Climate change and Australian tourism: a scoping study

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Publication details  
Buultjens, J, White, NE & Willacy, S 2007, _Climate change and Australian tourism: a scoping study_, Sustainable Tourism CRC, Brisbane, Qld. ISBN: 9781920965563  
Climate Change and Australian Tourism

Sustainable Tourism Cooperative Research Centre
Climate Change Policies and
Australian Tourism
Scoping Study of the Economic Aspects
Peter Forsyth, Larry Dwyer and Ray Spurr

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Centre for Tourism Economics and Policy Research
SUSTAINABLE TOURISM COOPERATIVE RESEARCH CENTRE
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Acknowledgements
This document results from a research project undertaken by the STCRC’s Centre for Tourism Economics and Policy Research.

    Qantas Airways Limited is a major supporter of the STCRC and its Centre for Tourism Economics and Policy Research, through its sponsorship of the Qantas Chair in Travel and Tourism Economics at the University of New South Wales.

    The STCRC was established and is supported under the Australian Government’s Cooperative Research Centre’s Program.
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SUMMARY

Costs of climate change to tourism

- Climate change will directly impact on Australian tourism and on the economic benefits that tourism generates through the loss or degradation of tourist attractions, the costs of adaptation, and replacement costs for capital infrastructure.

- Since Australia relies heavily on nature-based tourism, which is most at risk from direct climate change impacts, Australia is likely to be a net loser from changing international patterns of tourism as a result of climate change.

- It is possible to assess the costs to Australia of climate change damage by identifying attractions at risk, projecting impacts on visitor flows and adaptation costs, evaluating losses to domestic tourists and modelling the costs to the economy from reduced inbound international tourism.

Tourism impacts on GGE – measuring its carbon footprint

- It is important to distinguish between the Australian and global carbon footprints of tourism because greenhouse gas emissions (GGE) generated outside Australia, are associated with tourism, particularly international tourism.

- The carbon intensity footprint of tourism refers to the GGEs directly and indirectly associated with tourism activity. The sum of the indirect effects on output is commonly referred to as the ‘production induced’ effect. Clearly, GGE will be associated with both the direct as well as the ‘production induced’ effect.

- The carbon impact footprint of tourism refers to how changes in tourism impact on overall GGEs – this depends on its carbon intensity and also on how other industries are impacted upon (positively or negatively) by changes in tourism. The latter are commonly referred to as ‘industry interactive’ or ‘feedback’ effects. These effects are also associated with GGE. Thus, the carbon impact is the sum of the changes in GGE associated with the direct, indirect (production induced) and interactive effects of a change in final tourism demand.

- Measuring the carbon intensity footprint of tourism requires the use of economic models, which can link economic activity to fuel use and GGEs from industries that supply products and services to tourists directly and indirectly.

- Measuring the carbon impact of tourism involves using a model to project how changes in tourism, whether domestic or inbound, impact on other industries in Australia, and ultimately change GGEs in the domestic economy as a whole.

- Measuring the carbon impact footprint of international (global) tourism involves using a model to project how changes in international tourism flows affect other export industries and also GGEs outside Australia, e.g. through international aviation.

Climate change policies and impacts on tourism

- Tourism will be affected by the three main climate change mitigation policies – mandatory restrictions, carbon taxes and the Emissions Trading Scheme (ETS), all of which will increase the cost base of tourism firms.

- The ETS will include major direct emitters of GGEs. It will also indirectly affect smaller firms not included in the ETS through the requirement that sales of energy to them have emissions permits.

- Carbon taxes mean more revenue for the government than the ETS, if permits are given away or sold at a concessional price.
• Few tourism firms, other than airlines, are likely to participate directly in the ETS. Thus they will not gain from free permits; though they will face input cost increases, depending on the extent of pass through of permit values.

• The cost base of domestic tourism will increase – modelling is needed to determine by how much.

• Impacts of the ETS on international tourism are more complex and depend on how international aviation is handled, as well as on how other export industries are affected. Again, modelling is required to determine how costs will be affected and what the impact on the international competitiveness of the Australian tourism industry will be.

• When an effective and comprehensive ETS is in place, mandatory requirements or taxes imposed on specific industries such as aviation will be ineffective in reducing GGEs.

• Tourism is a ‘footloose export industry’ and tourism will shift offshore, to an extent, under the ETS depending upon the schemes that may or may not be introduced elsewhere. The special arrangements which have been proposed for such industries do not cover tourism very well, and the costs and benefits of alternative arrangements, which might involve leaving international aviation out of the ETS, need to be evaluated.

Climate change policies and land transport

Climate change mitigation policies will impact on ground transport, though preliminary estimates suggest that the direct impact will not be large.

Climate change policies and aviation

• Aviation accounts for a small proportion of GGEs (around 2%), though the damage from aviation emissions is considered to be significantly greater than from other emissions. While technology is leading to reduced emissions from aviation, this is not likely to counter the strong growth in aviation. Aviation is thus likely to account for a growing proportion of GGEs. Because technologies are locked in over a considerable time period, climate change mitigation policies are not likely to reduce GGEs from aviation by as much as in other industries.

• Major airlines are likely to be included in the Australian ETS, and in Europe the existing ETS is being widened to include aviation.

• Impacts of climate change policies on airfares will depend on the extent of pass through – a controversial issue. This is likely to be less than complete in the short run. When airlines are granted free permits, they may not increase airfares to reflect the full value of the permits.

• Under the ETS, domestic airfares will increase moderately and airlines will gain from free permits, at least for some years.

• Airfare increases on international routes, and especially long haul routes, are likely to be significant even if there is not full pass through.

• No convincing case has been made for treating aviation differently, either more or less favourably other than under general arrangements for footloose industries. Special taxes or restrictions on aviation, if aviation is also included in the ETS, will be ineffective in reducing GGEs.

Assessing the impacts of climate change policies on the cost of international visits to Australia – preliminary estimates

• High ($50/tonne) carbon prices could raise the cost of international flights to Australia by between 6-9% and 14-23%, depending on the route.

• High carbon prices could raise the all up cost of a trip to Australia by between 4-7% and 11-17%, depending on the route.
Scoping study of the economic aspects

- The effects of carbon taxes on tourism flows will depend upon their level, the extent of airfare rises, and the price elasticity of demand for travel and tourism.

**Consumer perceptions and voluntary actions**

- Consumer perceptions that travel, and especially air travel, is irresponsible because of its GGEs could hurt long haul destinations such as Australia.

- Voluntary carbon offset schemes can help in that they offer the ‘responsible’ traveller a carbon neutral alternative. However they will not address the demand for action against aviation because most travellers will not take up these carbon neutral options because they imply more expensive air transport.

- Tourism firms can take action to mitigate their direct and indirect GGEs and reduce emissions where doing this imposes little or no cost.

- However, for most tourism firms and destinations, going carbon neutral will be costly. Firms which sell in niche markets and are prepared to pay a premium for carbon neutrality will find it worthwhile. For the majority of tourism (and other) firms, this will not be the case, as going carbon neutral will increase their costs, leaving them at a competitive disadvantage. This is why government climate change mitigation policies are needed.

**Implications for tourism stakeholders**

- *Tourists* will incur higher transport costs as well as higher prices of products associated with GGEs. The extent to which this results in more or less tourism related expenditure in the economy depends on the relative price rises in tourism as compared with price rises of the products and services of non-tourism industries.

- *Private tourism operators* will incur higher costs of production as a result of climate change policies but so will operators in non-tourism industries. The effect on the competitive advantage of operators will depend on the efficiencies of production that they generate as compared to firms both within and outside the tourism industry.

- *Destinations* will become more or less price competitive depending upon the overall impact of climate change policies on operator costs and their affect on prices and visitor flows. This will affect tourism’s economic contribution to different destinations in terms of GDP, value added, employment etc.
Chapter 1

INTRODUCTION

This study focuses on climate change and its economic impacts on tourism. Thus, it considers climate change and the economic costs it poses for the tourism industry directly, such as through rendering some attractions no longer viable. It also considers the related question of adaptation to climate change and the costs associated with this. It analyses how tourism, and the economic activity connected to it, impacts on greenhouse gas emissions (GGE) – tourism directly creates emissions, through the use of fossil fuels but it also has an indirect impact through use of electricity and other products, where GGE are emitted in the chain of production. Finally, the study analyses how climate change policies, such as the proposed Australian emissions trading scheme (ETS), impact on tourism and especially on key sectors, such as aviation.

The focus is on the economics of climate change and tourism – thus it is not intended to provide a complete coverage of other effects that climate change may have on tourism. The science of climate change is taken as given and in relation to tourism the physical aspects of this will be addressed in a separate forthcoming Sustainable Tourism Cooperative Research Centre (STCRC) report. This said, it is important to realise that there is a close interplay between the science and economics of climate change. For example, the setting of GGE reduction targets is not just a scientific matter – the economic costs of achieving targets, as well as the benefits from reduction of climate change, are factors which need to be taken into account when they are set (and the costs to the tourism industry, along with costs to other industries, are relevant in target setting).

This study is intended as a scoping study, and thus it does not purport to be a comprehensive or final analysis of the issues even within its area of focus. Rather the objectives are to:

- Highlight the key connections between climate change and tourism;
- Outline the costs of climate change on tourism and the costs of adaptation;
- Outline the impact of tourism on GGEs – its ‘carbon footprint’ and how this might be measured;
- Indicate how tourism will be affected by climate change mitigation policies, such as the implementation of an ETS and how the costs of these might be estimated;
- Explore the impacts on key affected sectors, such as land transport and aviation;
- Pose some policy issues for consideration by the tourism industry; and
- Indicate where the knowledge gaps are and what the research priorities might be.

The intention is to provide a working document for the tourism industry – one which provides information, outlines possible effects and gives some guidelines for possible further work.

Climate change and tourism is a large topic and there are many different aspects to it. In handling it, we break the issues down into four main areas:

1. How climate change affects tourism – the physical side and what the costs of these impacts are.
2. How tourism can adapt and what adaptation will cost.
3. How tourism affects activity in the economy as a whole and thus how it impacts on climate change through its GGEs.
4. How climate change policies affect tourism and how to assess their cost and implications for the economy.

In this study, we shall analyse each of these issues. The impacts of climate change and its costs are best considered along with the costs of climate change adaptation. The major aspects on which economic analysis can be brought to bear are areas 3 and 4, the issues of focus here. There are two sectors of tourism to focus specific attention – land transport and aviation. These two sectors form the main direct source of tourism GGEs. Furthermore, they very much condition patterns and levels of tourism. Land transport is critical to domestic tourism, as well as some international tourism. Aviation is important for domestic tourism but it is critical for international tourism for a country like Australia. Climate change policies are likely to have a significant impact on international aviation and make both inbound and outbound tourism more expensive. In the short term, before the serious implementation of climate change policies, consumer reactions and aversion to air travel could be important. International aviation poses particular problems for climate change policies, since other countries will be involved. In addition, the impacts of aviation policies will also depend on what other countries are doing, and thus what impact climate change policies around the world are having on Australia’s competitiveness as a destination.
Chapter 2

THE COSTS OF CLIMATE CHANGE TO TOURISM

Climate change is likely to be, on balance, a negative for tourism and particularly for Australian tourism. Some of the attractions that tourists come to visit will be either destroyed entirely or the quality of the experience will be diminished. Natural attractions, such as the Great Barrier Reef, will be most affected but created attractions, such as beach resorts, marinas and major coastal icons such as the Sydney Opera House, could also be affected through storms or flooding. As a consequence, there is likely to be less tourism. In some cases it will be possible to adapt – to preserve the attraction, to lessen the damage done by climate change or to eliminate the damage. Adaptation, however, will have a cost. There will be some attractions which are created or improved by climate change – for example, some beaches may become warmer and more attractive. Domestic and international patterns of tourism will be changed. Not all tourism will be affected. Business and Visiting Friends and Relatives (VFR) tourism may be more or less unaffected by climate change and holiday tourists, who mainly come to see cities and participate in their life, will not be particularly affected. However, for Australia, it is very likely that the impact of climate change effects on tourism will be distinctly negative.

There are several costs and some benefits potentially associated with climate change. These include:

- **Loss of attractions.** It may be that some attractions cease to function as attractions for tourists. Tourists may be visiting a coastal town to see a nearby reef – climate change may render the reef unattractive and not worth visiting. Similarly, some ski fields may be forced to close. There will be a cost through loss of benefits to domestic tourists and an associated negative economic impact to the region. International tourists may also cease to visit the attraction and the lower visitation will mean a loss of tourism expenditure in the region and the whole economy, with associated economic costs. In addition, there may be increased outbound tourism, for example, as skiers go overseas to ski and this leads to a loss of tourism expenditure within Australia, with an associated impact on the whole economy.

- **Loss of quality of attractions.** Many attractions may survive but the quality of the visitor experience will decline. This will lead to similar effects to those for the complete elimination of an attraction. Domestic tourists will lose, fewer international visitors will come, and more Australian tourists will choose to go overseas or stay at home.

- **Costs of adaptation.** For many attractions it will be feasible to preserve their appeal by adapting. Thus ski fields will make their own snow and resorts will be able to control water flows. Adaptation will be costly. It is not feasible to project the costs of adaptation, as costs will vary on a case-by-case basis. Clearly adaptation is not always technically feasible and even where it is, it may be too costly to be worthwhile.

- **Costs of replacing tourism capital.** In a number of cases, it will be feasible to retain an attraction by shifting its location. Thus a ski field may no longer be viable but it may be feasible to open up another nearby or a beach resort may need to be shifted to higher ground. If this is to happen, considerable capital expenditure will be needed, both for the facilities and the associated infrastructure. Climate change will result in existing facilities and infrastructure becoming useless and new facilities will be needed at the new locations. In the case of the ski resort, new ski lodges and facilities will need to be built and access roads must be provided. Thus, even if on balance, a region is able to maintain its level of attractions, there will be a major cost in replacing the capital investments, which after climate change are located in the wrong places.

- **New or better attractions.** Climate change does not always work in the same direction – some attractions will be improved by climate change (Victoria’s beaches perhaps?) and some attractions, which were not viable before, will become viable. The effects of these will be the reverse of those of the first two bullets above.

It is important to put these changes in perspective. As a consequence of climate change, the natural capital of tourism will be altered and most likely be reduced or devalued, in Australia and in the world as a whole. However, tourism and nature-based tourism will continue. People will continue to have leisure time and income, and will wish to make nature-based leisure trips, as well as visits to the beaches. The demand for nature-based tourism will be unaffected and if supply contracts, the effective price will rise. Tourists will have to pay a higher price to visit the attractions of their choice, perhaps in cash, and perhaps in higher transport costs and longer travel times. This higher price will lead to some reduction in this type of tourism, with tourists spending their time and money more on other forms of tourism and/or on other goods and services.

What are the implications for Australia? Australia is arguably relatively well endowed with the resources for nature-based tourism and these are likely to be most adversely affected by climate change. For some of the most
important attractions, such as Kakadu or the Great Barrier Reef, adaptation may not be feasible or it may be very costly. Thus the supply/cost aspects of nature-based tourism could be quite negative. The overall impact depends also on how demand is affected. Australia’s competitors will also be affected – thus beach destinations such as Hawaii, Bali and Fiji will all be impacted by climate change. Certainly some competing destinations could be worse affected than Australia, though some beach destinations will rise in popularity as they become warmer.

Thus, there is a real issue as to how badly affected Australian tourism will be as a result of climate change. There will be a loss on the supply side and this might be partly counteracted by changes on the demand side or the demand side changes could make the problem worse. To resolve this issue it is necessary to assess the impact of climate change on tourism attractions in Australia and to make some assessment of how competing destinations will also be affected. With this information, it would be possible to assess the cost in terms of degradation of Australia’s natural tourism capital and the economic costs, which could come about as a result of reductions in tourism inflows and expenditure.

Assessing the Costs of Climate Change to Australian Tourism

Assessing the costs to Australia of the impacts of climate change on the tourism industry is not a simple or straightforward exercise. At its heart, it involves looking at each attraction, assessing the physical impact, assessing the impact on demand, and examining whether adaptation could lessen these impacts, how much such adaptation would cost, and determining whether it would be worthwhile. Altogether this is a very large exercise. The problem is that it must be done on a case-by-case basis, since all attractions are different. In principle, a number of things can be done. The stages could be as follows:

1. Develop a comprehensive inventory of possible attractions and how they would be affected.
2. Develop a taxonomy of attractions and how they would be affected, the feasibility of adaptation, the impacts on demand and the costs imposed by climate change. While this does not solve the problem, it helps set out what needs to be done. The result might be a table such as Table 1.

Table 1: Climate Change Impacts and Costs on Attractions

<table>
<thead>
<tr>
<th>1.</th>
<th>Attraction</th>
<th>Great Barrier Reef</th>
<th>Sydney Opera House</th>
<th>Kosciusko Ski Fields</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>Effects</td>
<td>Severe degradation</td>
<td>Flooding</td>
<td>Reduced precipitation &amp; warmer temperatures</td>
</tr>
<tr>
<td>3.</td>
<td>Adaptation Feasible?</td>
<td>No</td>
<td>Yes</td>
<td>Yes, partially</td>
</tr>
<tr>
<td>4.</td>
<td>Adaptation Cost</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Current Visitation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Current Value</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Reduction in Demand</td>
<td></td>
<td></td>
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<tr>
<td>8.</td>
<td>Loss of Value to Domestic Visitors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Loss of International Tourism Expenditure</td>
<td></td>
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<tr>
<td>10.</td>
<td>Cost to Economy of Reduced International Tourism Expenditure</td>
<td></td>
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<tr>
<td>11.</td>
<td>Cost to State Economy of Reduced Interstate and International Tourism Expenditure</td>
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<td></td>
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</tbody>
</table>

Filling in the cells of this table would involve the further steps below:

3. Assess feasibility and cost of adaptation. These two steps (3 & 4) require information specific to the attraction.
4. Assess impacts on demand. Current visitation should be easy to obtain information on and, based on this, projections on how climate change impacts will affect demand can be made by local experts.
5. The loss of value to domestic tourists can be assessed using standard techniques, such as the travel cost method. Expenditure changes can be forecast and the impacts, and costs upon, on regional and national economies can be estimated using regional and national economic models.

6. Losses of international visitor expenditure can be estimated. The more difficult matter is to assess the implications of this for international visitor expenditure in Australia – international visitors may still come to Australia, to a reduced extent, but visit other attractions. The impacts on the regional and national economies, along with the costs of these impacts, can be estimated using economic models.

It would clearly be impractical to undertake a comprehensive assessment, along the lines suggested by Table 1, of all tourism attractions in Australia. However, it is quite feasible to undertake an assessment of some of the main attractions, particularly those which account for the greatest number of visitors, domestic and international. Fortunately, the top attractions probably account for a high proportion of visitors. With information about these, it would be feasible to make an assessment of the total cost to Australia with a tolerable degree of accuracy. Thus, if the top 10 attractions account for X% of visits, and climate change will impose a total cost on them of $Y m, then the total cost would be in the order of ($1/X).Y.100.

The results of any such exercise must be treated with considerable caution. However, by carrying out this exercise, a rough order of magnitude of the costs of climate change for Australian tourism can be determined. This figure could be useful in policy analysis and help in the setting of GGE reduction targets.

Key Points

- Climate change will directly impact on Australian tourism and the benefits it creates through loss or degradation of attractions, the costs of adaptation and replacement of capital infrastructure.
- Since Australia relies heavily on nature-based tourism, it is likely to be a net loser from changing international patterns of tourism as a result of climate change.
- It is possible to assess the costs to Australia of climate change damage by identifying attractions at risk, projecting impacts on visitor flows and adaptation costs, evaluating losses to domestic tourists, and modelling the costs to the economy from reduced inbound international tourism.
Chapter 3

TOURISM IMPACTS ON GGEs – MEASURING THE CARBON FOOTPRINT

Tourism creates GGEs – it stimulates economic activity in a range of industries and this economic activity requires the use of fuels, which release GGEs. The problem of measuring the carbon footprint of an industry is, at least in part, a matter for economic analysis, relating tourism expenditure to economic activity and this, in turn, to emissions. To measure the carbon footprint of any industry, it is necessary to have a model of the economy. In this chapter we outline the issues in working towards a measure of the carbon footprint of tourism.

The Australian and Global Footprint

It is important to distinguish between the GGEs, which come about from Australian economic activity and those from global economic activity. Tourism, either to or from other countries, involves economic activity outside Australia and thus GGEs generated outside Australia. A visitor to Australia may create GGEs in Australia but in addition will create emissions elsewhere on part of the trip. The global GGEs will exceed the Australian emissions. If Australia imposes GGE mitigation policies, these may result in higher prices for the Australian tourism product – as a consequence, international tourists may shift to other destinations. This may lead to a reduction in Australian GGEs but globally GGEs could even rise. Tourism is in a sense a ‘footloose’ industry. While the tourism plant may not shift from one country to another, production will, since tourists can choose which countries to visit. Even domestic tourism creates GGEs outside Australia through its use of imports. Thus, it is essential to distinguish between an Australian carbon footprint and a global carbon footprint of tourism.

Both measures are relevant. Clearly, since climate change is a global problem, impacts on climate change are dependent on global emissions, not just the emissions from a particular country. However, the Australian or country-specific footprint is important too, since Australia may have some specific GGE targets or international commitments and it is the Australian footprint, which will determine how tourism impacts on these. In addition, the Australian footprint will be the base on which Australian mitigation policies, such as the ETS, work – the cost imposition on tourism as a result of Australian policies will depend on tourism’s Australian footprint, not its global footprint.

