **Possible Airline Operating Ratios on routes from/to LCY and NQY**

	%
LCY routes	104 - 108
NQY routes	102 – 108

In discussions with airline managers these possible levels were confirmed as "realistic, but optimistic". They are relatively poor, partly because shorthaul airline unit costs are higher than those for longhaul operations as a result of a number of factors including:

- lower aircraft utilisation
- lower economies of scale from use of smaller aircraft operating higher frequency levels to meet business traffic demand
- more time on the ground
- more time at lower altitudes
- shorter commercial day

The effect of the loss of passenger traffic as set out above (Tables 8.7 and 8.8), can be assumed to result in an equivalent fall in revenue, leading to a decline in Operating Ratios. An index approach has been used to demonstrate the position; for example with an OR of 104:

With an OR of 104 and a Revenue index of $\frac{100}{96} \times 100 = 104$
the Cost index is

As has already been described airline profitability is poor with the result that airline managements regularly review routes that fail to provide an acceptable return. Where passenger traffic declines, a small reduction in costs arises simply due to lower passenger costs for example, airport handling and catering costs. However, if traffic decline is more serious and seen to be permanent, discussions with airline managers suggest that the airlines operating such routes would:

- reduce the frequency of services or
- cease to operate the services during off peak periods such as the winter period or
- cease to operate the route altogether
- operate a smaller aircraft type or variant (if available).

To make a realistic assessment, which arose from discussions with airline managers, the following cost reduction rules have been developed and applied. The rules are generalised but are initially based on the proportions of Direct, Indirect and Fixed Costs appropriate for shorthaul operations.

- Where traffic loss reduces passenger load factors to around 60% but the service frequency is maintained, a small decrease in route total costs is assumed to arise. This is simply due to the lower number of passengers. The decrease applied, based on discussions with airline managers, is 5%
- Where service frequency cannot be maintained and a limited reduction takes place, route total costs are reduced by two-thirds of the percentage reduction in frequency. For example, if frequency is reduced from daily to 5 services per week (29%), the cost reduction is 66.67% of 29% = 19%
- Where service frequency is radically affected and services are reduced by half or more, the cost reduction is 75% of the percentage frequency reduction

This approach is seen to be reasonable for the short and medium term but in the longer term, if the airline was determined to maintain the route then a smaller aircraft type would need to be used – assuming such aircraft were available.

So in order to assess the effect of taxation increases at route level in the short term the amount of the fall in revenue has to be determined whilst at the same time, the likely airline response through cost reductions also needs to be taken into account. As a result both revenue and cost parts of the OR equation will change.

The following table – Table 8-10 illustrates the way in which the cost rules above have been applied.

Table 8-10: **Illustration of the application of the cost reduction rules**

Using LCY routes of less than 500kms with an initial OR level of 104 and with a fares increase of £50 the following steps are taken:

Step 1: Original OR situation is Revenue of 100 x 100 = OR 104
Costs of 96

Step 2: Revenue loss from Table 8-8 is -15.5%
Revenue is therefore 84.5 = OR 88.0
Costs are still 96

Step 3: Traffic loss is such that the Load Factor falls to around 60% and costs are therefore reduced by 5%
Revenue is still 84.5 = OR 92.7
Costs are now 91.2

After making both revenue and cost adjustments the resulting ORs obtained are shown in Table 8-11.

Table 8-11: **Airline Operating Ratios on routes from/to LCY and NQY reflecting the effect of further taxation and implementation of ETS**

LCY routes with initial OR = 104				
With fares increase of:	**£10**	**20**	**50**	**80**
<500 kms. New OR =	102.4	99.0	92.7	95.4
>500kms. New OR =	102.7	99.7	95.1	99.2
LCY routes with initial OR = 108				
With fares increase of:	**£10**	**20**	**50**	**80**
<500kms. New OR =	106.3	102.7	96.1	99.1
>500kms. New OR =	106.6	103.5	98.4	99.2
NQY routes with initial OR = 102				
With fares increase of:	**£10**	**20**	**50**	**80**
<500 kms. New OR =	96.7	88.4	78.7x	69.7x
>500kms. New OR =	100.5	96.1	92.3	86.4x

NQY routes with initial OR = 108

With fares increase of:	**£10**	**20**	**50**	**80**
<500kms. New OR =	102.5	93.6	83.4x	72.7x
>500kms. New OR =	106.5	101.8	92.6	91.6

x = services likely to be withdrawn immediately or the aircraft type changed – if available.

This suggests that on average the routes operated from LCY would;

- achieve less profit with a £10 imposed increase on routes both less than and more than 500kms
- lose steadily with higher increases where the original OR was 104
- lose once the increase reached £50 where the original OR was 108
- however, under the assumptions used, few of the routes appear likely to become untenable in the short run

The table suggests in the case of NQY, that on average where the OR was 102

- the routes of less than 500kms would all become loss making, even with the increase of £10
- these routes would be likely to be seen as untenable when the increase reached £50 and £80
- the routes of greater than 500kms would become unprofitable once the increase reached £20 with routes likely to be untenable with an increase of £80

In the case of NQY where the original OR was 108

- the routes of less than 500kms would start to lose money with increases of £20
- these routes would be likely to be seen as untenable when the increase reached £50 and £80
- the routes of greater than 500kms would achieve less profit with increases of £10 and £20 and would be unprofitable with higher increases

The figures in Table 8-11 do not however, allow for any increase in the prices charged for alternative means of travel which might influence the traveller's decisions. However, even in the medium term, for example two years, it is unlikely that airline managements would continue to operate services with ORs at levels below 90.

DEMAND CONSTRAINT ASSESSMENT

The UK Committee on Climate Change[8] has proposed, as mentioned earlier, that UK air transport growth should be limited to 60% in the period from 2005 to 2050. This would be a target figure with APD and ETS providing the instruments by which this might be achieved. The report does however, suggest that this growth constraint could be eased if the air transport industry successfully reduces emissions.

The paragraphs above show that for some airlines or for some airports or for some airline routes, the possible increases in fares due to increased taxation – particularly at the higher levels examined, will be sufficient to reduce demand but will result in some routes becoming unviable.

So how damaging is that?

If frequencies are reduced or routes terminated by airlines, the effect is likely to be considerable for the airport companies and their staff. The effect can be described as "serious".

In turn the effect on the local economies will be considerable. This will arise not only from reduced direct, indirect and induced employment benefits but also from reduced BATV benefits and from reduced visitor expenditure.

The effect on airlines is harder to assess. For a larger airline, cutting out a losing route or one that becomes a loss maker, could result in an overall financial improvement. However, even to achieve this would require careful "management" involving:

- reduction in overhead costs
- disposing of aircraft and other assets found to be surplus
- reduction in staff – possibly through redundancy
- the loss of synergy – that is, feed of traffic from one route to another
- re-assessing aircraft orders with possible cancellation penalties

The question arises of which routes would be eliminated? Obviously those that are unprofitable or only marginally profitable or those that enable a whole station to be closed, such as NQY.

The necessity to close routes and achieve the managerial changes listed above, suggests that for airlines too, the increases in fares arising from increased taxation would be serious.

REFERENCES, NOTES AND SOURCES

1 Building a better future. Planning and development document. Newquay Cornwall Airport 2008

2 London City Airport Master Plan November 2006

3 Airline web sites and Newquay Cornwall Airport web site

4 Various studies on increasing airline prices. British European Airways and British Airways internal papers 1976 – 1985 (Not publicly available)

5 The Final Call. Leo Hickman. Eden Project Books 2007

6 Civil Aviation Authority data for "Other UK carriers" 2008

7 Derived in part from data from Civil Aviation Authority annual returns including UK Airlines revenue and profits 2008/09

8 UK Committee on Climate Change's Aviation report "Meeting the UK aviation target. Options for reducing emissions to 2050" December 2009

SECTION 9

REGULATORY AND LEGAL ASPECTS

INTRODUCTION

In Section 3 evidence was given of EU/UK governments' intentions to restrict air travel in order to reduce CO_2 emissions. Many of the points referenced were statements with little quantification. However, the details proposed by the UK Committee on Climate Change in its paper "Meeting the UK Aviation Target"[1] are clear – that is, air transport growth should be limited to 60% over 2005 level to 2050. Some reservations are contained in the report, primarily that the limitation could be raised if faster progress is made to reduce emissions.

However, as suggested earlier, the instruments to be used to achieve this are the UK APD plus the EU ETS. Therefore achieving the stated objective is to be by market means – in this case carbon trading under ETS rules, with resulting fares increases expected to depress demand. Some airlines have urged that APD be withdrawn when ETS comes into effect but no decisions have been made on this so far.

REGULATORY AND LEGAL CONTROLS

The analysis presented in Section 8 suggested that the impact of APD plus ETS would be considerable and damaging for some market segments on some routes. Use of the market to achieve economic objectives is however, likely to provide inconsistencies with some airports, some airlines or some airline routes experiencing higher impact levels than others.

What if APD plus ETS are perceived to have insufficient effect?

With carbon trading at a price of around €10-15 per tonne at present, it is possible that only the lowest price increases used in the earlier analyses (that is, £10 and £20 per passenger) will apply in the initial years from 2012. While this might not be unwelcome to airports and airlines the question has to be considered "might EU/UK governments seek additional powers in order to depress air travel demand?" simply to ensure environmental targets are met. In the case of UK, the Climate Change Act of 2008 gives wide ranging powers to the government, should existing measures to reduce CO_2 emissions be seen as inadequate. Measures that could be considered by the UK alone include:

- Further increases in APD
- Tax on jet fuel
- Further imposition of ceilings for air transport movements – ATMs, at major airports

Further increases in APD

The demand elasticity calculations covered in Section 8, suggest that APD increases are effective. Even though at present, longhaul routes are bearing a greater burden, demand from leisure, vfr and other non –business market segments on shorthaul routes are likely to be impacted. Further increases would reduce demand. Charging airline premium passengers higher rates of APD on the grounds that "the market can bear it" will increase the tax income but other points have to be taken into consideration. If non-business market segment demand is reduced by APD plus ETS, airlines may not have sufficient traffic volume to enable them to maintain frequency of service or aircraft size. Even though some of the higher yielding traffic may remain, the total volume may not be sufficient to operate the same frequency level or to obtain the economies of scale needed to achieve route viability.

Tax on jet fuel

This has been proposed in the past but has proved to be legally difficult. All EU members are signatories to the Chicago Convention of 1944 which took place shortly before the end of World War II to co-ordinate the development of international air transport. Because international flights by definition cross borders, it was agreed at the Convention and subsequently agreed by ratifying states, that aircraft fuel should be "duty free". To tax aircraft fuel used for international journeys now, would probably require further EU/UK legislation[2] before an "opt-out" from the relevant clauses could be achieved. If other governments did not take similar action, UK or EU airlines would be made uncompetitive by the imposition of such a tax on aircraft fuel.

Imposition of a ceiling for Air Transport Movements

Limiting the number of take-offs and landings at major airports would clearly help to limit air traffic growth. Such a measure would not increase tax revenue but would:

- reduce the number of seats available for sale on some routes
- possibly lead to increased air fares as a result of less competition. Airlines might buy bigger aircraft to overcome the limited slot availability
- possibly lead to airlines dropping their financially weakest routes
- limit the number of runway slots available. The allocation of slots to airlines would become harder, particularly for any new entrant airlines

There are already caps on ATMs at some UK airports, mainly for noise limitation reasons but there are no stated plans for such action by the UK Government as a means for reducing demand at present. However, it is accepted that such a measure could be used if currently proposed measures to reduce CO_2 emissions are found to be unsuccessful.

DE-REGULATION POLICY

Background

The current international commercial air transport policy adopted by the EU and UK is based on the removal of regulatory constraints and the maximisation of fair and equal competition[3]. Under a fully liberalised Air Services Agreement (commonly known as a bilateral agreement), this means that in normal circumstances an airline based outside the EU and designated by its government to fly an international route to the EU is allowed to mount whatever frequency and seat capacity it wishes on the routes concerned and also to charge what fares it wishes. In such a situation competition is the main determinant of pricing.

However, many governments have not accepted such "open skies" policies and some routes from/to EU/UK remain restricted in some form or another. It is expected[4] that de-regulation policies will spread across the world over the next decade.

The intended results of open skies are:

- new airlines entering the market creating ....
- more competition leading to ....
- more air services and ...
- lower air fares

Is there a conflict of policies?

On the one hand de-regulation is designed to lead to increased air services, more competition and lower fares; on the other hand EU/UK environmental policy is aimed at reducing air services through increased taxation to depress demand. The UK government however, believes that "open skies" policies can continue but must be fulfilled within the EU environmental framework[5]. Increased APD plus ETS will lead to air fares increases which are expected to depress demand which in turn may deter new start-up airline companies or may lead to the least efficient airlines closing down and leaving the marketplace.

With this approach it could be said that the de-regulatory policy has not changed but that it is modified or influenced by the over-riding environmental policy. Greater competition and lower fares create financial pressures for incumbent carriers. However, environmental policies may impose more costs for such airlines but may also result in less competition. Airlines could therefore benefit. Airport companies on the other hand, with less flexibility may experience less passenger throughput and less air services and therefore less revenue.

IMPACT OF ENVIRONMENTAL POLICIES TOWARDS AIR TRANSPORT ON OTHER, NON-EU COUNTRIES

In Section 4 details were given of the importance to selected countries of inbound tourism (Table 4-1). Also, in Table 4-2 a random sample of imported (to the UK) fresh fruit and vegetables was given.

It is accepted[6] that global warming is a global matter – it would not therefore be globally beneficial if one country met all its GHG emissions targets at the expense of other countries. Consideration must therefore be given to the UK policy of limiting air transport growth in terms of its impact on tourist receiving countries such as Cyprus, Thailand, Egypt, Barbados, Spain etc, and on fresh fruit and vegetable exporting countries such as Kenya, Mexico, Morocco, Peru etc. Deliberately increasing air fares through greater taxation in order to depress demand could be seen as "blatant protectionism" by countries whose GDP's are significantly reliant upon tourism or fruit and vegetable exports. On the other hand the increased air fares could also lead to a transfer of tourists from say Thailand to Turkey resulting in less "tourist travelled miles" and therefore less CO_2 emissions plus an improvement in the Turkish economy but a worsening of Thailand's economy. Conversely efforts to constrain the number of air travellers might lead to tourist receiving countries increasing the air services operated by their national carriers. By offering bigger discounts they would continue to receive tourists, adopting the view that the benefit to their economies from tourism far outweighed any airline losses, even when these are partly caused by ETS costs. Many tourists buy "packages" and the total price may be a more important demand determinant than simply the air fares component plus APD and ETS.

Clearly this might not help efforts to reduce CO_2 emissions. It does suggest however, that the EU/UK policies should not be seen as isolationist although it may lead to conflicts with some developing countries. In such cases it is likely that more aid support might be requested.

Carbon Leakage

The EU and UK policies to reduce CO_2 emissions have already been described in Section 3. Carbon leakage may occur where a strict climate policy in one country, such as the EU ETS, leads to an increase in CO2 emissions in another country. This can occur if environmental policies lead to increased costs making local businesses less competitive than similar companies in another country where environmental policies are more liberal. In turn this may cause some companies to re-locate their production to a country where their costs will be lower and the environmental constraints less.

It is possible that EU airlines may find non-EU carriers encouraging passengers to travel to the Far East or Australia via their home base outside EU – for example, Gulf carriers. This may cause increases in CO_2 emissions in those countries. On the other hand any ETS costs charged to passengers by such airlines will be lower in comparison with ETS charges made by the EU carriers as the ETS charges will only apply to the first sector to the Gulf.

REFERENCES, NOTES AND SOURCES

1 UK Committee on Climate Change, Aviation Report. Meeting the UK Aviation Target – Options for reducing emissions to 2050. December 2009

2 Discussions with UK CAA April 2010

3 UK Civil Aviation Act

4 IATA AGM Kuala Lumpur report July 2009

5 Discussions with UK CAA April 2010

6 UK House of Commons Transport Committee report "The future of Aviation" December 2009

SECTION 10

FURTHER APPLICATION OF SELECTED PARTS OF THE STUDY METHODOLOGY

INTRODUCTION

This study has involved particular methodology to determine the economic benefits of air transport on a regional basis and to compare this with the perceived cost of the CO_2 emissions produced by the air services involved. Consideration is now given to how some of the methodology might be applied to other research. Also how it might be used by airports and airlines as they seek to determine or to show, the economic value of their airport or of some of their specific routes, in comparison with the emissions created.

The elements that are appropriate are:

- Assessment of the economic benefit of air services, particularly involving the use of time saving as the basis for the catalytic benefit from business travel
- Calculation of the cost of CO_2 emissions from different aircraft types operating scheduled services from specific airports
- Assessment of the resulting comparison between the two elements above using appropriate criteria
- Development of a socio-political factor for application to studies of the economic benefits of air services operated to remote or isolated regions

The extent to which these elements might be applied further is described below.

FURTHER APPLICATION OF METHODOLOGY

Assessment of the Economic Benefits of Air Services

This study has focussed on shorthaul air services from and to LCY and NQY with many of the air services being domestic within the UK. The distances involved have therefore generally been short with time saving over surface transport relatively short. The fact that the economic benefit was found to be considerable and far greater than the perceived cost of the CO_2 created on the routes studied, suggests that air services over greater distances or across sea barriers would have even more benefit.

Most of the parts that constitute the economic benefit arising from air services for a region around an airport, are straight forward to assess such as direct employment and visitor expenditure. However, assessing the catalytic benefit – the benefit derived from the use of air transport by business travellers based on time saved, requires market research survey data. This is then specific to that airport or route. It is therefore difficult to apply this aspect of the methodology generally, for example to the UK as a whole or to all of London's airports, without undertaking a series of market research surveys. This is clearly demonstrated by the differences in the survey results for LCY and NQY.

The conclusion therefore is that this part of the methodology is appropriate for a specific airport or for specific airline routes but not for general macro-level application.

Calculation of the Cost of CO_2 emissions and Assessment of the Resulting Comparison between the Economic Benefit and the cost of CO_2 Emissions

Calculation of the level of CO_2 emissions is straight forward and based entirely on the engine fuel consumption for the specific aircraft types. The relevant data can be provided by the aircraft manufacturer or by the operating carrier. The cost of CO_2 per tonne can be taken from the London Carbon Exchange or can be based upon a forecast future level.

Calculation of the resulting comparison between the economic benefit arising and the cost of CO_2 emissions from the air services concerned is straight forward but assessing the results requires specific criteria to be established. The resulting comparison has been termed "Environmental Ratio – ER" and a model to aid the necessary calculations is described in Appendix N.

Accepting that the economic benefit calculated for an airport or for specific airline routes will generally be greater than the perceived cost of the CO_2 emissions is realistic. However, the question arises of how much greater is appropriate for establishing that the airport or the airline route should be "approved" as economically important or not?

This point is illustrated hypothetically as follows:

Table 10-1: **Illustration of Comparison of Environmental Ratios**

Case A based on the study results

		LCY			NQY	
Route Economic Benefit / Route CO_2 Cost (@£57/t)	=	£2,873.20m / £30.353m	= 94.7	=	£329.99m / £2.345m	= 140.7
or with RFI (2.7)	=	£2,873.20m / £82.0m	= 35.0	=	£329.99m / £6.331m	= 52.1

Case B if hypothetically, all passengers were non-business

		LCY			NQY	
Route Economic Benefit / Route CO_2 Cost (@£57/t)	=	£548m / £30.4m	= 18.0	=	£149m / £2.4m	= 62.1
or with RFI (2.7)	=	£548m / £82m	= 6.7	=	£149m / £6.3m	= 23.5

In Case A the reason for the higher results for NQY reflects the large number of services from/to the airport operated by turboprop aircraft which have lower fuel burns and hence lower emission. In Case B, particularly if full RFI is applied with 2.7 as multiplier, the ER is considerably smaller, especially for LCY.

Obviously in the actual cases studied – LCY and NQY, there were many business travellers, but many other airports or airline routes will be predominantly leisure travel based. Consequently the following criteria are suggested for the Environmental Ratio levels.

Table 10-2: **Suggested Criteria for Environmental Ratios**

ER Level	**Approval Action**
> 100	Strongly support
50 – 100	Support
25 – 50	Further economic justification required
< 25	Air service operations not supportable

This criteria is obviously subjective and if such ratios were seen to be worthwhile for UK air services then the criteria would need to be considered and established by the appropriate authority which in the case of the UK, is assumed to be the Civil Aviation Authority (CAA).

Application to Longhaul Air Services and to larger Airports and use of Socio-political factors

As mentioned earlier the study has focussed on shorthaul services from LCY and NQY but application of the methodology to longhaul routes or to larger airports is entirely realistic although with some differences.

- The market research survey form would need to be revised for longhaul passengers. It is not sensible to ask a London-New York passenger how much time he saves flying rather than using surface transport! The Business Air Travel Value (BATV) would need to be based on the total time away multiplied by the business person's company call out rate or his/her salary per day plus allowances. This can be argued on the basis that the company values the person's travel purpose as equal to or greater than, the person's costs – otherwise they would not be sent on the trip.

- A larger airport will have a mix of longhaul and shorthaul passengers which merely makes the survey task larger and more complex

- The UK APD from 2010 is £85 for an economy passenger and £170 for a Business Class passenger on a trip of more than 6,000 miles – for example, London to Singapore. The current economy lowest "going rate" for London to Singapore return, without taxes is around £380. The total of taxes charged at both ends of the route including the UK APD is £125 giving a total fare of £505; the taxes are therefore 25% of the total fare.

- Europe to New Zealand is a predominantly leisure/vfr route and it is quite possible that making an ER calculation for such routes would produce levels that might not be supportable. However, it can be argued that deliberately stopping or even just limiting, air services on such a route would increase the country's isolation and severely damage its economy. In that sense New Zealand might argue that some form of socio-political factor should be applied as used in this study for Newquay.

