

BRISTOL INTERNATIONAL AIRPORT

**REVIEW OF BRISTOL  
INTERNATIONAL AIRPORT  
MASTER PLAN 2006 TO 2030:**

**CLIMATE CHANGE ASPECTS**

January 2007

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## EXECUTIVE SUMMARY

1. Parsons Brinckerhoff (PB) was commissioned by North Somerset Council to undertake a review of climate change aspects of the consultation Airport Master Plan (AMP) published by Bristol International Airport (BIA).
2. BIA notes that the DfT Guidance on the Preparation of Airport Master Plans does not explicitly require climate change to be considered in the scope of the BIA Master Plan, but they have done so, citing “requests for inclusion during consultation”. PB advises that BIA is wise to do this, since climate change policy is currently high profile and mobile, especially in relation to aviation; in addition, the DfT Guidance requires the effect of the Strategic Environmental Assessment Directive (SEAD) to be taken into account during preparation of Airport Master Plans; SEAD includes climatic effects on the environment.
3. PB’s general comment on the climate change components of the BIA AMP is that the scientific assumptions are not well referenced. For example, no reference is provided for the cited global warming impact of aviation emissions being “around two times” the effect of CO<sub>2</sub> emissions alone (that is, a Radiative Forcing Index (RFI) of 2 has been used). Another example is that no source is provided for the estimate of aviation’s current contribution to global warming. PB advises that the BIA document should be more authoritatively referenced (see our report for more specific examples and recommendations).
4. In its current form, PB does not consider that the BIA AMP sets out an effective approach to carbon emissions management. We recommend that emissions from flight operations and from land based operations should be estimated and reported separately. Three categories of emissions from land based operations should be identified: emissions from on-site use of fossil fuels; emissions arising from the generation of purchased electricity; and emissions from passenger, staff and suppliers transport to and from the airport. In order to manage climate change issues successfully the AMP should identify the boundaries of the operations that BIA considers are within its control, set out the methodologies to be used to measure and monitor emissions of Greenhouse Gas (GHG) and set out the current GHG inventory against which the effects of expansions and mitigation measures can be compared.
5. A reporting mechanism is not yet in place at BIA, but this is true of most UK airports. Of more concern is that the methodology used for quantification of emissions from flight operations may not be appropriate for developing an inventory for a single airport as it will not allow the identification of the impact of operational changes such as reduced taxiing times or continuous descent approaches and changes in fleet mix.
6. PB is concerned that claims in the AMP that low cost airline operations result in lower emissions of GHG, and indirectly that regional airports contribute to carbon savings, are not backed by good evidence and may be considered speculative.
7. Proposals for reducing carbon emissions in the AMP can be strengthened; a number of additional measures are suggested in our report. On mitigation, carbon offset is cited, but it is not clear from the AMP whether BIA is proposing to offset emissions from its own land-based activities and if so, how.
8. The December 2006 Progress Report on the Air Transport White Paper was published after the AMP went out for consultation, and PB recommends that the AMP

is updated accordingly. One notable recommendation from the Progress Report is that airports should “plan to become carbon neutral.” The Progress Report also provides some additional guidance on how the climate change impacts of airport development proposals should be evaluated. This will require the development of a methodology to evaluate the external costs of aviation GHG emissions and also further guidance on how the external costs should be used in assessing development proposals.

9. Also published after the AMP was the Stern Review on the Economics of Climate Change; this does not identify any fundamental inconsistency between the Air Transport White Paper projections and UK emission reduction targets but notes that the increase in emissions from aviation will require stringent reductions to be made by other sectors if the UK target emission reductions are to be met, implying that a trading mechanism is required. The European Commission has proposed (on 20 December 2006) legislation to include aircraft CO<sub>2</sub> emissions in the European Trading Scheme (by 2011 for internal EU flights, with all flights originating or ending in the EU by 2012). As part of the proposals aircraft operators will be required to report on fuel use, and fuel efficiency.
10. The decision of 30 November 2006 by Uttlesford District Council to refuse planning permission for an extension to Stansted Airport challenged the suitability of the Air Transport White Paper (ATWP) as a basis for assessing proposals for airport expansion, in particular its content on climate change. The decision was published in advance of the ATWP Progress Report. The ‘Uttlesford decision’, and especially its emphasis on climate change issues, is of considerable concern to all UK airports with expansion plans, and PB recommends that the BIA AMP responds to it. It should be noted that the decision to refuse planning permission was based on a number of different issues, though the climate change reason gained most media attention.
11. In summary, PB recommends that in the light of recent, significant and highly relevant policy developments on aviation and climate change since the publication of the BIA AMP for consultation, that the AMP is updated. Other recommendations in our report should also be considered during update.

## 1 INTRODUCTION

Parsons Brinckerhoff (PB) was commissioned by North Somerset Council to undertake a critical review of climate change aspects of the Airport Master Plan (AMP) for Bristol International Airport (BIA), commenting in particular on:

- whether the science is sound in terms of quantification of likely effects and by comparison with other areas and sectors
- whether the maximum practical measures are being proposed to reduce emissions and to mitigate the impacts of these emissions
- whether sufficient is being done to assess the impacts of and to adapt to the changing climate.

PB was also requested to comment on the extent to which the Air Transport White Paper (ATWP) remains "fit for purpose" (taking account in particular of the review of the White Paper, if available). This will include consideration of the implications of the Stern Review and the recent decision of Uttlesford District Council in relation to Stansted Airport.

Since the initial commission, there have been two significant publications related to aviation and climate change policy. A Progress Report on ATWP was published by the Department for Transport (DfT) on 14 December 2006 and proposed legislation to include CO<sub>2</sub> emissions from aircraft in the scope of the European Emissions Trading Scheme was published by the European Commission on 20 December 2006. PB has considered the implications of these publications in the development of this review.