The Meaning of the Carbon Footprint

In this study, we shall speak in terms of a carbon footprint, which is a useful summary term. We do recognise, however, that part of the ‘carbon footprint’ is not strictly carbon related at all. Carbon dioxide is not the only greenhouse gas – nitrogen oxides are also very important and, for some parts of the tourism industry, these are significant. In addition, global warming is not just related to the quantum of greenhouse gases – some carbon dioxide is more damaging than others – how it is produced is what matters. For instance, it is argued that aviation carbon emissions are more damaging than carbon emissions of power stations (see EU 2006; Hodgkinson, Coram & Garner 2007). Thus, in the development of a measure of the carbon footprint, some scaling of emissions from different sources will be needed to obtain a measure, which is reflective of the damage caused. This is quite feasible when using economic models to determine carbon footprints. There may be additional effects, which need to be factored in to obtain a damage measure, such as the contrails of aviation. In this study, when we speak of a carbon footprint this is to be understood as a complete measure of damage, not just a simple measure of carbon dioxide emissions.

Carbon Footprints – Carbon Intensity and Carbon Impacts

There are two types of ‘footprint’ that could be associated with tourism. The first is an intensity measure and the second is an impact measure. In discussions of tourism and climate change policies, it is important that the distinctions be appreciated.

The carbon intensity of tourism is an economic/technical relationship between tourism and carbon GGEs. Tourism is associated with economic activity, which creates GGE. A particular pattern of expenditure, for example, associated with a German backpacker or a Victorian intrastate tourist gives rise to GGEs. The carbon intensity measure includes the direct effects on GGE of the goods and services purchased by tourists as well as
the indirect (production induced) effect. This is to recognise that, to produce an extra unit of output to meet a one dollar increase in final demand, an industry must increase its purchases from other industries and from itself. These additional intermediate inputs sum to what are called ‘the first round effects’ (ABS 1997). Associated with these first round effects are GGE resulting from fuel use. Other industries in turn must increase their purchases of inputs to expand their output in order to meet the first round requirement. Following this will be second, third, and subsequent round requirements of indirect purchases. These indirect purchases sum to what is known as ‘the industrial support effect’. The first round effect can be combined with the industrial support effect to produce the production-induced effect. Clearly, GGE will be associated with all fuel use in production comprising the direct plus ‘production induced’ effect.

However, carbon intensity is not the same as the impact of these types of tourist on GGEs.

The carbon impact of tourism is the overall impact on GGEs that additional tourism will create. This is not the same as the carbon intensity since, to measure the impact, it is necessary to specify what further changes are associated with the increase in tourism. If there is an increase in domestic tourism, there will be less spending by residents on other goods and services – this reduction also has GGE implications. If there is a reduction in foreign inbound tourism, there will be less GGEs directly associated with this tourism. However, there will be other changes taking place – exports will fall, leading to a fall in the exchange rate and the stimulation of more exports of non-tourism goods and services, along with an increase in import competing production. These will create GGEs. The carbon impact is thus the sum of the changes in GGE associated with the direct, indirect (production induced) and interactive effects of a change in final tourism demand. Thus, the effects of a change in tourism on Australian and global GGEs is not given by the carbon intensity of tourism – it is necessary to employ the more comprehensive impact measure. In considering policy questions, such as whether to discourage domestic aviation because of its GGE effects, it is the impacts which are relevant – impacts are the comprehensive measure of how changes alter GGEs.

Carbon intensities can be useful. For example, assume one is interested in how a $20 per tonne carbon tax might affect the price of tourism in Australia. Multiplying the carbon intensity (e.g., measured in tonnes of carbon per person) would provide a first approximation to the change in price. Some estimates on this basis are presented in Chapter 7. It is only a first approximation, however. A carbon tax, if widely applied to industry, would change a number of technologies and prices throughout the economy and the final impact on tourism prices would be different. Such a measure could be a useful, simple approximate measure.

Measuring Carbon Footprints

Tourism is not a major direct producer of GGEs, with the exception of the transport sector. Aviation uses fuel, which directly creates emissions, as does land transport, which uses petrol, diesel and LPG. There is some direct fuel use by other sectors of the industry, such as the use of gas to heat accommodation. Tourism is, however, an indirect producer of GGEs through its purchases of goods and services (shopping items, food and beverage, accommodation services etc.), which use fossil fuels. Tourism uses electricity and it also uses IT services, which indirectly produce GGEs through its purchases of electricity.

To measure the carbon footprint of tourism, whether in terms of intensity or impact, it is necessary to have a model, which links tourism expenditure to economic activity and economic activity to GGEs (in the case of intensity) and, which also can track the effects of other changes that accompany any change in tourism (in the case of impact).

To measure intensity, it is sufficient to use a simple model such as Input-Output (I-O). Alternatively, a more comprehensive model, such as a computable general equilibrium (CGE), could be used – such a model incorporates an input-output structure of the economy. A model, which incorporates impacts of economic activity on GGEs is MMRF Green (Adams, Horridge and Wittwer 2003).

To measure the domestic GGE intensity of tourism, it is necessary to determine the extent to which tourism uses fossil fuels, directly and indirectly. This can be done by determining the production of each good and service directly and indirectly associated with tourism, by using the I-O or CGE model. Once the use of each type of fuel has been determined, the GGEs can be calculated, weighted if necessary (e.g., to pick up the higher damage caused by aviation’s carbon emissions) and summed. Domestic tourism uses, to an extent, imported goods and services. Production of these does not add to Australia’s GGEs, though it does add to global GGEs. Thus an allowance must be made for the carbon intensity of imports if a global, rather than merely Australian carbon intensity, footprint is to be measured.

Measures can be obtained for different types of tourists – all that is needed is information about expenditure patterns. Thus, it would be possible to measure the carbon intensity footprint of backpackers or VFR tourists; visits to Tasmania or Victoria; air-based trips or car-based trips. Granted that Tasmania uses hydro to produce electricity while Victoria uses brown coal, the GGE intensities of visits to different states could differ.

The carbon intensity of international tourism can be measured in a similar way. The main difference is that international tourism involves more economic activity outside Australia. Flights to or from Australia may be
made on a foreign airline, and the GGEs produced may not count as ‘Australian GGEs’. In addition, international visitors purchase goods and services, such as connecting flights or duty free purchases, before and after they visit Australia and these also contribute to non-Australian GGEs. Ideally, the GGEs associated with expenditure outside Australia could be calculated using global economic models. This is perfectly feasible, given the existence of such models, as used, for example by ABARE in its work (ABARE 2006). It may, however, be more practical to use some simple rules of thumb for estimating GGEs based on Australian relationships and intensities. Again, the footprints of different types of visitors, such as British backpackers or German VFR visitors, can be calculated in a straightforward manner.

To estimate carbon impact footprints, it is necessary to use a CGE approach, not the simpler I-O model. To find an impact on GGEs, it is necessary to pick up all of the effects of the change in tourism and associated changes. Consider an increase in domestic tourism – if this is to take place, consumers must be spending less on other goods and services (unless they draw down on their savings, which means less spending later). Lower expenditure on other goods and services will result in lower production of goods and services, directly and indirectly, used and lower GGEs. The net impact of the increase in tourism on GGEs will be smaller than the carbon intensity would suggest but by how much is something, which will only be revealed by the modelling. It is not impossible that an increase in tourism will be associated with a reduction in GGEs.

When there is an increase in international tourism, another set of forces comes into play. Presume an increase in inbound tourism. For an open economy, such as Australia with a floating exchange rate, this will push the exchange rate up and discourage other exports and increase imports – all of which results in less non-tourism production in the Australian economy and greater tourism imports as outbound travel increases. The net impact on Australian GGEs will be smaller than the GGE intensity would suggest. At the global level, the impact on GGEs will depend on what other changes accompanied the rise in tourism to Australia – did they involve less tourism to other countries or less spending on non-tourism goods and services? The changed pattern of global expenditures can be fed into a global model to estimate impacts on global GGEs. Clearly, the Australian and global carbon impact footprints can be very different as a result of these factors.

As with GGE intensity measures, it is possible to make estimates of the footprints of different types of visitors. Thus, the impact of more VFR visitors to Tasmania could be different from the impact of more Japanese honeymooners. As long as models with GGE capabilities exist for the states and territories, impacts in the states can be calculated.

Most policy questions are about impact not just intensity. The following example should illustrate this. Presume a policy to discourage domestic aviation, perhaps by levying a ‘green’ tax on it. There will be less domestic flying but tourists will still spend – perhaps on surface transport, perhaps on overseas trips or perhaps on other (non-tourism) goods and services. To estimate the impact on GGEs of the policy, it is necessary to specify what the discouraged air travellers do and to model the expenditure changes and their impacts. The GGE intensity of air travel may be a very poor indicator of the impact of such policies and the reduction in GGEs much less than hoped for. For policy purposes, it is necessary to use a comprehensive framework, such is possible using a CGE approach.

**Footprints Over Time**

Over time, tourism carbon footprints will change. This is a result of shifting market shares, changing expenditure patterns, and technological and policy changes.

Regardless of policy, new technologies will emerge and they can reduce the GGEs produced by economic activities, such as electricity generation, land transport and aviation. Fuel use by cars and aircraft has been declining for reasons unconnected with climate change considerations. Fuel substitution in cars, such as moves to diesel, LPG and hybrid cars, will affect GGEs associated with transport. Thus carbon footprints will change over time. It is possible to model this by changing the relationship between production, fuel use and emissions that are embedded in a model. Thus the footprint for an international visitor in 2020 could be quite different from that of a visitor now.

Carbon footprints will also change as a result of policy, especially climate change mitigation policy. Policy will make GGEs expensive, not free, as most of them are at present in Australia. This will lead to a shift in technology away from GGE intensive technologies. Thus, brown coal may be replaced by gas in electricity generation and electricity will become less GGE intensive. Production processes will move away from using inputs, such as electricity, whose prices have risen as a result of climate change policy. Consumers will also alter their patterns of expenditure in response to changed price patterns. The carbon footprint of tourism in an economy with a $50 per tonne carbon price will be very different from that of the present economy. These shifts will not take place instantaneously, though in a few years they could be substantial. A CGE model embodies the scope for substitution and estimates how firms will shift inputs and technology as the prices of fuels and other inputs change. Thus, it is possible to use a current CGE model to make an estimate of the carbon footprint of tourism in a $50 per tonne carbon price world.
Estimating Carbon Footprints

Estimating carbon footprints of tourism is essentially an economic modelling task. It involves relating tourism expenditures to the output of industries and then relating these outputs to fuel use. With information about fuel use, impacts on GGEs can be calculated. An I-O model can be used to obtain a first estimate of the GGE intensity of tourism, but it is not a sufficiently comprehensive model to go beyond this. CGE models can be used to determine GGE impacts of changes in tourism and can also model the effects of climate change policy options (such as the imposition of an ETS) and measure the carbon footprint of tourism in the new policy environment. To undertake analyses such as this, the CGE model must incorporate a GGE component relating GGEs to fuel use. Models which do this, such as MMRF Green, are readily available for the Australian economy and global models, such as GTAP, now also have GGE components. The STCRC’s Centre for Tourism Economics and Policy Research is developing a suite of state-based CGE models, incorporating detailed tourism sectors, in which it will be possible to incorporate GGE effects.

This said, there are some complexities which are important for tourism that may not be picked up in the more general GGE capable CGE models, which are available. These models are at a particular level of aggregation, and include industries such as ‘air transport’ – they do not distinguish between domestic and international air transport, nor between air travel on different international routes. They do not pick up air travel to or from Australia on foreign airlines. For many purposes, this does not matter. For example, in estimating the GGE consequences of domestic aviation, it may be sufficient to use such models. However, for estimating the GGE implications of international travel to and from Australia, it is a limitation. Thus, modelling work will need to be augmented by specific analysis of what changes occur in the demand for international air travel and how this impacts on GGEs.

Key Points

- It is important to distinguish between the Australian and a global carbon footprint of tourism, particularly as GGE generation outside Australia is associated with inbound and outbound tourism.
- The carbon intensity footprint of tourism refers to the GGEs directly and indirectly associated with tourism activity.
- The carbon impact footprint of tourism refers to how changes in tourism impact on overall GGEs – this depends on its carbon intensity and also on how other industries are impacted on by changes in tourism.
- Measuring the carbon intensity footprint of tourism requires the use of economic models, which can link economic activity to fuel use and GGEs.
- Measuring the carbon impact footprint of domestic tourism involves using a model to project how changes in domestic, outbound and inbound tourism impact on other industries and ultimately change GGEs in Australia.
- Measuring the carbon impact footprint of international tourism flows involves using a model to project how changes in international tourism affect other export industries and also GGEs outside Australia, e.g. through aviation.
Chapter 4

CLIMATE CHANGE POLICIES AND THEIR IMPACTS ON TOURISM

Climate change mitigation policies are directed towards reducing GGEs. They may do this by inducing less consumption of GGE intensive goods or by encouraging GGE emitters to use less GGE intensive technologies, where available. Such policies can usefully be divided into three types:

1. Mandatory or specific policies, which require consumers or firms to behave in particular ways. An example would be a requirement that electricity suppliers source a minimum proportion of their supply from renewable sources. Another example is the proposed ban on the sale of incandescent light globes.
2. Carbon taxes, which are taxes imposed on the output of GGE intensive goods or taxes imposed on use of carbon-based fuels or on measured production of GGEs.
3. Emissions Trading Schemes (ETS), which set a maximum permissible output of GGEs for a country or region and which create and allocate permits to emit and then allow these permits to be traded amongst firms.

Tourism in Australia is or will be affected by all three types of policies. There are mandatory requirements in place already (such as renewable requirements for electricity suppliers, which affect tourism. In Europe, there are taxes levied on air travel, which purport to be GGE-based (though there is little connection) and these affect the demand to travel to Australia. Carbon taxes might be used in Australia to cover those GGE producing activities, which are difficult to include in an ETS. Finally, the implementation of an ETS has been foreshadowed for Australia. An ETS involves setting a target for the number of permits to be allocated, allocating them amongst conflicting users, and then policing their use, to ensure that firms only generate GGEs to the extent that they have permits. This will be a widely-based scheme, which covers most large firms that directly produce GGEs and which incorporates upstream suppliers of energy to firms not directly included in the ETS so that these are included indirectly. It will affect tourism, both directly (e.g. in aviation) and indirectly (e.g. through the price of inputs, such as electricity). Here we shall concentrate most on the ETS. We shall discuss carbon taxes but focus mainly on the ways that these work differently from an ETS.

Mandatory and Specific Measures

There are several actual or proposed mandatory requirements which have the potential to impact on tourism. The objective of these measures is to reduce GGEs by requiring firms or consumers to change their behaviour – they prohibit behaviour rather than provide incentives to avoid it (as carbon taxes and an ETS would). Some actual or proposed examples are:

- Requirements for a minimum use of renewable energy for electricity supply;
- Bans on the sale of incandescent light globes;
- Reduced emissions standards for motor vehicles;
- Green fleet requirements; and
- Limits on air travel (as proposed in Europe).

Some of these will affect tourism directly – for example, lower vehicle emissions standards, which raise the cost of car-based travel, limits on numbers of flights taken over a period, and bans on incandescent light globes. Others affect tourism indirectly – for example, renewals targets for electricity add to the cost of the electricity that tourism firms buy. These mandatory requirements add to the cost of tourism and subsequent price rises make tourism less attractive for potential tourists. In some cases they make tourism less attractive – for example, a restriction on domestic flights would make a trip to Cairns by a Melbourne family distinctly less attractive, since it would necessitate the use of slow ground transport.

Thus, mandatory requirements serve to make tourism as a product less attractive. They also impact on the substitutes for tourism, such as home entertainment. The Australian tourism product becomes more expensive. This will have a negative impact on Australia’s competitive position in international tourism if other effects, including a decline in the value of the AUD$, do not offset it (these effects could be moderate if other export industries, such as aluminium are also negatively affected and the exports from them also fall). The exact impact on tourism competitiveness is not certain, though its effect is very likely to be negative. The extent of the effect
could be estimated in a modelling study. In the long run, most of the impact is likely to be passed on to the consumers/tourists, though in the short run, during which time firms have little scope to adapt, some of the cost would fall on tourism firms.

The size of the impact on tourism of these mandatory requirements is not likely to be large for those which affect tourism indirectly, such as renewals targets for electricity. Where the effect on tourism could be large is where tourism industries are specifically targeted, such as limits on air travel. A pertinent question is how they might work if other GGE mitigation policies are being implemented at the same time, as is very likely in Australia – this is considered later.

**Carbon Taxes**

The working of carbon taxes is quite straightforward. A tax might be imposed on measured GGE or on the use of fuels which generate GGEs. Thus, a tax might be levied on aviation fuel and the level of the tax is set in relation to the amount of GGEs produced by burning this fuel, so that there is effectively a tax of so much per tonne of GGEs. This tax will induce a reduction in GGEs, partly by inducing users of the fuel to adopt less GGE intensive technologies, possibly using other fuels, and partly by making the product the fuel is used to produce more expensive, inducing a shift away from it. Thus, a tax on aviation fuel induces airlines to switch to more fuel efficient aircraft, and the higher airline costs and airfares induce passengers to travel less by air. Carbon taxes could be used as the primary climate change mitigation policy. Governments, however, prefer to implement the ETSs as the main mitigation policy, though they are also attempting to reduce GGEs by mandatory policies, as discussed previously.

If carbon taxes were imposed, costs in the tourism industry would rise. To some extent, tourism enterprises would pay these taxes directly – for example, airlines would have to pay carbon taxes related to their fuel use. Much of the tourism industry’s carbon emissions are indirect – for example, through the use of electricity. So it would also have to pay carbon taxes indirectly through higher prices for inputs. Overall, cost levels of the industry would rise to an extent dependent on the industry’s carbon intensiveness. This would discourage tourism consumption and it would affect Australia’s competitiveness as a tourism destination.

An important difference between carbon taxes and ETSs lies in their effects on prices and quantities of GGEs. A carbon tax will increase the cost of production by a predetermined amount but its effect on GGEs will be uncertain. If the tax is high enough industries may adapt quickly and reduce their emissions significantly. Alternatively, they may be slow to adapt and the reduction in GGEs may be modest, even in the long run, for a high carbon tax. It will be possible to predict the effect on prices fairly accurately but not the effect on the level of GGEs. By contrast, an ETS has a certain impact on GGEs but an uncertain impact on prices. If a specific target of emissions is set and policed effectively, the impact on GGE levels will be clear cut. A set number of tradable permits will have been issued but it is not clear what the price will be. If industry finds it difficult to reduce their emissions, the price of permits will be high, while if industry can cut emissions easily at relatively low cost, the price of permits will be low.

Another, and very important, difference between the two policy measures lies in their effects on the revenues of industry and government. A carbon tax is, like other taxes, a form of government revenue. The revenue implications of an ETS depend on how permits to generate GGEs are allocated. If all the permits are auctioned, the revenue consequences are similar to those of a tax – the government receives all the revenue. However, the government could allocate some or all of the permits free of charge. The government would not gain any revenue but the firms which obtain the permits could be better off. Prices would be higher and firm profits would most likely by higher as well. There are more uncertainties about how an ETS would work than there are with a tax – for example, would firms try to keep prices down if they received free permits? (This is examined in later chapters).

From the tourism industry’s perspective, the two policies are likely to lead to the same impacts on tourism costs and prices. Except where a tourism sector gains free permits, the industry may be indifferent to which policy is implemented – it will have to pay a higher price for its inputs, such as electricity no matter which policy is implemented. If the government imposes a tax or sells off the permits, it will have much greater revenues than if it gives permits away. It may use the additional funds to lower prices to consumers, who are the definite losers from either policy and, in doing so, it may be able to counteract the inflationary pressures created. It may also be prepared to use some of the funds to assist industries, which have been negatively impacted by climate change itself and by the tax or ETS policy. Thus, the tourism industry may be in a better position to seek some government assistance under a carbon tax or if ETS permits are sold than if permits are given away. While the current intention is that Australia will rely on a comprehensive ETS, carbon taxes might be used in areas in which the ETS is not considered practical.

A carbon tax system is generally thought to be much easier to administer than an ETS. It would involve setting a tax on all fuels according to their GGE effects. Some fuel levies (e.g. on petrol) already exist and are easy to administer. By contrast, an ETS involves setting a target for the number of permits to be allocated,
allocating them amongst conflicting users, and then policing their use to ensure that firms only create GGEs to the extent that they have permits.

The Emissions Trading Scheme

The ETS is likely to be the main climate change mitigation policy adopted in Australia and probably in other regions, such as Europe. The government has announced its intention to introduce an ETS and it has the support of the opposition. While the design of the ETS has yet to be determined, it is likely to follow the recommendations of the Prime Ministerial Task Group on Emissions Trading (2007). An ETS will have major implications for tourism and it poses a number of issues, which will need to be addressed.

The Workings of an ETS

An ETS of the ‘cap and trade’ form involves setting a target (in reality, an allowable maximum) on GGEs for a specific period (say 2012) and issuing permits to create GGEs up to this level. Firms that create GGEs would need a permit to do so or else risk a potentially prohibitive fine. Permits could be issued free to firms, sold at a set price, or auctioned to the highest bidders. In principle, permits could be issued to firms on the basis of their past performance in creating GGEs or on quite different criteria, such as their value added or employment. Permits could even be issued to consumers. Most likely, they will be issued to GGE producing firms and to upstream suppliers of energy to firms not included directly.