An Environmental Ratio (ER-Ap) for Airports and for Airlines

To help airports demonstrate the economic value of the routes from and to their airports in comparison with the cost of the CO_2 emissions created, an Environmental Ratio calculation – ER-Ap is recommended:

$$\text{ER-Ap} = \frac{\text{Routes Economic Benefit}}{\text{Routes } CO_2 \text{ Cost}}$$

Similarly to help airlines demonstrate the economic value of an individual route in comparison with the cost of the CO_2 emissions created, a Route Environmental Ratio calculation - ER is recommended:

$$\text{ER-Al} = \frac{\text{Route Economic Benefit}}{\text{Route } CO_2 \text{ Cost}}$$

The details for calculating these ratios is given in Appendix N.

SECTION 11

ASSESSMENT OF THE CASE FOR AIR TRANSPORT

HOW IMPORTANT ARE THE ECONOMIC BENEFITS OF AIR SERVICES FOR THE LOCAL ECONOMIES?

The results and analyses given in Sections 7 and 8 indicate that the air services operated from and to LCY and NQY do provide considerable economic benefits. However, while this is clearly significant, it is even more so when considered in the context of the relevant local economies.

East London and the City of London

The area of London around LCY is seen as deprived and in need of economic stimulation. It is subject to a number of redevelopment and regeneration programmes including the London Gateway project and the preparations for the 2012 Olympic Games. The main boroughs around LCY all experience serious unemployment problems as the following table[1] shows.

Table 11-1: **Unemployment levels around LCY**

London boroughs	UK ranking	% Unemployment	Approx number unemployed
Hackney	1	16.4	14,000
Newham	2	13.5	12,000
Southwark	6	12.1	13,000
Tower Hamlets	8	11.8	9,000

Four of the boroughs around LCY are therefore in the top ten worst areas for unemployment in the UK. Analysis of the current importance of LCY to the surrounding community[2] shows that *"the continuing growth of the airport is of fundamental importance to sustaining confidence in the economic success of the businesses it serves by providing global connectivity".*

North and West Cornwall

The Cornwall region receives EU grants as an economically deprived area of the UK.

The EC has given the area "Convergence status" as an Objective 1 category requiring grants to aid development of sustainable economic growth. Both unemployment levels and Gross Value Added per head[3] are below the UK national average. Tourism is the major service industry upon which much of the region relies.

Although the problems for the airports in each of these areas are different in terms of:

- LCY is largely but certainly not entirely, focussed on business activities
- NQY is largely but also not entirely, focussed on tourism services and social travel

it is clear that any economic activity provides important support for the areas involved. This includes an airport with airline services but of greater importance is the catalytic effect which enables further increases in economic activity to occur. Evidence from the survey conducted at each location (for example, the proportion of respondents stating that they would not make their journey without the availability of air services) suggests that a high proportion of further increases in economic activity would not happen without the existence of the air services.

The conclusion therefore from the points above is that air services provide important economic support to regional economies.

THE POTENTIAL EFFECTS ON REGIONAL ECONOMIES OF INCREASED TAXATION OF AIR SERVICES

It has already been argued in Section 3 that increases in the UK APD and the implementation of the EU ETS, will increase passenger airfares. Further it was argued in Section 8 that the demand elasticity existing in the LCY and NQY markets is such that traffic would suffer a decline as a result of the increases, which in turn would lead to the airlines involved reducing service frequency or eliminating routes.

If airlines reduce frequencies or if they eliminate routes, the regional economies concerned will suffer. The economic benefit calculated in Section 6 demonstrated the importance of the air services to the regional economy and hence any reduction in frequencies or elimination of services to one or more destinations will simply reduce the economic benefit.

The effect of reduced economic benefit for LCY so far as the economy for London as a whole is concerned, may be claimed to be less significant since alternative air services may be available through Heathrow, Gatwick or Stansted. However, even in this case the impact arising from loss of employment would be significant. For the travelling passengers it would mean less convenience and for business travellers from the City and Canary Wharf, lower productivity which would be seen to be important and damaging. At the same time the damage to the local economies generally in East London is likely to be considerable. This is particularly important as the effect of reduced employment is in an area already suffering from high unemployment. It has proved difficult to isolate the GDP of the area immediately around LCY but an older figure for 2001 of £33.6bn for East London[4] is appropriate. Inflation will have increased this to approximately £45bn. The economic benefit calculated for LCY is £2.9bn – on this basis this would be just over 6% of the region's GDP. To deliberately restrict some of this amount in an economically deprived area has to be a serious problem for the region.

The effect of reduced economic benefit for Newquay and the regional economy of North and West Cornwall is likely to be considerable and damaging. The impact will be in terms of reduced business activity and more unemployment in a region that is already receiving EU grants to help support the economy.

If hypothetically, all air services to NQY were stopped the potential loss of economic benefit as calculated in Section 6 would be about £330m or a level equivalent to more than 9% of the region's GDP. In return, some 41,000 tonnes of CO_2 would not be created – which is estimated to be about 0.11% of the total CO_2 produced by all air services from and to the UK and 0.007% of the UK's total CO_2 production[5]. The CO_2 saving would be even lower if the alternative substitute travel by road was taken into account.

After completion of the survey work at NQY it was announced [6] ***that both British Airways, operating from London Gatwick and Ryanair, operating from London Stansted, were ceasing operations to and from Newquay Cornwall Airport. Air Southwest has increased its frequencies to London Gatwick and Flybe has started to operate the route, both with turboprop***

aircraft. Air Southwest has also introduced services from NQY to LCY although these were terminated in 2010.
Such cessation of services by BA and FR is before any further increases in air fares arising from the APD and from the ETS. However, this simply demonstrates the vulnerability of Cornwall when faced with worsening economic conditions. The loss of the two airlines will simply make the position worse.

It is also reasonable to suggest that the loss of these two airlines is considerably exacerbated because of the high profile of both of the carriers. This may result in further EU grant aid being needed.

ECONOMIC RATIONALE FOR CONSIDERING THE SUPPORT FOR AIR TRANSPORT

The economic benefits arising from the operation of LCY and NQY have been set out in Section 6. These are based on employment – direct, indirect and induced, on visitor expenditure by inbound travellers and on the catalytic effect of the business activities carried out by business travellers (based on the value of time saved). The latter benefit in this study is termed BATV – Business Air Travel Value. These benefits represent value added to the regional GDPs concerned.

It is accepted that the Value Added is notional since the value would be counted elsewhere, for example in the economic submissions by the business companies involved. Similarly visitor expenditure by inbound travellers would form part of the economic submissions by the companies receiving the expenditure. However, in assessing the economic significance of LCY and NQY it is necessary and appropriate to consider all the benefits arising. Without the air services much of the benefits would not arise.

The Stern Report[7] stated that failure to address climate change could lead to a worsening of global GDP of at least 5% each year. The report went on to suggest that even with appropriate action taken to reduce the extent of global warming, the impact on GDP would be a worsening in the region of 1-2%. In effect this would represent a decline in GDP by up to 2% per annum; for most developed countries this could mean that their economies would move into a period of recession.

Economic recession leads to less business activity, less profitability, less employment and less income which can easily become a downward spiral. Government measures to minimise the effects of recessions or simply GDP decline, would be to seek to move the economy back to a more stable position with growth. Such measures are likely to include stimulation packages, encouragement to spend, tax breaks and low interest rates.

It is therefore argued that any economic activity that involves a strong catalytic effect would be appropriate to help Government measures to reduce the effects of recession or GDP decline. Hence air services have a significant role which should be encouraged. The analysis given in this study suggests that increasing taxation of air services would act as a discouragement to the growth and development of air services. Air transport's enabling role in facilitating economic activity should therefore be taken into consideration before any further measures are taken by government to implement their policy of depressing demand for air transport.

> ***The conclusion at this point, must therefore be that air transport should not be treated as any other CO_2 creating business activity.***

However, this conclusion is too simple and must take more of the complexities of the situation into account. The following sections attempt to do this.

HOW IMPORTANT IS CLIMATE CHANGE?

A review of the environmental case and concerns was given in Section 3. It showed that much debate continues on both the causes and the possible extent of climate change, by environmentalists and environmental groups on one side and sceptics and doubters on the other. Various lobby groups, including several representing air transport's interests appear to be positioned somewhere in the middle - accepting that the climate change problem exists but urging that policy action be less dramatic.

The position can be stated as follows.

On the one hand:

- ***the damage and change that could arise from global warming would be potentially catastrophic for mankind in economic, social and political terms. The more extreme forecasts suggest enormous loss of land due to rising sea levels leading to mass migration, considerable loss of agricultural land, food and water shortages and probable wars***

but on the other hand:

- ***while global warming is occurring it will be earth-regulated as a normal cycle. The more critical commentators suggest that actions to address climate change will have little effect anyway and the world should not therefore precipitate action that would endanger economies and cause global upheaval and even conflict. Some even argue that global warming is not really happening, that the polar ice caps are increasing in some areas, that polar bear numbers are actually increasing and that the loss of species has been occurring for all the time that life has existed on the planet and is replaced by the evolution and discovery of new species.***

The UK Government in accepting the Stern Report[7] and the Committee on Climate Change's Aviation Report[8], appears to be adopting the approach that action must be taken urgently and that everyone – all nations and all people, must share the pain that will result. The Stern report suggests that action taken now will limit the economic damage and therefore will limit the pain to be endured.

The position of this study

This study suggested in the previous page that air transport should be treated as a special case and should not be penalised with increased taxation. It also suggested that the position was far more complex.

If we accept the views of the environmentalists, then it is clear that "life as we know it today" will not continue. If the forecasts of economic meltdown, mass migration, famine and war are correct, then it is obvious that air transport – along with everything else – must and will change. The conclusion above that air transport should be treated as a special case would simply be untenable.

This research work is not about the study of climate change and cannot therefore give scientific judgements. However, the range of views as described above are extremely far apart and yet are clearly important for reaching any meaningful judgements and conclusions for this study. Consequently a further survey has been carried out to provide an assessment of people's views on the likely severity of climate change. It was felt that this would provide a reasonable "hanger" enabling conclusions to be made. However, it is merely a straw poll without scientific basis and only used to enable more stable conclusions to be reached in this study.

Climate Change Severity Scale – CCSS

The survey presented a chart with a scale of 0 to 10 in 0.5 graduations with descriptions of different levels of climate change severity.

- these ranged from 0 "Do not believe that climate change is happening at all"
- through to 10 "End of the world as we know it – war, mass migration, crop failures, food shortages, mass unemployment, economic meltdown, population decline"
- the description for scale position 5 was "climate change is a big problem and due to human activity, but is soluble by realistic action".
- the assessment result was categorised into three levels before the survey was sent out. The levels were as follows:
    d. if the resulting opinion indicated a scale level of 4 or less then this suggested that the situation is not serious or
    e. if the resulting opinion indicated a scale level of 5 to 7.5 then this suggested that the problem is real and serious, but that it can be solved without changing life as we know it, or
    f. if the resulting opinion indicated a scale level of 8 to 10 then this suggested that the world as we know it will change drastically

If the resulting opinion indicated either of the first two levels given above then a case could be made for arguing that the economic benefits of air transport require special consideration or should be seen as playing an important role. If the resulting opinion indicated the third level above then in spite of the economic benefits, air transport would need to accept radical change – as would all business activities.

References were given at each point to assist respondents' understanding; for example, 5 is linked to the Stern Report, 6 to the UN IPCC reports. In addition to the request for a view on the scale position, respondents were also asked to state who they felt was responsible for taking action – assuming they felt that action was needed! They were asked to select as many as they felt appropriate from a list of seven.

The straw poll survey was sent out to about eighty people with 76% returned. It is only a straw poll since the respondents were not selected randomly and therefore the results are not necessarily representative of the views of the population as a whole. It is however, simply to provide a basis for some conclusions in this study and it is therefore seen to be adequate for that purpose.

The survey form and analysis are given in Appendix O but the following points summarise the results.

- *Responses to the scale ranged from 2.0 to 9.5*
- *The mean was 6.4 but the mode was 7.0*
- *12% selected scale positions of 3.5 or lower*
- *15% selected scale positions of 8.5 or higher*
- *A quarter of the responses stated that "All governments" should be responsible for action followed by15% stating that the UN should also be.*
- *More than 22% stated that "Everyone individually" should also be responsible*
- *Some 18% of the responses stated that "Business companies" were also responsible*
- *The "Any other" category was selected in 3.5% of cases with these including Scientific Institutions to assess the effectiveness of measures taken, Charitable organisations, NGOs and the airline industry*
- *One respondent stated that no action was needed as global warming was a natural climatic event.*

Initial Conclusion

The straw poll result in terms of severity scale assessment was 6.4 which is described as "Climate change is a serious problem needing urgent action – but is soluble with concerted global action". With this assessment it is possible to suggest that "life as we know it now" will largely continue and that air transport can be seen to have an important role justifying continued support. Therefore increasing taxation to deliberately depress demand may not be the right policy. If air fares are significantly increased through APD and ETS then regional and national economies may be damaged.

CAN THIS CONCLUSION BE SUPPORTED?

This conclusion is only made after considerations based on a non-scientific straw poll so can it be supported with further arguments or evidence? Accepting the mainstream scientific evidence, it is clear that global warming is occurring. Therefore action that limits the extent of global warming is essential but at the same time such action should seek to minimise the impact on the quality of life.

Many environmentalists and scientists including James Lovelock[9] are claiming that it is already too late and that we do not have the knowledge or capability to stop global warming from becoming catastrophic. Others, including many scientists, believe that the problem cannot be solved immediately but will be solved as current initiatives and new ideas come into effect over the next decade or so.

It is not good to leave a major potential catastrophe to be solved by future generations on the grounds that they will probably discover how to do so. However, mankind would seem to have done so in the past and perhaps may choose to do so again now.

The World is not marking time

There are frequent reports of new ideas and inventions that may contribute to solving the global warming problem. A few examples from various fields are listed below:

- The research and development of alternative energies is increasing rapidly with the UK focussing on wind turbines, wave power and nuclear power. While estimates suggest[10] that the UK cannot be self sufficient it is accepted that such alternatives will help to reduce fossil fuel dependency
- The EU has allocated €50bn for further research into alternative energy production and new bio-technologies[11]
- The use of alternative fuels for aircraft has already been mentioned in Section 4. Use of algae or Sir Richard Branson's Isobutanol are unlikely to be available commercially in the near term and are therefore some way ahead, but much progress has already been made. Air transport may well be revolutionised by such changes.

- China has announced[12] that it will build the world's largest solar power plant in Inner Mongolia that will power some 3 million homes by 2019. It is expected that other similar plants will follow.
- The International Thermonuclear Experimental Reactor (ITER) is a fusion reactor being constructed in France[13] by a consortium of nations including EU, US, China, Russia, India, Japan and Korea. ITER should be operational by 2022 but will take some 40 years before starting to solve the world's energy crisis
- "Biochar" which is essentially a new form of charcoal[14] developed by pyrolysis which enhances agricultural production while at the same time extracting CO_2 from the air
- A new invention which takes household rubbish and converts it into usable gas which can be added to the national grid[15]
- Use of hemp in construction materials which reduces the CO_2 resulting from use of cement[15]
- Designs for hydrogen powered cars are now being developed[16] with forecast introductory date of around 2020
- Studies are being carried out to harness solar power from photovoltaic panels to be erected in the Sahara desert[17] which can be transferred to national electricity grids in Europe
- The UK firm TMO Renewables is breeding bacteria that can turn waste material into fuel[18]

Although many commentators regarded the outcome of the 2009 Copenhagen Climate Conference as disappointing, it is clear that a great deal of action is taking place across the world. It would seem that all governments are taking notice which may arise because of:

- concerns of potential isolation, such as New Zealand
- concerns for the possible rise in sea levels, such as Maldives and most south west Pacific island nations
- concerns for the impact of global warming on agriculture, such as many African nations. Even France has concerns as vineyards in southern England[19]

claim rising temperatures are creating better conditions for viticulture than the conditions currently enjoyed in the champagne region of north eastern France

- concerns from developing nations that the developed nations which they claim caused the problem, will simply create more economic problems for them
- belief that change from fossil fuel use is necessary and that this change can involve extensive research projects and provide new business and more job opportunities. The US and the EC are encouraging such beliefs and leading the way in terms of increasing research expenditure.

Is the Air Transport industry accepting the need for radical change?

The answer would seem to be "yes". The plans as mentioned in Section 4 – IATA Director General's plan[20] that airlines should be carbon neutral by 2020 – have been mostly accepted by the member airlines[21] who appear to be working hard to reduce CO_2 emissions[21] This may be because of:

- concerns that some governments may increasingly seek to restrict airline growth
- concerns that some governments may increasingly seek to reduce air transport services significantly
- concerns for the environment. One airline CEO expressed considerable interest in any ideas to limit the airline footprint[22]
- the need to reduce dependency on oil for several reasons including the greater awareness that kerosene may not be available without very high cost, in the not too distant future[23]
- the need to reduce costs by more efficient operating procedures developed with ATC organisations

Virgin Atlantic's plans for the production of jet fuel[24] from Isobutanol and British Airways' joint venture with[25] US company Solena to create jet fuel from household waste, are further indications that help to confirm that the air transport industry is taking action to address their emissions problem.

PUTTING THE CONCLUSION INTO PERSPECTIVE

The crisis of World War II generated much research and development including the rapid development of aircraft which later led to the creation of a global network of air services. Many governments appear to believe that it is prudent to assume that new ideas and new technologies will not arise in time to solve the climate change problem. However, it is also unwise not to see that mankind's ability to solve threats and accept new challenges is enormous.

At the same time, this study has shown (see Section 3) that there remain many concerns about the correct policies to be adopted towards climate change. A recent newspaper headline[26] stated "World may not be warming, say scientists" following an interview with Professor John Christy a former lead author for IPCC. The professor stated that data errors may have occurred in past IPCC studies. In the face of such continued uncertainty, government policy making on climate change is extremely difficult – getting it right for everyone is likely to be almost impossible. So is the UK policy on air transport – with action taken to reduce demand, right? Or will it simply worsen regional and ultimately national, economies?

Climate change is a global matter not a national issue and must therefore be tackled globally. The Stern report identified[7] four key elements that must be involved internationally:

1. Emissions trading to provide cost-effective reductions in emissions that could also drive major investments to help developing nations
2. Technology cooperation, particularly in new low-carbon technologies and energy research and development
3. Action to reduce deforestation which is a highly cost-effective way to reduce CO_2 emissions
4. Adaptation to assist poorer nations to cope with the problems arising from climate change - particularly the problems arising from changing agricultural conditions

Implicit in this statement is that policies adopted in isolation will not be successful globally. Stopping imports because the transportation creates CO_2 or encouraging buying locally produced food or holidaying in the home country are all to some extent, forms of protectionism. It worsens the economic situation for farmers or tourism receiving companies in developing nations and yet such countries are likely to need help to cope with climate change.

This point is emphasised by Lord Mandelson, former UK Secretary of State for Business, Innovation and Skills who stated[27] "Economic openness is the engine that will power the global economy in the upturn. Protectionism may appear to treat the symptoms of economic downturn, but it is also the poison that prevents a full and fast recovery". In turn this view was echoed by Ambassador Kirk, US Trade Representative who said[27] "...now is not the time to turn inward. Now is not the time to be timid. Now is the time to revive global trade and to lay the groundwork for an even more robust, more open trading system in future decades". The air transport industry believes that it has an important role in helping this.

Sharing the pain created by global warming is clearly morally right and it is equally right that developed nations accept responsibility for a larger share of the pain. However, as suggested above, there are also many opportunities which should be shared as well. There appear to be more and more suggestions being made to solve the problems. Consequently the opportunities presented for solving CO_2 emissions are increasingly being seen as big – one estimate is that the low carbon business is worth £100bn to the UK economy[28].

The problems of climate change must be solved but the objective should be:

> ***to do so whilst endeavouring to maintain our quality of life –***
> ***that is, life as we know it today.***

If that objective is accepted then economic considerations must not be overlooked. Air transport acts as an economic catalyst and therefore on the evidence of this study it is seen that increasing taxation for air travel is inappropriate. Perhaps the right expression would be that the UK/EU Governments "must not throw the baby out with the bathwater"!

REFERENCES, NOTES AND SOURCES

1 HR Management Guide to Unemployment in the UK 2008

2 Socio economic impact of London City Airport. York Aviation 2006

3 Market and Coastal Towns Association: Cornwall evidence statistics 2006

4 UK Government Department for Business Innovation and Skills. Website information under Regional GDP - London

5 Based on data from The Economic contribution of the Aviation Industry in the UK. Oxford Economic Forecasting October 2006

6 Airline web sites

7 Stern Report: The Economics of Climate Change. HM Treasury October 2006

8 UK Committee on Climate Change. Aviation Report "Meeting the UK Aviation Target – Options for reducing emissions to 2050".

9 The Vanishing Face of Gaia – A final Warning. James Lovelock Allen Lane 2009

10 Sustainable Energy – without the hot air. Prof D MacKay UIT Cambridge 2009

11 EC Press release October 2009

12 Article in Singapore's Straits Times September 2009

13 ITER International Thermonuclear Experimental Reactor. Website www.iter.org

14 The Economist August 2009

15 Article in the Sunday Times October 2009

16 BBC Focus magazine report August 2009

17 Article in Times March 2009 and website www.ecolocalize.com

18 TMO Renewables Website www. tmo-group.com

19 Discussion with manager of Chapel Down Vineyard, Tenterden Kent, September 2009

20 IATA AGM in Kuala Lumpur report July 2009

21 Flight International - Environment section March 2010

22 Discussion with CEO of VLM May 2008

23 Website "Hubbert Peak of Oil production" . Also www. oilcrisis.com

24 Article in Sunday Times including coverage of Sir Richard Branson's investment in future energy sources. August 2009

25 British Airways News February 2010 and Flight International report February 2010

26 Article on interview with Prof Christy formerly of IPCC. UK Sunday Times February 2010

27 Quoted in Emirates Airline Public Affairs journal. March 2010

28 BBC Focus magazine February 2010

PART IV

SUMMARY AND CONCLUSIONS

Section 12: Summary and Conclusions

SECTION 12

SUMMARY AND CONCLUSIONS

This final section sets out a summary of the study and the conclusions arising from the research work. This is followed by a review of the research hypothesis and an assessment of the conclusions.