The format of this report is to set out the relevant text of the BIA AMP and to annotate this with PB's comments. The three particular questions set out above are then addressed specifically. Finally PB compares the way in which the climate change issues in aviation are addressed in the ATWP with the treatment in other reports and in the considerations of Uttlesford District Council in relation to the proposed expansion of Stansted Airport.



**2 PB COMMENTS ON THE BIA MASTER PLAN DOCUMENT**

BIA Master Plan Text	Comments	References
<p><b>10.1</b></p> <p>The Guidance on the Preparation of Airport Master Plans, published by the DfT does not explicitly require Climate Change to be considered in the scope of the Master Plan. This is presumed to be because the subject is a matter for national and international action. Nevertheless in response to requests for inclusion of this topic from the consultation this section considers the relationship between aviation and the problem of global warming</p>	<p>The DfT Guidance requires the effect of the Strategic Environmental Assessment Directive (SEAD) to be taken into account in preparation of Airport Master Plans.</p> <p>SEAD Annex I sets out information to be provided in Environmental plans. This includes climatic effects on the environment</p>	<p><i><a href="http://www.dft.gov.uk/stellent/groups/dft_aviation/documents/page/dft_aviation_031530.hcsp">http://www.dft.gov.uk/stellent/groups/dft_aviation/documents/page/dft_aviation_031530.hcsp</a></i></p> <p><i>DfT, Guidance on the Preparation of Airport Maser Plans, Undated.</i></p> <p><i>48. In preparing their master plans airport operators should also consider the effect, if any, of Directive 2001/42/EC (the Strategic Environmental Assessment Directive).</i></p> <p><i>Directive 2001/42/EC</i></p> <p><i>Article 5 Environmental Report</i></p> <p><i>1. Where an environmental assessment is required under Article 3(1), an environmental report shall be prepared in which the likely significant effects on the environment of implementing the plan or programme, and reasonable alternatives taking into account the objectives and the geographical scope of the plan or programme, are identified, described and evaluated. The information to be</i></p>



		<p><i>given for this purpose is referred to in Annex I.</i></p> <p><i>2. The environmental report prepared pursuant to paragraph 1 shall include the information that may reasonably be required taking into account current knowledge and methods of assessment, the contents and level of detail in the plan or programme, its stage in the decision-making process and the extent to which certain matters are more appropriately assessed at different levels in that process in order to avoid duplication of the assessment.</i></p> <p><i>ANNEX I Information referred to in Article 5(1)</i></p> <p><i>The information to be provided under Article 5(1), subject to Article 5(2) and (3), is the following:</i></p> <p><i>(f) the likely significant effects on the environment, including on issues such as biodiversity, population, human health, fauna, flora, soil, water, air, climatic factors, material assets, cultural heritage including architectural and archaeological heritage, landscape and the interrelationship between the above factors;</i></p>
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<p><b>10.2</b></p> <p>Scientific evidence is growing that man-made greenhouse gas emissions are having a noticeable effect on the earth’s climate and many consultees have focused on the growing contribution from air transport. Aircraft operations generate carbon dioxide, a direct greenhouse gas. However, other aircraft emissions are also linked to the effects in the atmosphere, including ozone generation, methane reduction, and cirrus cloud formation. The impacts from aircraft are therefore greater than that from carbon dioxide alone. There are various methods in use to measure these indirect warming effects. In 1999 the Intergovernmental Panel on Climate Change (IPCC) estimated that aviation’s impact is about 2 to 4 times higher than the effect of its past CO<sub>2</sub> emissions alone. Recent EU research indicates that this ration may be somewhat lower (around two times).</p>	<p>No reference is provided for the estimate of the global warming impact of aviation emissions being “around two times” the effect of CO<sub>2</sub> emissions alone (in other words, a Radiative Forcing Index (RFI) of 2 has been used). A central value estimate for the RFI of approximately 1.9 has been determined by Sausen et al. This value is also quoted by Jardine in describing the methodology used by Climate Care for offsetting the climate change effects of aviation. In fact, Climate Care uses a slightly more conservative value of 2.0. Sausen et al’s estimate does not include the effects of cirrus cloud formation as the magnitude of the effects and causal relationship are currently poorly understood. However, Sausen et al state that if the contribution to global warming from cirrus cloud formation were included, the RFI could be as high as 4. The Royal Commission on Environmental Pollution (RCEP) concluded that the appropriate RFI was about 3. DfT used a RFI of 2.7 in their</p>	<p><a href="http://www.ingentaconnect.com/content/schweiz/mz/2005/00000014/00000004/art00013">http://www.ingentaconnect.com/content/schweiz/mz/2005/00000014/00000004/art00013</a></p> <p><i>Sausen et al, Aviation Radiative Forcing in 2000: An Update on IPCC (1999): Meteorologische Zeitschrift, Vol. 14, No. 4, 555-561 (August 2005)</i></p> <p><a href="http://www.climatecare.org/_media/documents/pdf/Aviation_Emissions_&amp;_Offsets.pdf">http://www.climatecare.org/_media/documents/pdf/Aviation_Emissions_&amp;_Offsets.pdf</a></p> <p><i>Jardine, Calculating the Environmental Impact of Aviation Emissions: Environmental Change Institute. Oxford University Centre for the Environment, June 2005.</i></p> <p><a href="http://www.rcep.org.uk/aviation/av12-txt.pdf">http://www.rcep.org.uk/aviation/av12-txt.pdf</a></p> <p><i>Royal Commission on Environmental Pollution, The Environmental Effects of Civil Aviation in Flight, November 2002.</i></p> <p><a href="http://www.hm-treasury.gov.uk/documents/taxation_work_and_welfare/tax_and_the_environment/aviation/tax_avi_index.cfm">http://www.hm-treasury.gov.uk/documents/taxation_work_and_welfare/tax_and_the_environment/aviation/tax_avi_index.cfm</a></p>
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	<p>2003 report and 2.5 in their 2004 report. An RFI of 2 (based on Sausen et al.) is used by Stern. In all cases, it is noted that the figures are uncertain and may be underestimates because cirrus cloud effects are not included.</p> <p>An RFI of 2 is possibly at the lower end of the range of accepted values used to estimate global warming impacts of aviation emissions. However, based on the current state of knowledge, it is difficult to justify an alternative figure.</p>	<p><i>Department for Transport, Aviation and the Environment: Using Economic Instruments, March 2003</i></p> <p><a href="http://www.dft.gov.uk/stellent/groups/dft_aviation/documents/page/dft_aviation_031850.pdf">http://www.dft.gov.uk/stellent/groups/dft_aviation/documents/page/dft_aviation_031850.pdf</a></p> <p><i>Department for Transport, Aviation and Global Warming, January 2004.</i></p> <p><a href="http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm">http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm</a> Stern Review on the Economics of Climate Change, HM Treasury, November 2006. (box 15.6 and footnote 56)</p>
<p><b>10.3</b></p> <p>Aviation’s contribution to global warming is currently around 2% - 3% of global emissions, compared, for example with 25% for energy production. However, the IPCC forecasts that this could grow to between 5% and 15%, if action is not taken to tackle these emissions. Should other industries achieve significant cuts in their greenhouse gas emissions, in line with EU objectives, then aviation’s share as a proportion of the remaining emissions would rise. It</p>	<p>No source is provided for the estimate of aviation’s current contribution to global warming. It is also not stated whether the impacts include those from international as well as domestic flights. No time scale is stated for the IPCC forecasts.</p> <p>IPPC stated that aviation contributed approximately 2% of global CO<sub>2</sub> emissions in 1992 and, taking into account the indirect global warming factors, this represented approximately</p>	<p>Intergovernmental Panel on Climate Change, Aviation and the Global Atmosphere, 1999.</p>