A critical aspect is that permits would be tradable amongst firms. Thus, they would have to be issued on a non-industry specific basis and a firm in one industry would be able to sell to a firm in another industry — thus, an airline could buy permits from a power station. There might be different classes of permits, e.g. for carbon and nitrogen oxide emissions. Granted that permits are limited, they would be in demand and would sell for a price, developing a market for them (just as a market for water rights has developed). With a well functioning market, the firms that can reduce GGEs for a lower cost than the permit cost will do so, while other firms, which find GGE reduction costly, will buy permits and not reduce their emissions as much — this would result in achieving a GGE target at minimum cost to the economy.

If a target is set at a level below the amount of GGEs, which would be created under normal circumstances with no constraint, permits will be valuable. If a firm wishes to produce products in a way which creates GGEs, it will need permits to do so. It may have to purchase them in the market or it may be able to use permits, which have been allocated to it free of charge. If it uses free permits, it will suffer a cost in that it passes up the opportunity to sell them at a profit. Thus, a cost is imposed on a firm whenever it generates GGEs and it will seek to pass these costs onto its customers. Subject to the extent of pass through, an ETS will have a similar effect on prices to a carbon tax. The difference is that an ETS is like a tax, which is returned all or in part to the firm.

One emerging issue concerns the extent of the pass through. If a firm faces a carbon tax of $10 per unit on a product or needs to use permits valued at $10 to produce the product, will it be able to pass on the full $10 to its customers? This is a particular issue for aviation—see following discussion. When a firm faces a tax or a permit cost, its competitors will be in the same position if they use a similar technology. New competitors entering the market will need to purchase permits from a power station to enter the market. Thus, in the long run, it should be possible for firms to pass on the tax or permit price more or less in full (this was the case when the GST was implemented in Australia). In the short run, some firms may have difficulties in passing on all of the cost of the tax or permit. They may have considerable sunk expenditure in assets, which cannot be altered or reduced in the short term and they could face a fall in profits (if taxed or if given permits at a concessional rate). While most of the burden of the tax or ETS will be borne by consumers (or tourists), firms will face some costs, particularly in the short term.

Thus, an important feature of an ETS is that firms may be given permits free of charge. This will lead in most, though not all, cases to an increase in profits. Since permits are valuable and potential competitors will need to buy them if they are to enter the market, prices of products whose production requires permits will rise and firms will be able to gain higher profits if they have been allocated the permits free of charge. This is like a situation where the government levies a tax, which raises prices of the product and then hands back the proceeds to the firms but product prices stay higher. Granted that the value of the permits issued in Australia is likely to be very high—perhaps worth tens of billions of dollars—this would lead to a very large increase in the profitability of some firms.

There is an issue of whether some firms, if they are allocated free permits, may decide not to increase prices to the same extent as they would if they had been levied an equivalent carbon tax. Firms which seek to maximise shareholder value will introduce the full price increase. However, some firms may be more oriented to market share and may use the opportunity to keep prices low and expand their market share. This is a distinct possibility for international airlines, several of which are still publicly owned—see the discussion following. If many firms
in the economy did this, the ETS would still work because it sets an absolute maximum on the allowable emissions but the price of a permit would rise. The pattern of GGE reduction would be different from that under which all firms maximise shareholder value or from that under an equivalent carbon tax and, to a degree, the pattern of GGE reduction would be less efficient. Firms will have to pass on as much as they can of a tax increase but they will have discretion over price increases if they are allocated free permits. To this extent, a carbon tax would be more efficient than an ETS.

The allocation of permits poses several issues. If permits are to be fully or partly given away, the allocation system should not be one which gives an incentive to firms to increase GGEs now in order to qualify for more permits later. It is possible to design schemes which get around this problem (see Morrell 2006; Scheelhaase & Grimme 2007; CE Delft 2007a and 2007b). The other issue concerns pricing – should permits be given away free, sold at a concessional rate, or auctioned?

If permits are free or sold at a concessional price, the firms which receive them will experience profit increases. The prices of their products will rise and other industries will have to pay more for these products if they use them as inputs. Ultimately, directly or indirectly, prices to consumers and tourists will rise. There will be a significant revenue shift from consumers and tourists to firms which gain the permits. The CPI will rise and this could lead to inflationary pressure as the labour force seeks to compensate itself for the price rises. Unlike the situation with the GST, the government will not be in a position to compensate, since the revenue will be going to the firms. While most consumers/voters currently support the idea of an ETS, few may envisage that they will be paying for it. If the government sells permits, it will have revenues from which to compensate consumers for the price rises they face. For these reasons, the issue of the price of permits is likely to become an important issue. It will be a particularly important one for the tourism industry for reasons discussed following.

Most firms in the Australian economy will not be part of the ETS as foreshadowed. Because of the administrative difficulties, it is intended to include only the largest GGE emitters in the scheme. Producers and consumers who are creating GGEs through the use of fuels and who are not within the ETS, will still be faced with a price for doing so. Upstream suppliers of fuels will need to have emissions permits for the fuels they supply to firms not within the ETS. Thus a coach operator will pay for GGE permits through its fuel price and consumers who use their cars will also pay higher prices for fuel. In addition, mandatory standards, such as on the fuel efficiency of cars, will be imposed which also have the effect of increasing costs to the user.

The ETS and Tourism

As planned, the Australian ETS is likely to incorporate only a small number of large firms. This means that most firms in the tourism industry will remain outside of it. Major airlines are likely to be included and it is possible that some large chains, such as hotel chains, might be included.

For the most part, aviation and ground transport excluded, tourism is mainly an indirect producer of GGEs. Tourism uses electricity, aluminium, steel and food, and in doing so contributes indirectly to GGEs. Tourism firms do produce some GGEs directly – for example, hotels may use gas or fuel oil in central heating. Quite likely the main impact on tourism (apart from the impacts on tourism generally of aviation related measures) would be through its indirect use of products which generate GGEs.

The upshot of this is that the cost base of the tourism industry will rise as the result of the implementation of an ETS. In addition, the cost base of other industries that are substitutes for tourism will be increased. Granted the difficulties of passing on in full, the whole of the higher cost, it is probable that in the short run at least the profitability of the tourism industry will suffer.

Major airlines, however, can gain from the free or concessional allocation of emissions permits in which they will share. The aviation sector is the one part of the tourism industry, which may gain from the implementation of an ETS.

Impacts on Tourism of Climate Change Policies

Domestic tourism

The effects on domestic tourism are quite straightforward, though their measurement does pose some problems. The price of domestic tourism will rise, as tourism firms pass on their higher costs and as the costs of travel increase. Probably the most significant price increases will occur in travel – car travel will become more expensive and airfares will rise. The impact on prices depends partly on the GGE intensity of tourism (its carbon intensity footprint). It also depends on how other industries respond to the implementation of the ETS. For example, there is likely to be some switching away from brown coal in the electricity sector, which could moderate the impact of the ETS on electricity prices and ultimately, tourism prices.
The implementation of a climate change mitigation policy will affect the whole economy – it will not be a carbon tax on the tourism industry exclusively. Thus, to estimate the impact of such policies, it will be necessary to use a general model, such as a CGE model. With such a model, it will be possible to estimate how an ETS with a specific target or a carbon tax set at a specific level will impact on tourism prices. It will also be possible to determine how substitutes for tourism are affected by such policies. At this stage it is not possible to know if tourism will be relatively heavily impacted or not. The relatively high reliance on sectors, which will be affected significantly, such as ground transport and aviation, suggests that it could be relatively heavily affected, though this needs to be determined by the modelling.

**Inbound tourism**

International aviation is considerably more complex. Both the price of an international inbound trip and the airfare to Australia will rise. Airfares for outbound trips will rise, though the ground component price, the non-airfare related costs of the travel, will not change if other countries do not implement similar climate change policies. However, the costs of all Australian exports and import competing industries will rise due to the policy. For example, aluminium industry costs will rise and this will make Australian aluminium less competitive on international markets. This will lead to pressure on the exchange rate, which will fall. This will counteract the effect of the rising ground component cost. Determining the outcome of these processes will be a task for modelling.

As noted, international airfares will increase. The impact will depend very much from market to market and the importance of airfares in trip costs. Thus, the impact on United Kingdom travel to Australia could be much greater than the impact on New Zealand travel. However, there could also be some impact on trip duration with more distant visitors opting for fewer, longer trips. In analysing these effects of climate change policies, it is probably best to analyse major markets separately.

Impacts on Australian tourism will also depend on what is going on elsewhere in terms of climate change policies. The impacts if Australia is the only country implementing such policies will be more severe than if all other countries are also implementing them, since this would mean that Australia’s competitiveness as a destination would be less negatively affected. The most realistic scenario, for modelling purposes, may be one in which some major groups of countries (e.g. Europe) act strongly, while others (e.g. the United States and China) do not. Another sensitive area will be how international aviation is handled. Climate change policies pose specific difficulties for international aviation, which is not controlled by any one country. These are considered in more detail in Chapter 6.

**Outbound tourism**

One thing that is likely is that if Australia and a minority of other countries (e.g. including Europe) take strong action on climate change, the negative impact on inbound tourism will be significantly greater than the negative impact on outbound tourism. A negative impact on outbound tourism would be positive for the ground component of the Australian tourism industry (as Australians make more trips in Australia), but negative for the international aviation sector. Inbound tourism is likely to fall due mainly to higher airfares and possibly to a rise in ground component costs (partly offset by a fall in the exchange rate). Outbound tourism will face higher airfares, higher ground component costs of staying at home, and higher costs of overseas trips due to a slightly higher exchange rate. However, with the rise in airfares, all outbound destinations from Australia will be similarly affected. For inbound travel, on the other hand, airfares will rise to Australia and other countries implementing climate change policies but will not rise to other destinations. For a United States beach holidaymaker, a trip to Australia or Spain will become more expensive but a trip to Thailand or Bali will not. Thus, there will be a substitution away from Australia to its competitors. The effect of higher international airfares to and from Australia will be to decrease the net demand for the Australian tourism industry.

**The ETS and Specific Measures – Do They Conflict?**

It would be possible for an ETS to be implemented but for additional measures also to be imposed to target specific industries. An ETS and mandatory requirements (or taxes) can be imposed simultaneously. If this happens, the mandatory requirements will be completely ineffective if the area of activity they are applied to is also covered by the ETS (as is usually the case). Such mandatory requirements are costly but they do not have any affect whatsoever in reducing GGEs.

This comes about because the ETS effectively overrides the mandatory requirements. Under an effective and comprehensive ETS, GGEs are fixed. The imposition of a mandatory requirement (such as a limit on air travel or motor vehicle emissions standards) will have the effect of reducing GGEs created directly and indirectly by the
area on which the requirement is imposed. This will reduce the demand for emissions permits. However, the total amount of the permits and allowed GGEs is unchanged. The price of permits will fall and other industries will buy them expanding their GGEs. Increases in GGEs in other industries will exactly offset the reduction in GGEs of the targeted industry. The mandatory requirement imposes a cost but has no impact on GGEs. This issue is discussed in Chapter 6. The Prime Ministerial Task Group (2007:136-7) argued that mandatory restrictions should be removed when the ETS comes into operation. It was not very specific about why it recommended doing so but this was consistent with its preference for general measures to minimise the cost of meeting GGE targets. The ineffectiveness of such mandatory measures is a compelling reason for dropping them, however.

The issue of the interaction of the ETS and mandatory requirements is not a trivial one for tourism in Australia. Australia is likely to have an ETS. Nonetheless there are calls for specific mandated requirements or taxes to be applied to tourism industries, particularly aviation. Such calls are very strong in Europe and the calls in Australia may get stronger. Governments may seek popular approval by implementing them. Measures of this kind will raise the cost of tourism in Australia, make it less attractive, and make the industry less competitive internationally. If these policies worked, they could be worth considering. However, with an effective ETS, they are both costly and futile.

The Footloose Industry Problem

It is recognised that the ETS might pose problems for ‘footloose’ export industries. Incorporation in the ETS would raise their costs and they would lose international competitiveness – this could lead them to shift offshore. While this would result in a reduction in Australian GGEs, it need not result in any reduction in global GGEs, particularly of industries shifted to countries, which do not implement climate change policies and which have lower emissions standards than Australia.

Both the Productivity Commission (2007) and the Prime Ministerial Task Group (2007) have noted this problem and suggested that special arrangements might need to be made. The Task Group does not support leaving these industries out of the ETS, though it recommends transitional arrangements be made for these industries. These would include allocating free permits for direct as well as indirect GGEs created by these industries.

Tourism is very much a footloose export industry. If the cost of a visit to Australia rises, some tourists will shift their trips elsewhere. There is no need for the industry to shift plant and equipment, as would be the case with other industries such as aluminium. Rather, the tourists simply change their travel plans – something that can be done very quickly. The tourists will switch to other destinations, at least some of which are not implementing climate change mitigation policies. While Australia may be reducing its GGEs, global GGEs may not fall, though Australia will be incurring a cost through loss of benefits from tourism.

Thus, in principle, tourism should count as a footloose export industry for which special arrangements are in order. The difficulty is that tourism does not fit at all well into the proposed arrangements. Most tourism firms will not be part of the ETS. They will pay higher costs as a result of the ETS but they will not get permits. Airlines are part of the ETS and the transitional arrangements could apply to them. International airfares will be the component of the cost of a trip to Australia, which will be most affected by climate change policies (see Chapter 7). Australian international airlines could gain from permits being allocated to them based on their indirect GGEs (foreign international airlines would not be much affected by the ETS), however, it is unlikely that the saving in costs would be very large – the main increase in costs will come because of the airlines’ direct GGEs.

The impact of the ETS through loss of competitiveness could be lessened, though not eliminated, by leaving international aviation out of the ETS. This would impose higher costs on other industries within the ETS, though it would also result in larger tourism benefits to Australia. Australian GGEs would be no higher than if aviation were included in the ETS but GGEs elsewhere would be higher. Thus, there are costs and benefits from leaving aviation outside the ETS. This is a complex issue which warrants further research.

Key Points

- Tourism will be affected by the three main climate change mitigation policies – mandatory restrictions, carbon taxes, if used, and the ETS, all of which will increase the cost base of tourism firms.
- The ETS will include major direct emitters of GGEs and also indirectly, smaller firms not included although there is likely to be a requirement that suppliers of energy to them have emissions permits.
- Carbon taxes mean more revenue for the government than the ETS, if permits are given away or sold at a concessional price.
• Few tourism firms other than airlines are likely to participate directly in the ETS. Thus they will not gain from free permits, though they will face input cost increases, depending on the extent of pass through of taxes and permit values.

• The cost base of domestic tourism will increase—modelling is needed to determine by how much.

• Impacts of the ETS on international tourism are more complex. They will depend on how international aviation is handled, and on how other export industries are affected. Again, modelling is required to determine how costs will be affected and what the impact on the international competitiveness of the Australian tourism industry will be.

• When an effective and comprehensive ETS is in place, mandatory requirements or taxes imposed on specific industries such as aviation will be ineffective in reducing GGES.

• Tourism is a footloose export industry and tourism will shift offshore to an extent under the ETS. The special arrangements, which have been proposed for such industries do not cover tourism very well and the costs and benefits of alternative arrangements, which might involve leaving international aviation out of the ETS need to be evaluated.
Chapter 5

CLIMATE CHANGE POLICIES AND LAND TRANSPORT

Land transport is a major form of transport for domestic tourists in Australia but also to some extent for international visitors. Of the different forms of transport, motor vehicles are extensively used, particularly for domestic transport. As transport accounts for about 14% of Australian GGEs, it is likely to be explicitly included in any climate change mitigation policies, probably by emissions permits being required by upstream producers for supply of fuels, combined with emissions and fuel efficiency standards.

The impacts of transport directed policies on the costs of tourism are not likely to be large, even for car travel. The average domestic tourist spends $27.2 on motor fuel, primarily petrol, per trip and the average international tourist spends $54.7 (ABS TSA 2005-06). This would equate to about 24 litres and 48 litres respectively per tourist trip with a fuel price of $1.15 per litre. Working with a figure of 3.85 kg of carbon emissions per litre (derived from BTRE), this comes to an average of 91.9 kg per domestic trip and 183.8 kg per international trip. Carbon prices of $20 and $50 per tonne, which cover the range of likely prices are allowed for. At a carbon price of $20 per tonne, this adds $1.82 to the total cost of a domestic trip of $396.5 and $3.64 to an international trip cost of $3742.8 (TSA 2005-06). At a high carbon price of $50 per tonne, this adds $4.60 to a domestic trip cost and $9.20 to an international trip cost.

Tourists also use other forms of ground transport, such as coaches and trains. Estimates of expenditure on these are not available – expenditures are not likely to be large for domestic tourism, which is heavily oriented to motor vehicle use and probably only modest for international tourism. In addition, other forms of land travel are reputed to be less carbon intensive than the car. Thus, all up, the impacts of carbon prices on the prices of other forms of non car land transport are not likely to be very large.

Higher carbon prices are expected to about double the price of electricity but they will add only about 10-20% to the price of petrol. In addition, even the relatively motor vehicle oriented domestic tourists spend less than 10% of their trip budget on fuel. While the impact of land transport related climate change policies might, a priori, be thought to be potentially severe, in reality it turns out to be quite modest.

Key Point

- Climate change mitigation policies will impact on ground transport, though preliminary estimates suggest that the direct impact will not be large.
Chapter 6

CLIMATE CHANGE POLICIES AND AVIATION

Background

There has been considerable discussion of the role of aviation in producing GGEs. It is not necessary to go into detail here. The points that emerge include:

- Aviation only accounts for a small proportion of total carbon emissions, around 2% (Economist 2006; IATA 2006a; Sentance 2007). There are good reasons to believe that the damage from aviation carbon emissions is considerably greater than the carbon emissions from other sources (EU 2006; Hodgkinson et al. 2007). Aviation also produces non-carbon emissions, which are of concern (in particular nitrogen oxides) and condensation trails from aircraft are also considered to contribute to global warming. Thus aviation might account for 5-6% of damage from global warming.

- Air travel is growing faster than other transport modes and thus its contribution to GGE is growing. This is especially so for the Asia Pacific and Middle East regions. As a result it is expected to account for an increasing proportion of GGEs.

- The emissions per passenger are high. While the emissions per passenger kilometre are low, passengers typically travel longer distances than on other modes. The estimated unadjusted carbon emissions from a return passenger flight from Melbourne to Sydney is 0.16 tonnes and for a Melbourne London flight is 3.82 (British Airways carbon calculator).

- Over time, aircraft technology is improving and fuel use and emissions per passenger kilometre are falling. The lower fuel use leads to lower airfares and thus encourages more travel. Aircraft technology for the next decade or so can be forecast fairly accurately and there is limited scope for adoption of technologies, which produce significantly lower emissions in the short term. In addition, it takes airlines considerable time to change their fleets, since the average aircraft age is over fifteen years. Thus, even with new technologies it will take time for GGEs per passenger kilometre to fall significantly. Given that airlines are locked into their technologies, it will not be possible for them to alter technologies quickly if climate change mitigation policies, such as an ETS or carbon taxes are introduced. Individual airlines will be able to buy newer aircraft and thus reduce their own carbon footprint but the aircraft they sell will still be flying somewhere else. Thus, airlines will not be able to reduce their costs by very much in response to mitigation policies by switching technologies, in the ways that other industries, such as electricity can.

- To a significant extent then, the aviation industry is locked into existing and future technologies, which determine how much GGEs it produces. Existing aircraft cannot be adapted to produce significantly less GGEs. The GGEs from future aircraft are pretty much determined by the technologies they embody. There has been a gradual reduction in fuel use and GGE per passenger kilometre, as aircraft technologies have improved. New aircraft, such as the Airbus A380 and the Boeing 787 will use less fuel and produce less GGEs per passenger kilometre than existing aircraft. However, the world aircraft fleet and the Australian aircraft fleet will take time to adjust – older technology aircraft will take time to replace (for projections of emissions from Australian aviation, see BTRE 2002b).

- Operational arrangements and particularly air space and airport congestion do contribute significantly to the level of aviation related GGEs (Economist 2006), and less air space congestion would help considerably in reducing emissions. This is of particular relevance to the United States and Europe. For Australia, there is some limited scope to lessen GGEs, though improved flight paths or less running of engines on the ground.

- Aviation’s contribution to GGEs has now become a controversial political issue, especially in Europe. The European Commission is proposing to include aviation in its ETS but there are many calls for more dramatic action. The European Parliament is taking a stronger stand on the issue than the European Commission and some environmental groups are strident in their calls for aviation specific restrictions and consumer boycotts of air travel. Airlines are now recognising that they have a problem and they are concerned that passengers may reduce their travel or switch to surface modes. An increasing number of airlines are introducing carbon offset schemes, whereby passengers are able to calculate the carbon emissions for their flight and pay extra to have these offset, for example, in a tree planting scheme. British Airways has had such a scheme for some time. More recently, Qantas and Virgin Blue have also introduced carbon offset schemes.
The ETS and Aviation in Australia

The full details of the ETS that Australia is adopting are yet to emerge but it is likely that at least the major airlines will be included in the scheme. The ETS can be expected to cover domestic aviation and probably also international aviation to and from Australia, subject to the resolution of implementation problems (discussed following). The ETS is not likely to include the smaller airlines directly and supply of fuel to airlines, which are not part of the ETS will require permits to be used by the suppliers.