SUMMARY

Part I – Introduction

Section 1: Research Details

2. This Introductory section sets out the hypothesis that the research will seek to prove or disprove. Definitions of the key points are given together with the purposes behind the study and an overview of the report. Details are provided of the original research work carried out. This report is arranged in five parts:
    - i. I Introduction: Sections 1 - 2
    - ii. II The Environmental Case: Sections 3 - 5
    - iii. III Research Analysis and Evaluation: Sections 6 - 11
    - iv. IV Summary and Conclusions: Section 12
    - v. V Appendices: A - O

Section 2: Methodology Applied

3. Explanations are provided in this section of the many steps taken and the methodology used in the study. These enable conclusions to be drawn which provide the results for assessing the hypothesis.

Part II – The Environmental Case

Section 3: The Environmental Background and Concerns

4. There is reasonable evidence that global average temperatures have increased over the past one hundred and fifty years and that they also appear to be continuing to do so. In the views of many scientists including members of the UN Inter-governmental Panel on Climate Change (IPCC) the cause of the increase is also reasonably clear as the levels of carbon dioxide in the

atmosphere have increased significantly along with other gasses over the same period. Together these "greenhouse gasses" contribute to stopping the Earth's heat from escaping into space thereby increasing average temperatures

5. It is claimed that the period covering the rise in temperatures coincides with the period of the industrial revolution suggesting that the increase in temperatures is anthropogenic. Other theories exist to explain the increase in temperature but even if some of these prove to be correct in the long run, it would seem that mankind has little alternative at present but to attempt to reduce the level of CO_2 in the atmosphere in the hope that this will help to mitigate against the impact of global warming.
6. Various scientific assessments of the impact of global warming suggest that major social, political and economic problems would arise if mankind failed to stem the rise in average global temperatures. Many claim that the impact would verge on catastrophic for mankind. It is therefore clear that a very serious problem exists and in the beliefs of many, including the EU and UK Governments urgent action by everyone is vital.
7. The contributory causes for the increased CO_2 are numerous with much effort already being made to reduce its creation. Action being taken across the world – although with different degrees of urgency – includes use of alternative energy sources, adoption of electric and hybrid cars, and sequestration of CO_2 from power stations. Transport is seen to produce a level of global CO_2 of around 13 – 22%. Air transport specifically is seen to produce about 2-3% of global CO_2 although the level for the UK alone is estimated to be higher at around 5 – 6% of the UK's total emissions. This is because of the size of the UK international air transport market.
8. However, as aircraft operate at altitude and because aircraft emit other greenhouse gasses including methane, water vapour and NOx, many experts have argued that a multiplier should be applied to the amount of CO_2 emitted to reflect the total radiative forcing level (RFI). The correct multiplier level remains unclear with different studies providing a range from 1.1 to 4.0. This study has taken the level of 2.7 as being the most commonly quoted multiplier and one which is in the middle of the varying estimates.
9. Aircraft engines use a refinement of kerosene, commercially known as Jet A-1 and Jet A fuels. The chemical process and subsequent refinement means that

burning one tonne of Jet A-1 fuel releases 3.151 tonnes of CO_2. Aircraft engines also produce water vapour, Nitric Oxide and Nitrogen Dioxide – the latter two collectively known as NOx, which are also found to worsen global warming. Although the percentage of global CO_2 created by air transport is relatively small it is nevertheless clear that a serious problem exists for the air transport industry.

10. Aircraft emissions can be classed in economic terms as an external cost which should be borne by the polluters – thus making the airlines internalise the cost. This can be done by taxation or by means of some other financial penalty. In the UK air travellers have paid various forms of departure tax for many years and the current government tax known as Air Passenger Duty (APD). A rough assessment suggests that in 2007 the total APD was worth £1.9 billion. The level of APD was increased in 2009 and is being further increased again from late 2010.
11. The European Union has introduced the Emissions Trading Scheme (ETS) based on the Kyoto Agreement and this will be applied to all air transport operating to, from and within the EU from 2012. As a result a cap will be set on the amount of CO_2 emissions created by each carrier. Airlines will be given some free credits - Aviation Allowances, but must buy additional credits if needed. Some allowances will be auctioned.
12. Increasing APD and introducing ETS for air transport is likely to affect air travel demand. However, this would appear to be commensurate with government policy to restrict air transport growth by significantly increasing the cost of flying. The UK Committee on Climate Change has stated that air transport growth should be limited to 60% in the period from 2015 to 2050 unless air transport's CO_2 emissions are significantly reduced. The true cost of ETS has yet to be established but this study has found that ETS and the increase in APD together, could lead to fares increases in a very wide range from less than 1% to more than 100%. The range is dependent upon the level of the existing fare, the length of the route concerned, the class of travel purchased by the traveller and in particular, the final cost of the ETS.

Section 4: The Air Transport Case and Position

13. Air transport has grown enormously over its one hundred year life but particularly since the mid 1960s. Some 2.3 billion passengers were carried by

air in 2008/09 and about 36 million tonnes of cargo. Total revenue for the industry in that year was more than the GDP of Sweden or Belgium. However, airlines have a poor profitability record with operating margins rarely exceeding four percent in the past two decades.

14. The air transport industry's trade association IATA, states that air transport is essential for global business activity and for tourism, both of which improve the prosperity of the world's population. This study has considered just how important air transport is for the world and for the UK.
15. Quantifying the importance of air transport is obviously highly subjective and so a number of points have been considered against a scenario of no air transport services at all. While no serious suggestions have been made that this should happen, this analysis helps to put the significance of air transport into context. The conclusion is that air transport is inextricably woven into today's world in terms of our economic, social and leisure ways of life. For the people of one country, the decision to stop flying and stop importing goods by air might not be too damaging for them – in fact it might be beneficial for some. However, for tourist receiving countries and for farmers who export their produce to other parts of the world and for the overall economies of those countries, such a decision could be disastrous. It is clear that the term "global village" is applicable to today's way of life and standard of living for many. It means that all people are inextricably linked. Air transport is claimed as a significant catalyst – it enables the "global village" to function.
16. Examination of the air transport industry in the UK including aircraft manufacturing, shows that approximately 655,000 people are employed directly, indirectly and in support functions. Sixteen airlines are registered in the UK offering scheduled, low cost and tour operator services.
17. Air fares have reduced dramatically in real terms over the past fifty years, a factor that environmentalists believe has worsened the CO_2 pollution; cheaper fares mean more flights. Study of comparative fares shows enormous variations, for example fares from London to Barcelona varied from "free" to £637.
18. A review of initiatives to reduce and limit aircraft engine emissions has been made. It is evident that much work is in hand and this appears likely to have some effect. The air transport industry claims that it will <u>not</u> be a major

polluter in terms of emissions per flight in the future although it appears that this could be someway ahead. For example, the ability of the industry to fly the majority of commercial services using some form of alternative fuel to kerosene is seen to be at least twenty years ahead.

19. During this time air transport is forecast to grow and it is argued that the likely improvements in technology to reduce emissions over the next decade will merely keep pace with the growth. This would leave the level of emissions much the same as it is today. The study has examined the current industry forecasts for air transport and accepts that if unconstrained growth was allowed, the number of passengers travelling by air would double about every fourteen or fifteen years. It is therefore possible that some 4.5 billion passengers could be carried by 2022 in an unconstrained scenario. In such a situation, if the air transport industry is not to increase its pollution level it will have to replace all older aircraft with the most up to date technology. Such a task may be difficult to achieve.
20. However, the EU/UK plans to reduce CO_2 emissions provide a different scenario as the UK Committee on Climate Change report in 2009 proposes that the air transport growth be constrained to 60% for the period from 2005 to 2050 giving an average growth of around 1.3% per annum throughout the period. It is clear that the air transport industry and the UK Government have widely differing views of the future although the report does accept that the constraint could be lifted if the industry does succeed in significantly reducing CO_2 emissions.

Section 5: Consideration of the Macro-economic Benefits of Air Transport Services

21. Air transport is a service industry and consequently generates quantifiable economic benefit through its own direct, indirect and support activities. However, it also acts as a facilitator or catalyst for the business activities conducted by those using air services for business or tourism purposes. The study has found that this is difficult to quantify at a macro level but can be quantified at a more micro level in terms of productivity benefits.
22. Globally air transport is claimed to generate 32 million jobs with a global economic impact equivalent to 7.5% of world GDP. Air transport is seen to

facilitate trade, improve productivity, provide economic support through tourism and increase understanding of different cultures which facilitates closer international integration. It is accepted that these facts describe the important role of global air travel.

23. The study has analysed existing research on the benefit of air transport to the UK economy. The Value Added gives an air transport total of £16.7 billion, about 1.6% of UK GDP. The profit before tax is £1.4 billion and the contribution to the Public Finances is about £3.5 billion. Air transport has a negative contribution of -£3.3 billion to the Balance of Payments account. This is due firstly to the greater number of UK citizens travelling abroad compared with the number of visiting foreigners and secondly to the size of UK imports arriving by air.
24. Assessment of the overall economic contribution of air transport to the UK economy suggests that the employment aspect is significant but that the level of GDP and Balance of Payments contributions cannot be claimed to be vital.
25. Air transport to, from and within the UK produces CO_2 emissions estimated to be between 5% and 6.3% of UK total emissions. However, if the multiplier of 2.7 is applied then air transport's contribution to the UK total artificially increases to between 13.5 and 17.0%.

Part III – Research Analysis and Evaluation

Section 6: Consideration of the Regional Micro-economic Benefits of Air Transport Services

26. In order to examine the economic benefits of air transport on a quantified basis this study has carried out research at two UK airports – London City Airport (LCY) with predominantly business travellers and Newquay Cornwall Airport (NQY) with predominantly leisure and visiting friends and relatives (vfr) travellers.
27. LCY is in an economically deprived area but has fast links to the City of London and to Canary Wharf. In 2008 3.3 million passengers travelled to and from LCY to thirty five different destinations using ten different airlines. Over two thousand staff are directly employed there.
28. A survey was undertaken for the study involving interviews with 181 passengers (see Point 30) at LCY – 60% were business travellers. In order to

quantify the catalytic benefit of the air services the business traveller respondents were asked why they had used air services rather than surface. Those stating time saved (97%) were asked to put a money value that they or their company would put on the time saved – that is, their company call out rate or salary per day plus allowances.. The weighted average value per day was £914; this was termed the "Business Air Travel Value (BATV)". The amount spent by those visiting London/UK on accommodation, transport and entertainment etc was found to be £374 (business travellers) and £465 (leisure and vfr travellers). From further questions approximate measures of demand elasticity were made; these were strongly inelastic (-0.4) for business travellers and moderately elastic (-1.2) for the leisure and vfr travellers. Although the benefit of LCY arising from businesses locating nearby was difficult to assess there was reasonable qualitative evidence of the Airport's role.

29. NQY is located ideally for access to north and western Cornwall. The area is heavily dependent on tourism and currently receives EU funding to aid greater economic development. In 2008 some 700,000 passengers travelled to and from NQY to twelve different destinations using five different airlines. Over five hundred staff are directly and indirectly employed there.

30. The same survey that was carried out at LCY was applied to NQY involving interviews with 131 passengers (see Point 30) at NQY – 40% were business travellers. In order to quantify the catalytic benefit of the air services the business traveller respondents were asked why they had used air services rather than surface. Those stating time saved (90%) were asked to put a money value that they or their company would put on the time saved. The weighted average value per day was £576. The amount spent by those visiting Cornwall on accommodation, transport and entertainment etc was found to be £261 (business travellers) and £349 (leisure and vfr travellers). From further questions approximate measures of demand elasticity were made; these were strongly inelastic (-0.4) for business travellers and significantly elastic (-1.5) for the leisure and vfr travellers. Although the benefit of NQY arising from businesses locating nearby was difficult to assess there was reasonable qualitative evidence of the Airport's role.

31. The sample of passengers interviewed is small in relation to the total number of passengers. However, it is statistically significant in relation to the number

interviewed in each of the main market segments and also in relation to the number of destinations covered (LCY was 60% and NQY 63%) and in relation to the number of different airlines covered (LCY was 100% and NQY 83%).

32. Another factor considered during the study in NQY was the claim made by a number of Cornish residents that their area was relatively remote – Newquay and Truro are over two hours drive or train from Exeter and certainly over five hours from London, and hence the importance of the airport for the regional community. An additional benefit factor termed "Socio-political factor" was used to take this aspect into account.

Section 7: Relationship between the Economic benefits of Air Transport and the resulting levels of Carbon Dioxide Emissions

33. Following the surveys carried out at LCY and NQY a detailed analysis has been made of the air services operated from each airport during 2008. Using data supplied mainly by the relevant aircraft manufacturer a series of calculations have been made to determine the amount of fuel burnt on the flights during the year. This has then been converted into the amount of CO_2 produced by those services using a conversion rate of one tonne of Jet A1 fuel burnt produces 3.151 tonnes of CO_2. The RFI of 2.7 has also been applied.
34. An analysis has been made of the current and forecast cost per tonne of CO_2. At the time of completion of the study (2010) the price was low at about £13 per tonne but forecasts by DfT and in the Stern report suggest a considerably higher level. Consequently two price levels have been used for this study - £25 and £57 per tonne.
35. The amount of CO_2 created by the air services operated in 2008 from and to LCY was 532,500 tonnes and from and to NQY was 41,100 tonnes. These figures were then increased by the RFI multiplier of 2.7 to give LCY 1,438,000 tonnes and for NQY 111,100 tonnes.

36. In the full year the cost of CO_2 produced is therefore:

	CO_2 created 000 tonnes	Cost @ £25	Cost @ £57	CO_2 + RFI 000 tonnes	Cost @ £25	Cost @ £57
LCY	532.5	£13.3m	£30.4m	1,438.0	£36.0m	£82.0m
NQY	41.1	£1.0m	£2.3m	111.0	£2.8m	£6.3m

37. The sum of the economic benefit established for 2008 for each airport was LCY = £2,873.2m and for NQY = £330.0m. Consequently the economic benefit exceeded the cost of CO_2 significantly at both CO_2 prices and at both prices with the RFI multiplier. Further calculations showed that in order to match the level of economic benefit, the price of CO_2 for the services operated from and to LCY would need to be £5,396 per tonne or £1,999 per tonne using the 2.7 multiplier. The price of CO_2 for the services operated from and to NQY would need to be £8,021 per tonne or £2,971 per tonne using the multiplier.

38. A number of sensitivity tests were carried out although none changed the overall results. Even in the most extreme cases the levels of economic benefit considerably exceeded the perceived cost of the CO_2 emitted as a result of the air services from and to the two airports.

Section 8: Air Transport Market Elasticity and Assessment of the Impact of Further Taxation on Air Transport Services

39. A study was made of existing estimates of the demand elasticity for air transport made in other studies, together with the results taken from the surveys carried out at LCY and NQY. Consequently the survey co-efficients were applied for the further study work as these were fully realistic (see point 27 and 29 above) in comparison with the other studies. These were then applied to the likely increases in air fares arising from the increases in APD and the implementation of ETS. Based on previous work by the author, the traffic reduction levels arising from the elasticity co-efficients were adjusted to take inflation into account.

39 As the possible increases in fares covered a very wide range (less than 1% to more than 100%) the study examined a range of possible increases - £10, £20, £50 and £80 for both economy and business class fares. Average round trip fares were deduced for the routes from and to LCY and NQY and the elasticity coefficients applied to the increases to these fares. The results for LCY suggest that relatively little business traffic might be lost until significant increases start to occur, that is £80. LCY leisure and vfr traffic would appear to decrease significantly with increases of £20 and more. The likely loss of

leisure and vfr traffic when increases of £50 and £80 occur, appear to be considerable.

For NQY the results suggest that the impact of the fares increases on business class travel is relatively low until increases of £50 or more occur. However, the leisure and vfr traffic are almost immediately affected with significant loss of traffic with increases of £10 and £20. Increases of £50 and £80 appear likely to put many routes seriously at risk. For example, traffic loss of nearly 60% appears likely with an increase of £50 on routes of less than 500 kms.

40 Weighted average traffic loss levels were then calculated for the business and leisure/vfr travellers together, on each category of routes – less than and more than 500kms.

41 Using Operating Ratios (OR) the study has estimated the likely airline response should the impact on traffic as described above, arise. The ratio is obtained using the formula:

$$\frac{\text{Revenue}}{\text{Cost}} \times 100$$

with initial levels based on discussions with local managers at each station. The initial levels of 104 and 108 were applied to the routes from and to LCY and 102 and 108 to the routes from and to NQY. The change in revenue was based on the equivalent loss of traffic. Cost changes were also made to reflect likely airline responses to the reduction in traffic.

42 The data for LCY suggest that on average the routes operated would:

- achieve less profit with a £10 imposed increase on routes both less than and more than 500 kms
- lose steadily with higher increases where the original OR was 104
- lose once the increase reached £50 where the original OR was 108
- however, under the assumptions used, few of the routes appear likely to become untenable in the short run.

43 In the case of NQY where the initial level of 102 was applied:

- the routes of less than 500kms would all be likely to become loss making, even with the increase of £10
- these routes would be likely to be seen as untenable when the increase reached £50 and £80

- the routes of greater than 500kms would become unprofitable once the increase reached £20 with routes likely to be untenable with an increase of £80

In the case of NQY where the original OR was 108

- the routes of less than 500kms would start to lose money with increases of £20
- these routes would be likely to be seen as untenable when the increase reached £50 and £80
- the routes of greater than 500kms would achieve less profit with increases of £10 and £20 and would be unprofitable with higher increases

44 In assessing the proposed demand constraints including that by the UK Committee on Climate Change, (growth limited to 60% from 2015 to 2050 unless significant reduction in CO_2 emissions are achieved) consideration is given to how damaging these would be to airport companies and to airlines. The analysis in this section suggests that many airline routes would become unviable – particularly if the higher levels of taxation increases occurred

45 If frequencies are reduced or routes terminated by airlines, the effect is likely to be considerable for the airport companies and their staff. The effect can be described as "serious". In turn the effect on the local economies will be considerable. This will arise not only from reduced direct, indirect and induced employment benefits but also from reduced BATV benefits and from reduced visitor expenditure.

46 The effect on airlines is harder to assess. For a larger airline, cutting out a losing route or one that becomes a loss maker, could result in an overall financial improvement. However, even to achieve this would require careful "management" involving:

- reduction in overhead costs
- disposing of aircraft and other assets found to be surplus
- reduction in staff – possibly through redundancy
- the loss of synergy – that is, feed of traffic from one route to another
- re-assessing aircraft orders with possible cancellation penalties

The question arises of which routes would be eliminated? Obviously those that are unprofitable or only marginally profitable or those that enable a whole station to be closed, such as NQY.

47 The necessity to close routes and achieve the managerial changes listed above, suggests that for airlines too, the increases in fares arising from increased taxation would be serious.

Section 9: Regulatory and Legal Aspects

48 A number of regulatory and legal aspects are relevant to the examination of the impact of environmental policies. Earlier analysis confirmed that the EU/UK's efforts to reduce CO_2 emissions involved depressing demand for passenger air travel using pricing as the economic instrument to achieve this. The means to accomplish this were increases in the UK APD and the application of ETS to air transport – both added to the existing air fares.

49 Consideration has been given to any further action that could be taken should the resulting increase in air fares not produce the intended result. Action to tax aviation fuel involves withdrawing from certain parts of the Chicago Convention with consequent legal problems. Further increases in APD were seen to be possible and also the imposition of a ceiling on air transport movements at major airports. However, neither of these was seen to be imminent at this stage.

50 Conflict has been suggested to arise between the EU/UK policy on de-regulation of air transport – "open skies" and environmental policy. The former leads to more market entrants, more competition, lower fares and greater growth in air transport. The latter seeks to reduce demand. However, a review of the points involved suggests that the de-regulatory policy has not changed but it is modified or influenced by the over-riding environmental policy.

51 Some concerns have been considered about the UK policy to depress demand for air travel and the implications for tourist receiving countries and for fresh fruit and vegetable exporting countries. Such countries could suffer economically leading to suggestions that the UK would be introducing "blatant protectionism". A review of the points involved in this argument, suggest that the UK policy would not harm UK but could lead to a reduction in air traffic to some destinations. Conversely other destinations might benefit.

Section 10: Further application of selected parts of the study methodology

52 The methodology applied in this study was outlined in Section 2 but consideration was given in this section to the extent that the methodology could be applied to other research or to environmental research undertaken by airports or airlines. Such work might be to determine the economic value of an airport and its air services, or to determine the economic value of specific routes of an airline, all in comparison with the emissions created by the air services involved.

53 The methodology to assess the economic benefits for an airport or for an airline's specific route or routes is seen to be straightforward. However, the work relies on passenger surveys which are appropriate for a single airport or for specific airline routes, but which are less easily applied at a macro-level.

54 Calculation of the amount of CO_2 created by the air services from and to a particular airport or on specific routes is straightforward using data provided by the aircraft manufacturers or by the operating carrier. The cost of CO_2 per tonne can be taken from the London Carbon Exchange or can be based upon a forecast future level. A comparison can then be made by calculating the ratio between the economic benefit divided by the CO_2 cost for an airport or for specific routes for an airline. This ratio has been termed "Environmental Ratio – ER" for this study.

55 Accepting that the economic benefit will generally be greater than the perceived cost of CO_2 is realistic, but criteria are needed to establish whether an airport or specific airline route is significantly important economically. The study has proposed such criteria which would enable airports, airlines or an appropriate authority such as the UK CAA, to make economically and environmentally sound assessments. The methodology for calculating airport and airline ER's is set out in Appendix N.

56 Application of the methodology to shorthaul routes is proven by this study and it is suggested that it is equally applicable to longhaul services. However, some differences in approach would be necessary – for example, the questions in the travellers survey concerning BATV would need to address all the time away and not simply time saved by using air rather than surface, travel.

Section 11: Assessment of the case for Air Transport

57 This section brings together a number of different aspects that enable the case for air transport to be assessed:

a. the impact of fares increases through increased taxation (APD plus ETS) on the regional economies around LCY and NQY
b. the economic rationale for consideration of the air transport case
c. a straw poll assessment of the possible severity of climate change
d. supporting the conclusions

58 An assessment of the importance of the economic benefits was considered so far as the regions around the two airports was concerned. In both cases many economic problems exist. LCY is located in the middle of a number of London boroughs with unemployment problems. Four of the boroughs are in the top ten worst areas for unemployment in the UK. Cornwall receives EU support to help develop more economic activity.