<p>is important therefore that the aviation sector can demonstrate that its impact on climate change is under control.</p>	<p>3.5% of worldwide inputs to anthropogenic global warming. However, historically, aviation is estimated to have contributed only 1% of the anthropogenic increase in atmospheric CO<sub>2</sub> concentration, because of the bulk of the emissions have happened only in the last 50 years, whereas the impact of CO<sub>2</sub> is considered over a 100 year timescale.</p>	
<p><b>10.4</b> The impacts of aviation on climate change principally occur when the aircraft are flying at altitude between airports rather than when they are at or near a particular airport. Action to address the climate change impact therefore has to be taken by Government at an international level, and by the aviation industry across all its sectors, including airports, aircraft manufacturers and airlines. BIA is a signatory to the recently published cross industry Sustainable Aviation initiative set out in “A Strategy towards sustainable development of UK Aviation”, along with most of the airlines currently operating here. The issues concerning aviation and climate change were also considered by the Government in</p>	<p>ATWP also states that the Government will press for the following emissions-reducing actions in addition to economic instruments:</p> <ul style="list-style-type: none"> <li>• adoption by airports, airlines and air traffic controllers – including EUROCONTROL – of working practices that minimise the impact of their activities on climate change;</li> <li>• research and development by aerospace manufacturers of new technologies to reduce the climate change impact of future fleets; and</li> <li>• voluntary action by airlines, airports and aerospace companies to control greenhouse gas emissions and develop sustainability</li> </ul>	<p>Department for Transport, The Future of Air Transport, December 2003.</p> <p>Department for Transport, The Future of Air Transport Progress Report, December 2006.</p>