The implementation of an ETS will increase the cost base of the airlines and they will seek to pass the higher costs through. If the ETS involves free or concessional allocation of permits, airline profits could well increase, as they increase their fares but receive free permits. There could be some limits to the ability of airlines to pass on these higher costs, particularly in the short run – these are considered following. The extent of pass through will have significant implications for the size of consumer responses to climate change mitigation policies and for airline profitability. There is a particular issue for responses under an ETS with free allocation of permits – will airlines increase their fares and increase their profits or not?

Climate Change and Aviation – Policies in Other Countries

Much of the action in terms of moving towards implementation of GGE reduction policies in aviation has been taking place in Europe. International developments are of relevance to Australia, not least in that they will affect the cost of international flights to and from Australia.

Some countries have begun to impose charges on aviation, which are claimed to be justified as GGE reduction policies. In the United Kingdom, the air passenger duty was doubled and this action was justified by the government as being a GGE reduction policy. These taxes will now account for about 4.4% of the average short haul economy return fare and about 3.8% of the long haul economy return fare (IATA 2006b). Taxes on aviation will reduce air travel and thus they will have some impact on GGEs. However, the link between the two is somewhat strained. Passenger taxes will not give airlines an incentive to reduce GGEs per passenger kilometre, since they are not related to GGEs or proxies for GGEs, such as fuel burn. This tax can probably be better regarded as a revenue levy rather than a targeted GGE reduction policy (For discussion of other carbon tax experiments, see BTRE 2002a).

Of much greater significance is the European Union’s (EU) proposed inclusion of aviation in its ETS. By 2011, all intra EU flights are to be included and by 2012 all flights arriving and departing at EU airports will be included (EU 2006; Thompson 2007). The intention is to include aviation in a broad system of emissions trading rather than to have an aviation only scheme. Airlines will be able to buy permits from other industries if they exceed their allocation. The likelihood is that a significant proportion of the permits will be allocated free of charge to the airlines on a grandfathered or benchmarked basis, though a proportion of permits could be auctioned. Initially carbon emissions only are to be targeted, though in future other emissions, such as NOx could be, either directly or by application of a multiplier to carbon emissions. The EU considers that airlines would be able to pass on the cost to their passengers of any carbon permits they need to buy (though this has been challenged: see Ernst and Young/York Aviation 2007; CE Delft 2007a for discussion).

The EU scheme is still evolving and its final form has yet to emerge. It is claimed to be likely to make a substantial reduction in GGEs by 2020. If it is to do this, it will need to have a substantial impact on airfares, particularly airfares on long haul routes, such as those to Australia. It is not clear as yet how the EU scheme will interact with schemes, which its international partner countries implement for aviation and how double taxation will be avoided. The US is critical of Europe’s unilateral action in proposing the imposition of an ETS for international flights.

Reducing GGEs is also on the agenda of the International Civil Aviation Organization (ICAO), which was given the task of developing a policy framework for international aviation at the time of the Kyoto conference (which excluded international aviation from targets). It has been difficult for the different countries to make substantial progress on how to incorporate international aviation (a further conference is scheduled for September 2007), partly because of their diverging interests and partly because of their attitudes towards climate change policies. If ICAO succeeds in advancing the issue, it will not be implementing a policy itself – rather, it may produce a set of recommendations on how international aviation can be incorporated within a country’s chosen policy, for example, Australia’s ETS. Thus it might make recommendations of how permits could be distributed to international airlines and on what basis emissions are to be controlled (for inbound flights, outbound flights or both?).
The Pass Through Issue: Impacts on Airfares, Travel Demand and Airline Profits

How airfares, travel demand and airline profits are affected by carbon taxes or tradeable permits is considered in detail in the Appendix. This section provides a brief summary of these effects.

The impacts on airfares, demand and profits depend on supply and demand conditions (Frontier Economics 2006):

- Whether airline route markets are highly competitive, oligopolistic or monopolistic;
- Whether the routes make use of slot constrained airports; and
- Whether airlines maximise profits or allow prices to be set at average cost.

The following effects will come about:

- The effects of a carbon tax or a carbon permit, issued free to the airlines, set at the same level, will be the same on airfares and travel demand, if airlines are maximising shareholder value. If airlines are not maximising shareholder value, free permits will result in a smaller rise in airfares and smaller fall in air travel demand.
- If the airline market is a competitive one, the carbon tax will be passed on in full to passengers for both a carbon tax and a permit in the long run, though not necessarily in the short run. The airlines will not lose under the carbon tax in the long run and will gain a substantial increase in profit under the free allocation of permits, even if they need to buy some permits (see Stern 2006, on profit implications of permits).
- If the market is a less competitive one, for example, an oligopolistic one, the cost will not be passed on in full to the passengers, and the reduction in travel demand will be moderated in the short run. Airlines will bear some of the cost of the carbon tax. Under a free allocation of permits, they may gain or lose. In the long run, some airlines will exit less profitable routes, and this will enable airlines to raise fares higher and achieve a higher level of pass through.

When flights on a route use a slot constrained airport, for which other airports cannot be used as alternatives, airfares will be set so as to ration demand to the available airport capacity. If all airlines pay the same permit cost, airfares will not change and all of the cost increase will be paid by the airlines (slot values fall by the amount of the tax). If airlines are granted free permits, airfares will be unchanged and airline profits will be unchanged. Travel demand will not be reduced. When airlines are not maximising shareholder value (for example, they are maximising market share), they may seek to recover only the additional cash costs they face from their passengers. When a carbon tax or permit cost is levied on them they will seek to recover it in full as long as this does not have an adverse impact on their market share. If carbon permits are allocated free, airlines will only put fares up to cover the cost of additional permits they need to buy in the market. The rise in airfares will be less than the rise in the value of the permits and the impact on travel demand will be less. Overall, there is likely to be less than full pass through of the carbon tax or the value of the permit in the short term – the only case in which pass through is complete is where airlines are competitive and airport capacity is not constrained. With a tax, airlines will lose profits except in the competitive case. Airlines will gain in several situations where permits are issued free to them. They will gain most in competitive markets. In the longer term, pass through is likely to be more complete, though it may not be complete in all markets, particularly those which face capacity constraints, such as those using slot controlled airports.

Impacts on travel demand, with consequent effects on GGE will be moderated by the likelihood that the full tax or permit value will not be passed on to passengers in the short run. Impacts on demand will be quite small if airlines practise average cost pricing when allocated free permits.

Impacts on Australian Airfares and Airlines

In this section we summarise how Australian domestic and international airfares will be affected by GGE mitigation policies such as the ETS, backed up with carbon taxes for the smaller airlines. It will be taken that a tax per tonne of greenhouse gas is levied on all airlines at the same rate, or that all airlines are subjected to the same permit trading scheme. Foreign airlines flying to Australia will be treated in the same way as Australian owned airlines.

Domestic impacts

Impacts will depend on how competitive Australian domestic routes are. There are no routes which are constrained by airport capacity (though in the longer term, routes into and out of Sydney may be constrained by the availability of slots). A number of routes are quite competitive. For these, carbon taxes will be passed on to
Scoping study of the economic aspects

passengers and the airlines will not be adversely affected to any major extent. Airlines may lose some traffic to other modes of transport, though the costs of these will also have risen, so that this effect is not likely to be large. If carbon permits are allocated free of charge to domestic airlines, as long as they are not practising average cost pricing, airfares will still rise and the airlines will gain a very substantial profit boost.

In the less competitive routes, prices will be partly passed on to passengers. Airlines will suffer a profit reduction in the short run, though in the long run they will exit unprofitable routes making it easier for remaining airlines to recover their profits. If they are given permits, there will still be a rise in airfares.

Overall, in the Australian domestic market, the airlines will suffer some loss of profits where carbon taxes are levied in the short run, though probably not in the long run. They are likely to enjoy a gain in profits if permits are distributed at no charge to them.

**International impacts**

If carbon taxes are imposed in long haul international markets which are quite competitive (e.g. Australia – South East Asia), they will be mostly passed on to passengers. Airlines will not lose profits. If a carbon permit scheme is in place, they will experience a significant gain in profitability.

In less competitive markets (Australia – US or Japan) airfares will rise by less than the carbon tax and airlines will suffer a reduction in profits in the short run. If carbon permits are distributed free, the airlines may gain a little or could lose a little, depending on the extent of pass through and airline strategies.

In those markets, which make use of scarce airport slots (flights from Australia to London Heathrow, Frankfurt and Tokyo Narita) airfares may rise, though by well short of the carbon taxes. If the airlines gain free permits, they will not lose profits and may gain a little, at least in the short run.

As with domestic flights, airlines will lose profits if carbon taxes are levied. Given the presence of slot constrained airports and several less competitive routes, the effects on airline profits could be more negative. On balance the airlines will gain if given free permits. Impacts on travel demand and GGEs will be smaller than if the carbon tax/value of a carbon permit were fully passed on to passengers. In the long run the pass through will be greater but the airlines will need to purchase more permits to accommodate growth.

In determining the impacts on travel to and from Australia, it is necessary to specify what is happening to airfares in other parts of the world and especially to competitive destinations. If all international airlines are similarly subjected to carbon taxes or permit schemes, all airfares will be affected similarly. The impact on demand to Australia will be significantly less than if other air routes are not subjected to GGE mitigation policies.

**Assessing Impacts of Climate Change Policies on Aviation and Tourism**

**Impacts on airfares**

The impact of climate change policies on airfares will depend on the direct production of GGEs by flights, along with the indirect effects on GGEs via airline purchases of goods and services.

It is possible to obtain a rough idea of the direct impact of the policies on fares. Various estimates of the GGEs produced by flights now exist – in this case we use the readily available British Airways calculator (www.ba.com). As Table 2 shows, a return flight from Melbourne to Sydney produces 0.16 tonnes of emissions, while a return flight from Melbourne to London produces 3.82 tonnes. The addition to fares of a $20 per tonne and $50 per tonne carbon price are calculated assuming full pass through. As it is argued that the damage to the environment of carbon and nitrogen oxide emission is two to three times the basic carbon emissions, in the second part of the Table estimates are provided of the addition to fares if the carbon emission estimates are scaled up by 2.5.

**Table 2: Impacts on Airfares of Carbon Prices**

<table>
<thead>
<tr>
<th>Flight</th>
<th>Melbourne-Sydney</th>
<th>Melbourne-London</th>
<th>Melbourne-Sydney (scaled up 2.5 times)</th>
<th>Melbourne-London (scaled up by 2.5 times)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tonnes of emissions (equivalent)</td>
<td>0.16</td>
<td>3.82</td>
<td>0.4</td>
<td>9.55</td>
</tr>
<tr>
<td>$20 Carbon Price</td>
<td>$3.2</td>
<td>$76.4</td>
<td>$8.0</td>
<td>$190.0</td>
</tr>
<tr>
<td>$50 Carbon price</td>
<td>$8.0</td>
<td>$190.0</td>
<td>$20.0</td>
<td>$475.0</td>
</tr>
</tbody>
</table>

*Source: British Airways carbon calculator and own calculations*
As this Table indicates, inclusion of aviation in an ETS will have some impact on airfares. A $20 per tonne carbon price will not have a large impact on a short haul flight, which would cost around $300 even under the high damage scenario. The impact will be more significant on a long haul flight. The impact of the $20 per tonne carbon price is much the same as the current carbon offset amount – this can be compared to the airfare of around $2000. The impact is more significant under the high damage scenario – nearly 10% of the airfare. With a high carbon price of $50 the addition to the airfare rises to $475, almost a 25% increase in the base airfare.

It needs to be stressed that these estimates only include the direct effects of the permit or tax system on fuel. If a general ETS is implemented in Australia, the cost of all the goods and services purchased by an airline other than fuel and labour will also rise – these total around 40% of airline costs and would add to the airfare increase. The impact of the ETS on these would have to be estimated using a modelling approach.

To estimate the impacts of the ETS on international tourism to and from Australia, via its effects on airfares, it is first necessary to determine the impacts on airfares. As discussed previously, this involves estimating direct and indirect effects. As noted earlier, it would be desirable to estimate effects on airfares on a market by market basis, since the significance of airfares differs from market to market. With information about airfares for major markets, it would be possible to make estimates about the impacts on tourism and tourism expenditure flows and thus the impact on the Australian tourism industry. Finally, using a modelling approach, it would be possible to simulate the impact on the Australian economy of climate change policies to aviation.

**Aviation – A Special Case?**

The implementation of an ETS, which includes aviation is very likely to give rise to a situation under which the response measured in terms of the reduction in GGEs in aviation will be smaller than for other industries. The strong demand for air travel, combined with the limited ability of airlines to switch to less GGE intensive technologies, will mean that the introduction of the ETS only has a small impact on aviation related GGEs initially and as a result, GGEs from aviation will continue to grow.

Partly for this reason transport and particularly aviation have often been suggested as a ‘special case’, in that special measures are warranted to target their emissions – for example, see suggestions by Macintosh and Downie (2007) for a special tax on aviation passengers, along with arguments that air travel will have to be stabilised or reduced. Thus, already in the UK there are taxes on air passengers, which purport to be targeting GGEs and there are suggestions for banning or limiting short haul flights or restricting the number of flights individuals can take. Aviation bodies are very concerned that that there are now strong pressures for measures to be taken to restrict aviation.

Aviation targeted special measures would be a very costly and possibly a counterproductive means of addressing the problem of climate change. Once appropriate targets for GGE reductions have been set, it makes good sense to seek to achieve these at minimum cost to the economy as a whole and to the environment. Measures directed to aviation (or for any other sector) will not achieve this. It is a standard proposition of economics that the costs of adaptation to a change are minimised if the burden of adaptation is spread as widely as possible (see Productivity Commission 2007). This means that all activities, which lead to GGE should be treated equally – all should be charged the same per unit of damage created. Some activities can be adapted more easily and cheaply than others and it makes good sense that these will be relied upon more heavily than others, which cannot adapt easily. Thus, with an ETS, permits should be required at the same rate for all GGE producing activities. The impacts on the costs of final goods will differ – some, which cannot adapt by much, will experience higher price rises than others that can adjust easily. Thus, in the long term, if fuel intensities are comparable, the price of aviation services would rise by a greater percentage than the price of electricity but the contribution of electricity to GGE damage reduction would be greater than that of aviation. This will be consistent with GGE reduction objectives at whatever level they are set being met at minimum cost.

For these reasons, economists normally strongly advocate general measures, such as broadly based carbon taxes or emissions trading schemes, rather than narrow measures, such as bans on incandescent light bulbs or mandated use of specific sources of power. It is also a general rule that it is better to target measures as closely to the source of the externality problem as possible. Thus, it is preferable to link permits to fuel use or GGEs, rather than relate them to passenger traffic. The more direct the tax, the greater the incentive to choose technologies which lessen GGEs. The various measures of the costs to economies of achieving GGE reduction targets, as produced in the Stern Review (2006), assume reliance on general instruments such as these. GGE reductions can be achieved by other, industry specific means but at a higher cost. The recent Eddington Report on UK transport also recommends that transport face the full environmental costs it generates – this would include an allowance for the cost of GGEs produced by aviation (Eddington 2006:30). Thus, however demanding GGE reduction targets are they can most effectively be met by general measures. It is neither important nor desirable that the proportional reduction of GGEs be the same for all industries. There is a strong economic argument for including aviation within a broadly based tax or permit system and not imposing different or additional measures on the industry (Sentance 2007; Thompson 2007).
Scoping study of the economic aspects

In fact, the case against special measures for aviation is stronger than this general argument implies. There are sound reasons for believing that, in the context of an effective ETS, special measures directed against aviation (or any other industry included in the ETS) would be, at best, ineffective.

These reasons have been canvassed earlier in this report. An ETS sets an absolute limit on the amount of GGEs for the specified period. If special measures are adopted for one industry in the ETS, such as aviation, this industry will reduce its demand for permits. However, the total amount of permits is fixed and permits are in demand. The price of permits would fall and other industries would take up the reduction. The net effect will be a precisely zero impact on GGEs. The effect of special measures would be to raise the cost of achieving a given level of GGE reduction, though it would lead to no reduction in GGEs. Special measures involve all costs and no benefits.

While much of the discussion of aviation as a special case advocates the application of additional GGE reduction measures, sometimes the reverse case is made – that aviation should be excluded from GGE mitigation measures.

One argument, which is sometimes used is that GGEs from aviation are only a small proportion of the total and thus can be ignored. This is a peculiar argument – if there are damaging GGEs and it is feasible to lessen them then they cannot be ignored. Another argument has more substance. It is sometimes suggested that aviation creates very large external economic benefits – well above the revenues to airlines and the benefits that travellers enjoy (see Oxford Economic Forecasting 2006). If this were so, then any reduction in the size of the industry could be costly in economic terms. Certainly there can be some external benefits associated with aviation – aviation stimulates inbound and outbound tourism and additional inbound tourism can bring economic benefits to a country (while additional outbound tourism may bring costs to a country). Granted that both inbound and outbound tourism will be stimulated by aviation, the net gain need not be positive. Transport, especially of goods, can give rise to ‘agglomeration’ economies, facilitating the better location of production (Eddington 2006, has some discussion of this). Air freight can contribute to these benefits. However, while aviation, like other forms of transport and communications can create some external economies, there is no reliable evidence to suggest that these are particularly large. While there have been studies which purport to find very large external benefits from aviation (OEF 2006) their methodologies are either not clearly specified or are questionable. Thus, given current knowledge of this issue, there is no clearly documented or strong case to exclude aviation from climate change mitigation policies such as the ETS (it should be remembered that airlines would gain from inclusion within an ETS with free or concessional allocation of permits).

Implementation Issues

It should be relatively straightforward to incorporate domestic aviation into a climate change mitigation policy framework. Tradeable permits based on fuel use required by airlines could be included within the ETS or on fuel supplied to airlines not included within the ETS. Permits would ultimately be linked to the extent to which fuels produce carbon and other GGEs. Ideally the same carbon price would be levied on all industries and users, and the ETS would cover all industries and yield the same cost of producing a tonne of carbon or GGEs. In the case of aviation, the higher damage per tonne of carbon, and the other greenhouse gases produced would necessitate scaling up the effective price so that it reflects the damage done. If permits are to be allocated on a free or partly free basis, the allocation rule needs to be determined. It would be possible to allocate on the basis of past GGEs or ‘grandfathering’, though this would reward users, which have not tried to limit their emissions in the past. An alternative approach, widely suggested in Europe, is for a ‘benchmarking’ approach to be used (see Morrel, 2006; EU 2006; Scheelhaase & Grimme 2007; CE Delft 2007a, 2007b). Users would be issued with permits on the basis of the GGEs that they would have produced if all had used the same technology. This would avoid the problem of rewarding poor performers, as would happen under grandfathering.

Another issue concerns smaller airlines, such as the regional airlines. If only large GGE producers are to be included in the ETS, as has been suggested by the Prime Ministerial Task Group (2007), regional airlines would be excluded. Rather than obtain free permits, they would be subjected to a carbon tax on fuel. This would be distinctly less favourable treatment than the major airlines. There is no necessity for this to be the case – most discussion in Europe presupposes that small airlines would be included in an ETS.

International aviation provides much more serious implementation challenges. An international flight operates between two or more countries, each of which may have a different GGE mitigation policy. Ideally, international action would be coordinated but this is unlikely in the short to medium term. Two countries may both seek to incorporate international aviation into their schemes but their carbon taxes and the values of their permits may be quite different. Two countries may unilaterally impose carbon taxes on international aviation, resulting in a situation of double taxation. There is the problem of multi stage long haul flights – can Australia incorporate all of a Melbourne–London flight in its ETS, or only the Melbourne–Singapore stage? Some countries may not impose any carbon taxes or emissions permits at all – this poses an issue for other countries which do. It is desirable that countries include all airlines which fly to them in their ETS, regardless of whether they are home
owned or not. If this is not done, airlines from countries, which do not impose climate change policies will have an artificial competitive advantage over airlines from countries which do. If a permit trading system is in place in a country, will foreign airlines be eligible to receive such permits, free of charge if home airlines are obtaining free permits?

Finally, under current bilateral air services agreements, countries agree not to impose taxes on international aviation, such as fuel taxes. This would appear to rule out the introduction of fuel use based carbon taxes, though it does not rule out passenger based taxes (which are less effective). Bilateral agreements can be changed but it is difficult to do so and this is not likely to happen until countries have determined the best ways to incorporate international aviation into GGE reduction policies. The EU has begun to alter its bilateral Air Service Agreements to allow for inclusion of aviation in an emissions trading scheme (EU 2006), though its largest aviation trading partner, the USA, is strongly objecting to the European actions.

The problems raised previously can be resolved, though they are quite complex. It is only recently that they have been given much consideration. It is likely to take some time before generally satisfactory solutions are agreed upon. In the meantime, countries like Australia, as well as regions such as Europe, will need to determine which approach best advances their objectives in the short to medium term.

Consumer Attitudes and Voluntary Offsets

One possible development is that consumers may become hostile to air transport, may perceive it as a rogue industry, and boycott air travel. If nothing is done about air travel and its emissions, this development could gather strength. It is probably unlikely that there will be a serious boycott of air travel – people rely on it too much. However, the feeling of hostility may result in strong pressure for aviation specific GGE measures. As noted previously, if there is an effective ETS in place, these measures would be ineffective or counter productive. One issue will be that of convincing the public that the ETS captures the GGE producing effects of aviation adequately.