59 The analysis of possible traffic loss arising from the increase in air fares from APD plus the introduction of ETS showed that where the increases were relatively high – for example £20 and more, the loss of traffic could be severe. This could lead to reduction of frequencies and elimination of routes leading to a reduction in the level of economic benefits – including employment. This would be extremely important for the areas around LCY and NQY as both are categorised as deprived areas with high levels of unemployment.

60 The economic benefit for the LCY region was estimated to be just over 6% of the region's GDP so that reduction in air services would create a serious problem for the region.

61 The economic benefit for the NQY region was estimated to be more than 9% of the region's GDP. Here also, a reduction in air services would create a serious problem for the region.

62 It was suggested that the economic benefit established for LCY and NQY was significant for the local economies since without the air services much of the benefits might not arise. The benefit included BATV – the catalytic benefit arising from business travellers' activities as well as their expenditure as visitors. The Stern report stated that addressing climate change would worsen UK GDP by around 1-2% per annum. This could lead to a period of recession. Government action to solve recession and return the economy to growth would include

stimulation packages, encouragement to spend, tax breaks and low interest rates. In its role as a catalyst, air transport is an important feature for helping to boost the economy.

63 In view of this it can be argued that air transport should not be treated as any other CO_2 creating business activity and should not be penalised with further taxation. However, it must also be accepted that if the extreme effects of climate change as forecast by some scientists, prove to be correct then air transport – like everything else, would have to change radically.

64 A straw poll was carried out to obtain the view of respondents on an assessment of the likely severity of climate change. Analysis of the straw poll results produced a position which was described as "Climate change is a serious problem needing urgent action – but the problem is soluble with concerted global action". With this assessment it is possible to suggest that "life as we know it now" will largely continue and therefore air transport should be seen to have an important role, particularly its catalytic role, justifying continued support. Increased taxation to depress demand may not therefore be the correct policy.

65 Can this conclusion be supported? In the sense that much progress is being made to reduce CO_2 emissions across the world, the answer would seem to be "yes". Alternative energy sources and significant innovation all promise solutions to the global warming problem – not instantly, but progressively.

66 It also appears that the air transport industry is determined to play its part in helping to solve its own problem with many initiatives aimed at significantly reducing aircraft engine emissions.

CONCLUSIONS

A. It is evident that the World has a serious environmental problem. The level of CO_2 in the atmosphere is the major cause of global warming. The seriousness is such that the standard and quality of life is threatened for people in many countries across the World. Global economic stability is threatened. Social and political cohesion could also be threatened

B. All activities involving the conversion of fossil fuels are responsible for the rapid increase in CO_2 levels. The air transport industry is one amongst many industries and other activities, which must accept such responsibility. Air transport is therefore culpable.

C. However, air transport is perceived to be particularly blameworthy because not all air travel is essential, because one large aircraft on one longhaul flight creates a large amount of CO_2 and because air travel is forecast to grow significantly in the future. While all these points are valid there are other aspects which need to be considered. These suggest that while air transport has a responsibility it should not be treated as a "scapegoat".

D. Examination at a more micro-economic level of the economic benefits arising from the operation of air services from two UK airports showed that the benefits far exceeded the current and forecast cost of the CO_2 created by the air services concerned. This remained the case even when a multiplier of 2.7 was applied to the amount of CO_2 created in order to reflect the full radiative forcing involved.

E. The precise level of increased taxation plus the cost of the implementation of the ETS is still uncertain. However, using a range of possible increases suggests that anything above the lower level of increases could be damaging to air transport and hence to the regional economies. Airline profitability is poor with the result that even moderate increases are likely to lead to reduced demand and hence reduced frequency of operations or route closures.

F. An assessment of the proposed demand constraint measures suggest that the impact of the increased taxation through APD and ETS would be serious for both airport companies and for airlines.

G. The term "global village" encapsulates the extent to which the world is increasingly inter-linked both economically, socially and politically. This has helped to increase wealth, prosperity and the standard of life for many. Air transport is a fundamental part of this in its role as a catalyst helping business activity. If mankind can solve the global warming crisis then the global village will continue. The Stern report stated that even with action taken to stem global warming, economic recession was likely. Government action to counteract this would include economic stimulation packages. Air transport can help this in its role as a business catalyst. Air transport should therefore be sustained.

H. This does not mean that air transport can continue to create large amounts of CO_2 without concern. What it does mean is that measures to constrain and limit the growth of air transport may not be appropriate.

I. The air transport industry is active in its efforts to significantly reduce CO_2 emissions. Requests from the industry that it should be supported in its research efforts should be encouraged – not least because this can provide opportunities for work and innovation. Penalising air transport in order to constrain its growth, will have a damaging effect on regional economies. Almost certainly this would equally apply to the national economy.

J. Sharing the pain created by global warming is clearly morally right and it is equally right that developed nations accept responsibility for a larger share of the pain. However, there are also many opportunities emerging from the growing low carbon business which should be shared as well.

K. The problems of climate change must be solved but the objective should be:

> ***to do so whilst endeavouring to maintain our quality of life – that is, life as we know it today.***

If that objective is accepted then economic considerations must not be overlooked. Air transport acts as an economic catalyst and therefore on the evidence of this study it is seen that increasing taxation for air travel is inappropriate.

REVIEW OF THE RESEARCH HYPOTHESIS

The research work has been undertaken in order to prove or disprove the following hypothesis:

> ***"That the economic cost of Government environmental measures which are aimed at reducing demand for air travel, would be considerable and damaging to the economy. That such action would be serious for regional economies and serious for the elements of the air transport industry involved."***

This is considered by determining the regional economic benefits of specific air services and comparing these with the perceived cost of aircraft emissions of CO_2 - as shown by examination of air transport services operated from and to London City Airport and from and to Newquay Cornwall Airport.

Assessment of the economic benefit includes catalytic benefit using the value of the time saved by business travellers in using air services.

Research was therefore carried out to determine the relationship at a regional economic level, between:

c. the economic benefits that arise from the existence of air services to and from and to specifically selected airports and
d. the perceived cost of the emissions, primarily carbon dioxide (CO_2), which are produced by the aircraft operating those services.

Determining this relationship has been accomplished. However, in order to prove or disprove the hypothesis it was necessary to fulfil a number of points that were set out in Section 1 of this paper. These points are repeated below with confirmation of what has been achieved.

- *describe some of the current evidence showing that a serious environmental problem exists.*

  That evidence was described in Section 3. There can be no doubt that serious environmental problems exist. These affect the entire planet and nothing can be more important than finding the right solutions

- *provide factual evidence that air transport is part of the cause of the problem.*

  This was also provided in Section 3. The amount of CO_2 created by aircraft emissions is considerable although in global terms only about 2-3% of the total. Nevertheless airlines must accept that air transport is part of the problem

- *quote evidence that governments (UK and EU) are seeking to reduce or limit the growth of air transport.*

  This point, with appropriate references and description of the taxation (APD) and ETS plans, was covered in Section 4 and later sections. In particular, the UK Government's Committee on Climate Change in its 2009 report, proposed that air transport growth should be limited to 60% for the period from 2005 to 2050 – an average growth of 1.3% per annum during that period. The report did suggest that this limit could be eased if the air transport industry succeeded in significantly reducing its CO_2 emissions. However, the proposed limit can be contrasted with an air transport industry projection of a traffic increase of considerably more than 100% for the period from 2009 to 2030 – with an average growth of 5% per annum.

- *describe the relevance and value of air transport.*
  This was described in Section 4 detailing the size and shape of air transport both globally and in the UK

- *consider whether air transport is really important.*
  This was also covered in Section 4 by the examination of a hypothetical situation without the availability of air transport. It was found to be important economically, socially and politically.

- *establish the amount of planned and likely future increases in air fares arising from increased taxation (APD) and the introduction of the EU ETS*
  This was covered in Section 3 leading to the adoption for this study, of a range of fares increases based on the actual APD increase and various forecasts of the cost of ETS on a per passenger basis.

- *examine the economic benefits that are claimed for air transport.* This was considered in macro terms in Section 5 with details of the contribution of air transport to the UK economy

- *produce and quantify evidence of the economic benefits arising at regional levels from the operation of air transport services.*
  This was covered in Section 6 with details of the surveys carried out at London City Airport and Newquay Cornwall Airport

- *produce and quantify details of the amount of CO_2 produced by the operation of air transport services from and to the specific regional locations.*
  This was covered in Section 7 using analyses of fuel consumption data for the relevant aircraft types.

- *establish the cost of CO_2 emissions and compare this with the value of the assessed economic benefits. Establish the relationship between these.*
  The cost of CO_2 was covered in Section 7 together with an analysis of the relationship between the total CO_2 cost and the value of the economic benefits determined in Section 6.

- *examine market elasticities to determine the likely effect of the increases in various forms of government taxation (APD plus ETS) on the regional air transport services examined..*
  This was covered in Section 8 using market demand Elasticities derived from the market surveys conducted at LCY and NQY. These were used to determine the likely effect of fares increases due to the increased taxation and to the implementation of the ETS, on the services currently operated.

- *determine the potential loss of business and leisure traffic on the routes concerned and establish the likely impact on airport and airline profitability in order to provide a guide to the continued viability of some of the air services.*
  This is also covered in Section 8. Having determined the likely effect of the air fares increases on demand, an assessment was then made of the potential impact this might have on the profitability of the air services provided at LCY and NQY. The potential effect can be described as "serious" for both airport companies and airlines.

- *produce and quantify an assessment of the potential severity of climate change and analyse the implications of the assessment for air transport so far as this study is concerned.* This is covered in Section 11. with a description of the straw poll used to establish respondent's views on the likely severity of climate change. This was used simply to enable an acceptable assessment to be made of the study results.

- *determine the possible impact on the regional economies around LCY and NQY, of the potential loss of business and leisure traffic on their air services.* This is also covered in Section 11 and is relevant to determining the changes to the air services operated there and the consequent impact on the regional economies. The damage to the regional economy around LCY is estimated to be potentially up to 6% of the GDP or £2.9bn. For the NQY region the damage is potentially estimated to be up to 9% of GDP or £330m.

RESULT

Given the analysis above of the points covered in the study and taking all the research and desk analysis into consideration, the hypothesis is proved as follows:

- ***the economic cost of Government environmental measures aimed at reducing demand for air travel would be considerable and damaging to the economy .... serious for regional economies.*** **The evidence provided by the research carried out on the air services from and to LCY and NQY and the subsequent analyses, is clear. The evidence shows that damage to the regional economies concerned is likely.**

- ***serious for the elements of the air transport industry.***
  The evidence of the potential changes arising to airline operating ratios is clear, probably resulting in the operation of less frequencies or the closure of some routes. The impact of this on the airport and airline companies is clear.

However, because of the current uncertainty of the precise cost of the EU ETS, the Hypothesis is not proved if only the lower levels of the range of increases in fares arising from APD and ETS, are subsequently found to arise.

Philip Shearman
City University

April 2010

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Part V: Appendices

REGIONAL ECONOMIC BENEFITS OF AIR SERVICES VERSUS THE ENVIRONMENTAL COST OF EMISSIONS

THE CASE OF LONDON CITY AIRPORT AND NEWQUAY CORNWALL AIRPORT

Submitted by:
Philip Shearman

Submitted to:
Professor R Wootton
City University

April 2010

LIST OF APPENDICES

APPENDIX

Appendix A

REVIEW OF RELATED LITERATURE

There is a great deal of literature on the subject of Global Warming both scientific and general. However, much of this is broad or national or global. Reference has been made to many documents throughout the study and details of each reference are annotated at the end of each section. All of these references are deemed to be relevant to this study.

However, in addition the following list which cannot claim to be exhaustive covers the work that enters the area of research followed in the study.

RELATED LITERATURE and COMMENTARY

1. ***Economics of Climate Change***: HM Treasury Stern Report 2006. This has been useful for some of the basic data for the UK.
2. ***Transport Study***: DfT Eddington Report 2006. Almost entirely national and international
3. ***IPCC Reports*** United Nations 1999 onwards. Useful for global information
4. ***The Economic Contribution of the Aviation Industry in the UK.*** Oxford Economic Forecasting 2006. This has been very useful for UK data and for employment details together with the methodology for calculating indirect and induced employment.
5. ***Aviation and the Environment*** DfT 2003. This provides a guide to HMG policy and taxation of air travel
6. ***Aviation Duty: a Consultation.*** HM Treasury 2009 This is useful for up to date thinking on APD
7. ***The Economic and Social benefits of air transport.*** Air Transport Action Group Geneva 2008. This has provided a useful international basis for determining economic benefits. It is however, very broad.
8. ***UK Air Passenger Demand and CO_2 Forecasts*** DfT 2003 A useful attempt to link these subjects and provided some useful basic information

9. ***The Environmental effects of Civil Aircraft.*** Royal Commission on Environmental Pollution 2002. Some points on emissions useful
10. ***Aviation Emissions Cost Assessment*** DfT 2008 This was useful to show how uncertain the position still is.
11. ***Aviation in EU ETS.*** Merrill Lynch 2008. Useful in providing a realistic assessment of the possible cost of ETS
12. ***Plane, Simple Truth.*** Thomas, Norris, Creedy, Forbes-Smith. Pepper Aerospace Technical Publications 2006 This is an attempt to show how good aviation is and that all the critics are wrong! Some useful facts especially on current aircraft developments.
13. ***Greener by Design Reports*** Royal Aeronautical Society 2007 and 2008. Also excellent on current aircraft research work for emissions reductions
14. ***Socio-Economic impact on London City Airport*** York Aviation Consulting Group 2006. This is part of the work done for planning application purposes and was most helpful being specific to LCY. Some limited data only have been used in my study concerning part of the economic benefit study. However, I have adopted a different approach to other aspects of the economic benefit. The York Aviation paper does not seek to link the benefits with emissions cost.
15. ***Community and Environment Report 2007*** LCY report 2007. Useful for the background information
16. ***Newquay Cornwall Airport Ltd Development Plan*** Issued by NQY 2008. Useful for the background information and for the coverage of the economic benefits. However, these were relatively broad assessments only.
17. ***Building a better future*** Planning and Development document Newquay Cornwall Airport 2008 Useful for the growth projections for NQY
18. ***Flybe website*** This airline has sought to show how little CO_2 is produced by its aircraft but this is not allied to any specific routes nor with any route economic benefits
19. ***Entec study and press release.*** This engineering consultancy carried out work for Flybe to assess the emissions from specific aircraft – DHC8 (Dash-8) and to develop an aircraft ecolabelling scheme. Some interesting ideas including the eco-labelling for different aircraft types but not entirely relevant for this study.

20. ***Rain Forests – The Burning Issue.*** Produced by the Prince's Trust for HRH Prince Charles' Rainforest Project. A good public relations booklet with some useful points

21. ***Sustainable energy – without the hot air.*** Professor David MacKay, published by UIT Cambridge 2009. A fascinating review of where CO_2 comes from now and how it might be changed. The author accepts that the book does not take economic aspects into consideration.

22. ***The Vanishing Face of Gaia – a Final Warning.*** James Lovelock published by Allen Lane 2009. This book provides a very clear statement of the view that mankind is already too late to solve global warming problem.

23. ***Committee on Climate Change Aviation Report – Meeting the UK target – Options for reducing emissions to 2050.*** This Committee was set up by the UK Climate Change Act 2008. The report is thorough but does not appear to take enough consideration into account of the economic consequences of some of the recommended policies.

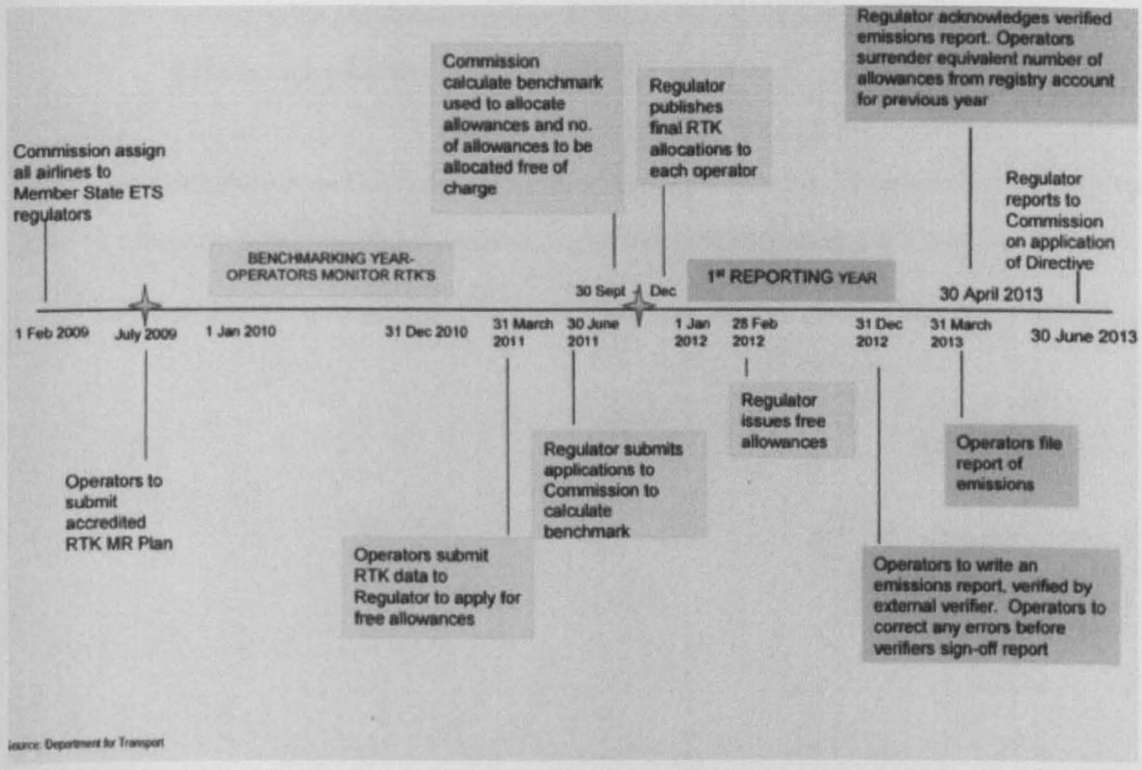
24. ***UK Climate Change Act 2008*** This is the definitive legal instrument allowing the government to impose change in the UK. The bill was sponsored, and the on-line document was prepared by the Department of Environment, Food and Rural Affairs (DEFRA).

After considering all these publications the author believes that no other work has covered the research work carried out in this study. While some research papers and reports for government have covered the economic benefits of air transport these have been at a national level and not at local or regional levels.

No other work has been identified that calculates the CO_2 levels created by specific air services on specific routes. No other work has been identified that then relates such CO_2 levels to the economic benefits arising from the operation of specific air services on specific routes. No other work has been identified that develops a series of calculations that produce assessments of the impact on air travel demand and then on airlines, of increases in air fares arising from increased taxation. Nor has any other work been found that develops a ratio approach to examining the environmental and economic value of an airport or an airline route together with proposals for assessing the result.

Appendix B

Timeline for the introduction of the Emissions Trading Scheme for air transport



Reproduced from Department for Transport web site

Appendix C

SURVEY QUESTIONNAIRE FORM

The survey used a questionnaire form in two variants:

A = for use with business travellers

B = for use with non-business travellers, basically leisure and visiting friends and relatives (vfr) travellers

These are both shown on the following pages together with two display cards which were used to allow respondents to select their answers to certain more personal questions.

CITY UNIVERSITY AIR TRANSPORT STUDY **A**

Location ________________ **Date** ________________

Q1. What is the primary reason for your journey?

Business _____ Leisure/Holiday _______ vfr _______ Other ___________

[If business traveller – go to Q2; If leisure/holiday traveller – go to Q3
If visiting friends or relatives or any other reason for travel – go to Q4]

Q2. ***For business travellers.***

a. Where are you travelling to? __________

b. Which airline are you using and your flight number? __________

c. How many people are travelling together with you? __________

d. Is this your outward or return journey? O R

e.. How many days away does your journey involve? __________

f.. What type of business are you in? ______________________________

g. What is the reason for your journey? eg sales, promotion, inter-office meeting, buying, technical servicing, managing, consultancy etc

____

h.. *[If the journey is outbound]* How many business trips do you make by air a year? __________

How will your journey benefit **your** company? Eg more sales, lower costs, better supplies, new contract etc.

____

i. *[If the journey was inbound and now returning home]*

How many business trips do you make by air a year to this area?__________

How will your journey benefit the company(ies) **you visited**?

eg more sales, lower costs, better supplies, new contract etc.

____

j. Why are you using air transport for this trip for your company? For example:

Time saved = greater productivity _____ Money value of business involved____

[If this, what is approximate value?]__________ Other ______________

k. If time saved, how many days altogether and what money value would you put on this? eg Company call-out rate per day or approx salary + expenses per day

[Show card with this question and the money ranges to let the respondent select]

Days____________£ per day______________________

l. *[For returning home pax only]* Approximately how much have you spent on accommodation, meals, leisure, car hire etc during your stay? ___________

[Show card with this question and the money ranges to let the respondent select]

Is this for you alone _____ or for all travelling with you? ______________

m If air services were not available would you have still made the journey? Y N

If yes, how? Train ______ Car______ Coach/bus_______ Boat/ferry _______

If no, would you have used telephone ____video conferencing ____Other____

n. If the air fare was increased due to environmental taxes would you still use air services to/from here – for example:

If the fare was increased up to 20% more? Y N Less

If the fare was increased up to 50% more? Y N Less

If the fare was increased up to 100% more i.e doubled? Y N Less

Thank you for your help.

CITY UNIVERSITY AIR TRANSPORT STUDY **B**

Location ________________ **Date**________________

Q1. What is the primary reason for your journey?