<p>the Air Transport White Paper. The key points from the White Paper are:</p> <ul style="list-style-type: none"> <li>• By 2030 aviation could account for about a quarter of UK’s contribution to global warming;</li> <li>• The Government is committed to reducing carbon dioxide emissions by 60% compared to current levels by 2050;</li> <li>• There is no international agreement on ways of allocating aircraft emissions and therefore international flights do not count in the national inventory of greenhouse gas emissions;</li> <li>• The aviation sector, nevertheless needs to take its share of responsibility for tackling this problem;</li> <li>• The Government is committed to a comprehensive approach, using economic instruments to ensure that growing industries are catered for within a reducing total;</li> <li>• Fuel efficiency gains will make a contribution to reducing carbon dioxide emissions. The Advisory Council for Aeronautic Research in Europe (ACARE) has set a goal to reduce fuel consumption by 50% by 2020.</li> </ul>	<p>strategies. Such action should include emissions reporting and targets at a company level.</p> <p>The AMP refers to measures to reduce on-site emissions of GHGs in paragraph 10.12. These would contribute to the Government objective identified in the first bullet above. However, the effects of the measures are not quantified.</p> <p>Further measures that would reduce emissions of GHGs are mentioned in paragraph 8.13 under the section heading “Air Quality”. These include the following:</p> <ul style="list-style-type: none"> <li>• Adopting airfield layout, scheduling and operating protocols designed and operated to minimise idling and taxi times;</li> <li>• Reducing the use of aircraft auxiliary power units through the use of fixed ground power and mobile ground power units;</li> <li>• designing traffic management schemes to achieve free flow traffic conditions;</li> </ul>	
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<ul style="list-style-type: none"> <li>• A unilateral approach to aviation fuel tax would not be effective in the light of international legal constraints; and therefore</li> <li>• The Government believes that the best way of ensuring that aviation contributions towards the goal of climate stabilisation would be through a well-designed emissions trading regime.</li> </ul>	<ul style="list-style-type: none"> <li>• Achieving improvements to public transport connections and use, to reduce private car use;</li> <li>• Designing roads and car parks to minimise congestion;</li> <li>• Reducing emissions from ground support equipment, including the use of alternative fuels and technology (the airport vehicle fleet has recently been converted to biodiesel).</li> </ul> <p>The impact on GHG emissions of these measures is neither mentioned nor quantified.</p> <p>The December 2006 Progress Report on the ATWP (ATWP PR) includes the following “next steps”:</p> <ul style="list-style-type: none"> <li>• we would recommend that all airports follow the example of Manchester and Luton airports and plan to become carbon neutral;</li> <li>• we invite airport operators to publish an environmental statement alongside their master plans, setting targets for recycling,</li> </ul>	
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	<p>reducing carbon emissions and improving the energy efficiency of their business operations, with the aim of achieving carbon neutrality as quickly as possible;</p> <ul style="list-style-type: none"> <li>• we ask industry to report annually on the progress it has made on reaching the targets in its Sustainable Aviation Strategy.</li> </ul> <p>The recommendation in ATWP PR that airports become carbon neutral is a more stringent target than is stated in the original ATWP. The measures to reduce carbon emissions described in the AMP would help to achieve this goal but are unlikely to be sufficient on their own.</p>	
<p><b>10.5</b> UK Targets for overall CO<sub>2</sub> reductions of 12.5% by 2010 relative to 1990 have been set through the Kyoto Protocol. The UK Government has set longer term targets for 2020 and 2050 and has also projected that emissions from aircraft will grow. The UK aviation industry accepts that growth is an issue and is committed to play its full part in meeting internationally agreed targets alongside other</p>	<p>This appears to imply that the UK aviation industry is not committed to contributing to the UK Government's longer term targets that are not "internationally agreed".</p>	



<p>industries. The Sustainable Aviation Strategy therefore sets out measures for aviation to minimise its impacts through technology and operational improvement, and meeting the external costs of its remaining emissions. The Strategy includes the following goal:</p> <p>“Aviation (to be) incorporated into a global policy framework that achieves stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous man-made interference with the climate system”.</p>		
<p><b>10.6</b></p> <p>The strategy includes the following commitments:</p> <ul style="list-style-type: none"> <li>• Airline and airport signatories to build support and assist policy makers in developing practical solutions for inclusion of aircraft CO<sub>2</sub> emissions in the EU Trading Scheme by 2008, or as soon as possible thereafter, as a first step towards a global approach;</li> <li>• Take a proactive role towards securing a positive engagement from the international aviation community to support measures to address climate impacts;</li> </ul>	<p>The AMP refers in paragraph 10.13 to the use of improved operational procedures to reduce fuel burn and to making information about climate change available to passengers and to promoting the use of suitable offsetting schemes.</p> <p>No information has been identified regarding progress by the Sustainable Aviation Group on the implementation of common reporting of total CO<sub>2</sub> emissions and fleet fuel efficiency. This issue is not mentioned elsewhere in the AMP.</p>	



<ul style="list-style-type: none"> <li>• Provide relevant data and expertise for the scientific community to enhance understanding of the non-CO<sub>2</sub> atmosphere effects of aviation, and support improvements in metrics for quantifying and report effects;</li> <li>• Propose appropriate mechanisms by 2012 for mitigating non-CO<sub>2</sub> effects based on a consensus of scientific understanding;</li> <li>• Continual improvement in technology and air traffic management towards the ACARE emission targets;</li> <li>• Develop and implement common reporting of total CO<sub>2</sub> emissions and fleet fuel efficiency by airline by end 2005;</li> <li>• Inform passenger understanding of climate impacts of air travel, including evaluating carbon offset initiatives as a practical short term measure; and</li> <li>• Provide an update by 20?</li> </ul>	<p>The European Commission has proposed (on 20 December 2006) legislation to include aircraft CO<sub>2</sub> emissions in the European Trading Scheme (by 2011 for internal EU flights with all flights originating or ending in the EU by 2012). As part of the proposals aircraft operators will be required to report on fuel use, and fuel efficiency.</p>	
<p><b>10.7</b> BIA has assessed its contribution to greenhouse gas (GHG) emissions in response to comments received during the consultation. Specialist consultants have</p>	<p>Insufficient information is provided in the AMP to allow the appropriateness and accuracy of the estimation methodology to be assessed. The use</p>	