Voluntary carbon offset schemes, such as those in place at British Airways and Virgin Blue, make good sense in the absence of an ETS. While there are some doubts concerning the legitimacy of some of the offset programs, they do offer travellers the option of carbon neutral flying. Thus they can limit the problem of adverse consumer perceptions. So far, travellers do not seem to be taking up the option in large numbers (which also suggests that they would not be prepared to boycott airlines). However, airlines appear to be taking the threat that they may do so seriously. When the ETS is brought in, they will become redundant. Airlines might still wish to offer them to highlight their climate change credentials. They could be integrated into an ETS – where travellers buy carbon offsets, the airline might be required to purchase fewer emissions permits.

One useful selling point of including aviation within the ETS is that it implies that travellers are offered an effectively carbon neutral flight. Any additional flights a traveller makes add nothing to GGEs – this is because any GGEs created by the flight require permits and all permits must be obtained from reducing GGEs elsewhere, since total GGEs are fixed.

Key Points

- Aviation accounts for a small proportion of GGEs (around 2%), though the damage from aviation emissions is considered to be significantly greater than from other emissions. While technology is reducing emissions, this is not likely to counter the strong growth in aviation and thus aviation is likely to account for a growing proportion of GGEs. Because technology is locked in, climate change mitigation policies are not likely to reduce GGEs from aviation by as much as in other industries.
- Major airlines are likely to be included in the Australian ETS and in Europe the existing ETS is being widened to include aviation.
- Impacts of climate change policies on airfares will depend on the extent of pass through – a controversial issue. This is likely to be less than complete in the short run. When airlines are granted free permits, they may not increase airfares to reflect the full value of the permits.
- Under the ETS, domestic airfares will increase moderately, and airlines will gain from free permits, at least for some years.
- Airfare increases on international routes, particularly long haul routes, are likely to be significant even if there is not full pass through.
- No convincing case has been made for treating aviation differently from other industries, either more or less favourably (other than under general arrangements for footloose industries). Special taxes or restrictions on aviation, if it is included in the ETS, will be ineffective in reducing GGEs.
Chapter 7

ASSESSING THE IMPACTS OF CLIMATE CHANGE POLICIES ON THE COST OF INTERNATIONAL VISITS TO AUSTRALIA – PRELIMINARY ESTIMATES

While modelling is needed to obtain more accurate estimates of the impact of climate change mitigation polices on the cost of tourism, it is possible to provide some indication of the orders of magnitude of the impacts. Some estimates of the impacts on airfares, costs incurred within Australia, and total trip costs to Australia from various origin countries, for particular types of travellers are presented in Tables 3, 4 and 5. These estimates assume full pass through of the cost of permits for international flights and allow for the direct and indirect costs of permits for the ‘within Australia’ expenditure. They do not include any estimate of the additional cost to the airlines of higher goods and services prices due to the ETS.

The ‘within Australia’ GGEs associated with tourist expenditure are based on a study undertaken by Lundie, Dwyer and Forsyth (2007), which developed environmental yield estimates (energy use, water use, greenhouse gas emissions and ecological footprint) for several different market segments of Australian inbound tourism. A hybrid approach was employed, combining input–output analysis with an on-site audit for tourist accommodation. The emissions estimates are essentially carbon intensity footprints of the different tourists – they include direct and indirect GGEs resulting from the expenditures of these tourists. Since they are based on intensity estimates, they only provide a first approximation to the impact of carbon pricing on the cost of Tourism – modelling would be needed to measure the full impact of carbon pricing.

Table 3 reproduces the estimated GGE per trip associated with New Zealand over 55’s, first time visitors from Hong Kong, repeat visitors from the United Kingdom and Canadian over 55s. The bottom row indicates the average amount of expenditure within Australian associated with each of the two rows indicating the total cost of the GGE when priced at $20 and $50 per tonne, respectively. These prices cover the range of probable carbon prices. The bottom row of Table 3 indicates the total tourism expenditure per trip for each of the selected markets based on data from the International Visitor Survey (IVS), undertaken by the Australian Bureau of Statistics. This enables us also to estimate the percentage of total tourism expenditure represented by these costings. Thus at $20 per tonne the GGE represent 4.1% of the total ‘within Australia’ expenditure of New Zealand matures, with 3.0% for Hong Kong first timers and 4.8% for UK repeat visitors and Canadian mature tourists. At $50 per tonne the percentages are, respectively 10.4%, 7.6%, 9.1% and 10.7% of total ‘ground content’ expenditure.

In this way we estimate the GGE associated with the ‘ground content’ of tourism to Australia from different source markets. Of the selected markets, UK repeaters are the greatest spenders per trip and are also the greatest emitters of Greenhouse gases (with costs representing 9.1% of their total expenditure). The second greatest spenders per trip and second greatest emitter of greenhouse gases is the mature Canadian tourist. Given that the expenditure data indicates purchasing patterns, destination managers have the opportunity to determine which are preferred inbound markets from an environmental perspective.

<table>
<thead>
<tr>
<th>Country</th>
<th>NZ Mature</th>
<th>% of Total within destination Expenditure</th>
<th>Hong Kong 1st time</th>
<th>% of Total within destination Expenditure</th>
<th>UK Repeat</th>
<th>% of Total within destination Expenditure</th>
<th>Canadian Mature</th>
<th>% of Total within destination Expenditure</th>
</tr>
</thead>
<tbody>
<tr>
<td>NZ Mature</td>
<td>2.5</td>
<td>3.6</td>
<td>4.8</td>
<td>1205.0</td>
<td>2381.0</td>
<td>2626.0</td>
<td>2246.0</td>
<td></td>
</tr>
<tr>
<td>Cost at $20 per tonne ($)</td>
<td>50.0</td>
<td>4.1</td>
<td>72.0</td>
<td>3.0</td>
<td>96.0</td>
<td>3.7</td>
<td>96.0</td>
<td>4.3</td>
</tr>
<tr>
<td>Cost at $50 per tonne ($)</td>
<td>125.0</td>
<td>10.4</td>
<td>180.0</td>
<td>7.6</td>
<td>240.0</td>
<td>9.1</td>
<td>240.0</td>
<td>10.7</td>
</tr>
<tr>
<td>Total Expenditure ($)</td>
<td>1205.0</td>
<td>2381.0</td>
<td>2626.0</td>
<td>2246.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: GGE estimated are from Lundie, Dwyer and Forsyth (2007). Visitor expenditure data are from Tourism Australia (2004) and based on Australia’s International Visitor Survey.
Table 4 provides estimates of the impact of GGE on airfares, assuming that their cost is passed on fully to airline passengers. The increased costs depend upon the amount of GGE and its costs per tonne. These estimates are made for low and high carbon prices and they are made for different assumptions about the damage caused by aviation emissions. The high damage scenario assumes that once non-carbon emissions and the higher damage done by aviation as compared to ground carbon emissions are taken into account, the damage is 2.5 times more than the simple carbon emissions would indicate. If the damages are high and the cost per tonne is high, GGE associated with flying from the long haul markets of UK and Canada comprise over 20% of tourist expenditure.

These calculations provide an indication of possible orders of magnitude of the impact on the price of international visits to Australia of climate change mitigation policies. With a low carbon price, these policies would increase the cost of the ‘within Australia’ component of the trip by about 2-4% and they would raise airfares by about the same (or perhaps a little more, once the indirect GGEs from aviation are allowed for). If carbon pricing factors in a higher damage allowance for aviation generated GGEs, the impact on airfares increases from about 6-9%. With a high carbon price, the ‘within Australia’ trip cost rises by about 7-11%, and the airfares rises by 6-9% under the low damage scenario to 14-23% under the high damage scenario.

Table 4: Impacts on Airfares of Climate Change Policies, Visitors from Selected Countries, 2002-2004

<table>
<thead>
<tr>
<th></th>
<th>New Zealand</th>
<th>Hong Kong 1st Time</th>
<th>UK Repeat</th>
<th>Canadian Mature</th>
<th>% of Total Airfare</th>
<th>% of Total Airfare</th>
<th>% of Total Airfare</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tonnes of GGE</td>
<td>0.6</td>
<td>1.67</td>
<td>3.82</td>
<td>3.67</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost at $20 per tonne</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low damage ($)</td>
<td>12</td>
<td>24</td>
<td>33</td>
<td>76</td>
<td>3.4</td>
<td>73</td>
<td>3.6</td>
</tr>
<tr>
<td>High damage ($)</td>
<td>30</td>
<td>6.0</td>
<td>84</td>
<td>191</td>
<td>8.5</td>
<td>184</td>
<td>9.0</td>
</tr>
<tr>
<td>Cost at $50 per tonne</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low damage ($)</td>
<td>30</td>
<td>6.0</td>
<td>84</td>
<td>191</td>
<td>8.5</td>
<td>184</td>
<td>9.0</td>
</tr>
<tr>
<td>High damage ($)</td>
<td>75</td>
<td>15.0</td>
<td>209</td>
<td>478</td>
<td>21.2</td>
<td>459</td>
<td>22.3</td>
</tr>
<tr>
<td>Total Expenditure on Airfares ($)</td>
<td>501</td>
<td>1198</td>
<td>2259</td>
<td>2054</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Expenditure data supplied by Tourism Australia (2004); British Airways Carbon Calculator (www.ba.com)

The impacts on the overall trip cost are shown in Table 5. Table 5 is an aggregate table indicating the total GGE associated with a trip to Australia including air travel plus the ‘within Australia’ content. Overall trip costs would rise by 3-4% in the low carbon price, low damage scenario; by 4-7% under the low carbon price, high damage scenario; and by 11-17% in the high carbon price, high damage scenario.

Table 5: Impacts on Total Trip Costs of Carbon Pricing, Visitors from Selected Countries, 2002-2004

<table>
<thead>
<tr>
<th></th>
<th>New Zealand</th>
<th>Hong Kong 1st Time</th>
<th>UK Repeat</th>
<th>Canadian Mature</th>
<th>% of Total trip Expenditure</th>
<th>% of Total trip Expenditure</th>
<th>% of Total trip Expenditure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost at $20 per tonne</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low damage ($)</td>
<td>62</td>
<td>3.6</td>
<td>105</td>
<td>172</td>
<td>3.5</td>
<td>169</td>
<td>3.9</td>
</tr>
<tr>
<td>High damage ($)</td>
<td>80</td>
<td>4.7</td>
<td>156</td>
<td>287</td>
<td>5.9</td>
<td>279</td>
<td>6.5</td>
</tr>
<tr>
<td>Cost at $50 per tonne</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low damage ($)</td>
<td>155</td>
<td>9.1</td>
<td>264</td>
<td>431</td>
<td>8.8</td>
<td>424</td>
<td>9.9</td>
</tr>
<tr>
<td>High damage ($)</td>
<td>200</td>
<td>11.7</td>
<td>389</td>
<td>718</td>
<td>14.7</td>
<td>699</td>
<td>16.3</td>
</tr>
<tr>
<td>Total Expenditure on Trip ($)</td>
<td>1706</td>
<td>3579</td>
<td>4885</td>
<td>4300</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: authors’ estimates; Source: Calculated from Tables 3 and 4

The emissions estimates are essentially carbon intensity footprints of the different tourists – they include direct and indirect GGEs resulting from the expenditures of these tourists. Since they are based on intensity estimates, they only provide a first approximation to the impact of carbon pricing on the cost of tourism – modelling would be needed to measure the full impact of carbon pricing.

Information on the price sensitivity of passengers is needed to predict the effectiveness of mitigation policies. When climate change mitigation policies come into effect, while all trips by air are affected, the impact on the cost of long haul trips is certain to be perceptible.
Scoping study of the economic aspects

It might be thought that long haul travellers are more sensitive to price than short haul travellers given the initial greater airfare outlay. However, in his meta-analysis of factors affecting the demand for international tourism Crouch (1995) has concluded that long haul travellers are less sensitive to airfare changes than short haul travellers. He puts this down to three factors: (i) the relative lack of substitute modes on longer distance flights; (ii) the fact that long distance flights are usually more expensive than short distance flights, so that an increase in costs will require a larger share of a passenger’s budget – suggesting that long haul travel may attract wealthier travellers who might be less price sensitive; and (iii) a lower awareness of prices in the more distant destinations and a lesser ability to change travel plans upon arrival (Crouch 1992, 1994).

The Bureau of Transport and Communications Economics (1995) estimated demand elasticities for air travel between Australia and 12 countries: Germany, Italy, UK, Japan, Korea, Taiwan, Indonesia, Malaysia, Singapore, Fiji, New Zealand and USA. The travel demand equations were estimated using quarterly data from March 1986 to June 1994. Airfares were found to be important determinants of leisure travel. Airfare elasticities for international leisure visitors ranged from -0.5 to -1.86. Generally, airfare elasticities tended to be lower on shorter distance routes. In a meta-analysis of airfare elasticities (Brons, Pels, Nijkamp & Rietveld 2002) found that travellers are less price sensitive as flight distance increases. Another finding was that long-run price elasticities are higher in absolute value. This implies that basing long-run policy instruments on short-run elasticities will lead to distortions. The fact that passengers become more price sensitive over time also needs to be acknowledged in the design of long-run policy instruments.

While inbound tourism is likely to be reduced as the price of flying rises, so will outbound tourism. Depending on the extent to which outbound travellers divert to a domestic tourism experience as a result of higher airfares, this will offset losses to the host tourism industry. There are several unknowns here. One uncertainty involves the perception of travellers as to the ‘substitutability’ of domestic tourism for international tourism. The more highly regarded a domestic tourism experience is the more holiday travellers will be inclined to substitute one for the other. Another uncertainty involves the mode of travel taken for the domestic tourism experience. Flying domestic short haul will increase GGE’s as will increased use of ground transport.

Key Points

- High ($50/tonne) carbon prices could raise the cost of international flights to Australia by between 6-9% and 14-23%, depending on the route.
- High carbon prices could raise the all up cost of a trip to Australia by between 4-7% and 11-17%, depending on the route.
- The effect of increased air travel costs on tourism flows to Australia depends on the elasticity of the demand for long haul travel. This may be expected to vary between different origin markets.
CONSUMER PERCEPTIONS AND VOLUNTARY ACTIONS

Consumer Perceptions and Actions

Voluntary actions by either consumers/travellers and by tourism firms to mitigate the climate change impacts of tourism are possible. Travellers are well aware that their trips create carbon emissions, particularly when air travel is used. Tourism industry firms are aware that they create emissions and are able to reduce them.

Consumer perceptions and preferences can have implications for the tourism industry. Some tourists may see travel as somewhat irresponsible and they may seek to limit the GGEs they create by travelling. This may make them willing to forego trips altogether or to reduce the number of trips they make, to alter the modes they use, and to lessen their use of long haul travel. If low emissions or carbon neutral tourism products are not available, these ‘responsible travellers’ will make less use of the products of the tourism industry. If the industry is able to supply them with low carbon or carbon neutral products, at a modest extra cost, then presumably these tourists will still travel. Such consumers may be willing to pay extra to buy carbon neutral products – it appears that they are prepared to voluntarily cut their own emissions. Thus, such a traveller might be willing to pay for carbon offsets for a flight or to deal with a carbon neutral travel agent. Such travellers constitute a distinct minority, though there is a growing market niche. Addressing this group is a relatively small problem, which can be solved when carbon neutral options are feasible.

There is another group of residents who are concerned not so much about their own travel as travel by other people. They are concerned about GGEs in aggregate, and from tourism, and recognise that most travellers do not factor their emissions into their travel decisions. As a consequence, there is a problem of excessive creation of GGEs. This group would like to see travel discouraged as a way of reducing GGEs. Thus, they advocate specific measures to discourage travel and particularly air travel, such as special taxes or limits on flights. The presence of carbon neutral tourism products is not a sufficient response for them, particularly if as is the case, only a very small minority of travellers avail themselves of carbon neutral tourism products. In tourism and aviation, as elsewhere, the free rider problem of GGEs means that it is not being addressed.

This issue would be addressed if tourism and aviation became carbon neutral, with emissions being reduced to zero or all emissions being offset. This is a very unlikely situation. The complaint also loses its validity if there is an effective and comprehensive climate change mitigation policy in place and aviation and tourism are included within it. This would be the case under the ETS as proposed for Australia. Such a policy would limit overall GGEs and ensure that any economic activities, which were undertaken such as tourism, do not add to overall emissions. In such an environment, a decision by a traveller to make a trip or take a flight would not add to GGEs and there would be no valid case for further restricting travel. It may be that some residents would object to the target or cap for emissions, which the government sets but this would be an objection to the scheme and its implementation – it would not be a reason for restricting travel.

It may take some time before comprehensive climate change mitigation policies such as the ETS are implemented. In the meantime, tourism and aviation like all other forms of economic activity will contribute to GGEs. If there is a community desire to cut GGEs before the policy is effective, then ad hoc measures such as taxes on certain forms of activity can be used. These will be much more effective if broadly based than if they are restricted to one or a few industries. Taxes on aviation or tourism, if applied on their own, will be relatively ineffective in reducing GGEs, since the scope for substituting lower emissions technologies is limited in aviation and higher trip prices will not reduce travel by much. In addition, aviation specific measures will encourage greater use of other transport models, which also produce GGEs – the net impact on GGEs is not likely to be large.

Industry Responses

There is much discussion about what the tourism industry can do itself about climate change. This was a strong focus of the UNWTO Davos Conference in October 2007, which called for the industry to mitigate its own GGEs (UNWTO 2007). If the industry acts on a voluntary basis, it will make a small contribution to lessening climate change and it will have very little impact on lessening the climate change damage that it is itself facing. The industry will be imposing costs upon itself and these would be significant if it attempts to achieve full carbon neutrality (e.g. through offsets).

Tourism firms can go to one of several stages:
1. They can determine what their carbon footprints are and what actions can be taken to reduce their footprint;
2. Where identified, they can take measures which reduce GGEs at the same time as reducing costs (for example, when an airline finds ways of reducing fuel use without adding to other costs or a hotel introduces more energy efficient equipment);
3. They can take measures to reduce GGEs where these measures do not add or subtract from costs; or
4. They can take measures which reduce GGEs at a cost to their business.

Tourism firms, which are focused on maximising shareholder value will take action on the first three of these, though not the last unless they are able to pass on the higher costs to their customers. While there will be measures which firms can take to reduce GGEs at no cost, measures which deliver substantial reductions are likely to only come at a cost.

Firms will, in some cases, be able to pass on costs of reducing their GGEs to their customers. If customers are offered carbon offsets on an optional basis some will take up the option. Thus some airline passengers now pay for carbon offsets. Some firms will be able to pass on the costs of reducing GGEs on a non optional basis. Thus an ecotourism lodge may be able to pass on the costs of GGE reduction to all of its customers and a carbon neutral travel agent may be able to operate on a fully carbon neutral basis. However, it should be recognised that these are only niche markets and most tourism firms would not be able to survive if they add the costs of GGE reduction to the prices of their products, at the same time that their competitors do not. At this stage, the responsible travel market does exist and is perhaps growing; however, it is still a limited niche market. There are many more gas guzzling four wheel drives sold in Australia than low emissions Toyota Prius cars. Tourism firms can choose to reduce their GGEs substantially but only at a cost. Since most of their customers will not be willing to pay, these costs would result in reduced profits.

Overall, it makes good sense for tourism firms to account for their GGEs and to be aware of ways of reducing them. It makes good sense for them to reduce GGEs where this is feasible at little or no cost. Firms can also gain by offering carbon neutral products where customers are prepared to pay for them. This will be possible in some niche markets and it will be feasible where firms serving a general market make such products available on an optional basis.

It should not be expected that tourism firms will voluntarily reduce GGEs at a significant cost to themselves. However, in Australia it is very likely that comprehensive climate change mitigation policies will be implemented in the next five years and that these will cover tourism firms. Those tourism firms, which have assessed their carbon footprints and have examined ways in which they can cut their emissions, will be in a stronger position to minimise the cost to themselves of the climate change policy. With an effective climate change policy in place, the role for voluntary action to lessen GGEs is removed. The responsible traveller can travel to and within Australia knowing that they are not adding to total GGEs. In addition, calls for special action directed towards the tourism industry will be less frequent and less effective.

**Key Points**

- Consumer perceptions that travel, and particularly aviation, is irresponsible because of its GGEs could hurt long haul destinations such as Australia.
- Voluntary carbon offset schemes can help in that they offer the ‘responsible’ traveller a carbon neutral alternative. However, they will not address calls for action against aviation because most travellers will not take up these carbon neutral options because they are more expensive.
- Tourism firms can take action to mitigate their direct and indirect GGEs and reduce emissions where doing this imposes little or no cost.
- However, for most tourism firms and destinations going carbon neutral will be costly. Firms which sell in niche markets and are prepared to pay a premium for carbon neutrality will find it worthwhile. For the majority of tourism (and other) firms, this will not be the case, as going carbon neutral will increase their costs leaving them at a competitive disadvantage. This is why government climate change mitigation policies are needed.
EMERGING POLICY ISSUES FOR THE TOURISM INDUSTRY

There are several issues that emerge from this study on which the tourism industry may wish to take a policy stance. Here we identify and comment briefly on a number of these.