Business _____ Leisure/Holiday _______ vfr _____ Other ___________

[If business traveller – go to Q2: If leisure/holiday traveller – go to Q3
If visiting friends or relatives or any other reason for travel – go to Q4]

Q3. ***For leisure/tourist travellers.***

a. Where are you travelling to? ______________

b. Which airline are you using and your flight number? ______________

c. How many people are travelling together with you? ______________

d Is this your outward or return journey? *{If outward – go to Q3g / h]*

O__R

e *[For returning home pax]* How many days did you spend here?___________

f Approximately how much have you spent on accommodation, meals, leisure activities, car hire etc during your stay? ______________

[Show card with this question and the money ranges to let the respondent select]

Is this for you alone ______ or for all travelling with you? ______________

g. If air services were not available would you have still made the journey to this specific destination? Y_____N

If yes, how? Train ______ Car______ Coach/bus______ Boat/ferry _________

h. If the air fare was increased due to environmental taxes would you still use air services to/from here – for example:

If the fare was increased up to 20% more? Y N Less

If the fare was increased up to 50% more? Y N Less

If the fare was increased up to 100% more? Y N Less

Thank you for your help

Q4. ***For vfr or those travelling for other reasons.***

a. Where are you travelling to? ______________

b. Which airline are you using and your flight number? ______________

c. How many people are travelling together with you? ______________

d Is this your outward or return journey? *[If outward – go to Q4g / h]*

O____R

e *[For returning home pax]* How many days did you spend here? _________

f Approximately how much have you spent on accommodation, meals, leisure activities, car hire etc during your stay? ______________

[Show card with this question and the money ranges to let the respondent select]

Is this for you alone ________or for all travelling with you? ____________

g If air services were not available would you have still made the journey?

Y___N

If yes, how? Train ____ Car____ Coach/bus____ Boat/ferry ____Other______

h If the air fare was increased due to environmental taxes would you still use air services to/from here – for example:

If the fare was increased up to 20% more? Y N Less

If the fare was increased up to 50% more? Y N Less

If the fare was increased up to 100% more? Y N Less

Thank you for your help

The following display cards were used in connection with Questions 2k for business travellers; 2l also for business travellers and 3f for leisure travellers and 4f for vfr or those travelling for other non-business purposes.

Q2k If time saved, how many days altogether and what money value would you put on this? eg Company call-out rate <u>per day</u> or approximate salary + expenses <u>per day</u>

(1)**£<100** (2)**£101-300** (3)**£301-500** (4)**£501-700**

(5)**£701-900** (6)**£901-1,100** (7)**£1,101-1,300** (8)**£1,301-1,500**

(9)**£1,501-1,700** (10)**£1,701-1,900** (11)**£>1,901**

Q2l / Q3f / Q4f. Approximately how much have you spent on accommodation, meals, leisure, entertainment, car hire etc during your stay?

(1) **£<100:** (2)**£101-250:** (3)**£251-500:** (4)**£501-750:**

(5)**£751- 1,000:** (6)**£1,001-1,250:** (7)**£1,251-1,500:**

(8)**£1,501-1,750:** (9)**£1,751-2,000** (10)**>£2,001**

Appendix D

RESEARCH FOR CITY UNIVERSITY

REPORT ON PASSENGER SURVEY AT LONDON CITY AIRPORT AUGUST 2008

Philip Shearman
City University

August 2008

RESEARCH FOR CITY UNIVERSITY

REPORT ON PASSENGER SURVEY AT LONDON CITY AIRPORT AUGUST 2008

CONTENTS

RESEARCH FOR CITY UNIVERSITY

REPORT ON PASSENGER SURVEY AT LONDON CITY AIRPORT AUGUST 2008

PART A: INTRODUCTION

Background
This survey forms part of the research work being carried out to determine the economic benefits arising from air services in comparison with the cost of the carbon dioxide emissions produced by the aircraft operating the air services concerned. The survey represents a key part of the evaluation of the economic benefits and the questionnaire will be used at another UK airport shortly in order to provide further data.

The management of London City Airport (LCY) were most helpful in permitting the survey and ensuring that it could be carried out airside, this being by far the most effective interview point. This did necessitate attending two short courses with accompanying exams – fortunately passed successfully! The LCY liaison staff member was particularly helpful throughout. However, it was agreed from the outset that a specific report would be provided for LCY Management covering the survey results for the airport.

This part of the report - Part A, describes the reason for the research and the method of operation. Part B details the basic data and results for the "business travellers" interviewed with Part C providing the details for the "non-business travellers" interviewed. A brief summary of key points is provided in Part D.

Coverage
Face-to-face interviews were conducted with passengers departing from LCY using a questionnaire designed specifically for business travellers and two further variants of the questionnaire for non-business travellers. The questionnaire formats used are given in Attachment 1. The total number of interviews conducted were:

		%
Business travellers	93	51.4
Leisure & Holiday travellers	80	44.2
Visiting Friends & Relatives (vfr)	8	4.4
Total	181	100.0

The survey was carried out as follows:

Wednesday August 23	afternoon / early evening
Thursday August 24	morning / afternoon / early evening
Friday August 25	morning

Other work for LCY has shown a higher proportion of business travellers than we encountered. [LCY Passenger Profile 2006 recorded 63% business travellers]. However, our results reflect the time of year of the study - August. This is not important for the overall purpose of the research and in any case the sample size is sufficient to provide reasonably representative results. In all cases the travellers were selected at random and no account was made of possible destination, nationality etc. Two interviews were conducted in French.

The small number of vfr travellers is partly because a number of passengers stated that although they would be meeting friends during their trip the primary reason for travel was holiday. Consequently the Leisure & Holiday and vfr data have been analysed together although specific comments on vfr have been made where the data are sufficiently robust.

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August 2008

REPORT ON PASSENGER SURVEY AT LONDON CITY AIRPORT AUGUST 2008

PART B: BUSINESS TRAVELLERS

Over the three days 93 business travellers were interviewed. The following analyses relate to the questionnaire as shown in Appendix D.

Question 2a/b: Where are you travelling to? Which airline are you using?

The number of destinations covered by the survey was 20 (nearly 60%) out of a total number of 34 served from LCY. Respondents were travelling on all 8 airlines operating from LCY (100%).

The main destinations covered were:

Edinburgh	25 travellers	Zurich	10
Dublin	13		

The main carriers covered were:

British Airways	40 travellers	VLM	17
Air France	21		

While the selection of routes and carriers was entirely co-incidental and the aggregated data are entirely robust, it does mean that the number of respondents to many of the destinations and for many of the carriers, were few. This is not critical for the overall research but the data for many specific routes and some specific airlines would not be adequate on their own. For example, only one passenger to Milan was interviewed and hence only one passenger travelling on Air One (AP).

Question 2c: How many people are travelling together including you?

	%
Travelling alone	86.0
2 people	12.9
3	-
4	-
More than 4	1.1

The latter included a group of 12 who were the support team for a pop group (Pendulum). See Question 2h.

Question 2d: Is this your outward or return journey?

	%
Outward journey	31.2
Return journey	68.8

The greater proportion of returning passengers may simply reflect the days of the week of the study. However, the question was relevant for the study as some later questions are specific to outward or returning passengers.

Question 2e: How many days away does your journey involve?

	%
One (ie out and back in the day)	38.7
Two days	32.3
Three days	16.1
Four days	6.4
Five days	1.1
More than 5 days	5.4

These were: 7, 11, 17, 21, 23 days

The weighted average stay in the UK for the returning home passengers was 2.1 days.

Question 2f: What type of business are you in?

	%
Banking/Finance	36.6
Manufacturing/Engineering	11.8
IT/Communications	8.6
Consultancy	6.5
Government/EU/Civil Service	2.1
Other	34.4

The latter included a very wide range of occupations such as:

Education	Musician	Legal
Broadcasting	Artist	Vet Surgeon
Property Dealing	Publishing	Cleaning Contractor
Pharmaceuticals	Seafarers' charity	Writer/Playwriter
Events Management	Retail	Surveyor

This simply shows that although a high proportion of the respondents were involved in Finance the remaining occupations were extremely varied.

Question 2g: What is the reason for your journey?

	%
Client meeting/Sales work	45.2
Internal company meeting	25.8
International/Government meeting	5.4
Other	23.6

The large "other" category reflects the wide range of occupations. It included "giving a concert" and "directing a play at the Edinburgh Festival".

Question 2h Part 1: How many business trips do you make by air a year? [This question was for Outbound travellers only.]

	%		%
1 – 3	17.2	13 – 15	3.5
4 – 6	20.7	16 – 18	3.5
7 – 9	13.8	19 – 21	3.5
10 – 12	17.2	> 21	20.6

The >21 category included 13.8% who travelled every week and one respondent – part of the pop group support team - who claimed to travel about 200 times a year!

Question 2h Part 2: How will your journey benefit <u>your</u> company? [Outbound passengers only]

	%
More sales	41.4
Problem solving	34.5
Improved staff morale & better communication	6.9
Political presence at internationl meeting	6.9
New contracts	6.9
Other	3.4

Question 2i Part 1: How many business trips do you make by air a year to this area? [This question was for returning home travellers only. "This area" was defined for the respondents as being the whole London region with five airports]

	%		%
Up to 18 trips a year:			
1 – 3	15.6	10 – 12	15.6
4 - 6	17.2	13 – 15	4.7
7 – 9	4.7	16 – 18	3.1
More than 18 trips a year:			
19 – 29	14.1	40 – 60	14.1
30 – 39	9.4	> 60	1.5

The highest in the last category was 100 ie two round trips a week.

Question 2i Part2: How will your journey have benefited the company/ organisation that <u>you visited</u>? [Returning home passengers only]

	%
More sales	29.7
Greater efficiency & Problems solved	28.1
Improved performance & better communications	23.4
New contracts	7.8
Better supplier service	4.7
Other	6.3

Question 2j: Why are you using air transport for this journey?

	%
Time saved/greater productivity	96.8
Other	3.2

The "other" category cited "cheaper" as the reason for using air transport!

Question 2k Part 1: If "time saved" is the reason for using air transport, then how many days are you saving and what money value would you/ or your company, put on this?
[Respondents were shown a card which gave the question and added "for example, a company call-out rate <u>per day</u> or approximate salary + expenses <u>per day</u>". The card showed a range of money values for them to select.]

No. of days saved	%
Nil	1.1
Up to 1	67.7
2	28.0
3	3.2

This is entirely realistic given the short haul nature of the flights from LCY.

Question 2k Part 2: [The money value to the time saved]

UK£	%
<100	4.3
101 – 300	9.7
301 – 500	18.3
501 – 700	6.5
701 – 900	11.8
901 – 1,100	8.6
1,101 – 1,300	4.3
1,301 – 1,500	4.3
1,501 – 1,700	3.2
1,701 – 1,900	3.2
>1,900	12.9
Not willing or able to answer	12.9

Very few respondents refused to answer this question but some felt that they were simply unable to do so. For example, the artist, the playright and the seamen's charity organiser all stated that they did not know.

The response overall to this question was good and the weighted average value <u>per day</u> was £914.

Question 2l: Approximately how much have you spent on accommodation, meals, leisure, transport etc during your stay? [This question was for returning home passengers only and has been calculated on a per person basis.]

UK£	%
<100	33.3
101 – 250	15.9
251 – 500	27.0
501 – 750	11.1
751 – 1,000	6.3
1,001 – 1,250	3.2
1,251 – 1,500	1.6
1,501 – 1,750	-
1,751 – 2,000	1.6
>2,000	-

This clearly reflects the short stay nature of the LCY business traveller. Many were travelling out and back in the day and hence the high proportion spending less than £100. The weighted average expenditure was £374.

Question 2m Part 1: If air services were not available would you have still made the journey? [Clarification was given that this meant no air services from the London area at all]

	%
No	40.9
Yes	59.1

Question 2m Part 2: If yes, how? Eg train, car, boat etc.

	%
Train	89.1
Boat	5.5
Coach/bus	3.6
Car	1.8

Question 2m Part 3: If no, would you have used telephone, video conferencing, other?

	%
Video Conferencing	71.1
Telephone	21.1
Other	7.8

The Other category was generally e-mail. Although video conferencing was the preferred option, it was only if air services were not available. Clearly they were still travelling by air now and not using teleconferencing, presumably preferring face-to-face contact as being more effective!

Question 2n: If the air fare was increased due to environmental taxes would you still use air services to/from here, for example:

	%YES	% LESS	%NO
If the fare was increased			
up to 20% more?	91.4	6.5	2.1
up to 50% more?	61.2	19.4	19.4
up to 100% more?	44.1	24.7	31.2

It was stressed that this question was about tax increases and not airlines' fares increases and the responses appeared to be quite realistic. However, the idea of the fare doubling inevitably produced an automatic "no" response although many respondents said "yes, I have to travel, I have no choice".

Using the above data to produce an approximate measure of price elasticity, the results suggest an inelastic demand moving from -0.3 for an increase of up to 20%, to -0.4 for the +100% case. These figures are relatively low but not too surprising for the LCY business market.

REPORT ON PASSENGER SURVEY AT LONDON CITY AIRPORT AUGUST 2008

PART C: LEISURE AND VISITING FRIENDS & RELATIVES (vfr) TRAVELLERS

Over the three days 80 Leisure and Holiday travellers were interviewed and 8 vfr travellers. In view of the small number of vfr travellers the two categories have been merged for analysis and reporting purposes, giving a total of 88 respondents. The following analysis relates to the questionnaire as shown in Appendix D.

Question 3a/b: Where are you travelling to? Which airline are you using?

The number of destinations covered by the survey was 17 (50%) out of a total number of 34 served from LCY. Respondents were travelling on 7 of the 8 airlines operating from LCY.

The main destinations covered were:

Zurich	14 travellers	Geneva	12
Nice	13	Frankfurt	8

The main carriers covered were:

British Airways	29 travellers	Air France	18
Swiss	23	VLM	9

Question 3c: How many people are travelling together including you?

	%
Travelling alone	63.7
2 people	26.2
3	4.5
4	4.5
More than 4	1.1

Question 3d: Is this your outward or return journey?

	%
Outward journey	71.6
Return journey	28.4

The high proportion of outbound travellers clearly reflects the inclusion of Friday in the survey period.

Question 3e: How many days did you spend here? [This question was for returning home passengers only]

	%		%
One (ie out and back in the day)	8.0	Five days	12.0
Two days	4.0	More than 5 days	32.0
Three days	24.0	These were mainly: 7, 12,14 days	
Four days	20.0		

The weighted average length of stay was 6.9 days.

Question 3f: Approximately how much have you spent on accommodation, meals, transport, leisure activities etc during your stay? [This question was for returning home passengers only and has been calculated on a per person basis.]

£	%
<100	16.0
101 – 250	24.0
251 – 500	28.0
501 – 750	12.0
751 – 1,000	-
1,001 – 1,250	4.0
1,251 – 1,500	-
1,501 – 1,750	4.0
1,751 – 2,000	-
>2,000	4.0
No response	8.0

The "no response" category was from people claiming that they had stayed with friends and therefore there was no cost! The weighted average expenditure was £465 reflecting the high cost of visiting London.

Question 3g Part 1: If air services were not available would you have still made the journey? [Clarification was given that this meant no air services from the London area at all]

	%
No	34.1
Yes	65.9

Question 3g Part 2: If yes, how? Eg train, car, boat etc.

	%
Train	70.7
Car	19.0
Boat/Train	10.3

Question 3h: If the air fare was increased due to environmental taxes would you still use air services to/from here, for example:

	%YES	% LESS	%NO
If the fare was increased			
up to 20% more?	85.2	5.7	9.1
up to 50% more?	35.2	20.5	44.3
up to 100% more?	15.9	13.6	70.5

It was stressed that this question was about tax increases and not airlines' fares increases and the responses appeared to be quite realistic. However, the idea of the fare doubling inevitably produced an automatic “no” response although some respondents such as one of the vfr passengers said that he was travelling to a wedding and so would pay even 100% more..

Using the above data to produce an approximate measure of price elasticity, the results suggest an elastic demand of -0.6 for an increase of up to 20% moving to a response of -1.2 for the +100% case, only marginally inelastic.

REPORT ON PASSENGER SURVEY AT LONDON CITY AIRPORT AUGUST 2008

PART D: SELECTED KEY POINTS

1 Overall the passenger survey has answered the primary questions needed for this part of the research work.

2 The face-to –face interviews covered 181 respondents with 51% being business travellers. This is a lower proportion than experienced in other LCY surveys, simply reflecting the time of year used – August.

3 The business passengers from LCY are frequent travellers with more than 20% making more than 21 trips a year. Some 86% of the business passengers were travelling alone and over 60% of the leisure and vfr passengers. Over 70% of the business passengers were travelling for one or two days with nearly 40% travelling out and back in the day. For the leisure and vfr passengers nearly 65% were travelling for 4 days or more.

4 The weighted average length of stay in the UK for the business travellers now returning home was 2.1 days and 6.9 days for the leisure passengers.

5 The amount spent per person on accommodation, meals, transport, leisure activities etc in the UK by returning business travellers was £374 but was £465 per person for the leisure travellers.

6 Business passengers were asked why they were using air travel rather than surface transport. Some 97% gave time saving as the reason with nearly 68% stating that up to one day was saved. They were asked to put a money value to the time saved in terms of a company call-out rate or salary plus expenses per day. Nearly all respondents were willing to answer and the weighted average value per day was £914.

7 When asked if no air services were available to their destination would they still make the journey, nearly 60% said yes. Of the remainder, more than 70% would use teleconferencing as a substitute. However, they still preferred the air journey and face-to-face contact, assuming this was available.

8 Respondents were asked about a fares increase due to the further imposition of environmental taxes and would they still travel by air. Even with an effective doubling of the fare 44% of business travellers said "yes" but only 16% of the leisure passengers. Approximate measures of price elasticity were made which suggested that, predictably the business travellers' demand was strongly inelastic while the leisure and vfr travellers' demand was elastic but only moderately so.

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August 2008

Appendix E

RESEARCH FOR
CITY UNIVERSITY

REPORT ON PASSENGER SURVEY AT NEWQUAY, CORNWALL AIRPORT OCTOBER 2008

Philip Shearman
City University

November 2008

RESEARCH FOR CITY UNIVERSITY

REPORT ON PASSENGER SURVEY AT NEWQUAY CORNWALL AIRPORT OCTOBER 2008

CONTENTS

RESEARCH FOR CITY UNIVERSITY

REPORT ON PASSENGER SURVEY AT NEWQUAY CORNWALL AIRPORT OCTOBER 2008

PART A: INTRODUCTION

Background
This survey forms part of the research work being carried out to determine the economic benefits arising from air services in comparison with the cost of the carbon dioxide emissions produced by the aircraft operating the air services concerned. The survey represents a key part of the evaluation of the economic benefits and the questionnaire was used at another UK airport in July this year.

The management of Newquay Cornwall Airport (NQY) were helpful in granting permission for the survey to be carried out. The NQY airport staff were most helpful throughout. However, it was agreed from the outset that a specific report would be provided for NQY Management covering the survey results for the airport.

This part of the report - Part A, describes the reason for the research and the method of operation. Part B details the basic data and results for the "business travellers" interviewed with Part C providing the details for the "non-business travellers" interviewed. A brief summary of key points is provided in Part D.

Coverage
Face-to-face interviews were conducted with passengers departing from NQY using a questionnaire designed specifically for business travellers. Two further variants of the questionnaire were used for non-business travellers. The questionnaire formats used are given in Attachment 1. The total number of interviews conducted were:

			%	
Business travellers	52		39.7	
Leisure & Holiday travellers	53)	) 79	40.5)	) 60.3
Visiting Friends & Relatives (vfr)	26)		19.8)	
Total	131		100.0	

The survey was carried out as follows:

Tuesday October 21 morning / afternoon / early evening
Wednesday October 22 morning / afternoon / early evening
Thursday October 23 morning

The use of October for the survey while not ideal, was necessitated by a number of factors, but it did enable the work to still take place during the summer schedule period. However, the passenger loads were very low with the exception of the Ryanair flights and a number of airlines withdrew flights in advance of the start of the winter schedules.

The results therefore do inevitably reflect to some extent the time of year of the study. This is not important for the overall purpose of the research and in any case the sample size while not large, is sufficient to provide reasonably representative results. In all cases the travellers were selected at random and no account was made of possible destination, nationality etc.

The smaller number of vfr travellers is partly because a number of passengers stated that although they would be meeting friends during their trip the primary reason for travel was holiday. Consequently the Leisure & Holiday and vfr data have been analysed together although specific comments on vfr have been made where the data are sufficiently robust.

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November 2008

REPORT ON PASSENGER SURVEY AT NEWQUAY CORNWALL AIRPORT OCTOBER 2008

PART B: BUSINESS TRAVELLERS

Over the three days of the survey 52 business travellers were interviewed. The following analyses relate to the questionnaire as shown in Appendix D.

Question 2a/b: Where are you travelling to? Which airline are you using?

The number of destinations covered by the survey was 10 (44%) out of a total number of 23 served from NQY although a number of these (7) are charter type operations with limited seasonal frequency. If these are excluded the proportion covered by the survey rises to 63%. Respondents were travelling on 5 airlines operating from NQY (83% of the total).

The main destinations covered were:

London – Gatwick/Stansted	29 travellers
Manchester	9
Scotland – Edinburgh/Glasgow	6

The main carriers covered were:

Air Southwest	42 travellers
British Airways	7

While the selection of routes and carriers was entirely random and the aggregated data are reasonably robust, it does mean that the number of respondents to many of the destinations and for many of the carriers, were few. This is not critical for the overall research but the data for many specific routes and some specific airlines would not be adequate on their own. For example, only one business passenger to Dublin was interviewed and only one business passenger travelling on the Skyvan sevice to the Isles of Scilly..

Question 2c: How many people are travelling together including you?

	%
Travelling alone	78.8
2 people	15.5
3	-
4	3.8
More than 4	1.9

Question 2d: Is this your outward or return journey?

	%
Outward journey	57.7
Return journey	42.3

The greater proportion of outward passengers may simply reflect the days of the week of the study and the month involved. However, the question was relevant for the study as some later questions are specific to outward or returning passengers.

Question 2e: How many days away does your journey involve?

	%		%
One (ie out and back in the day)	21.2	Five days	5.8
Two days	28.8	More than 5 days	9.6
Three days	25.0	These included: 6.7.14.30 days	
Four days	9.6		

The weighted average number of days involved was 3.5 days.

Question 2f: What type of business are you in?

	%		%
National and Local Government/EU/Civil Service	19.2	Tourism/Leisure/ Hotels	7.8
Consultancy	11.5	Construction/Civil Engineering	7.7
Medical	9.6	Banking/Finance	5.8
IT/Communications	9.6	Manufacturing	3.8
Other	25.0		

The "Other" category included a very wide range of occupations such as:

Printing Energy/Oil
Retail Architect
Military

This simply shows that although a higher proportion of the respondents were involved in various aspects of local and national government the remaining occupations were extremely varied.