<p>been engaged to carry out this calculation. GHG emissions from aircraft operations at BIA have been calculated for the landing and take-off cycle (LTO) and the cruise phase of flights. For 2005 and 2019 information relating to the number of LTOs has been used to estimate emissions of CO<sub>2</sub>, CH<sub>4</sub> (methane) and N<sub>2</sub>O (nitrous oxide). Default emission factors and fuel consumption for aircraft are derived from IPCC Guidelines for National Greenhouse Gas Inventories. Emissions from auxiliary power units (APUs) have been calculated based on the carbon content of fuel.</p> <p><b>10.8</b> Emissions from aircraft cruise, defined as movements above 1000m between airports, have been calculated based on the departure airport to avoid double counting. The cruise emissions have been taken from the Emissions Inventory Guidebook (EMEP 2005) and calculated using the generic aircraft types therein. The distances to each destination for 2005 and the forecast destinations for 2019 were calculated based on Great Circle</p>	<p>of aircraft-specific emission factors and fuel consumptions appears to indicate that a Tier 3A methodology based on aircraft movements as used in the IPCC Guidelines for National Greenhouse Gas Inventories has been used. However, this is not stated in the AMP.</p> <p>Particular information that would assist in an assessment includes the following:</p> <ul style="list-style-type: none"> <li>• Are all flights originating at BIA included in the reported figures or only those for domestic flights (in accordance with UNFCCC reporting rules)?</li> <li>• Are emissions during cruise phase included in the reported figures other than those in bullet 4 of paragraph 10.9</li> <li>• What would be the effect on the results reported in bullet 4 if cruise phase emissions were included?</li> <li>• Have the LTO cycle parameters been estimated for BIA operations?</li> <li>• Were the 2005 figures based on actual aircraft mix?</li> </ul>	
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<p>distances, adding 9.5% to the distance to take account of variations in the flight path. The emissions were calculated by the individual components of carbon dioxide, methane and nitrous oxide and converted to carbon dioxide equivalents.</p> <p><b>10.9</b></p> <p>The conclusions of the climate change impact study are as follows:</p> <ul style="list-style-type: none"> <li>• Direct GHG emissions from aircraft activity at BIA is forecast to increase by approximately 66% between 2005 and 2019, from 437,000 tonnes to 725,000 tonnes CO<sub>2</sub> equivalent.</li> <li>• Aircraft emissions from BIA constitute some 1.2% of the total aircraft emissions (using 2002 figures - latest available); 0.2% of 2004 emissions from UK transport sources and 0.06% of total UK GHG emissions in 2004.</li> <li>• Aircraft emissions from BIA in 2005 were 0.4% of the total emissions from the South West Region. If the emissions from other sources remain stable BIA would rise to 0.7% in 2019.</li> <li>• The emissions inventory in the Bristol Climate</li> </ul>	<ul style="list-style-type: none"> <li>• What assumptions were made regarding aircraft mix in 2019?</li> <li>• What assumptions were made regarding aircraft efficiency improvements in 2019?</li> <li>• What is the contribution of emissions from APUs? Paragraph 10.7 states that these emissions have been calculated.</li> <li>• It is not clear from the Bristol Climate Change and Sustainable Energy Strategy that emissions from BIA have been included in the inventory described in bullet 4. Is the comparison with Bristol emissions an appropriate measure to include in the AMP?</li> </ul> <p>The comparisons with UK, South West Region and Bristol emissions appear to be based only on direct GHG emissions. If the aviation RFI is included in the assessment the proportional impact of emissions from BIA would be expected to be significantly higher.</p>	
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<p>Change and Sustainable Energy Strategy (published by Bristol City Council in 2000) indicates that Bristol City’s total emissions amount to around 3.9m tonnes per annum. The BIA landing and take off emissions (LTO), being the on-site emissions contribution from flights, is 0.18m tonnes on the basis of the 2005 calculation. This represents 4.6% of Bristol’s total, potentially rising to 7% at 2019.</p>		
<p><b>10.10</b> Growth in aviation at BIA is dominated by low fare airlines. Low cost or low fare airlines distinguish themselves by providing a low cost “no frills” service. This model, originally developed in the USA, has been successfully propagated in Europe through deregulation of the market. It involves minimising costs and maximising efficiency in order to offer lower fares to consumers. Characteristics of the low fares model include:</p> <ul style="list-style-type: none"> <li>• Efficient operations that maximise aircraft utilisation and minimise fuel burn;</li> <li>• Use of standardised and modern aircraft fleets that aim to reduce operational and</li> </ul>	<p>No evidence is provided to support or quantify the assertion that low cost airline operations result in lower emissions of GHG.</p> <p>It is not clear whether the assumed lower emission rates have been taken into account when developing emission projections. The assumption that low cost airlines generate lower quantities of emissions implies that there is less scope for efficiency improvements than at airports serving a higher proportion of “traditional” airlines.</p> <p>No information is provided on the climate change</p>	



<p>maintenance costs for the airline;</p> <ul style="list-style-type: none"> <li>• A focus on serving uncongested regional airports, which have fewer delays and necessitate less fuel loss due to holding patterns and long taxi times;</li> <li>• The use of regional airports means that passengers have shorter distances to travel to catch their flights thereby reducing greatly the number of miles travelled by road which is the greater polluter;</li> <li>• A “no frills” in flight service that costs less to deliver and reduces aircraft payload and therefore requires less fuel burn; and</li> <li>• More passengers per flight and therefore less fuel and emissions per passenger.</li> </ul> <p><b>10.11</b></p> <p>The low cost airlines operating at BIA operate with a young aircraft fleet which is associated with more efficient engines and lower fuel consumption per passenger kilometre and therefore less CO<sub>2</sub>. These airlines serve both the business and leisure market.</p>	<p>impacts of passenger journeys to and from the airport.</p> <p>It is not clear what is meant when it is stated in bullet 4 that road “is the greater polluter”.</p>	
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<p><b>10.12</b></p> <p>The greater part of GHG emissions associated with the airport expansion, that from aircraft, will be dealt with at national and international policy levels. In this respect BIA supports the inclusion of aviation in the EU Emissions Trading Scheme as the primary means of addressing aviation’s impact on climate change. In addition BIA will play its full part in reducing the on-site emissions of GHGs by:</p> <ul style="list-style-type: none"> <li>• Designing building to achieve a saving in energy use over and above that required by the Building Regulations;</li> <li>• Incorporating on-site renewable energy sources in future development where possible. In addition BIA will seek to purchase a significant proportion of its electricity requirements from renewable sources;</li> <li>• The use of improved operational procedures such as Continuous Descent Approaches to reduce fuel burn;</li> <li>• Designing the taxiway layout to minimise aircraft holding and taxiing times;</li> <li>• Using low embedded energy products in</li> </ul>	<p>The effects of the proposed mitigation measures have not been quantified.</p> <p>Other measures that would reduce GHG emissions are discussed in paragraph 8.13. Some of these may overlap entirely or partly with those described in paragraph 10.12. Again the effects of these measures have not been quantified.</p>	
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<p>construction and consumable materials used by the airport;</p> <ul style="list-style-type: none"> <li>• The use of a Staff Travel Plan to reduce private car usage by staff; and</li> <li>• The use of ambitious targets to increase the usage of public transport by passengers.</li> </ul>		
<p><b>10.13</b></p> <p>Tree planting has been suggested through the consultation as one form of compensation for climate change impacts. Increased afforestation forms part of the Government’s Climate Change Programme and on this basis it would be appropriate to adopt this approach and include a tree planting programme as part of the Master Plan initiatives, both for climate change and landscape compensation reasons. However, there is increasing unease about the appropriateness of tree-planting schemes as a means of off-setting climate change impacts. These concerns can be largely overcome by taking a more sophisticated approach that includes investment in quality environmental projects, involving renewable energy and low carbon technology. Voluntary offset</p>	<p>The Master Plan does not make it clear whether BIA is undertaking to offset emissions arising from its operations or only to encourage passengers to use offsetting schemes.</p>	