Handling Footloose Industries
Tourism is, quintessentially, a footloose industry. More so than other industries, such as aluminium, if the international price of tourism to Australia increases, tourism production will shift elsewhere. It is not necessary to shift industrial plants – tourists simply decide to visit other destinations. This would impose a cost on the tourism industry and an economic cost on Australia. It would have the effect of reducing Australia’s GGEs, i.e. it would reduce tourism’s Australian carbon footprint. However, it need not result in any, or much, reduction in global GGEs, since the tourists will still travel – they will just be visiting other destinations, which may not have GGE mitigation policies in place.

Hence there is a risk that GGE mitigation policies in Australia could impose a cost on Australia for little benefit in terms of global GGEs. Australian tourism has a strong interest in monitoring government policies towards footloose export industries.

Should ETS permits be sold or given to firms?
When the ETS is introduced, most of the tourism industry in Australia will not be directly included. Few if any firms outside aviation will qualify for permits. Tourism will face the costs of the ETS, in that input prices will rise for tourism firms. If the government issues free permits, it will gain no additional revenue. If the government sells the permits, possibly at a rate below that which becomes established in the market, it will gain revenues. With these additional revenues it can compensate some industries or firms which lose out and it can assist industries in adapting to climate change. Thus, a few tourism firms (airlines) will gain from free permits and the rest of the industry will not be directly affected, though it may lose out indirectly from a smaller quantum of government assistance for adaptation.

Inclusion of Tourism in the ETS
If permits are to be given to firms free or sold at a concessional rate, it is in the interest of the tourism industry to ensure that as many tourism firms as possible are included within the ETS. The problem is that tourism firms are small and are not likely to be include, and furthermore, most of them are not large direct sources of emissions. This could change if the government expands the scope of the ETS to include smaller firms. It might be possible for groups of tourism firms to qualify for inclusion in the ETS.

Promoting International Action on Climate Change
Of all industries, tourism is likely to be a clear loser from the direct effects of climate change. The costs could be large. It does have a strong interest in effective climate change mitigation policies being implemented, not just in Australia but at a global level. While it is difficult for the tourism industry in any one country to do much itself, it could well be in the interests of the Australian tourism industry for Australia to take a lead in the international forum to encourage action.

International Systems and Carbon Trading
Several countries will be implementing climate change mitigation policies such as ETS. In general, the global economic cost of action will be lessened if there is international trading of permits. The effects of such trading on the Australian tourism industry are uncertain, since trading could result in a higher or lower carbon price in Australia. While substantial trading is not likely to come about soon, it is an issue which the Australian tourism industry has an interest in monitoring.
Target Setting
The Australian government will have to determine how tightly it will set ETS targets. Generally, it takes time for industry to adapt to higher carbon prices. Tight targets set early could impose higher adaptation costs on industries such as tourism, though strong action by Australia could have a good demonstration effect, and encourage Australia’s destination competitors to take action earlier. This is another issue which the tourism industry has an interest in monitoring.

Should International Aviation be Excluded from the ETS?
Including international aviation in the ETS for Australia will have a negative impact on its tourism industry if other competitor countries are not implementing GGE reduction policies. Tourists will switch to other destinations and this will impose a cost on Australia and its tourism industry but it may not result in any significant reduction in global GGEs. International airlines could gain from inclusion if permits are granted to them free of charge. Subject to further analysis, the tourism industry is likely to have a strong interest in developing a position on this issue.

Determining the Mix of General and Specific Policies
Governments may address climate change mitigation through comprehensive general policies, such as the proposed ETS or specific policies, such as aviation taxes or renewable energy targets, or a combination of these. As noted in this report, there are problems if both approaches are used at the same time. The emphasis put by governments on the different approaches is yet to be determined – for example, governments may shy away from implementing a comprehensive policy and prefer to implement a range of specific policies, even though the more comprehensive approach will be more cost effective in achieving a given GGE reduction. While the impact on the tourism industry of specific measures will depend on exactly which measures are adopted, it could be that the industry does better under one broad approach than another. It is possible that tourism will fare better under a comprehensive approach since it is likely that key tourism industries, such as aviation, will be targeted for strong action under an approach which emphasises specific measures. It will be in the industry’s interest to assess the cost to itself of the different broad approaches to mitigation as they develop and advocate the approach which imposes least cost on it.

Handling International Aviation
If it is decided to incorporate international aviation in the ETS, the issue then arises of how to achieve this. The International Civil Aviation Organization (ICAO) is considering this issue, and it may set out guidelines, which most countries are willing to go along with – Australia could follow these guidelines. However, it is quite possible that any ICAO guidelines will be very general and leave much discretion to the implementing states. Australia will then need to resolve a number of issues, such as whether to give free permits to foreign airlines, how to handle long haul multi stage flights, whether to impose the ETS on both inbound as well as outbound flights, and how to coordinate its policies with those of partner countries or regions such as Europe, which are also incorporating international aviation within their ETSs.

Exclusion of Specific Sectors
With the exception of international aviation, discussed previously, there is probably not much scope for specific sectors of the tourism industry to be excluded from the ETS. In the main, tourism is indirectly affected by the ETS, not directly. Thus even if it were desired to exclude the land component of inbound international trips, it would be very difficult to do so. In principle it might be possible to exclude domestic aviation from the ETS, though there is no good reason for doing so and it would not be in that industry’s interest if permits are to be given free or sold on a concessional basis.

Special Measures Imposed on Specific Sectors
There are strong calls for additional GGE reduction measures to be applied to specific sectors in the tourism industry. In particular, many are calling for measures which target aviation. If general GGE reduction policies
such as the ETS are effective, there is no case for specific measures, such as aviation taxes. Efficient climate change policies will result in bigger reductions in GGEs in some industries (e.g. electricity) than in others because the technological possibilities for GGE reduction are more readily available than in others and such measures will add to the economic costs of climate change policies.

This point is strongest if the chosen policy is an ETS, as will be the case for Australia. Under an ETS, additional measures such as aviation taxes are at best, totally ineffective in reducing GGEs.
Chapter 10

IDENTIFYING THE RESEARCH PRIORITIES

In this report, we have set out the key economic implications of climate change and climate change policies for tourism in Australia. Many of the more important aspects require further research to establish effects, measure them, and quantify how they will impact on tourism. In this chapter some propositions that are reasonably well supported are set out and some key areas for further research are identified.

The Costs of Climate Change to Tourism

Propositions

- Climate change affects patterns of tourism. These effects are likely to lead to reduced tourism expenditure in Australia and to a reduction in Australia’s international tourism competitiveness. There will be consequential impacts on the Australian economy as a whole.

Research Priorities

- Documentation of the effects of climate change on specific major attractions.
- Determining the feasibility and cost of adaptation.
- Assessing the costs of climate change and adaptation on the industry and consumer.
- Assessing the likely tourism flows and expenditures, and determining their impacts on the economy by modelling.

Tourism Impacts on GGE – Measuring Its Carbon Footprint

Propositions

- It is important to distinguish between the Australian and global carbon footprints of Australian tourism.
- The impact of tourism on GGEs depends on how intensive tourism and the industries which supply it, are in GGE production and on how changes in tourism affect other GGE producing industries.
- Measuring the carbon intensity or impact footprint requires a modelling framework, which links economic activity to GGE production. The STCRC Centre for Tourism Economics and Policy Research model of state and national economies is being adapted to do this.

Research Priorities

- Measuring the carbon footprint of different types of tourists, such as domestic and international, VFR or business, UK or US origin.
- Measuring changes in GGE as a consequence of changes in tourism, such as more domestic tourism, more international tourists such as Japanese holiday visitors, or as a consequence of policy changes, such as aviation liberalisation or promotional marketing.
- Measuring the broader global implications of tourism changes, which have effects outside Australia, such as changes in international inbound and outbound tourism flows, using global economic models.
- Measuring the implications for GGE production of changes in technology over time using the modelling framework.
- Modelling aviation and land transport impacts on GGE production in detail.
Climate Change Policies and Their Impacts on Tourism

Propositions

• Australian climate change mitigation policies will involve a mix of mandatory measures, possibly some carbon taxes and an ETS, though the main emphasis will be on the ETS.
• When the ETS is introduced, few if any tourism firms other than airlines will be able to participate directly in the ETS.
• Information on the price sensitivity of passengers is needed to predict the impacts of mitigation policies.
• Tourism will be indirectly affected through rises in input costs and higher airfares will affect the level and patterns of travel.
• If an ETS is in place, mandatory policies such as restrictions on air travel will be ineffective in reducing GGEs.

Research Priorities

• Better estimates of the price elasticity of demand for tourism to Australia. This would include improved estimates of the affects of relative price levels on destination choice and very importantly demand elasticities for air travel between Australia and its major tourist origin markets.
• Assessing the impacts on domestic tourism prices of climate change policies and ultimately on tourism flows, expenditures, and impacts on the economy using CGE models, which can capture how other industries adapt to these policies.
• Assessing the impacts on international tourism, which is a more complex exercise. This will need to capture the detail of how international airfares are changed and how climate change policies affect other export industries, exchange rates, and feed back on to tourism. A CGE approach is required for this.
• Assessing the impacts on, and consequences of, inbound and outbound international tourism and the balance between these.
• Analysing the role of tourism as a footloose export industry and evaluating the costs and benefits of special arrangements to handle this, including leaving international aviation outside the ETS.
• Assessing the impacts on Australian tourism of climate change policies being implemented or not implemented, in other countries using a global model such as GTAP.

Climate Change Policies and Land Transport

Propositions

• Land transport costs will be affected directly by a carbon price, though the percentage rise in costs is not likely to be large.

Research Priorities

• Documenting how large the impact on land transport of climate change policies in general will be using a modelling framework.

Climate Change Policies and Aviation

Propositions

• Aviation accounts for about 2% of carbon emissions but when additional emissions and higher damage factors from aviation emissions are taken into account it accounts for about 5-6% of greenhouse damage.
• Airlines are reducing GGEs, though there is little scope for rapid reductions.
• Aviation is growing rapidly so its relative contribution to GGEs is increasing.
Airlines are likely to be included in the ETS in Europe and this will have some impact on air travel to Australia.

Airlines may have some difficulties in passing on to passengers the full cost of permits in the short run, though in the long run most will probably be passed through. The impact on airfares of carbon change policies could be significant especially if higher estimates of damage are used.

If airlines are incorporated in the ETS, specific measures directed at aviation such as taxes would not reduce GGEs.

Research Priorities

- Analysis of the response by airlines to the ETS, and the extent of pass through and assessment of the impacts on airfares and airline profits;
- Estimating the impacts of climate change policies on airfares to Australia and competing destinations;
- Research on the implications of including international aviation in the ETS for tourism, benefits to Australia and Australian and global GGEs; and
- Research on the best design of international aviation arrangements to incorporate climate change policies.

Assessing the Impacts of Climate Change Policies on the Cost of International Visits to Australia – Preliminary Estimates

Propositions

- Climate change policies are likely to raise the cost of visiting Australia by 3-4% if low carbon tax ($20/tonne) and low damage estimates are adopted; by 4-7% if low carbon prices and high damage costs are adopted; and by 11-17% if a high carbon price ($50/tonne) and a high damage cost estimate are adopted.

Research Priorities

- Developing more reliable estimates of the impacts of climate change policies on airfares and total trip costs using modelling to capture indirect effects and impacts through responses of other industries.
- Developing more reliable estimates of the impacts of increased travel costs on the demand for long haul travel.
APPENDIX A: TAXES, PERMITS, PRICES AND PROFITS

Airlines might be subject to either carbon taxes or an emissions permit scheme. How they respond to such schemes will depend on:

- Market structure of the airlines;
- Whether the airports they fly to/from are slot constrained or not; and
- What objectives they have and how they pursue their pricing policy.

For simplicity, it is assumed that there is a carbon tax of a specified amount on airline passengers or there is a carbon permit per passenger. In practice, it would be more efficient to target emissions directly to encourage substitution of more GGE intensive aircraft. However, the points to be made do not depend on this simplification. Initially, it is assumed that airlines are maximising their profits – this assumption is relaxed later.

**Competition on non slot constrained routes**

This case is illustrated below. The long run average and marginal cost curves are assumed to be straight and horizontal (no scale economies). The initial equilibrium is one of price $P_1$ and output $X_1$. The imposition of a carbon tax, of $t$, raises the airline costs to $LAC + t$, and the new price $P_2$, will cover this. Output falls to $X_2$. There is full pass through of the carbon tax to the passengers and the reduction in output will depend on the elasticity of demand for flights. Airlines neither gain nor lose from the implementation of the carbon tax in the long run (they may lose in the short run, however).

The result in terms of price and output will be the same if airlines are subjected to a carbon permit trading scheme, which has a permit price of $t$. In setting their prices, airlines factor in the price of the permit, $t$, and the price to the passenger again rises to $P_2$. If permits are allocated free of charge to airlines, on a grandfathering or benchmarking basis, the airlines will gain. If an amount of $OX_2$ permits are given to the airlines, their profits will rise by $P_2 P_2 A B$. There is a transfer from passengers to the airlines. The amount of free permits need not equal $OX_2$ – the size of the allocation is a policy decision for the government or environmental regulator.
Monopoly on non slot constrained routes

Not all airline routes are competitive – at the extreme, some may be monopolies. The case of monopoly is shown in the next figure. Assume that a carbon tax, of t, is levied. This raises the marginal cost of the monopoly by t. It does however, not raise the price to the passengers by this amount – the rise in price is from \( P_1 \) to \( P_2 \), less than the amount of the carbon tax. With the smaller price increase, the impact on output will be smaller than under competition. The monopoly is unable to pass on the full carbon tax. The airlines will face an unambiguous reduction in profit.

![Graph showing the impact of carbon tax on monopoly airlines](image)

The same impacts on price and output will come about when there is a carbon permit scheme. Depending on how many free permits the monopoly airlines are issued with, the monopoly will gain or lose. If the monopoly is issued with \( OX_2 \) permits, it will lose out, since profits are less at \( OX_2 \), with costs at \( LAC = LMC \), than at \( OX_1 \).

More generally, airline markets may be oligopolistic. Results then depend on the strategies they employ, e.g. whether Cournot or Bertrand competition is present. Typically, it is likely that the carbon tax will be less than fully passed on to the passengers. The airlines will lose if there is a carbon tax but may gain if carbon permits are issued to them free of charge.

Competition on slot constrained routes

Many airline routes, especially in Europe and some parts of Asia, use airports which are slot constrained. Most of the major airports in Europe are slot constrained at least for part of the day. To schedule a flight into such an airport, the airline must have a slot. This may have been allocated to it earlier, or it may be able to gain a slot through trading with other airlines. Granted that there is excess demand for the airports, these slots are valuable. For present purposes, it is necessary to note that there is an overall limit on the number of flights into and out of slot constrained airports.
This situation is illustrated in the previous figure. The demand by flights to use the airport is shown as D and the available capacity is shown as S. Slots ration demand to S and the market clearing price is $P_1$. Given that $LMC < P_1$, there is excess demand and slots command a premium.

If a carbon tax is levied at the rate of $t$, the average and marginal costs to the airlines rise to $LAC + t$. The price to the passengers, $P_1$, cannot change, since it is set by the balance of demand to slot capacity. In this situation, the airline is unable to pass on any of the carbon tax and there is no reduction in output. Airline profits fall by the amount of the carbon tax levied on them. The value of a slot falls by the amount of the carbon tax.

If a carbon permit scheme is in place, the same impacts on price and output will come about. The position of the airlines depends on how many free permits they are allocated. If they are issued with $S$ permits, enough for all of their flights to the airport, they will neither gain nor lose. If they are allocated any less, they will lose. This indicates that for a substantial proportion of air traffic, which uses slot constrained airports, carbon taxes will have no effect on emissions through reducing airline demand. Taxes levied on emissions will have some effect on emissions through inducing airlines to use less GGE intensive aircraft, though this is not likely to be a large effect except in the very long run.

There is a situation where airlines may be able to pass on some of the costs of a carbon tax. Assume that some airlines, such as British Airways, operate short haul flights from a slot constrained airport such as London Heathrow, while others such as easyJet operate competing short haul flights from non-constrained airports, such as Luton and London Stansted. If carbon taxes are imposed on all airlines, the fares which easyJet charges will rise, though in the first instance, BA fares will not. However, since the fare premium for using London Heathrow has fallen and since BA flights and easyJet flights are imperfect substitutes, the demand for BA flights will increase, as will the demand for use of London Heathrow airport. This is shown in the previous figure – the demand curve shifts upwards somewhat, to $D'$. Fares on short haul flights using the airport will rise to $P_2$. The value of a slot at London Heathrow will be higher, though it will be lower than the value before the imposition of the carbon tax. In this situation, the airline loses less as a result of the imposition of the carbon tax than in the case where the demand curve does not shift. If the airline is issued with free permits it will gain as a result of the introduction of emissions trading and the effects this has on the fares being offered by its competitors using other airports.

**Differential taxes on slot constrained routes**

It is quite likely that different users of slot constrained airports will be paying different carbon taxes. For example, long haul flights are likely to have to pay higher carbon taxes per flight than short haul flights. This will affect the outcome in terms of prices and slot values.

This is illustrated in the next figure. Assume there are two types of flights, with demand curves $D_1$ and $D_2$. Airline markets are competitive. The aggregate demand for the use of the airport is shown as $D$, and the price is set at $P_1$. A carbon tax $t$ is levied only on flights of type 1, and this can be shown as a downward shift in the
Scoping study of the economic aspects

demand curve to $D_1^1$. The new overall demand curve is shown as $D^1$. The shift downwards is less than $t$ and the new market clearing price is $P_2$. The value of a slot falls but by less than the carbon tax. The price of type 1 flights will rise and the price of type 2 flights will fall. More type 2 flights will use the airport and fewer type 1 flights. Because slot values and prices have fallen, passengers of Type 2 airlines will gain but the airlines will lose, even though they have not been subjected to the tax. By contrast, passengers on the type 1 flights will lose and airlines will limit their losses by being able to pass on some of the carbon tax. Another way of looking at this is the fall in the slot value is smaller than the carbon tax imposed.

If carbon permits are allocated free to the type 1 airlines, they may gain. If the amount of permits allocated is equal to their new output, then they will gain. Their prices will rise but their costs will be the same. This is rather like the case of competition in the non-slot constrained situation. Airlines, which are not part of the carbon permit scheme, type 2 airlines, will still lose as a result of the introduction of the scheme. This is a slightly paradoxical result – if there is a scheme and free allocation of permits, it is better to be in it than out of it.

This case may be a realistic one in Europe. Long haul flights are likely to be subjected to higher carbon taxes than short haul, intra-European flights. The legacy carriers, such as British Airways and Lufthansa, tend to have slots at and use extensively the tightly slot constrained airports, such as London Heathrow and Frankfurt. Their low cost carrier (LCC) competitors tend to use less constrained airports. When carbon taxes are levied on the LCCs, they will pass them on to their passengers in full. When carbon taxes are levied on the long and short haul flights using the slot constrained airports, slot prices will fall by more than the amount of the taxes levied on the short haul flights. The premium for using preferred airports will fall. Thus the costs faced by short haul flights operated by legacy carriers will fall and in a competitive market these cost savings will be passed on. While the airlines themselves will be worse off as a result of a fall in slot values, legacy airlines’ prices will fall, while the prices of their LCC competitors will rise.

Average cost pricing under carbon permit schemes

The analysis so far has assumed that firms maximise profits. Also, an airline will factor in the value of a carbon permit when setting the price to passengers. Even if it was granted the permit free of charge, it recognises that it can sell it at the going market price. It is possible that airlines will simply seek to recover the average cost of their flights from passengers. This cost will be made up of operating costs plus the cost of any permits they need to buy. The implications of this approach are considered in Scheelhaase and Grimme (2007). The case of competitive airlines using non-slot constrained airports is considered here.

The case is illustrated in the following figure. Assume that a scheme of carbon permits is introduced, and that the value of the permits is $P_2 - P_1$. Consider a typical firm in a competitive industry. Assume that this airline is granted $OX_2$ permits. The profit maximising price would be $P_2$ and this would induce an output of $X_2$. The airline would be profitable. Alternatively, it could choose to set prices at an average cost. If it goes beyond an output of $X_2$ it will experience increasing average costs, since it would need to purchase more permits as output
The average cost will begin to rise at $J$ and will asymptote to the price $P_2$. By setting prices equal to $P_3$ and allowing an output of $X_3$ the airline will just achieve cost recovery.

Thus, the impact on prices will be smaller than under profit maximisation and the reduction in output will be smaller. In fact, output will be inefficiently large, since the social marginal cost can be regarded as $P_2$ (if the level of carbon credits has been set optimally) and the actual price is less than this. If the benefits from carbon permits are passed on to the passengers, they will be relatively inefficient as a GGE mitigation strategy. Carbon taxes would be preferable on this ground, since they would be automatically passed on to passengers.