Question 2g: What is the reason for your journey?

	%
Client meeting/Sales work	21.2
External meeting	19.2
Client inspection visit	19.2
Government conference/ training	13.5
Internal company meeting	7.7
Other	19.2

The large "other" category reflects the wide range of occupations. It included "oil rig work", "visiting a naval vessel" and "delivering a boat from the Netherlands".

Question 2h Part 1: How many business trips do you make by air a year? [This question was for Outbound travellers only.]

	%		%
1 – 3	36.7	10 – 12	10.0
4 – 6	26.7	13 – 15	-
7 – 9	3.3	>15	23.3

The >15 category included 20 trips, 22, 40 and 50 indicating the high level of travel by some Cornwall based business travellers.

Question 2h Part 2: How will your journey benefit <u>your</u> company? [Outbound passengers only]

	%
Problem solving/greater efficiency and productivity	43.3
Improved staff morale and better communication	20.0
More sales	20.0
Improved government work and effectiveness	10.0
New contracts	3.3
Other	3.4

Question 2i Part 1: How many business trips do you make by air a year to this area? [This question was for returning home travellers only. "This area" was defined for the respondents as being the Cornwall region]

	%		%
Up to 15 trips a year:			
1 – 3 trips	54.6	10 – 12 trips	4.5
4 - 6	13.6	13 – 15	4.5
7 – 9	9.2	> 15	13.6
Those making more than 15 trips a year:			
19 – 29	3		

Nearly 80% of returning business travellers made less than 10 trips to Cornwall a year..

Question 2i Part2: How will your journey have benefited the company/ organisation that <u>you visited</u>? [Returning home passengers only]

	%
Greater efficiency & Problems solved	59.1
More sales	22.7
Improved performance & better communications	18.2

Question 2j: Why are you using air transport for this journey?

	%
Time saved/greater productivity	90.4
Other	9.6

The "other" category included respondents citing "convenience" and "cheaper" as the reason for using air transport.

Question 2k Part 1: If "time saved" is the reason for using air transport, then how many days are you saving and what money value would you/ or your company, put on this?
[Respondents were shown a card which gave the question and added "for example, a company call-out rate per day or approximate salary + expenses per day". The card showed a range of money values for them to select.]

No. of days saved	%
Nil	3.8
Up to 1	71.2
2	25.0

This is entirely realistic given the short haul nature of the flights from NQY.

Question 2k Part 2: [The money value to the time saved]

UK£	%
<100	-
101 – 300	26.9
301 – 500	26.9
501 – 700	21.2
701 – 900	3.9
901 – 1,100	3.8
1,101 – 1,300	3.8
1,301 – 1,500	-
1,501 – 1,700	3.9
1,701 – 1,900	-
>1,900	3.8
Not willing or able to answer	5.8

Very few respondents refused to answer this question but some felt that they were simply unable to do so. For example, the sailor delivering the boat from the Netherlands simply stated that he did not know. The response overall to this question was good and the weighted average value per day was £576.

Question 2l: Approximately how much have you spent on accommodation, meals, leisure, transport etc during your stay? [This question was for returning home passengers only and has been calculated on a per person basis.]

UK£	%
<100	27.3
101 – 250	36.4
251 – 500	22.7
501 – 750	13.6
751 – 1,000	-
1,001 – 1,250	-
1,251 – 1,500	-

1,501 – 1,750	-
1,751 – 2,000	-
>2,000	-

This clearly reflects the short stay nature of the NQY business traveller. Some were travelling out and back in the day and hence the relatively high proportion spending less than £100. The weighted average expenditure was £261.

Question 2m Part 1: If air services were not available would you have still made the journey? [Clarification was given that this meant no air services to/from the Cornwall area at all]

	%
No	11.5
Yes	88.5

Question 2m Part 2: If yes, how? Eg train, car, boat etc.

	%
Train	58.7
Boat	2.2
Coach/bus	-
Car	39.1

Question 2m Part 3: If no, would you have used telephone, video conferencing, other?

There seemed to be virtually no interest in use of video conferencing, e-mail was the main alternative suggested or they would not seek any further business relationship.

Such response clearly emphasises the importance of the air service links for Cornwall.

Question 2n: If the air fare was increased due to environmental taxes would you still use air services to/from here, for example:

	%YES	% LESS	%NO
If the fare was increased			
up to 20% more?	90.7	7.7	1.9
up to 50% more?	46.2	36.5	17.3
up to 100% more?	26.9	63.5	9.6

It was stressed that this question was about tax increases and not airlines' fares increases and the responses appeared to be quite realistic. However, the idea of the fare doubling inevitably produced an automatic "no" response although a number of respondents said "yes, I have to travel, I have no choice"

Using the above data to produce an approximate measure of price elasticity, the results suggest an inelastic demand moving from -0.3 for an increase of up to 20%, to -0.4 for the +100% case. These figures are relatively low but not too surprising for a business market.

REPORT ON PASSENGER SURVEY AT NEWQUAY, CORNWALL AIRPORT OCTOBER 2008

PART C: LEISURE AND VISITING FRIENDS & RELATIVES (vfr) TRAVELLERS

Over the three days 53 Leisure and Holiday travellers were interviewed and 26 vfr travellers. In view of the smaller number of vfr travellers the two categories have been merged for analysis and reporting purposes, giving a total of 79 respondents. The following analysis relates to the questionnaire as shown in Appendix D.

Question 3a/b: Where are you travelling to? Which airline are you using?

The number of destinations covered by the survey was 8 (35%) out of a total number of 23 served from NQY although a number of these are charter type services with limited frequencies. Respondents were travelling on 5 airlines operating from NQY.

The main destinations covered were:	
London: Gatwick and Stansted	27 travellers
Edinburgh	18
Leeds/Bradford	9
Glasgow	8
The main carriers covered were:	
Air Southwest	58 travellers
Flybe	16

While the selection of routes and carriers was entirely random and the aggregated data are reasonably robust, it does mean that the number of respondents to many of the destinations and for individual carriers, were few. This is not critical for the overall research but the data for many specific routes and for specific airlines would not be adequate on their own. For example, only two leisure/vfr passengers to Cork were interviewed and only one leisure/vfr passenger travelling on the Skyvan sevice to the Isles of Scilly – clearly a reflection of the time of year.

Question 3c: How many people are travelling together including you?

	%
Travelling alone	45.2
2 people	43.4
3	1.9
4	5.7
More than 4	3.8

Question 3d: Is this your outward or return journey?

	%
Outward journey	43.0
Return journey	57.0

Question 3e: How many days did you spend here? [This question was for returning home passengers only]

	%		%
One (ie out and back in the day)	6.7	Five days	13.3
Two days	11.1	More than 5 days	53.4
Three days	13.3	These were mainly: 7-14 days with 4 between 20 and 60 days plus another at 90 days	
Four days	2.2		

The weighted average length of stay was 10.5 days.

Question 3f: Approximately how much have you spent on accommodation, meals, transport, leisure activities etc during your stay? [This question was for returning home passengers only and has been calculated on a per person basis.]

£	%
<100	33.3
101 – 250	28.9
251 – 500	22.2
501 – 750	4.4
751 – 1,000	4.4
1,001 – 1,250	2.2
1,251 – 1,500	-
1,501 – 1,750	-
1,751 – 2,000	2.3
>2,000	2.3
No response	-

The high proportion spending less than £250 (62.2%) reflects the number of respondents staying with friends or relatives and therefore incurring little cost. The weighted average expenditure was £349.

Question 3g Part 1: If air services were not available would you have still made the journey? [Clarification was given that this meant no air services from the Cornwall area at all]

	%
No	27.8
Yes	72.2

Question 3g Part 2: If yes, how? Eg train, car, boat etc.

	%
Train	59.6
Car	21.1
Boat/Train	14.0
Coach/Bus	5.3

Question 3h: If the air fare was increased due to environmental taxes would you still use air services to/from here, for example:

	%YES	% LESS	%NO
If the fare was increased			
up to 20% more?	79.7	3.8	16.5
up to 50% more?	17.7	13.9	68.4
up to 100% more?	7.6	12.7	79.7

It was stressed that this question was about tax increases and not airlines' fares increases and the responses appeared to be quite realistic. However, the idea of the fare doubling inevitably produced an automatic "no" response although some respondents such as one of the vfr passengers said that he was travelling to a funeral and so would pay even 100% more..

Using the above data to produce an approximate measure of price elasticity, the results suggest an inelastic demand of -0.9 for an increase of up to 20% moving to a response of -1.5 for the +100% case, showing a clear elastic type demand.

REPORT ON PASSENGER SURVEY AT NEWQUAY, CORNWALL AIRPORT OCTOBER 2008

PART D: SELECTED KEY POINTS

1 Overall the passenger survey has answered the primary questions needed for this part of the research work.

2 The face-to –face interviews covered 131 respondents with 40% being business travellers. This is a similar proportion to the level quoted in interviews/data provided by various authorities in Cornwall.

3 The business passengers from NQY are moderately frequent travellers with more than 20% making more than 15 trips a year. Some 80% of the business passengers were travelling alone and over 45% of the leisure and vfr passengers. Fifty percent of the business passengers were travelling for one or two days with over 20% travelling out and back in the day. For the leisure and vfr passengers nearly 70% were travelling for 4 days or more.

4 The average length of trip for the business travellers was 3.5 days.

5 The weighted average length of stay in Cornwall for the leisure/vfr travellers now returning home was10.5 days.

6 The amount spent per person on accommodation, meals, transport, leisure activities etc in Cornwall by returning business travellers was £261 but was £349 per person for the leisure travellers.

7 Business passengers were asked why they were using air travel rather than surface transport. Some 90% gave time saving as the reason with over 70% stating that up to one day was saved. They were asked to put a money value to the time saved in terms of a company call-out rate or salary plus expenses per day. Nearly all respondents were willing to answer (94%) and the weighted average value per day was £576.

8 When asked if no air services were available to their destination would they still make the journey, nearly 90% said "yes". Of the remainder, most would not pursue the business – clearly representing a potential loss for the Cornish economy!

9 Respondents were asked about a fares increase due to the further imposition of environmental taxes and would they still travel by air. With an effective doubling of the fare 27% of business travellers said "yes" but only 8% of the leisure passengers. Over 60% of the business travellers said that they would travel less if the effective fare was doubled. Approximate measures of price elasticity were made which suggested that, predictably the business travellers' demand was inelastic while the leisure and vfr travellers' demand was strongly elastic.

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December 2008

Appendix F

Sample of aircraft basic data

The following two pages provide an illustration of the basic operating and performance data provided by Bombardier Aerospace Regional Aircraft Company for the DHC Dash 8-400 and by Fokker Aircraft Services BV for the Fokker 50.

The information provided is specific for the routes served from and to LCY and NQY

Attachment F

BOMBARDIER

En Route Performance - CITY UNIVERSITY

Q400 70% Load Factor

Total Taxi Time for all Sectors: 10 min
Total Taxi Fuel for all Sectors: 70 kg

En Route Temp: ISA
En Route Wind: Zero
Diversion Wind: Zero

SECTOR							TIME		FUEL				ALTERNATE			WEIGHTS		PAYLOAD			
No.	From	To	Dist. nm	Wind kt	Cruise FL	Cruise Speed kt	Flight hr:min	Block hr:min	Flight kg	Block kg	Res. kg	Total kg	Code	Dist. nm	FL	TO kg	Ldg kg	Pax & Bags	Pax. kg	Total kg	Limitation
1	LCY	XXX	100	0	150	260	0:29	0:39	440	510	921	1,431	DIV	100	150	24,142	23,702	54	0	5,130	
2	LCY	XXX	150	0	180	268	0:40	0:50	584	654	936	1,590	DIV	100	150	24,301	23,717	54	0	5,130	
3	LCY	XXX	200	0	220	279	0:50	1:00	717	787	949	1,736	DIV	100	150	24,447	23,730	54	0	5,130	
4	LCY	XXX	250	0	230	281	1:01	1:11	848	918	963	1,880	DIV	100	150	24,591	23,744	54	0	5,130	
5	LCY	XXX	300	0	250	285	1:11	1:21	971	1,041	975	2,016	DIV	100	150	24,727	23,756	54	0	5,130	
6	LCY	XXX	350	0	250	286	1:22	1:32	1,100	1,170	988	2,158	DIV	100	150	24,869	23,769	54	0	5,130	
7	LCY	XXX	400	0	250	286	1:32	1:42	1,229	1,299	1,001	2,301	DIV	100	150	25,012	23,782	54	0	5,130	
8	LCY	XXX	450	0	250	286	1:43	1:53	1,359	1,429	1,014	2,444	DIV	100	150	25,155	23,795	54	0	5,130	
9	LCY	XXX	500	0	250	286	1:53	2:03	1,489	1,559	1,028	2,587	DIV	100	150	25,298	23,809	54	0	5,130	
10	LCY	XXX	550	0	250	287	2:04	2:14	1,620	1,690	1,041	2,731	DIV	100	150	25,442	23,822	54	0	5,130	
11	LCY	XXX	600	0	250	287	2:14	2:24	1,751	1,821	1,054	2,875	DIV	100	150	25,586	23,835	54	0	5,130	
12	LCY	XXX	650	0	250	287	2:24	2:34	1,882	1,952	1,067	3,020	DIV	100	150	25,731	23,848	54	0	5,130	
13	LCY	XXX	700	0	250	287	2:35	2:45	2,014	2,084	1,081	3,165	DIV	100	150	25,876	23,862	54	0	5,130	
14	NQY	XXX	100	0	150	260	0:29	0:39	437	507	921	1,429	DIV	100	150	24,140	23,702	54	0	5,130	
15	NQY	XXX	150	0	180	268	0:40	0:50	582	652	936	1,588	DIV	100	150	24,299	23,717	54	0	5,130	
16	NQY	XXX	200	0	220	278	0:50	1:00	713	783	948	1,731	DIV	100	150	24,442	23,729	54	0	5,130	
17	NQY	XXX	250	0	230	281	1:01	1:11	844	914	961	1,875	DIV	100	150	24,586	23,742	54	0	5,130	
18	NQY	XXX	300	0	250	285	1:11	1:21	967	1,037	974	2,011	DIV	100	150	24,722	23,755	54	0	5,130	
19	NQY	XXX	350	0	250	285	1:22	1:32	1,096	1,166	987	2,152	DIV	100	150	24,863	23,768	54	0	5,130	
20	NQY	XXX	400	0	250	286	1:32	1:42	1,225	1,295	1,000	2,294	DIV	100	150	25,006	23,781	54	0	5,130	
21	NQY	XXX	450	0	250	286	1:43	1:53	1,354	1,424	1,013	2,437	DIV	100	150	25,148	23,794	54	0	5,130	
22	NQY	XXX	500	0	250	286	1:53	2:03	1,484	1,554	1,026	2,580	DIV	100	150	25,291	23,807	54	0	5,130	
23	NQY	XXX	550	0	250	286	2:04	2:14	1,614	1,684	1,039	2,724	DIV	100	150	25,435	23,820	54	0	5,130	
24	NQY	XXX	600	0	250	287	2:14	2:24	1,745	1,815	1,053	2,868	DIV	100	150	25,579	23,834	54	0	5,130	
25	NQY	XXX	650	0	250	287	2:24	2:34	1,877	1,947	1,066	3,013	DIV	100	150	25,724	23,847	54	0	5,130	
26	NQY	XXX	700	0	250	287	2:35	2:45	2,009	2,079	1,079	3,158	DIV	100	150	25,869	23,860	54	0	5,130	
27	SDZ	XXX	100	0	150	260	0:29	0:39	440	510	921	1,431	DIV	100	150	24,142	23,702	54	0	5,130	
28	SDZ	XXX	150	0	180	268	0:40	0:50	584	654	936	1,590	DIV	100	150	24,301	23,717	54	0	5,130	
29	SDZ	XXX	200	0	220	278	0:50	1:00	717	787	949	1,736	DIV	100	150	24,447	23,730	54	0	5,130	
30	SDZ	XXX	250	0	230	281	1:01	1:11	847	917	962	1,880	DIV	100	150	24,591	23,743	54	0	5,130	
31	SDZ	XXX	300	0	250	285	1:11	1:21	971	1,041	975	2,016	DIV	100	150	24,727	23,756	54	0	5,130	
32	SDZ	XXX	350	0	250	286	1:22	1:32	1,100	1,170	988	2,158	DIV	100	150	24,868	23,769	54	0	5,130	
33	SDZ	XXX	400	0	250	286	1:32	1:42	1,229	1,299	1,001	2,300	DIV	100	150	25,011	23,782	54	0	5,130	

MAI0818A, 18-Feb-2008

ROUTE ANALYSIS (PERFORMANCE) FOR PhD
AIRCRAFT FOKKER 50
ENGINES P&WC PW125B Engines
CONFIGURATION Standard Configuration 50 seats

6-MAR-08 / 1
RAP version 5.4
f50125.rbj / f5001

100 % Pax Payload

MAXIMUM WEIGHTS							
O.E.W.	TAKE-OFF	LANDING	PAYLOAD	FUEL	SEATS	PAX WEIGHT	EN ROUTE TEMP
12500	20820	19730	6100	4123	50	97.00	ISA

WEIGHTS (KG) DISTANCE (NAUTICAL MILES) TEMPERATURE (DEGREES CELSIUS) * - REFUELING STATION
TIME (HR-MIN) BLOCK SPEED (KNOTS) WIND SPEED (KNOTS) HEADWINDS ARE NEGATIVE

FLIGHT			EN ROUTE			TO ALTERNATE			AIRPORT WEIGHTS				PERFORMANCE					
FROM	TO	DIST	PROC	FL	WIND	AIR PORT	WIND	DISTANCE	ALLOW T.O.W.	REQ T.O.W.	ALLOW L.W.	REQ L.W.	BLOCK TIME	BLOCK SPEED	BLOCK FUEL	FUEL CARR	PAY LOAD	NO.OF PAX
*LCY	DES	100	2511	160	0	ALT	0	100	20820	18360	19730	18066	0-44	136	347	1038	4850	50
*LCY	DES	200	2511	220	0	ALT	0	100	20820	18559	19730	18072	1-09	173	540	1237	4850	50
*LCY	DES	300	2511	240	0	ALT	0	100	20820	18748	19730	18078	1-33	193	723	1426	4850	50
*LCY	DES	400	2511	240	0	ALT	0	100	20820	18939	19730	18083	1-58	203	909	1617	4850	50
*LCY	DES	500	2511	240	0	ALT	0	100	20820	19131	19730	18089	2-23	209	1095	1809	4850	50
*LCY	DES	600	2511	240	0	ALT	0	100	20820	19325	19730	18095	2-48	214	1283	2003	4850	50
*LCY	DES	700	2511	240	0	ALT	0	100	20820	19520	19730	18100	3-13	217	1472	2198	4850	50

Attachments G & H

The following spreadsheets are provided in these appendices:

Appendix G: Annual fuel burn and CO_2 levels for aircraft services operated from/to London City Airport

Appendix H: Annual fuel burn and CO_2 levels for aircraft services operated from/to Newquay Cornwall Airport

Spreadsheet notes These details which follow, provide the notes relating to the various columns in the spreadsheets

SPREADSHEET NOTES

1. CARRIERS

VG	VLM	AF	Air France
KL	KLM	SK	SAS
BA	British Airways	LG	Luxair
LX	Swiss International	AP	Air One
LH	Lufthansa	OS	Austrian
FR	Ryanair	WW	Bmi Baby
WOW	Air Southwest	BE	FlyBe
BA	British Airways		

2. AIRCRAFT TYPES

F50	Fokker 50	ATR42	Aerospatiale
AvroRJ100	BAe Avro	ERJ70	Embraer RJ
D38	Dornier 328	CRJ700	Bombardier RJ
BAe146	BAe146 various		
B737	Boeing 737 various		
DHC8-400	Bombardier Dash 8		

3. FUEL BURN CALCULATION

As stated in the study the fuel burn calculations are made using a straightline formula based on performance charts for each aircraft type.

Formula using data in annotated columns A/B is:

= (Constant A*Distance)+ Constant B

The constants A and B in the formula vary with each aircraft type and variant.