<p>schemes, involving passengers or companies paying to offset the CO<sub>2</sub> emissions from their flights can contribute to reducing the carbon footprint of the Airport in this way. Such measures should be viewed as an interim measure pending the achievement of the technology improvements targeted by the Aviation Industry as set out in the Sustainable Aviation Strategy. Many businesses already adopt this approach and British Airways and a number of tour operators selling holidays out of BIA promote such schemes. BIA will take steps to ensure that information on climate change and aviation is made available to passengers and promote the use of suitable offsetting schemes. This will include the offsetting of BIA's own business activities.</p>		
<p><b>10.14</b> The UK's Climate Change Programme emphasises the need for adaptation to climate change. In the period of this Master Plan the South West is expected to experience an increase in mean annual temperature of around 1°C; a small decrease in summer precipitation and an increase in winter</p>	<p>The AMP does not consider the effects of increased wind speeds on airport operations. The South West Climate Change Impact Partnership Scoping Study indicates that average winter wind speeds are likely to increase by 2 - 3% in the Bristol Area.</p>	<p><a href="http://www.oursouthwest.com/climate/scopingstudy.htm">http://www.oursouthwest.com/climate/scopingstudy.htm</a> South West Climate Change Impact Partnership, Warming to the Idea, SW Climate Change Impact Scoping Study</p>



<p>precipitation. Increased risk of flooding is likely to be an issue for coastal areas. The need to plan for increased visitor numbers in the South West has been identified. No specific measures are expected to be required in the design of the Master Plan facilities in order to adopt to Climate Change.</p>		
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### 3 GENERAL COMMENTS

#### 3.1 Is the science sound in terms of quantification of likely effects and by comparison with other areas and sectors?

The methodology used in the AMP to quantify emissions is not described in detail. Only emissions from flight operations appear to have been quantified. Emissions from land based operations such as heating and ventilation and vehicle movements are not mentioned.

BIA has identifiably different degrees of control over emissions from flight operations and from land based operations. The emissions from these categories of operations should be estimated and reported separately. Three categories of emissions from land based operations should also be identified: emissions from on-site use of fossil fuels; emissions arising from the generation of purchased electricity and emissions from passenger, staff and suppliers transport to and from the airport.

In order to manage climate change issues successfully the AMP should identify the boundaries of the operations that BIA considers are within its control, set out the methodologies to be used to measure and monitor emissions of GHGs and set out the current GHG inventory against which the effects of expansions and mitigation measures can be compared. BIA is a signatory to the UK Sustainable Aviation Initiative which includes in its objectives "Establishing a common system for the reporting of total CO<sub>2</sub> emissions and fleet fuel efficiency by the end of 2005". However, PB has not identified any information about progress on this objective. In the absence of this common reporting system, BIA should consider basing its reporting practices on a generally accepted methodology such as the World Business Council for Sustainable Development (WBSCD). Greenhouse Gas Protocol (WBSCD, March 2004).

The methodology for quantification of emissions from flight operations appears to follow a Tier 3A methodology as set out in IPCC Guidance for National Greenhouse Gas inventories. However, the AMP states that default emission factors and fuel consumptions have been used to estimate LTO emissions and that generic aircraft types have been considered in estimating cruise phase emissions. While such a methodology is useful in developing an aggregated national inventory it is less useful when developing an inventory for a single airport as it will not allow the identification of the impact of operational changes such as reduced taxiing times or continuous descent approaches and changes in fleet mix.

In order to identify these effects, it would be necessary to measure actual operating parameters at BIA and use these to modify the default parameters used to estimate LTO emissions. This approach would also allow verification of the assertion that the operational characteristics of low cost airlines tends to result in lower emissions from their flight operations.

The European Commission's proposals for including aircraft emissions of CO<sub>2</sub> in the European Trading Scheme would include, within the scope of tradable emissions, those arising from the use of APUs. The BIA proposal to reduce the use of aircraft APUs by switching to ground power would have the effect of reducing emissions in the traded sector and increasing emissions in a non-traded sector. The detailed effects of this transfer should be evaluated.

3.2 Are the maximum practical measures being proposed to reduce emissions and to mitigate the impacts of these emissions?

The ATWP PR notes that Manchester and Luton Airports have adopted targets of achieving carbon neutrality and recommends that all airports should follow this example. The AMP does not include specific targets for carbon emissions.