The extent to which airlines behave as profit maximisers or implement average cost pricing (thereby being sales maximisers) is an important empirical issue for determining the likely impact of including airlines in an emissions trading scheme. The difference between fares under profit and sales maximisation will be very substantial. Quite high carbon prices can be consistent with very low changes in average costs (Morrell 2006; Scheelhaase & Grimme 2007). Thus, the impacts on GGEs will also differ markedly. The fact that airlines often gain very valuable airport slots free of charge and often operate in oligopolistic and sometimes monopolistic markets with potential for high profits, suggests that they are not always solely focused on profit maximisation. Airline behaviour may be the most significant unknown factor in assessing the impacts of different GGE mitigation policies.
REFERENCES


# ABBREVIATIONS

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<tr>
<th>Abbreviation</th>
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<tbody>
<tr>
<td>ABARE</td>
<td>Australian Bureau of Agricultural and Resource Economics</td>
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<td>ABS</td>
<td>Australian Bureau of Statistics</td>
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<td>BA</td>
<td>British Airways</td>
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<td>BTRE</td>
<td>Bureau of Transport and Regional Economics</td>
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<td>CGE</td>
<td>Computable General Equilibrium</td>
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<td>CO2</td>
<td>Carbon dioxide</td>
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<td>CTEPR</td>
<td>STCRC Centre for Tourism Economics and Policy Research</td>
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<td>ETS</td>
<td>Emissions Trading Scheme</td>
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<td>EU</td>
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<td>International Civil Aviation Organization</td>
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<td>IO</td>
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<td>STCRC</td>
<td>Sustainable Tourism Cooperative Research Centre</td>
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<td>TSA</td>
<td>Tourism Satellite Account</td>
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<td>VFR</td>
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<td>UNWTO</td>
<td>United Nations World Tourism Organization</td>
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Climate Change and Australian Tourism
A Scoping Study

Jeremy Buultjens, Nadine White and Steven Willacy
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Acknowledgements
This document results from a research project undertaken by the STCRC, in conjunction with ARTRC. The STCRC was established and is supported under the Australian Government’s Cooperative Research Centre’s Program.

Australian Regional Tourism Research Centre
The ARTRC is a partnership between the Sustainable Tourism Cooperative Research Centre (STCRC) and Southern Cross University (SCU). The Centre was formed to undertake research and extension activities to assist in the growth of tourism industries which would contribute to sustainable communities in regional Australia. Since its inception, the Centre has undertaken numerous projects, produced various occasional papers as well as industry-relevant kits. Web: www.regional.tourism.com.au
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1.0 INTRODUCTION

Tourism\(^1\) is essentially a climate-dependent industry with tourists and many of their activities being very sensitive to climate, and therefore climate change (Amelung, Nicholls & Viner 2007; Bigano, Hamilton & Tol 2006; Lise & Tol 2002). The impacts of climate change on tourism can be classified as either physical (e.g. the loss of biodiversity, damage to tourism infrastructure), economic (e.g. reduced tourism expenditure, reduced employment opportunities and increased costs for businesses and society), and social (e.g. health impacts). Bigano et al. (2006) suggest that the impacts on the tourism industry are potentially one of the most significant of all market/industry impacts. The Sustainable Tourism Cooperative Research Centre (STCRC) has identified three key risks to the future viability of tourism industries in relation to climate change:

1. market related risks;
2. regulatory related risks; and
3. weather related risks.

Consumer responses to climate change and government policies introduced to address the impacts of climate change will also impact on the tourism industry. Australia, one of the most distant long haul destinations, may be particularly vulnerable. For example, there may be an increased reluctance by consumers to undertake long haul travel, substituting close destinations. Also policy responses by governments that increase the costs of long haul travel may have significant implications for the Australian tourism industry.

In addition to being affected by climate change, the tourism industry can also impact on climate change (Preston & Jones 2006). For example, numerous activities undertaken by various sectors of the tourism industry, such as travel and accommodation, leave a carbon footprint that contributes to climate change. Mitigation and adaptation strategies undertaken by the industry will also impact on climate change.

Despite the important interrelationships between tourism and climate change, research on these interrelationships has been relatively limited with the industry giving little consideration to the issue until relatively recently (Scott 2003; Hamilton, Maddison & Tol 2005). This is in sharp contrast to a number of other climate change receptive industries (Scott & McBoyle 2006). In order to develop short and long-term strategies to address the impacts on and from climate change it is important for the industry to have a good understanding of the relationships that exist between climate change and tourism. This report provides an overview of this relationship and attempts to identify some research gaps that need to be addressed. The report begins with a brief overview of the causes of climate change and some of the major impacts arising from the changes. The following chapters examine the relationship that exists between climate change and the tourism industry.

---

\(^1\) Tourism is not a single industry but rather a sector that is comprised of a variety of industries. The Australian Bureau of Statistics has developed the concept of ‘tourism related industries’ consisting of ‘tourism characteristic’ industries where more than 25 per cent of output is purchased by visitors (for example, tour operators service, accommodation, cafes and restaurants) and ‘tourism connected’ industries where less than 25 per cent but a significant proportion of output is consumed by visitors (for example, clubs and pubs, casinos and gambling services)
2.0 IMPACTS OF CLIMATE CHANGE

The world’s climate is changing and there is enough evidence and global consensus that a significant element of this change is due to an increase in concentration of greenhouse gases (GHGs) in the atmosphere and much of it as a direct result of human activities (IPCC 1997, 2001, 2007). Increased levels of atmospheric gases (GHGs) also mean that our climate will continue to change throughout this century and beyond (AGO 2007a). The average global surface temperature has increased by 0.6 ± 0.2°C since 1900 and it is expected that the rate and extent of warming are greater than anytime in the past 1,000 years (Hughes 2003). Global warming, together with rainfall and sea level change, appear to be greater than natural decadal and century scale variability. It is now evident from observations of increases in global average air and ocean temperatures that there is widespread melting of snow and ice as well as a rising in the global average sea level (IPCC 2007).

There is also clear evidence to support the view that current climate trends have already had significant impacts on species and ecosystems. For example, in some regions an increase in the incidence of extreme high temperature events, floods and droughts have resulted in increased incidences of fires, pest outbreaks, and changes to ecosystem composition, structure and functioning, including primary productivity (Bicknell & McManus 2006; IPCC 1997). The question now is not whether the climate will change but rather how it will change and what the consequences are for regions and sectors (AGO 2007a). A general description of climate change and major environmental impacts on Australia are illustrated in Table 1.

Table 1: Summary description of environmental impacts on Australia caused by climate change

<table>
<thead>
<tr>
<th>IMPACT</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Changing temperature</strong></td>
<td>• Australia’s continent average temperature has increased by approximately 0.8°C since 1910. Recent warming has been greatest in winter and spring with night-time temperatures increasing more than daytime temperatures by 0.96°C per century (Hughes 2003)</td>
</tr>
</tbody>
</table>
| **Rainfall** | • Projections by CSIRO (2007) for annual average rainfall between 2030 and 2070, relative to 1990, tend toward decreases south-west of the continent (–20% to +5% by 2030 and –60% to +10% by 2070), and in parts of the south-east and Queensland (–10% to +5% by 2030 and –35% to +10% by 2070). Most other locations show changes which vary from –10% to +10% by 2030 and –35% to +35% by 2070.  
• Decreases are most pronounced in winter and spring. Some inland and eastern coastal areas may become wetter in summer and some inland areas may become wetter in autumn. Where average rainfall increases, there would be more extremely wet years and where average rainfall decreases there would be more dry spells. Most models simulate an increase in extreme daily rainfall leading to more frequent heavy rainfall events and flooding (CSIRO 2007). |
| **Sea level rise** | • Global sea levels have remained stable for some 2,000 years until the early 1800s. Coastal tide gauges and satellite altimeter measurements indicate that between 1870 and 2005, the global mean sea level has risen around 20 cm, which translates to an average rise of 1.7 mm per year during the 20th Century. Satellite data suggests that the increase rate is not globally uniform, with higher rates of rise in some areas and even falls in others (AGO 2007a). However, Australia’s coastline is experiencing a rising sea level trend (Newton 2007).  
• The general factors that cause sea level rise include: expansion of ocean water as it warms, the melting of ice on mountain glaciers and ice sheets in Antarctica and Greenland, changes in snowfall, water storage, and vertical land movement caused... |
<table>
<thead>
<tr>
<th>IMPACT</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>by geological processes (AGO 2007a).</td>
</tr>
<tr>
<td></td>
<td>• Approximately half of the indicated global sea level rise in the late 20th Century has been associated with thermal expansion due to warming oceans. There are greater concerns in more recent years of the Greenland Ice Sheet melting at an increasing rate, possibly becoming the next major contributor to sea level rise in the future (Newton 2007).</td>
</tr>
<tr>
<td>Cyclones</td>
<td>• Current indications are that a modest to moderate 20% increase in average and maximum cyclone intensities are expected by the end of the century in northern regions of Australia (Hughes 2003). Tropical cyclones are associated with the occurrence of oceanic storm surges, gales and flooding rains in northern Australia and the frequency of these events would rise if the intensity of tropical cyclones increases (Agnew &amp; Viner 1999; Hughes 2003).</td>
</tr>
<tr>
<td>Storm surge</td>
<td>• Many parts of the Australian coastline are vulnerable to storm surge and Australians have been killed in the past by storm surge events (BOM 2007).</td>
</tr>
<tr>
<td></td>
<td>• Projected rises in average sea level and an increase in intense cyclone activity in the northern regions of Australia will contribute to extreme storm surges, increasing the probability of ocean inundation causing: coastal flooding, coastal erosion, ocean flooding of complex coastal estuarine and wetland areas, low lying islands and coastal communities (Agnew &amp; Viner 1999; McInnes, Walsh &amp; Pittock 2000; Newton 2007).</td>
</tr>
<tr>
<td>Coastal Erosion</td>
<td>• The return of the stormy phase of Inter-decadal Pacific Oscillation (IPO) in combination with sea level rise suggests that future erosion will be greater than during the last 200 years (Tomlinson 2005).</td>
</tr>
<tr>
<td></td>
<td>• The three major effects of climate change that are likely to impact coastal erosion are sea level rise, wave climate shifts and intensification of major storm events (Ash 2005; Tomlinson 2005).</td>
</tr>
<tr>
<td>Coral bleaching</td>
<td>• When corals are exposed to a 1.5-2°C increase in average sea water temperatures for a period of six to eight weeks, their algal symbiosis is disrupted leading to a process known as bleaching (Hughes 2003; Newton 2007).</td>
</tr>
<tr>
<td></td>
<td>• According to various scientific reports, coral bleaching associated with unusually hot sea water temperatures have already caused serious damage to 16% of the worlds coral reefs (Newton 2007).</td>
</tr>
<tr>
<td></td>
<td>• Coastal and shallow reef habitats also face added challenges including sea level rise and increasing intensity of disturbance events such as cyclones, rainfall and runoff (Hughes 2003).</td>
</tr>
<tr>
<td>Species loss</td>
<td>• Shifts in species distribution towards the south by bats and birds and an upward shift in elevation by alpine mammals along with semi-arid reptiles shifting geographic ranges have already been recorded (Hughes 2003; Thomas et al. 2004).</td>
</tr>
<tr>
<td></td>
<td>• The prospect of changes in temperature and rainfall are predicted to have substantial impacts on most vegetation communities (Hughes 2003).</td>
</tr>
<tr>
<td></td>
<td>• Modelling possible impacts of climate change on specific Australian taxa using bioclimatic analysis programs consistently predict contraction and/or fragmentation of species and their current rangers (Hughes 2003; Thomas et al. 2004).</td>
</tr>
<tr>
<td></td>
<td>• According to extinction models used by Thomas (2004), 15-37% of our taxa on earth will commit to extinction with a mid-range global warming scenario of 1.8-2.0°C by the year 2050.</td>
</tr>
<tr>
<td></td>
<td>• Bioclimates of some species of plants and vertebrates in Australia are predicted by Hughes (2003) to disappear entirely with as little as 0.5-1.0°C of warming.</td>
</tr>
<tr>
<td>IMPACT</td>
<td>DESCRIPTION</td>
</tr>
<tr>
<td>--------</td>
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</tr>
</tbody>
</table>
| Fire   |  • Changes in fire regimes are highly likely in the future (Hennessy et al. 2004).
|        |  • Increased fuel load is expected under higher CO$_2$-e levels due to increased plant growth, particularly if reductions in wood and litter nitrogen concentrations reduce decomposition rates (Hughes 2003).
|        |  • Increased temperatures and reductions in humidity will increase fuel dryness and will be exacerbated in those regions where rainfall decreases (Hennessy et al. 2004; Hughes 2003).
|        |  • Using the Macarthur Forest Fire Danger Index and CSIRO climate scenarios by incorporating climatic parameters such as air temperature, relative humidity and days since rain and fuel load, indicates an increase in fire danger over much of Australia with an increase in the number of days of very high and extreme fire danger (Hughes 2003). |
3.0 AUSTRALIAN TOURISM INDUSTRY

As stated previously, tourism is not a single industry but rather a sector that is comprised of a variety of industries including:

- Accommodation: hotels, motels, backpackers, resorts, caravan parks, bed and breakfasts, holiday letting, real estate agents;
- Tour operators;
- Transportation;
- Travel agents;
- Tourist attractions;
- Food and beverage providers; and
- Entertainment venues.

The sector is one of Australia’s biggest and fastest growing industries (Agnew & Viner 1999), is an important economic contributor to many regions throughout Australia and is a major contributor to Australia’s export earnings. In 2005/06, tourism contributed 10.5% of total exports of goods and services and $37.6 billion to the Australian economy. This 10.5% share indicates that tourism is now more significant than many of our long established industries such as: Agriculture, forestry and fishing; Communication services; and Electricity, gas and water supply. International visitors contributed 24.2% of tourism industry GDP, consuming $20.5 billion worth of goods and services, while domestic visitors contributed 75.8% (ABS 2007). In 2005/06, the industries that accounted for the largest share of gross tourism income were:

- Air and water transport (14%);
- Accommodation (13.6%);
- Other retail trade (11.5%); and
- Cafes, restaurants and takeaway food outlets (9.8%).

The sector also contributes significantly to Australia’s regions. In the year ending March 2007, Australians made 46.4 million trips to regional Australia and on average tended to spend just under four nights in accommodation. In the same year approximately 1.9 million international visitors visited regional Australia and, on average, tended to spend 24 nights (DITR 2006b). Tourism overall continues to contribute significantly to Australia’s employment. The tourism industry share of total employment between 2005 and 2006 was 4.6% (ABS 2007).

Domestic tourism forecasts indicate a slight increase in visitor nights of 1% in 2007, followed by a decline of 2% in 2008 and 3% in 2009. This decline is expected due to: continuing high petrol and aviation fuel prices and associated surcharges on airfares; the development of new competitor destinations in Asia; continuing decline in average trips per person; an aging Australian population; and increases in room rates due to capacity constraints. International arrivals forecasts indicate an increase of just under 3% and economic growth of 4% in 2007. Over the long term, international arrivals are expected to increase by 4.9% per annum up to 2016. The total economic value of inbound tourism as a proportion of Australia’s total tourism market is forecast to increase to 35% in 2016 (TFC 2007).

In specific relation to air travel, from late 2008 an increase in aviation capacity, in particular between the United States and Australia and the Middle East and Australia, is expected to place downward pressure on airfares, which will stimulate growth in travel to Australia. This increased capacity is expected to be facilitated by the delivery of new Airbus A380 and Boeing 787 aircraft in 2008. These domestic and international tourism forecasts, developed by the Tourism Forecasting Committee at Tourism Australia, have not taken into account any new greenhouse gas reduction strategies or associated consumer responses beyond those relating to existing taxes and charges (TFC 2007).
3.1 Visitation

During the year to September 2005, there were 204,063,000 domestic and international visitors in Australia. These visitors accounted for 415,458,000 visitor nights spent in Australian cities and regions. International visitors constituted approximately 32% of all visitor nights. Total visitor nights spent in regional Australia constituted approximately 51% of all visitor nights.

International arrivals to Australia grew strongly following the Asian economic crisis in 1998, through to the Sydney Olympics in 2000. However, the next three years saw declines in arrivals due to a number of external impacts, such as the September 11 terrorist attacks, the Ansett collapse and SARS, as well as slow economic growth in 2001. International arrivals recovered strongly in 2004 and continued to grow in 2005, totalling 5.5 million, an increase of 5.4% on previous years. In 2005, the largest number of International visitors came from New Zealand, accounting for approximately 20% of total arrivals. Visitors from the United Kingdom were the next largest group accounting for 12.9%. Japan provided 12.5% of all arrivals, while the United States provided 8.1% (DITR 2006a) (see Figure 1).

In the year to September 2005, the total number of overnight visits by domestic tourists in Australia totalled 282,692. New South Wales received most of the visitor nights at 30%, followed by Queensland with 27%, with the other 43% of domestic visitors shared between the remaining states and territories. Statistics show that 67% of overnight domestic visitors stayed in their own state or territory, while 33% visited other states or territories. In 2005, overnight visitors spent an average $562 per trip totalling $15.5m (DITR 2006a).

In the same period there were 128,831 domestic day visits. These visitors stayed away from home for at least four hours but did not spend a night away from home as part of their travel activity. New South Wales had the most day visitors with 32%, followed by Victoria with 24% and Queensland with 22%, while the remaining states and territories shared the remaining 22%. Expenditure by same day visitors in Australia amounted to $12.4m (TRA 2006). Australia is ranked number five in the world for domestic tourism (number of trips) per capita (Bigano et al. 2006).

3.2 Popular Destinations

Generally the main attractions for international and domestic tourism in Australia are cosmopolitan cities, the Great Barrier Reef, the Blue Mountains, water-based recreation activities and winter sports in the Alps.
(Agnew & Viner 1999). A strong indication of where international and domestic tourists are going is gained by looking at tourists expenditure by region (DITR 2006b). According to DITR (2006a), out of the top 20 most visited regions the top six, which include three Queensland regions, account for 88.2% of the total international expenditure. The top 20 regions comprise 91.2% of international expenditure and 69% of domestic visitor expenditure. Overall the top 20 regions account for 73.4% of all visitor expenditure in Australia (see Figure 2).

![Domestic & International Expenditure by Region (2005)](chart)

Figure 2: The top 20 most visited regions in Australia determined by domestic and international tourist expenditure
(Source: DITR 2006a)

Clearly the tourism industry is an important component of the Australian economy and is reliant on a number of destinations that are susceptible to the impacts from climate change. Some strategic drivers associated with climate change that are likely to directly influence the destination choice of tourists include increased temperatures; increased demand and competition for water; increased demand for energy; increased sensitivity and interest in the environment; and changing attitudes affecting consumer preferences for types of products purchased and transport systems (Miles 2005). In addition, tourism has impacts on climate change. The tourism impacts on climate change and climate change impacts on tourism are discussed in the following chapters.
4.0 TOURISM IMPACTS ON CLIMATE CHANGE

According to the World Tourism Organisation (2003), tourism accounted for 76.5% of total transport emissions in the USA, while tourism in New Zealand accounted for 69% of total transport emissions. Since energy used by tourists travelling to particular destinations in Australia has not been published so far, a report from the Australian Greenhouse Office (2006) is reviewed and illustrates the 2006 GHG emission projections for the Australian domestic transport sector. GHG emissions in the transport sector are defined as emissions produced from the direct combustion of fuels in road transportation, railways, navigation, aviation and off-road recreational vehicle activity, with a view that tourism possibly shares a reasonable portion of total emissions produced from the Australian domestic transport sector. Transport is the third largest contributor of global GHG emissions, producing 14% of all emissions, behind electricity and heat (30%) and agriculture (17%) (TFC 2007). The inclusion of environmental impacts of tourism, in particular energy use and GHG emissions, in the discussion of sustainable tourism development is lacking or ‘almost excluded’ (Becken 2002).

4.1 Greenhouse Gas Emissions Produced by Air Travel

Environmental impacts of air travel itself have been discussed in detail (e.g. IPCC 1999), without reference to tourism. Aviation’s share of total GHG emissions is relatively small at 1.6%, however the forecast growth in aviation traffic has attracted considerable attention in the global media (TFC 2007). GHGs produced by aviation are currently excluded from international inventories for the Kyoto Protocol (Brouwer, Brander and van Beukering 2007). According to the IPCC (1999), global aviation emissions have increased due to an increase in demand for air transport from international and domestic passenger traffic, which continues to grow at rates in excess of reduction in specific emissions from improved technology and operational procedures. For example, carbon dioxide emissions from UK aviation doubled in the ten years from 1990 to 2000 (Brouwer et al. 2007).

Aircraft emit particles and gases straight into the upper troposphere and lower stratosphere where they have an impact on atmospheric composition. These particles and gases alter the concentration of atmospheric GHGs, including carbon dioxide (CO₂), ozone (O₃), and methane (CH₄), which trigger formation of condensation trails, which contribute and increase the formation of cirrus clouds, all of which contribute to climate change (IPCC 1999). Emissions produced from domestic aviation services between 1990-2005 represents one of the fastest growing sources of GHG emissions in the Australian transport industry. Despite accounting for only 4.7% (2.9 Million tonnes (Mt) CO₂-e) of total transport emissions totalling 61.6 Mt CO₂-e in 1990, the growth of international tourism and the decline in cost of domestic air travel mean emissions from domestic aviation are projected to grow 101% to 5.9 Mt CO₂-e in 2010, increasing its share of total emissions from 4.7 to 6.8%. By 2020, emissions from domestic aviation is predicted to increase 140%, which will account for 7% or 7.0 Mt CO₂-e of total transport emissions (AGO 2006) (see Table 2).