4. FREQUENCY PER WEEK – SEASONS

Number of weeks used for each season in 2008 =

January – March	13 weeks
April – September	30
October – December	9

LONDON CITY AIRPORT

2008 **APPENDIX G**

APPENDIX G **Page 1**

ROUTE LCY FROM / TO	(See Note) CARRIER	(See Note) AIRCRAFT TYPE	GC DIST. KMS	GC DIST. D + 10%	(See Note) FUEL CALCULATION FORMULA A	B	FUEL BURN KGS	FUEL BURN *2 for RT TONNES	CO2 PER TONNE OF JET FUEL	CO2 CREATED TONNES PER FLT	(See Note) W / S / W	FREQNCY PER WK	TOTAL SECTORS PER SEASON (13/30/09)	CO2 CREATED TONNES PER YEAR	CO2 CREATED WITH RFI = 2.7 TONNES PER YEAR
AMSTER- -DAM	VG	F50	336	369.6	1.016	160	535.51	1.071	3.151	3.375	A	64	832	2807.84	7581.17
											B	67	2010	6783.36	18315.08
											C	60	540	1822.40	4920.47
AMSTER- -DAM	KL	F50	336	369.6	1.016	160	535.51	1.071	3.151	3.375	A	40	520	1754.90	4738.23
											B	34	1020	3442.30	9294.22
											C	40	360	1214.93	3280.31
AMSTER- -DAM	BA	AvroRJ100	336	369.6	2.988	624	1728.36	3.457	3.151	10.892	A	0	0	0	0
											B	20	600	6535.29	17645.29
											C	21	189	2058.62	5558.27
ANTWERP	VG	F50	309	339.9	1.016	160	505.34	1.011	3.151	3.185	A	28	364	1159.21	3129.87
											B	28	840	2675.10	7222.77
											C	31	279	888.52	2398.99
BARCEL- -ONA	BA	AvroRJ100	1145	1259.5	2.988	624	4387.39	8.775	3.151	27.649	A	0	0	0	0
											B	6	180	4976.88	13437.56
											C	6	54	1493.06	4031.27
BASLE	LX	AvroRJ100	694	763.4	2.988	624	2905.04	5.810	3.151	18.308	A	12	156	2855.98	7711.14
											B	12	360	6590.72	17794.95
											C	12	108	1977.22	5338.48
BELFAST CITY	AF	D38 (e)	527	579.7	0.884	121	633.45	1.267	3.151	3.992	A	17	221	882.24	2382.05
											B	6	180	718.57	1940.13
											C	0	0	0	0.00
BRUSSEL(	VG	F50	317	348.7	1.016	160	514.28	1.029	3.151	3.241	A	16	208	674.13	1820.14
											B	16	480	1555.67	4200.32
											C	10	90	291.69	787.56
BERLIN	LH	ATR42-50(	922	1014.2	0.884	121	1017.55	2.035	3.151	6.413	A	12	156	1000.37	2700.99
											B	12	360	2308.54	6233.06
											C	18	162	1038.84	2804.88
COPENH- -AGEN	SK	DHC8-400	950	1045	1.534	*255*	*1858.03*	3.716	3.151	11.709	A	11	143	1674.43	4520.96
											B	*11*	330	3864.07	10432.99
											C	11	99	1159.22	*3129.90*
DUBLIN	AF	BAe146 -200	480	528	2.018	634	1699.50	3.399	3.151	10.710	A	34	442	4733.94	12781.64
											B	29	870	9317.94	25158.43
											C	28	252	2698.99	7287.27
DUBLIN	BA	AvroRJ100	480	528	2.988	624	2201.66	4.403	3.151	13.875	A	0	0	0	0
											B	0	0	0	0
											C	17	153	2122.86	5731.72
DUNDEE	AF	D38 (e)	586	644.6	0.884	121	690.83	1.382	3.151	4.354	A	23	299	1301.7228	3514.65
											B	23	690	3003.98	8110.73
											C	23	207	901.19	2433.22
DUSSEL- -DORF	LH	ATR42-50(	468	514.8	0.884	121	576.08	1.152	3.151	3.630	A	18	234	849.53	2293.73494
											B	18	540	1960.46	5293.23
											C	18	162	588.14	1587.97
EDI'BURGI	BA	AvroRJ100	544	598.4	2.988	624	2412.02	4.824	3.151	15.201	A	44	572	8694.71	23475.7217
											B	45	1350	20520.736	55405.9865
											C	56	504	7661.07	20684.9016
EDI'BURGI	AF	D38 (e)	544	598.4	0.884	121	649.99	1.300	3.151	4.096	A	37	481	1970.28	5319.75
											B	38	1140	4669.68	12608.13
											C	41	369	1511.50	4081.05

ROUTE LCY FROM / TO	(See Note) CARRIER	(See Note) AIRCRAFT TYPE	GC DIST. KMS	GC DIST. D + 10%	(See Note) FUEL CALCULATION FORMULAE B	C	FUEL BURN KGS	FUEL BURN *2 for RT TONNES	CO2 PER TONNE OF JET FUEL	CO2 CREATED TONNES PER FLT	(See Note) FREQNCY W / S / W	PER WK	TOTAL SECTORS PER SEASON (13/30/09)	CO2 CREATED TONNES PER YEAR	CO2 CREATED WITH RFI = 2.7 TONNES PER YEAR
EINDHOVN	AF	BAe146 -200	370	407	2.018	634	1455.33	2.911	3.151	9.171	A	12	156	1430.75	3863.02
											B	12	360	3301.73	8914.66
											C	11	99	907.97	2451.53
FRA'FURT	BA	AvroRJ100	621	683.1	2.988	624	2665.10	5.330	3.151	16.795	A	16	208	3493.46	9432.34036
											B	16	480	8061.83	21766.9393
											C	21	189	3174.35	8570.73
FRA'FURT	LH	BAe146 -300	621	683.1	2.523	792	2515.46	5.031	3.151	15.852	A	29	377	5976.37	16136.20
											B	28	840	13316.05	35953.3274
											C	28	252	3994.81	10786.00
GENEVA	LX	AvroRJ100	735	808.5	2.988	624	3039.80	6.080	3.151	19.157	A	43	559	10708.66	28913.37
											B	43	1290	24712.281	66723.1588
											C	43	387	7413.68	20016.9476
GENEVA	AF	BAe146 -200	735	808.5	2.018	634	2265.55	4.531	3.151	14.278	A	17	221	3155.33	8519.39
											B	22	660	9423.16	25442.5317
											C	28	252	3597.93	9714.42
GLASGOW	BA	AvroRJ100	569	625.9	2.988	624	2494.19	4.988	3.151	15.718	A	23	299	4699.80	12689.45
											B	23	690	10845.68	29283.3426
											C	29	261	4102.50	11076.74
GRONIN - GEN	VG	F50	480	528	1.016	160	696.45	1.393	3.151	4.389	A	6	78	342.34	924.33
											B	6	180	790.02	2133.06
											C	0	0	0	0
HAMBURG	LH	ATR42-500	713	784.3	0.884	121	814.32	1.629	3.151	5.132	A	11	143	733.85	1981.41
											B	11	330	1693.51	4572.48
											C	11	99	508.05	1371.74
I. OF MAN	VG	F50	426	468.6	1.016	160	636.10	1.272	3.151	4.009	A	6	78	312.68	844.23
											B	6	180	721.56	1948.22
											C	5	45	180.39	487.06
JERSEY	VG	F50	302	332.2	1.016	160	497.52	0.995	3.151	3.135	A	5	65	203.80	550.25
											B	5	150	470.30	1269.81
											C	5	45	141.09	380.94
LUX'BURG	VG	F50	483	531.3	1.016	160	699.80	1.400	3.151	4.410	A	22	286	1261.30	3405.51
											B	18	540	2381.48	6429.99
											C	18	162	714.44	1929.00
LUX'BURG	LG	ERJ70 (e)	483	531.3	1.856	515	1501.09	3.002	3.151	9.460	A	22	286	2705.53	7304.92
											B	21	630	5959.73	16091.27
											C	28	252	2383.89	6436.51
MADRID	BA	AvroRJ100	1255	1380.5	2.988	624	4748.93	9.498	3.151	29.928	A	12	156	4668.73	12605.58
											B	11	330	9876.17	26665.6538
											C	11	99	2962.85	7999.70
MANCH-ESTER	VG	F50	260	286	1.016	160	450.58	0.901	3.151	2.840	A	32	416	1181.24	3189.36004
											B	37	1110	3151.88	8510.07
											C	27	243	690.01	1863.02
MILAN LINATE	AP	AvroRJ70 (e)	957	1052.7	2.092	437	2639.25	5.278	3.151	16.633	A	12	156	2594.68	7005.63
											B	12	360	5987.72	16166.83
											C	12	108	1796.31	4850.05
MUNICH	LH	Bae 146- -300	911	1002.1	2.523	792	3320.30	6.641	3.151	20.925	A	22	286	5984.41	16157.91
											B	22	660	13810.183	37287.4944
											C	22	198	4143.05	11186.25

ROUTE LCY FROM / TO	(See Note) CARRIER	(See Note) AIRCRAFT TYPE	GC DIST. KMS	GC DIST. D + 10%	(See Note) FUEL CALCULATION FORMULA B	C	FUEL BURN KGS	FUEL BURN *2 for RT TONNES	CO2 PER TONNE OF JET FUEL	CO2 CREATED TONNES PER FLT		(See Note) FREQNCY PER WK W / S / W	TOTAL SECTORS PER SEA$ON (13/30/09)	CO2 CREATED TONNES PER YEAR	CO2 CREATED WITH RFI = 2.7 TONNES PER YEAR
NICE	BA	AvroRJ100	1024	1126.4	2.988	624	3989.68	7.979	3.151	25.143	A	6	78	1961.15	5295.11
											B	7	210	5280.03	14256.07
											C	12	108	2715.44	7331.69
NICE	AF	BAe146 -300	1024	1126.4	2.523	792	3633.91	7.268	3.151	22.901	A	8	104	2381.69	6430.57
											B	7	210	4809.19	12984.80
											C	7	63	1442.7556	3895.44
OSLO	SK	DHC8-400	1186	1304.6	1.534	255	2256.26	4.513	3.151	14.219	A	11	143	2033.31	5489.93
											B	11	330	4692.25	12669.06
											C	11	99	1407.67	3800.71941
PARIS CDG	AF	BAe146 -300	330	363	2.523	792	1707.85	3.416	3.151	10.763	A	42	546	5876.52	15866.61
											B	42	1260	13561.209	36615.2647
											C	36	324	3487.1681	9415.35
ROTTER- -DAM	VG	F50	307	337.7	1.016	160	503.10	1.006	3.151	3.171	A	69	897	2843.99	7678.77
											B	44	1320	4185.13	11299.86
											C	45	405	1284.08	3467.00
STOCK- HOLM	SK	AvroRJ70 (e)	1427	1569.7	2.092	437	3720.81	7.442	3.151	23.449	A	11	143	3353.14	9053.49
											B	11	330	7738.02	20892.6667
											C	11	99	2321.41	6267.80
STRASB- OURG	AF	BAe146 -300	635	698.5	2.523	792	2554.32	5.109	3.151	16.097	A	17	221	3557.50	9605.26
											B	17	510	8209.62	22165.977
											C	12	108	1738.51	4693.97
STUTT- GART	LH	ATR42 -500	726	798.6	0.884	121	826.96	1.654	3.151	5.212	A	5	65	338.75	914.62
											B	5	150	781.73	2110.66
											C	0	0	0	0
VIENNA	OS	CRJ700	1244	1368.4	1.856	515	3054.75	6.110	3.151	19.251	A	10	130	2502.63	6757.11
											B	10	300	5775.31	15593.34
											C	0	0	0	0
WARSAW	BA	AvroRJ100	1438	1581.8	2.988	624	5350.42	10.701	3.151	33.718	A	0	0	0	0
											B	6	180	6069.30	16387.11
											C	6	54	1820.7902	4916.13
ZURICH	BA	AvroRJ100	761	837.1	2.988	624	3125.25	6.251	3.151	19.695	A	23	299	5888.91	15900.0607
											B	28	840	16544.099	44669.0668
											C	27	243	4785.9714	12922.12
ZURICH	LX	AvroRJ100	761	837.1	2.988	624	3125.25	6.251	3.151	19.695	A	46	598	11777.823	31800.1214
											B	46	1380	27179.591	73384.8955
											C	54	486	9571.94	25844.2458
ZURICH	AF	BAe146 -300	761	837.1	2.523	792	2904.00	5.808	3.151	18.301	A	17	221	4044.53	10920.22
											B	24	720	13176.741	35577.2
											C	0	0	0	0
														532516.27	1437793.93

Total fuel burnt - tonnes = 168999.13

NEWQUAY CORNWALL AIRPORT 2008 APPENDIX H

ROUTE NQY FROM / TO	CARRIER (See Note)	AIRCRAFT TYPE (See Note)	GC DIST. KMS	GC DIST. D + 10%	FUEL CALCULATION FORMULA (See Note) A	B	FUEL BURN KGS	FUEL BURN x 2 for RT TONNES	CO2 PER TONNE OF JET FUEL	CO2 CREATED TONNES PER FLT	(See Note) W / S / W (13/30/09)	FREQNCY PER WK	TOTAL RTs PER SEASON	CO2 CREATED TONNES PER S'SON	CO2 CREATED WITH RFI = 2.7 TONNES PER S'SON
STN	FR	B737-800	399	438.9	3.061	992	2335.473	4.671	3.151	14.718	A	5	65	956.68	2583.04
											B	10	300	4415.45	11921.70
											C	0	0	0	0
LGW	WOW	DHC8-400	348	382.8	1.534	255	842.22	1.684	3.151	5.308	A	28	364	1931.98	5216.35
											B	33	990	5254.56	14187.32
											C	28	252	1337.53	3611.32
NCL	WOW	DHC8-400	558	613.8	1.534	255	1196.57	2.393	3.151	7.541	A	7	91	686.21	1852.77
											B	7	210	1583.56	4275.62
											C	6	54	407.20	1099.45
MAN	WOW	DHC8-400	374	411.4	1.534	255	886.09	1.772	3.151	5.584	A	12	156	871.12	2352.03
											B	12	360	2010.28	5427.77
											C	12	108	603.09	1628.33
LBA	WOW	DHC8-400	444	488.4	1.534	255	1004.21	2.008	3.151	6.329	A	13	169	1069.52	2887.70
											B	13	390	2468.12	6663.91
											C	12	108	683.48	1845.39
GLA	WOW	DHC8-400	606	666.6	1.534	255	1277.56	2.555	3.151	8.051	A	7	91	732.66	1978.18
											B	7	210	1690.75	4565.04
											C	6	54	434.77	1173.87
DUB	WOW	DHC8-400	343	377.3	1.534	255	833.78	1.668	3.151	5.254	A	7	91	478.16	1291.02
											B	7	210	1103.44	2979.28
											C	7	63	331.03	893.79
ORK	WOW	DHC8-400	290	319	1.534	255	744.35	1.489	3.151	4.691	A	4	52	243.93	658.60
											B	6	180	844.36	2279.76
											C	4	36	168.87	455.95
BRS	WOW	DHC8-400	191	210.1	1.534	255	577.29	1.155	3.151	3.638	A	12	156	567.54	1532.37
											B	12	360	1309.72	3536.24
											C	12	108	392.92	1060.87
GNB	WOW	DHC8-400	955	1050.5	1.534	255	1866.47	3.733	3.151	11.762	A	1	13	152.91	412.86
											B	0	0	0	0
											C	1	9	105.86	285.83
LGW	BA	B737-500	348	382.8	2.709	910	1947.01	3.894	3.151	12.270	A	0	0	0	0
											B	7	210	2576.71	6957.11
											C	0	0	0	0
MAN	WW	B737-500	374	411.4	2.709	910	2024.48	4.049	3.151	12.758	A	6	78	995.15	2686.90
											B	7	210	2679.24	7233.95
											C	0	0	0	0
BHD	BE	DHC8-400	469	515.9	1.534	255	1046.39	2.093	3.151	6.594	A	1	13	85.73	231.46
											B	1	30	197.83	534.14
											C	0	0	0	0
EDI	BE	DHC8-400	623	685.3	1.534	255	1306.25	2.613	3.151	8.232	A	5	65	535.08	1444.71
											B	5	150	1234.80	3333.96
											C	0	0	0	0
														41140.22	111078.58

Total fuel burnt tonnes 13056.24

APPENDIX I:

SECTOR DISTANCES FROM LONDON CITY AIRPORT AND FROM NEWQUAY CORNWALL AIRPORT

Great Circle Mapper

This information may not be accurate or current and is not valid for navigation or flight planning. No warranty of fitness for any purpose is made or implied.

From	To	Initial Heading	Distance
NQY (50°26'26"N 04°59'43"W)	BRS (51°22'58"N 02°43'09"W)	55° (NE)	191 km
NQY (50°26'26"N 04°59'43"W)	LGW (51°08'53"N 00°11'25"W)	75° (E)	348 km
NQY (50°26'26"N 04°59'43"W)	STN (51°53'06"N 00°14'06"E)	64° (NE)	399 km
NQY (50°26'26"N 04°59'43"W)	DUB (53°25'17"N 06°16'12"W)	345° (N)	343 km
NQY (50°26'26"N 04°59'43"W)	LBA (53°51'57"N 01°39'38"W)	29° (NE)	444 km
NQY (50°26'26"N 04°59'43"W)	MAN (53°21'13"N 02°16'30"W)	28° (NE)	374 km
NQY (50°26'26"N 04°59'43"W)	CWL (51°23'48"N 03°20'36"W)	46° (NE)	158 km
NQY (50°26'26"N 04°59'43"W)	ORK (51°50'29"N 08°29'28"W)	303° (NW)	290 km
NQY (50°26'26"N 04°59'43"W)	EDI (55°57'00"N 03°22'21"W)	9° (N)	623 km
NQY (50°26'26"N 04°59'43"W)	GLA (55°52'19"N 04°25'59"W)	3° (N)	606 km
NQY (50°26'26"N 04°59'43"W)	NCL (55°02'15"N 01°41'30"W)	22° (N)	558 km
NQY (50°26'26"N 04°59'43"W)	BHD (54°37'05"N 05°52'21"W)	353° (N)	469 km
NQY (50°26'26"N 04°59'43"W)	GNB (45°21'47"N 05°19'58"E)	122° (SE)	955 km
Total:			5758 km

Code	Source	Location
NQY	DAFIF	*Newquay [St. Mawgan Airport], Cornwall, England, GB*
BRS	DAFIF	*Bristol [Bristol Intl (Lulsgate)], Somerset, England, GB*
LGW	DAFIF	*London [Gatwick], Surrey, England, GB*
STN	DAFIF	*London [Stansted], Essex, England, GB*
DUB	AIP	*Dublin [Intl], County Dublin, Leinster, IE*
LBA	DAFIF	*Leeds/Bradford (Yeadon) [Leeds Bradford Intl], Yorkshire, England, GB*
MAN	DAFIF	*Manchester [Ringway Intl], England, GB*
CWL	DAFIF	*Cardiff [Intl], Glamorgan, Wales, GB*

http://gc.kls2.com/cgi-bin/gc?PATH=NQY-BRS%2CNQY-LGW%2CNQY-STN%2... 25/03/2009

ORK	AIP	*Cork [Intl], County Cork, Munster, IE*
EDI	DAFIF	*Edinburgh, Midlothian, Scotland, GB*
GLA	DAFIF	*Glasgow [Abbotsinch], Renfrewshire, Scotland, GB*
NCL	DAFIF	*Newcastle, Northumberland, England, GB*
BHD	DAFIF	*Belfast [George Best Belfast City], County Down, Northern Ireland, GB*
GNB	AIP	*Grenoble [St-Geoirs], FR*

Paths
(e.g., ORD-HKG, SFO-SYD, London-Tokyo)

NQY-BRS,NQY-LGW,NQY-STN,NQY-DUB,NQY-LBA,NQY-MAN,NQY-CWL,NQY-ORK,NQY-EDI,NQY-GLA,NQY-NCL,NQY-BHD,NQY-GNB

Ranges
(e.g., 8000nm@LHR, 1300nm@DAL)

Display Map

Path Color red

Path Distance km

Min. Distance

Mark locations along path

Ground Speed or Mach kts

Range Style best

Display Map

Outline Color navy

Reset Input

Map Style default

ETOPS Rule-Time
- 60 minutes
- 90 minutes
- 120 minutes
- 138 minutes
- 180 minutes
- 207 minutes
- 240 minutes
- 330 minutes

ZRH DAFIF *Zürich [Zürich-Kloten], CH*

Paths
(e.g., ORD-HKG, SFO-SYD, London-Tokyo)

LCY-AMS, LCY-ANR, LCY-BCN, LCY-BSL, LCY-BHD, LCY-BRU, LCY-BER, LCY-CPH, LCY-DUB, LCY-DND, LCY-DUS, LCY-EDI, LCY-EIN, LCY-FRA, LCY-GVA, LCY-

Path Color
red

Path Distance
km

Min. Distance

Mark locations along path

Ground Speed or Mach
kts

Ranges
(e.g., 8000nm@LHR, 1300nm@DAL)

Range Style
best

Display Map

ETOPS Rule-Time
- 60 minutes
- 90 minutes
- 120 minutes
- 138 minutes
- 180 minutes
- 207 minutes
- 240 minutes
- 330 minutes

Outline Color
navy

Display Map

Reset Input

Map Style
default

Locations may be specified using FAA, IATA, or ICAO airport codes, or by latitude and longitude. You can also search for a code: Search

Great Circle Mapper

This information may not be accurate or current and is not valid for navigation or flight planning. No warranty of fitness for any purpose is made or implied.