The measures to reduce emissions proposed by BIA are set out in paragraph 10.12. Other measures that might be considered are:

- Implement energy saving measures in existing buildings;
- Adopt operational procedures that minimise fuel use in airport vehicles;
- Substitute low emission vehicles (electric, LNG, hydrogen) where possible. (ATWP PR notes that BIA has converted its airport fleet to biodiesel and quotes this as an example of best practice. However, this measure is identified in the AMP as affecting local air quality rather than climate change.)
- Raise staff awareness of climate change issues and involve staff in identifying and implementing emission reduction opportunities;
- Implement energy reduction targets for tenants and franchisees.

Mitigation by offsetting is discussed in paragraph 10.13. The discussion is mainly in the context of offsetting emissions from flight operations. BIA appears to undertake only to promote offsetting to passengers. In view of the approach taken by the proposed inclusion of aircraft CO<sub>2</sub> emissions in the European Trading Scheme, whereby aircraft emissions are attributed to aircraft operators and not to airport operators. It is probably not appropriate for BIA to undertake any offsetting of flight-related emissions. However, it is not clear from the AMP whether BIA is proposing to offset emissions from its own land-based activities and if so how.

In principle BIA could offset the global warming impacts of all or part of the emissions from land based operations through the purchase and retirement of carbon emission credits generated by Kyoto CDM or JI mechanisms or of emission allowances circulating within the UK or European Emission Trading Schemes. The degree to which impacts should be offset is essentially a commercial decision.

3.3 Is sufficient being done to assess the impacts of and to adapt to the changing climate?

The impacts of changing climate and adaptation are discussed in paragraph 10.14. The effects of these impacts on BIA operations are not discussed other than a need to plan for increased visitor numbers in the South West. No specific measures are identified to adapt to the predicted climate changes. Thus, it is implied in the AMP that the likely impacts will not have a significant effect on BIA operations. However, the AMP does not refer to any analysis that demonstrates this conclusion.



The AMP considers only annual and seasonal averages and totals. The impact of increased climatic variability and increased frequency of large magnitude events is not considered. These could potentially result in increased need for cooling and heating and more frequent disruption of flight operations.

## 4 COMMENTARY ON THE AIR TRANSPORT WHITE PAPER

### 4.1 Does the Air Transport White Paper remain “fit for purpose”?

The decision of 30 November 2006 by Uttlesford District Council to refuse planning permission for an extension to Stansted airport has thrown into question the suitability of the Air Transport White Paper (ATWP) “The Future of Air Transport” as a basis for assessing proposals for airport expansion. Among other reasons for refusal, the Council’s decision notice stated the following reason under the heading Climate Change: “In the light of the Stern Review, the proposed Climate Change Bill put forward in the Queen’s Speech and the increasing evidence of the adverse effects of climate change, it would be premature to grant planning permission in advance of clarification by the Government as to whether its response to the Stern Review and other recent research will include direct implications for the aviation industry beyond the provisions of the Air Transport White Paper”.

The main area of contention appears to be whether the assumptions regarding growth of UK air transport are consistent with Government targets for greenhouse gas emissions. An officers’ companion report on the climate change issues of the proposed development was considered by the planning committee. This report included the following comment:

*“Until the Government has responded to Stern, and in light of the other evidence showing aviation demand management is a necessity to achieve emission reduction targets, it is uncertain whether the policy of encouraging airport growth as advocated in The Future of Air Transport is a reasonable basis on which to proceed. [...] [T]he significance of the changes in context over the past three years since The Future of Air Transport was announced puts a question mark over the weight that should be attached to it.”*

The Government has identified a target of reducing UK emissions of greenhouse gases by 60% of 1990 levels by 2050. This follows a recommendation in the 22nd Report of the Royal Commission on Environmental Pollution (RCEP) “Energy - the Changing Climate”. RCEP identified the target of 60% reduction by considering the global per-capita emission that would result in stabilisation of atmospheric CO<sub>2</sub> at a concentration of 550 ppm. This process is termed “contraction and convergence” as the overall global emission rates would contract while the per-capita emissions of developed countries would converge with those of less developed countries. Modelling indicates that an atmospheric CO<sub>2</sub> concentration of 550 ppm would result in a stabilised average global temperature some 2.9°C higher than present day by the end of the 22nd century. The Climate Change Bill announced in the Queen’s Speech of 15 November 2006 includes a statutory commitment to this 60% reduction target.

The 60% emission reduction target is discussed briefly in the ATWP. However, the projections in the ATWP do not extend to the 2050 deadline as it considers only a 30 year period (from 2003). The technical paper “Aviation and Global Warming” published by DfT in January 2004 describes the analysis that contributed to the CO<sub>2</sub> emission projections in the ATWP but this paper also covers the period to 2050. Three cases are presented which differ only in the assumptions regarding improvements in fuel efficiency. Passenger demand is assumed to increase but at a steadily reducing rate. The worst case forecast considers that there will be limited fuel efficiency improvement of 15% achieved by renewal of the aircraft fleet

according to current planned aircraft lifetimes. A central case forecast assumes an additional 50% improvement in the fuel efficiency of aircraft as a result of technological improvements and a best case forecast assumes a further 10% fuel saving over the central case as a result of economic instruments. In the central and best cases, the total CO<sub>2</sub> emissions from aviation are predicted to have a downward trend by 2050; thus efficiency improvements are predicted to outweigh increases in demand.

Current internationally agreed greenhouse gas accounting policies do not include emissions from international air transport in national greenhouse gas inventories as it has not been agreed how the emissions should be attributed to individual nations. On this basis, the UK's target for greenhouse gas emissions in 2050 is 65.8 MtC. For accounting convenience, emissions from international flights departing from the UK have been included in the historical and projected totals for aviation reported in Aviation and Global Warming and in the ATWP. If emissions from international aviation are included in the 1990 base year on the same basis (this represents an additional 4.4 MtC according to Aviation and Global Warming), the UK target for 2050 including international aviation would be 67.6 MtC. The three estimates of emissions from aviation in 2050 set out in Aviation and Global Warming represent 43.0% (worst case), 25.7% (central case) and 23.2% (best case) of this modified target respectively. If the non-CO<sub>2</sub> global warming impacts of emissions (estimated to result in a total global warming some 2 to 4 times that of CO<sub>2</sub> alone) are included, these proportions would be significantly higher.