From	To	Initial Heading	Distance
LCY (51°30'19"N 00°03'19"E)	AMS (52°18'31"N 04°45'50"E)	72° (E)	336 km
LCY (51°30'19"N 00°03'19"E)	ANR (51°11'22"N 04°27'37"E)	94° (E)	309 km
LCY (51°30'19"N 00°03'19"E)	BCN (41°17'49"N 02°04'42"E)	171° (S)	1145 km
LCY (51°30'19"N 00°03'19"E)	BSL (47°35'24"N 07°31'45"E)	125° (SE)	694 km
LCY (51°30'19"N 00°03'19"E)	BHD (54°37'05"N 05°52'21"W)	313° (NW)	527 km
LCY (51°30'19"N 00°03'19"E)	BRU (50°54'05"N 04°29'04"E)	100° (E)	317 km
LCY (51°30'19"N 00°03'19"E)	BER (52°31'N 13°24'E)	77° (E)	922 km
LCY (51°30'19"N 00°03'19"E)	CPH (55°37'05"N 12°39'21"E)	56° (NE)	950 km
LCY (51°30'19"N 00°03'19"E)	DUB (53°25'17"N 06°16'12"W)	298° (NW)	480 km
LCY (51°30'19"N 00°03'19"E)	DND (56°27'09"N 03°01'33"W)	341° (N)	586 km
LCY (51°30'19"N 00°03'19"E)	DUS (51°17'22"N 06°46'00"E)	90° (E)	468 km
LCY (51°30'19"N 00°03'19"E)	EDI (55°57'00"N 03°22'21"W)	336° (NW)	544 km
LCY (51°30'19"N 00°03'19"E)	EIN (51°27'01"N 05°22'28"E)	88° (E)	370 km
LCY (51°30'19"N 00°03'19"E)	FRA (50°01'35"N 08°32'35"E)	102° (E)	621 km
LCY (51°30'19"N 00°03'19"E)	GVA (46°14'17"N 06°06'32"E)	140° (SE)	735 km
LCY (51°30'19"N 00°03'19"E)	GLA (55°52'19"N 04°25'59"W)	330° (NW)	569 km
LCY (51°30'19"N 00°03'19"E)	GRQ (53°07'11"N 06°34'46"E)	65° (NE)	480 km
LCY (51°30'19"N 00°03'19"E)	HAM (53°37'49"N 09°59'18"E)	66° (NE)	713 km
LCY (51°30'19"N 00°03'19"E)	IOM (54°05'00"N 04°37'26"W)	314° (NW)	426 km
LCY (51°30'19"N 00°03'19"E)	JER (49°12'29"N 02°11'44"W)	212° (SW)	302 km
LCY (51°30'19"N 00°03'19"E)	LUX (49°37'24"N 06°12'16"E)	113° (SE)	483 km
LCY (51°30'19"N 00°03'19"E)	MAD (40°29'37"N 03°34'00"W)	194° (S)	1255 km
LCY (51°30'19"N 00°03'19"E)	MAN (53°21'13"N 02°16'30"W)	323° (NW)	260 km
LCY (51°30'19"N 00°03'19"E)	LIN (45°26'42"N 09°16'36"E)	131° (SE)	957 km
LCY (51°30'19"N 00°03'19"E)	MUC (48°21'14"N 11°47'10"E)	108° (E)	911 km

LCY (51°30'19"N 00°03'19"E)	NCE (43°39'55"N 07°12'54"E)	145°	(SE)	1024 km
LCY (51°30'19"N 00°03'19"E)	CDG (49°00'35"N 02°32'52"E)	146°	(SE)	330 km
LCY (51°30'19"N 00°03'19"E)	OSL (60°11'38"N 11°06'01"E)	31°	(NE)	1186 km
LCY (51°30'19"N 00°03'19"E)	RTM (51°57'25"N 04°26'14"E)	78°	(E)	307 km
LCY (51°30'19"N 00°03'19"E)	STO (59°20'N 18°03'E)	45°	(NE)	1427 km
LCY (51°30'19"N 00°03'19"E)	SXB (48°32'37"N 07°38'14"E)	118°	(SE)	635 km
LCY (51°30'19"N 00°03'19"E)	STR (48°41'24"N 09°13'19"E)	111°	(E)	726 km
LCY (51°30'19"N 00°03'19"E)	WAW (52°09'57"N 20°58'02"E)	78°	(E)	1438 km
LCY (51°30'19"N 00°03'19"E)	VIE (48°06'37"N 16°34'11"E)	101°	(E)	1244 km
LCY (51°30'19"N 00°03'19"E)	ZRH (47°27'53"N 08°32'57"E)	122°	(SE)	761 km
Total:				24435 km

Code	Source	Location
LCY	DAFIF	London [City], England, GB
AMS	DAFIF	Amsterdam [Schiphol], NL
ANR	AIP	Antwerpen (Antwerp) [Deurne], BE
BCN	DAFIF	Barcelona [Aeropuerto Transoceanico de Barcelona], ES
BSL	AIP	Basel/Mulhouse/Freiburg (Mulhouse) [EuroAirport], FR (alias for **MLH**)
BHD	DAFIF	Belfast [George Best Belfast City], County Down, Northern Ireland, GB
BRU	DAFIF	Brussels [National/Zaventem], BE
BER	city	Berlin [Metro Area], BE, DE
CPH	AIP	København (Copenhagen) [København Airport - Kastrup], DK
DUB	AIP	Dublin [Intl], County Dublin, Leinster, IE
DND	DAFIF	Dundee, Angus, Scotland, GB
DUS	DAFIF	Düsseldorf (Duesseldorf) [Rhein-Ruhr], NW, DE
EDI	DAFIF	Edinburgh, Midlothian, Scotland, GB
EIN	DAFIF	Eindhoven, NL
FRA	DAFIF	Frankfurt [Rhein-Main], HE, DE
GVA	DAFIF	Geneva [Geneve-Cointrin], CH
GLA	DAFIF	Glasgow [Abbotsinch], Renfrewshire, Scotland, GB
GRQ	DAFIF	Groningen [Eelde], NL
HAM	DAFIF	Hamburg [Fuhlsbuttel], HH, DE
IOM	DAFIF	Isle of Man [Ronaldsway Airport], Isle of Man, GB
JER	DAFIF	Jersey, Channel Islands, GB
LUX	AIP	Luxembourg [Luxembourg-Findel Intl], LU
MAD	DAFIF	Madrid [Barajas], ES
MAN	DAFIF	Manchester [Ringway Intl], England, GB
LIN	DAFIF	Milano (Milan) [Linate], IT
MUC	DAFIF	München (Munich, Freising) [Franz Josef Strauss Intl (Munich Intl)], BY, DE
NCE	AIP	Nice [Côte d'Azur], FR
CDG	AIP	Paris (Roissy-en-France) [Charles de Gaulle (Roissy)], FR
OSL	DAFIF	Oslo [Gardermoen], NO
RTM	DAFIF	Rotterdam, NL
STO	city	Stockholm [Metro Area], SE
SXB	AIP	Strasbourg [Enzheim], FR
STR	DAFIF	Stuttgart [Echterdingen], BW, DE
WAW	DAFIF	Warsaw [Fryderyk Chopin (Okecie)], PL
VIE	DAFIF	Wien (Vienna) [Vienna Intl (Schwechat)], AT

Appendices J and K

The following two appendices provide details of the calculations relating to the economic benefits found from the study of air services at London City Airport and Newquay Cornwall Airport.

ECONOMIC BENEFIT STATEMENT LONDON CITY AIRPORT **APPENDIX J**

2008

BENEFIT CATEGORY		M'PLIER %	NUMBER	% OF TOT TRAFFIC	NUMBER OF PAX	VALUE £	BENEFIT £	PERCENTAGE OF TOTAL
1.EMPLOYMENT								
Direct employment		0	2110	0	0	26,020	54902200	1.9
Indirect employment		0.89	1878	0	0	20,000	37560000	1.3
Induced employment		0.25	997	0	0	20,000	19940000	0.7
Sub-Total			4985				112402200	3.9
2.BUSINESS TRAFFIC								
Catalytic value	£914per day		1.33	60	1,960,000		2382615200	82.9
Local expend - inboun	£374			40	544,000	374	203456000	7.1
Sub-Total					110,252		2586071200	90.0
3.LEISURE TRAFFIC								
Local expend -inbounc	£465				375,000		£174,375,000	6.1
4.OTHER								
Air Cargo							0	
Socio-political							0	0.0
TOTAL BENEFIT							2872848400	100.0

ECONOMIC BENEFIT STATEMENT NEWQUAY CORNWALL AIRPORT — APPENDIX K

2008

BENEFIT CATEGORY	M'PLIER %	NUMBER	% OF TOT TRAFFIC	NUMBER OF PAX	VALUE £	BENEFIT £	PERCENTAGE OF TOTAL
1.EMPLOYMENT							
Direct employment	0	232	0	0	16,000	3712000	1.1
Indirect employment	1.38	320	0	0	16,000	5120000	1.6
Induced employment	0.25	138	0	0	16,000	2208000	0.7
Sub-Total		690			16,000	11040000	3.3
2.BUSINESS TRAFFIC							
Catalytic value £576 per day		1.2 days	39.7	280,000	691.2	193536000	58.6
Local expend - inboun £261 per bus pax				118,440	261	30912840	9.4
Sub-Total				110,252		224448840	68.0
3.LEISURE TRAFFIC							
Local expend -inbound £349 per pax				240,600	349	83969400	25.4
4.OTHER							
Air Cargo						0	
Socio-political				301,000	35	10535000	3.2
TOTAL BENEFIT						329993240	100.0

Appendix L

DEMAND ELASTICITIES

A number of studies have been made in the past to determine the impact of price changes on demand for air travel services. The following list shows a few of the studies and provides an indication of the ranges quoted.

SOURCE	ELASTICITY OF DEMAND	
CE Delft	-0.2 to -1.0	
Government of Canada	-0.7 to -1.5	
Oum, Waters and Yong	-0.76 to -1.51 -1.15 to -1.5	
Royal Commission on National Transportation	-1.57 to -3.51	Business travel
Morrison and Winston	-0.86	
CAA Elasticity Study	-0.8 to -1.5	
IATA Air Travel Demand Study. Intra-Europe	-0.9 to -2.0	

Appendix M

CALCULATION OF AVERAGE ROUND-TRIP FARES FROM LCY AND NQY

From LCY. Routes <500kms based on an average of Internet available fares March 2009. All fares in UK£

	Economy Class	Business Class
Amsterdam	146	410
Brussels	172	620
Edinburgh	122	397
Jersey	221	-
Manchester	155	-
Paris	151	567
Average	161	499

From LCY. Routes >500kms based on an average of Internet available fares March 2009

Berlin	174	495
Copenhagen	151	659
Frankfurt	179	498
Madrid	161	590
Milan	220	843
Munich	188	450
Nice	147	632
Zurich	130	323
Average	181	560

From NQY. Based on an average of Internet available fares March 2009 - Economy class fares.

	Routes <500kms		Routes >500kms
Belfast	140		
Bristol	82	Edinburgh	213
Dublin	175	Glasgow	246
Gatwick	69		
Leeds/Bradford	142		
Manchester	105		
Average	120	Average	230

Average fares for Business Class have been estimated based on similar routes, as few business class services were operated.

	300		450

Appendix N

CALCULATION OF ENVIRONMENTAL RATIOS FOR AIRPORTS

CALCULATION OF ENVIRONMENTAL RATIOS FOR AIRLINES

Calculation of an Environmental Ratio (ER-Ap) for airports

To help airports demonstrate the economic value of the routes from and to their airports in comparison with the cost of the CO_2 emissions created, an Environmental Ratio – ER-Ap is recommended:

$$\text{ER-Ap} = \frac{\text{Route Economic Benefits}}{\text{Routes } CO_2 \text{ Cost}}$$

The calculations that follow are basic and do not include a number of features such as:

- Airport company profits and dividends which may or may not be spent locally. They have therefore been excluded
- Airline rents paid to airport companies
- Additional fuel costs arising from weather diversions

The calculation is as follows:

- The Route Economic Benefit is calculated for all the routes from and to the airport concerned.
    - Direct Cost = Staff cost for all the airport company staff, ATC staff, for all the staff of airlines operating at the airport and/or for the staff of agents providing ground handling services.
    - Indirect and Induced Costs = The multipliers used in the main study are seen to be realistic and acceptable for application at other airports unless there are special conditions. Use the multipliers multiplied by the number of direct employees to obtain the numbers of people for Indirect and Induced employment (0.89 for Indirect and 0.25 of the totals of Direct and Indirect for Induced employment). The levels used are taken from the research carried out by Oxford Economic Forecasting which were applied to all UK airport activities. Apply average local salaries to obtain the money value
    - Passenger Survey. This is necessary to obtain airport specific data. Obtain BATV based upon the proportion of business travellers using the airport x total number of passengers x the value per day based upon the company daily call-out rate or their salary plus expenses per day taken from the survey.
    - Determine the Business visitor and Leisure/vfr visitor expenditure during their stay in the region of the airport as derived from the passenger survey
    - Sum all the values from the points above.

- The formula is therefore:

Route Economic Benefit = (D + (D *0.89)) = A + (A*0.25) + B + Xb + Xl + S

where D = Direct cost; B = BATV; Xb and Xl = Business and leisure travellers' local expenditure; S = any additional benefit that is applicable to the airport concerned such as the Socio-political factor applied in the study to Newquay Cornwall Airport

- For the Route CO_2 cost:
  - Use the appropriate fuel burn formula for each aircraft type operating from the airport + sector distance based on Great Circle distance +10%. The formula may be either:
    - For shorthaul routes with jet or turboprop aircraft use a straightline approach: (Constant A * Distance) + Constant B
    - For longer routes with jet aircraft use an exponential approach.

    (EXP((Distance+Constant C)/ConstantA)-1)*Constant B
    - The Constants are derived from the basic aircraft operating data and the actual performance of fuel consumption. These can be obtained from either the operating airline or from the aircraft manufacturer.
  - Fuel burn per sector (Kgs) is then x 2 for the roundtrip/1000 to give the tonnes and x frequency per season (w/s/w) and x 3.151 to provide the number of tonnes of CO_2 created per annum
  - Multiply the tonnes of CO_2 by the price assumption £ per tonne to be used eg the current market price of CO_2 per tonne or the Stern report forecast of £57.
  - The formula is aircraft type specific and is therefore:

CO_2 Cost = ((Constant A *Distance) + Constant B) *2 / 1000 * f * 3.151 * P
where Constants A and *B are specific to the aircraft* type as described above;
f = frequency of service per year; P = CO_2 price assumption *per tonne*

- ER-Ap is then determined by dividing the Route Economic Benefit by the Route CO_2 cost.

Calculation of a route Environmental Ratio (ER-Al) for airlines
To help airlines demonstrate the economic value of an individual route in comparison with the cost of the CO_2 emissions created, a Route Environmental Ratio – ER-Al is recommended:

$$\text{ER-Al} = \frac{\text{Route Economic Benefit}}{\text{Route } CO_2 \text{ Cost}}$$

This can be calculated as follows:

- The Route Economic Benefit is calculated for the route from the base station to the outstation or from the point of origin of the service..
  - Direct Cost = Staff cost per route at the airline's base station or at the point of origin for the service, is derived from the number of passengers on the route x frequency per week on the route as a

proportion of the totals for these factors from/to the base station. Apply the proportion to the airline's total staff numbers and costs at the airport.

  - Staff cost at the destination airport is as per staff budget or taken from the staff element of the ground handling contract where a handling agent is used.
  - Indirect and Induced Costs = The multipliers used in the main study are seen to be realistic and acceptable for application at otherairports unless there are special conditions. Use the multipliers multiplied by the number of direct employees to obtain the numbers of people for Indirect and Induced employment (0.89 for Indirect and 0.25 of the totals of Direct and Indirect for Induced employment). The levels used are taken from the research carried out by Oxford Economic Forecasting which were applied to all UK airport activities. Apply average local salaries to obtain the money value
  - Passenger Survey. This is necessary to obtain route specific data. Apply BATV based upon the proportion of business travellers on the route (%) x total number of passengers x the value per day based upon the company daily call-out rate or their salary plus expenses per day as derived from a passenger survey.
  - Determine the Business visitor and Leisure/vfr visitor expenditure for <u>both</u> ends of the route as derived from a passenger survey
  - Sum all the values from the points above.
  - The formula is therefore:

Route Economic Benefit = (D + (D *0.89)) = A + (D*0.25) + B + Xb + Xl + S

where D = Direct cost; B = BATV; Xb and Xl = Business and leisure travellers' local expenditure; S = any additional benefit such as the Socio-political factor

- For the Route CO_2 cost:
  - Use the appropriate fuel burn formula for each aircraft type + sector distance based on Great Circle distance +10%. The formula may be either:
    - For shorthaul routes with jet or turboprop aircraft use a straightline approach:

      (Constant A * Distance) + Constant B
    - For longer routes with jet aircraft use an exponential approach.

      (EXP((Distance+Constant C)/Constant A)-1)*Constant B
    - The Constants are derived from the basic aircraft operating data and the actual performance of fuel consumption. These can be obtained from either the operating airline or from the aircraft manufacturer.
  - Fuel burn per sector (Kgs) is then x 2 for the roundtrip/1000 to give the tonnes and x frequency per season (w/s/w) and x 3.151 to provide the number of tonnes of CO_2 created per annum
  - Multiply the tonnes of CO_2 by the price assumption £ per tonne to be used eg the market price of CO_2 per tonne or the Stern report estimate of £57.
  - The formula is aircraft type specific and is therefore:

CO_2 Cost = ((Constant A *Distance) + Constant B) *2 / 1000 * f * 3.151 * P

where Constants A and B are specific to the aircraft type; f = frequency of service per year; P = CO_2 price assumption per tonne

- ER-AI is then determined by dividing the Route Economic Benefit by the Route CO_2 cost.

Appendix O

CLIMATE CHANGE SEVERITY SCALE SURVEY AND REPORT

Report on Straw Poll to assess perceptions of the potential severity of climate change

The research work has been about the economic benefit of air services compared with the perceived cost of CO_2 emissions. It has not been about the study of climate change and hence no attempt has been made to give scientific judgements on that subject. However, the views on global warming and climate change are extremely wide ranging and are clearly important in terms of reaching meaningful conclusions for the study.

To help work putting the conclusions into perspective a questionnaire was sent out to help assess people's views on the likely severity of climate change. It was a straw poll rather than an academically robust survey as participants were not selected randomly. This was acceptable since the purpose was simply to gain a wider viewpoint than just the author's.

Climate Change Severity Scale – CCSS Results
The original survey form is attached, but in summary this was presented as a chart with a scale of 0 to 10 in 0.5 graduations with descriptions of different levels of climate change severity. The assessment was categorised in advance of calculating the results, into three levels as follows:

a) if the resulting opinion indicated a scale level of 4 or less this would indicate "situation not serious" or

b) if the resulting opinion indicated a scale level of 5 to 7.5 this would indicate "the problem is real, serious, but can be solved without changing life as we know it" or

c) if the resulting opinion indicated a scale level of 8 to 10 this would indicate "the world as we know it will change drastically".

If the overall resulting opinion indicated a level as in a) or b) above, then a case could be made for arguing that really extreme measures were not yet required and that the economic benefits of air transport were important and air transport should not be penalised by further taxation. If the resulting opinion indicated the third level above – c), then in spite of the economic benefits, air transport would need to accept radical change – as would all business activities.

The questionnaire was sent out to more than eighty people with some 76% returned. The following points summarise the results.

- *Responses to the scale ranged from 2.0 to 9.5*
- *The mean was 6.4 but the mode was 7.0*
- *13% selected scale positions of 3.5 or lower*

- *16% selected scale positions of 8.5 or higher*
- *A quarter of the responses stated that "All governments" should be responsible for action followed by15% stating that the UN should also be.*
- *More than 22% stated that "Everyone individually" should also be responsible*
- *Some 18% of the responses stated that "Business companies" were also responsible*
- *The "Any other" category was selected in 3.5% of cases with these including Scientific Institutions to assess the effectiveness of measures taken, Charitable organisations, NGOs and the airline industry*
- *One respondent stated that no action was needed as global warming was a natural climatic event.*

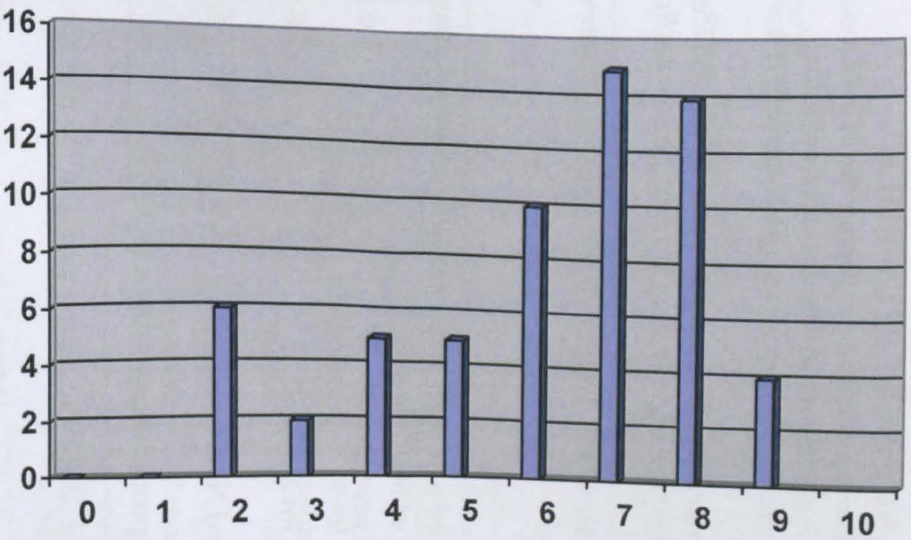
Conclusion

The straw poll weighted average result in terms of severity scale assessment was 6.4 which was described as "Climate change is a serious problem needing urgent action – but is soluble with concerted global action".

With this assessment it is possible to suggest that realistic action to reduce CO_2 emissions will take place and therefore "life as we know it now" will largely continue. Air transport can be seen to have an important role particularly as an economic catalyst, thus justifying continued support. In such a situation increasing taxation to deliberately depress demand may not be the right policy.

The graph below illustrates the results

CLIMATE CHANGE SEVERITY SCALE



Philip Shearman
City University
February 2010

PhD RESEARCH: CITY UNIVERSITY LONDON

CLIMATE CHANGE SEVERITY POLL

Climate change is clearly a major topic facing the World today. Action is being taken, including the EU Emissions Trading Scheme, the UK Carbon Reduction Commitment and many other initiatives. A lot of experts believe that such action will be largely sufficient. However, the media bombard us with conflicting views, often making it hard for people to be sure about the real facts.

My research work concerns the economic value of air services versus the perceived cost of CO_2 created by the air services. This straw poll will help me to understand what level of severity people really believe applies to climate change.

1. Using the scale on the diagram on the following page, which number (between 0 and 10) most represents your views on the climate change issue?

   ____

2. If you selected a number greater than 0, whose responsibility do you think it is to take action to solve the problem? Please put X against one or more of the following:
   a. UK Government _____ d. All Governments _____
   b. EU Government _____ e. Everyone individually _____
   c. United Nations _____ f. Business companies _____
   g. Other people/organisations (specify) ______________________________

Please copy this page, complete your answers to the two questions and e-mail it back to me at Consultaip@aol.com

Philip Shearman [Mark X here ______ if you would like me to e-mail you with the survey results]
City University
September 2009 **Please return before October 10. Thank you for your help.**

CLIMATE CHANGE SEVERITY SCALE

CC = Climate change

Do not believe CC exists at all	CC is happening but not that serious eg former Pres Bush	CC is happening but not due to human activity eg Svensmark	CC is serious but World Leaders have it under control	CC = big problem due to human activity but soluble eg Stern Report	CC = big problem – needs urgent action but soluble eg UN IPCC	CC is serious but concerted global effort can succeed	CC is very serious. Radical measures essential globally which should succeed. Democratic consensus not sufficient	End of the World as we know it – war, mass migration, crop failures, food shortage, massive unemployment, economic meltdown, population decline. eg James Lovelock/ M McCarthy

0 1 2 3 4 5 6 7 8 9 10

SCALE 1.5 2.5 3.5 4.5 5.5 6.5 7.5 8.5 9.5

GLOBAL ECONOMY (% change in GDP)

← Growth +2% →

Growth zero% →

← Recession -2% →

Recession -6 to -10% →

Hyper-deflation up to -50% ↓ ↓

* To help your thinking, this box gives an indication of the possible impact on Global GDP of the different levels of climate change.