The ATWP states that the Government's view on the best way of ensuring that aviation contributes to the goal of climate stabilisation would be through a well-designed emissions trading regime. Stern strongly supports this view and points out that it will be difficult for aviation to adopt radically new technologies and that trading will transfer funding to sectors where technological emission reductions are easier and cheaper to implement. The implication is that sectors other than aviation will need to achieve emission reductions significantly more stringent than the 60% overall reduction target.

Stern also points out that there are a number of issues that must be addressed before aviation emissions can be successfully traded. The main difficulties are:

- How should the indirect effects of aviation emissions be accounted for?
- How should emissions from international flights be allocated?

Stern notes that progress has been made on resolving other potential difficulties by The International Civil Aviation Organisation and the EU Environment Council.

Other commentators have questioned the validity of some of the key assumptions on which the ATWP is based. For example, the paper presented to Uttlesford District Council identifies a view supported in the Tyndall Centre report "Decarbonising the UK" that atmospheric CO<sub>2</sub> concentration should be stabilised at 450ppm. A DEFRA report in January 2006 on the Scientific Symposium on Stabilisation of Greenhouse Gases held at the Meteorological Office in February 2005 indicates that if global warming is to be limited to 2°C (identified as the threshold of 'dangerous' climate change) atmospheric CO<sub>2</sub> concentration would need to be stabilised at below 400 ppm. Another Tyndall Centre paper (Bowes, A., Anderson, K.L., Policy Clash: Can projected aviation growth be reconciled with the UK Government's 60% carbon-reduction target? Transport Policy (2006), doi:10.1016/j.tranpol.2006.10.002) also supports stabilisation at 450 ppm. This paper also questions the validity of the assumptions regarding the growth rate of emissions and points out that emissions grew by 11% between 2003 and 2004. Based on these alternative assumptions, the

paper shows that if unconstrained, aviation alone could prevent the achievement of UK emission rates consistent with stabilisation at 450 ppm. The Tyndall papers conclude that the UK 2050 target 60% reduction is unlikely to be achieved without some restraint on demand for aviation.

Stern considers the feasibility of aiming for stabilisation at 450 ppm and concludes, "It would already be very difficult and costly to aim to stabilise at 450ppm CO<sub>2</sub>e. If we delay, the opportunity to stabilise at 500-550ppm CO<sub>2</sub>e may slip away."

The Impact Assessment prepared to support the proposed amendment of the EU Emissions Trading Scheme describes alternative methods of attributing aircraft emissions to entities that could participate in trading. These alternatives include attributing emissions to airports rather than to aircraft operators. The discussion stated that:

*"The airport option would imply that each EU airport would surrender allowances for the emissions from flights to and/or from that airport. This option would have the advantage that an airport provides a possible "point of aggregation" for the polluting activity. However, although airport managers may take certain decisions that have an influence on aircraft emissions (in particular at congested airports) they cannot directly influence investment decisions or the actual operation of aircraft and therefore do not exercise any direct control over the emissions from the aircraft operating to and from their facilities. While the economic signal that emissions trading is designed to establish could conceivably be transferred to aircraft operators via airport landing charges, defining and agreeing on sufficiently accurate and harmonised mechanisms for providing correct price signals to those actually in control could be very difficult given the wide variety of approaches to airport charging that exists in the Community. If airports failed to pass on the costs or failed to pass on the costs by reference to emissions, then the scheme would not provide the right incentives and the objective of the policy would not be achieved."*

It was concluded that attributing emissions to aircraft operators was far more practical. The option of attributing emissions to airports was discarded at an early stage in the development of the proposals and not considered further.

Similar considerations will apply to other measures to restrict flight-related emissions. However, neither the ATWP nor ATWP PR makes it clear whether airports might be considered to have at least partial responsibility for flight-related emissions. Indeed, the ATWP PR states:

*"We are also clear that major decisions on increases in airport capacity need to take into account [...] not only their local environmental effects, but also the wider context of aviation's climate impact."*

This appears to imply that the Government expects that the planning process will be used to influence aviation-related emissions by restricting aircraft movements, either through the imposition of caps or by constraining physical capacity.

The ATWP PR does not make it clear what methodology should be used to assess airport development proposals. However, the discussion is made in the context of proposals to develop an emissions cost assessment methodology to evaluate the external climate change costs.

**5 CONCLUSIONS**

5.1 The ATWP and ATWP PR only covers the period to 2030 and therefore does not consider in detail the implications for the government target for 2050 of a 60% reduction from 1990 emission levels. This longer timeframe is considered in supporting technical papers and in the Stern Review.

5.2 Stern does not identify any fundamental inconsistency between the ATWP projections and UK emission reduction targets, but notes that the increases in emissions from aviation will require stringent reductions to be made by other sectors if the UK target emission reductions are to be met. Stern sees a trading mechanism as a means of achieving these reductions equitably.

5.3 The ATWP PR provides some additional guidance on how the climate change impacts of airport development proposals should be evaluated. This will require the development of a methodology to evaluate the external costs of aviation GHG emissions and also further guidance on how the external costs should be used in assessing development proposals.

5.4 In summary, PB recommends that in the light of recent, significant and highly relevant policy developments on aviation and climate change since the publication of the BIA AMP for consultation, that the AMP is updated.