4.2 Greenhouse Gas Emissions Produced by Shipping

Domestic shipping emissions are defined as coastal shipping, coastal ferries, inland ferries, pleasure craft, cruise ships and fishing boats. The most dominant shipping activity is long distance carriage of bulk goods on coastal ships, therefore domestic shipping emissions are mainly driven by bulk commodity movements. However, there has been a downward trend in emissions observed between 1990 and 2004, which is mostly due to improvements in modern energy efficient ships that have replaced a number of the existing older fleet, along with improved operational practices and continued rationalisation of services. Emissions from domestic shipping made up 2% of total transport emissions in 2005. Updated projections continue to report domestic shipping emissions to be below 1990 levels in 2010 and 2020 with shipping emissions projected to be 1.8 Mt CO₂-e in 2010 (27% below 1990 levels) and 1.9 Mt CO₂-e by 2020 (23% below 1990 levels) (AGO 2006).
4.3 Greenhouse Gas Emissions Produced by Road Transport

Road transport includes civilian passenger vehicles, light commercial vehicles, trucks, buses and motorcycles. The emissions from road transport made up 89% of total domestic transport emissions, with cars on their own accounting for 54%. Cars also accounted for approximately half of total transport emissions growth with an increase of 7.9 Mt CO$_2$-e, over the period from 1990 to 2005, followed by heavy trucks and buses and light commercial vehicles, with an increase in emissions of 4.3 Mt CO$_2$-e (AGO, 2006) (see Table 2).

4.4 Greenhouse Gas Emissions Produced by Rail Transport

Rail emissions produced within the transport sector include only those emissions that occur from non-electric rail and includes light rail, heavy urban rail, heavy non-urban passenger rail, hired freight and ancillary freight. Emissions from non-electric rail made up only 3% of total transport emissions in 2005 producing 2.1 Mt CO$_2$-e. Rail emissions are predicted to grow at 2.9% per annum between 2005 and 2010, reaching 2.5 Mt CO$_2$-e, (41% over 1990 levels). Between 2010 and 2020, growth in rail emissions is predicted to slow to 1.8% per annum, and reach 3.0 Mt CO$_2$-e by 2020 (69% over 1990 levels) (AGO 2006) (see Table 2).

Table 2: Projected growth of GHG emissions from the Australian Transport Sector, 1990-2020

<table>
<thead>
<tr>
<th></th>
<th>1990</th>
<th>2005</th>
<th>2010</th>
<th>2020</th>
<th>2010 (%)</th>
<th>2020 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passenger cars</td>
<td>35.2</td>
<td>43.2</td>
<td>45.4</td>
<td>49.0</td>
<td>29</td>
<td>39</td>
</tr>
<tr>
<td>Motorcycles</td>
<td>2</td>
<td>0.2</td>
<td>0.3</td>
<td>0.3</td>
<td>23</td>
<td>48</td>
</tr>
<tr>
<td>Buses</td>
<td>1.2</td>
<td>1.4</td>
<td>1.6</td>
<td>1.9</td>
<td>34</td>
<td>63</td>
</tr>
<tr>
<td>LCVs</td>
<td>7.6</td>
<td>11.4</td>
<td>13.4</td>
<td>18.3</td>
<td>77</td>
<td>141</td>
</tr>
<tr>
<td>Rigid trucks</td>
<td>4.1</td>
<td>5.6</td>
<td>6.0</td>
<td>6.4</td>
<td>45</td>
<td>55</td>
</tr>
<tr>
<td>Artic trucks</td>
<td>6.1</td>
<td>8.7</td>
<td>9.6</td>
<td>11.6</td>
<td>58</td>
<td>91</td>
</tr>
<tr>
<td>Aviation</td>
<td>2.9</td>
<td>5.1</td>
<td>5.9</td>
<td>7.0</td>
<td>101</td>
<td>140</td>
</tr>
<tr>
<td>Rail</td>
<td>1.7</td>
<td>2.1</td>
<td>2.5</td>
<td>3.0</td>
<td>41</td>
<td>69</td>
</tr>
<tr>
<td>Shipping</td>
<td>2.4</td>
<td>1.7</td>
<td>1.8</td>
<td>1.9</td>
<td>-27</td>
<td>-23</td>
</tr>
<tr>
<td>Total</td>
<td>61.6</td>
<td>79.5</td>
<td>86.4</td>
<td>99.5</td>
<td>40</td>
<td>62</td>
</tr>
</tbody>
</table>

Note: Emissions from off-road vehicles are not separately identified in this table but are included in total emissions.


4.5 The Pressure on Water from Tourism

In the wider area of sustainable tourism, concerns raised about tourism's high per capita consumption of water, was far in excess of that of local residents and much of the resulting water stress arises in regions and areas which already suffer from inherent water shortages (WTO 2003). Australia is presently facing widespread water management challenges, predominantly in the southwest, where current rainfall, run-off, and stream flows have fallen to levels well below long-term average. Water storage is now well below capacity throughout much of Western and South Australia, Victoria, and Queensland. Water resources are becoming core issues for both the developed and particularly developing areas due to limited resources and a growing population. Water resources are imperative for the supply of a broad range of goods and services, including drinking water, waste management, hydroelectric generation, irrigation, habitat for wildlife, and tourism and recreation opportunities. Past and present experiences in Australia show that climate has the most impact on water management practice. Extreme events are the major challenge. For example, prolonged droughts diminish water availability and sporadic extreme rainfall events produce extensive run-off increasing flood hazards. Patterns of the El Niño–Southern Oscillation affecting Australia signify that the
incidence of flood following drought is higher than just a random pattern. These climatic pressures are indicative of their general high vulnerability to further climatic changes (Jones & Preston 2006).

4.6 Energy Consumed by Tourism

By far the most energy consumed in the tourism industry is travel and is seen as the most important contribution to the rising concentration of GHG emissions (WTO 2003). According to Wall (2004), once tourists have reached their point of destination, the energy consumed is viewed as a very small contribution to global emissions since people eat, sleep, and like to be comfortable whether they are at home or away. However, according to the WTO (2003), the increased demands for energy, water and the generation of wastes have far-reaching local consequences, particularly as tourists tend to make much larger demands than local residents on these already scarce resources. While there is little information or literature available which examine energy consumed by tourism in Australia, in the USA 23.5% of emissions were derived from accommodation, restaurants and retail activities (WTO 2003).

4.7 Impacts of Tourism on Flora and Fauna

High tourism numbers visiting certain regions of the world has impacted negatively on flora and fauna, which in many cases are what tourists come to see. These stresses themselves may intensify the unfavourable effects that climate change is already having on ecology (WTO 2003). However, there appears to be few studies and relatively little published information, particularly in journals, on the effects of tourism on flora and fauna in Australia (Kelly, Pickering & Buckley 2003). According to Kelly et al. (2003), many Australian plant species and communities are recognised as threatened by tourism. A review of management plans, restoration plans and a study by experts found that tourism was considered to be a direct or indirect threatening process for 72 plant taxa. This accounts for one-fifth of threatened species for which threats have been identified. In addition, numerous plant species are listed as threatened by introduced plants, trampling, pathogens, collecting and clearing (Kelly et al. 2003).

A good example is the Jarrah Dieback Fungus which is widespread across Australia, is currently threatening many Australian flora species, and ecosystems and is listed as one of six key threatening processes under the Environment Protection & Biodiversity Conservation Act 1999 (Cth). In Tasmania, 36 of 47 rare plant species tested are susceptible to Jarrah Dieback Fungus, which is spread by wildflower pickers, bushwalkers, vehicles and roadworks. Another threat by tourism is unpremeditated collecting of plants. Seventeen plant species in Australia are listed as threatened by collecting (e.g. Swamp Orchids (Phaius spp.,) and cycads such as Macrozamia macdonnellii in the Northern Territory). However, the distinction between planned collection for horticultural purposes, and casual collecting during tourism activities is not clearly defined. In either case, collecting can include poaching flower stems, fruit, or whole plants for commercial purposes. These are often indirect impacts of tourism, particularly in conservation reserves where tourism is the only commercial activity permitted. Tourism is also considered to be a threatening process for several plant communities. A lack of acceptance of the magnitude of direct and indirect impacts of tourism may potentially delay the conservation of plant species and communities both in Australia and overseas, and also limit the success of sustainable tourism policies, particularly in conservation reserves (Kelly et al. 2003).
5.0 GLOBAL WARMING AND THE IMPACTS ON TOURISM

Climate change can impact and be impacted upon by all the parts of the tourism system. Certain impacts are more obvious, for example, the physical impacts of coastal erosion (Church 2006) and the economic impacts of increased insurance costs. While many others, which are less obvious such as restrictions on tourism development due to limited fresh water supplies and increased cases of tropical diseases, may also have an impact within varied spatial and temporal frames (Agnew & Viner 2001). In addition to the overall impact of climate change on tourism industries in Australia, it is important to assess the relative impact of climate change on the different types of tourism, for example, domestic and international tourism, and nature-based tourism and alpine tourism.

The STCRC has identified regulatory risks to tourism associated with climate change resulting from existing or future government pressure and/or regulations. These include pressures for environmental compliance, assessment and reporting, as well as emission trading and carbon markets (STCRC 2007). Market related risks arise from changes in relative market competitiveness including degraded natural assets, increased energy costs, imposts on travel, and increased concern of travellers relating to purchasing environmentally friendly tourism products (STCRC 2007). The development and promotion of Australia as a ‘clean, green’ destination with a healthy natural environment can be expected to decrease risk in this specific area, however, preparedness to address and mitigate all of these risks is crucial to the sustainability of Australia’s tourism industries.

As stated previously, tourism is climate-dependent and numerous tourism destinations throughout the world are in demand due to their favourable climate and landscapes (Amelung et al. 2007). In addition, climate change poses a major risk to physical resources of tourism industries (Hamilton, Maddison & Tol 2005a). Berrittella, Bigano, Rosona and Tol (2006) suggest that climate change will probably not result in a decrease in international tourism demand but rather there will be a change in which destinations attract tourists. Tourists are likely to be attracted towards the poles and mountainous areas as cooler regions get warmer (Hamilton et al. 2005a). Countries, such as Canada, Scandinavia and Russia are likely to receive a boost in tourism (Stern 2006). Other countries, such as the Maldives, are likely to suffer significant negative tourism. For example, the Maldives which are, on average, less than one metre above sea level will suffer from land submerging and coastal erosion as a result from a small sea level rise.

Perhaps it can be envisaged that tourism demand will decline as climate change diminishes the attractiveness of the physical make up of tourist destinations. However, such a view is one-dimensional as it does not take into account the attractiveness of a destination relative to its competitors. Climate change may also induce the re-structuring of tourism demand and supply patterns, due to displacement of tourist visitation to shoulder seasons and to different regions such as inland or mountain regions. This re-structuring will affect various Australian regions in different ways and a comprehensive regional assessment of risks and opportunities needs to be conducted in order to plan for change.

Several recent studies have investigated the optimum climate for tourism. Lise and Tol (2002) found that OECD tourists prefer a temperature of 21°C at their choice of holiday destination. However, Maddison (2001) found that British tourists are attracted to climates which deviate little from an averaged daytime maximum of 30.7°C. These findings indicate a substantial range in the preferred temperature.

A recent study by Amelung et al. (2007) analysed projections of a Tourism Climatic Index (TCI), the index used to assess the suitability of climatic conditions for tourism activity. The analyses were based on a single, general, global climate model (the HadCM3) and two of four available emissions scenarios. They predicted the number of comfortable months across Australia from a baseline of 1970s for 2020s, 2050s and 2080s. Central Australian regions rated an average of seven ‘good’ months per annum, with a TCI above 70 through to the 2080s. However, the number of ‘good’ months per annum in northern Australia reduced from four in
the 1970s to one in the 2080s. These trends are repeated across both the B1A and A1FI Special Report on Emissions Scenarios (SRES) (IPCC 2001).²

5.1 The Impacts of Sea Level Rise and Storm Surge on Coastal Tourism

There is approximately 70 thousand kilometres of open coast surrounding Australia, including 12 thousand islands and extensive estuarine and wetland areas, which could be inundated by sea level rise (Agnew & Viner 1999). More than 80% of the Australian population live on the east and south-west coastlines of the continent with an estimated quarter of the population growth now occurring within three kilometres of these coastal zones (Newton 2007). In a warmer climate the risk of storm surge may increase as a result of sea level rise mainly caused by thermal expansion of the oceans, and changes in the frequency and intensity of tropical cyclones (McInnes et al. 2000). A combination of storm surge and normal (astronomical) tide is known as ‘storm tide’. When this happens, storm tides reach areas that are normally safe. The worst impacts occur when storm surge arrives on top of a high tide, including massive destruction caused from the pounding waves generated by powerful winds. The area of ocean inundation may extend along the coast for over 100 kilometres, with the ocean pushing several kilometres inland if the land is low lying (BOM 2007). Storm surge poses a larger threat to islands in the South Pacific where many islands are small with a maximum elevation of one or two meters above sea level. Even a small rise in sea level and associated severe events could have devastating effects on these populations (Newton 2007).

The most recent catastrophic events, such as the Indian Ocean tsunami (2004), Hurricane Katrina (2005) and Cyclone Larry (2006) highlight that coasts are already vulnerable (Newton 2007). According to the Bureau of Meteorology (2007), if Cyclone Tracy arrived in Darwin during a high tide, the devastation would have been a lot worse. Similarly, a low tide saved Townsville from a dangerous storm surge that accompanied Cyclone Althea in 1971 (BOM 2007). Cairns is highly valued as a tourist destination and is also at risk to sea level rise and storm surge (Agnew & Viner 1999). Current indications are that a modest to moderate 20% increase in average and maximum cyclone intensities are expected by the end of the century in the northern regions of Australia (Agnew & Viner 1999; Hughes 2003). Modelling by McInnes et al. (2000) point out that if tropical cyclone intensity around Cairns increases up to 20% by 2050, the flood level associated with a one in 100 years flood would increase from the present height of 2.3 to 2.8 metres. An increase in flood level together with sea level rise and storm surge could spell tragedy for Cairns (Hughes 2003). Most of Australia’s top tourist destinations are located on the coastline. Loss of beach and coastal amenity due to erosion may have significant impacts on tourism to beaches and coastal areas in affected regions (Craig-Smith & Ruhanen 2005).

5.2 Global Warming and the Great Barrier Reef

Coral reefs are a crucial source of tourism and other associated income in Australia. The Great Barrier Reef generates $1.5 billion from tourism and is an important reason for Tropical North Queensland being the sixth most visited region in Australia. According to recent scientific reports, coral bleaching associated with global warming will bring devastation to these tropical marine ecosystems. At higher than average temperatures, reef-building corals become increasingly susceptible to damage by light. The organisms important for coral to survive abandon the reef and corals die in large numbers. It has been estimated within the next 20-40 years, the Great Barrier Reef will be severely damaged due to an increase in sea temperature, which will reduce the attractiveness of the area as a tourist destination (Agnew & Viner 1999).

² The SRES are a range of mutually consistent climate and non-climatic scenarios, describing the relationships between the forces that drive GHG and aerosol emissions. Each scenario represents different developments that diverge and result in different levels of GHG emissions. The A1FI scenario is that of a fossil intensive, market oriented world. The economy would be the fastest per capita growth of all scenarios, have a population peak at 2050, then a decline, and governance would consist of strong regional interactions and income convergence. The B1A scenario assumes the further implementation of advanced pollution control measures and exists within a convergent world. Under this scenario, the economy would be service and information based with lower growth than the A1 scenarios and the population would be the same as A1. Governance would consist of global solutions to economic, social and environmental sustainability, and technology would be clean and resource-efficient.
5.3 Climate Change and Kakadu National Park

World Heritage listed Kakadu National Park (KNP) is a significant tourist attraction for the Northern Territory with extraordinary natural and cultural heritage values. KNP contributes approximately $15 million to tourism in the Top End region (Tremblay 2007). Much of the park consists of freshwater wetlands, however these wetlands are at risk of saltwater intrusion, which would result in large scale changes (Eliot, Finlayson & Waterman 1999) particularly to vegetation (Bell, Menges & Bartolo 2001). The CSIRO models of the predicted impacts of climate change suggest that 80% of Kakadu’s freshwater wetlands would be lost under a 2°C temperature rise scenario (Preston & Jones 2006). Fluctuations in sea level are likely to affect the coastal wetlands due to the proximity of certain parts of KNP to sea level (Bell et al. 2001). The protection of the natural assets of KNP is essential to sustainability of tourism in the Kakadu and Top End regions.

5.4 Climate Change and the Snow Skiing Industry

The snow skiing industry is directly linked to climate and its dependence on a steady predictable amount of snow. Snow deficient winters are seen as an indication of global warming impacting on snow skiing, which has driven research into the possible outcome of the ski industry in Switzerland, Scotland and Canada (Bicknell & McManus 2006). The Australian snow skiing industry takes place in New South Wales and Victoria where there are 10 ski resorts spread across the Australian Alps. Four of the resorts are located within the Kosciusko National Park in New South Wales, and another six resorts located on Crown Land in the Victorian alpine region within close proximity to national parks. Vertical drops of ski fields in Australia are quite modest in comparison to European standards and are also at the lower end of international mean elevation level and mean annual snowfall compared with other resorts around the world (König 1998).

On average the Australian Alps provides a significant winter snow cover for up to a few weeks at an altitude of 1200–1400 metres and up to four months or more at higher elevations of 1800–2200 metres (Agnew & Viner 1999). Recent climate modelling indicates that climate change is expected to reduce the amount of snow cover and duration due to increases in temperature. In addition, it is also understood that climate change will reduce the ability to generate artificial snow, which require low humidity and low temperatures. At present, ski resorts can only manufacture snow when these conditions are present, which will occur less frequently as mean temperature rises (Bicknell & McManus 2006). Climate change modelling to simulate snow cover duration and snow depth over the snow season under best case and worst case scenarios developed for the Australian alpine region by CSIRO demonstrate that, under a best case climate change scenario, moderate reduction in snow cover is expected where the area of snow cover will be reduced by 18% by 2030 and by 39% by 2070.

Under the worst case scenario changes are much poorer with an area simulated to have more than 30 days cover reduced by 66% by 2030 and 96% by 2070 (Bicknell & McManus 2006). Under the best case scenario current snow duration is projected to decline to around 10 days by 2030 and 20 days by 2070. Under the worst case scenario, snow duration is proposed to be zero days of snow cover at 1400 m and approximately 40-50 days shorter than current snow duration at higher altitude resorts (Hughes 2003). The relationship between snow cover duration and elevation under climate change means that resorts at lower elevation are potentially more vulnerable to a decline of snow cover (Bicknell & McManus 2006). According to Galloway (1988), a mean snow period of 60 to 70 days is the estimated minimum for a financially viable downhill ski operation in Australia. This would indicate that, under the worst case scenario, only one resort would have enough natural snow cover for a sufficient duration to maintain a financially viable ski operation in 2030. By 2070 no resort would be financially viable if the worst case scenario eventuated (Hughes 2003).

5.5 Climate Change and the Impacts on Human Health

The impacts of climate change on human health in Australia may be considerable. For example, death or illness due to heatwaves or bushfires and other ‘indirect’ health impacts such as a rise in insect borne diseases, such as Ross River Virus and Dengue Fever, could become more common. With an increase in
temperature and precipitation influencing seasonal and geographical abundance, major malaria vector species and vertebrate hosts may increase the potential for the transmission of mosquito-borne diseases in both tropical and temperate Australia (Agnew & Viner 1999; Bosello, Roson & Tol 2006).
6.0 CLIMATE CHANGE AND CONSUMER RESPONSES

The response to climate change by consumers will also have important implications for tourism industries. Negative repercussions for Australian tourism industries may arise from the current media focus on the relationship between air travel, GHGs and climate change. Australia is one of the most distant long haul destinations in the world for the majority of international travellers and, as a market, is almost completely reliant on aviation for the movement of international travellers. Recently a United Kingdom newspaper website reported that a return flight from the UK to Australia is equivalent to the climate change impacts of lighting, cooking and heating in an average house for almost three years (Hailes 2007), exemplifying the type of ‘guilt travel’ media perspective placed on long haul aviation and climate change.

Tourists from Europe are particularly under increasing pressure to consider the impacts of long haul travel on the environment, from both activist groups and government. A significant risk factor for the future of Australian inbound tourism is the reluctance of potential consumers to undertake long haul air travel due to ‘guilt’ from perceived impacts (TFC 2007). Strategies that are available or are already in use to reduce the ‘greenhouse footprint’ of the aviation sector include:

- the use of alternative fuels;
- better management of load factors;
- optimisation of aircraft climb/descent trajectories;
- reductions in cruise speed/altitudes;
- more direct flights;
- improvements in engine efficiency, aircraft design, air traffic control management and infrastructure (TFC 2007).
7.0 CLIMATE CHANGE AND GOVERNMENT POLICIES

Government strategies aimed at climate change will have important implications for the tourism industry. Tourism is a transport-intensive industry and therefore is currently highly dependent on fossil fuels, making it vulnerable to GHG policies. A significant risk to the Australian tourism market, arising from the growing focus on aviation impacts on global warming is policy responses from governments that increase the costs of long haul air travel (TFC 2007). In the United Kingdom, for example, the passenger duty was recently doubled as the treasury believed that the aviation industry needed to better meet its environmental costs. Aircraft emissions are currently not part of the European Union emissions trading scheme and aviation fuel is untaxed (Brown 2006). In Europe, Germans are being urged to take their holidays within Germany, encouraged by Chancellor Angela Merkel who wants significant changes in the European Union’s climate policies (Deutsche Welle 2007). A recent study conducted in Amsterdam shows that 75% of all passengers interviewed would be willing to pay an average surcharge of 23 euros per flight to compensate for the environmental effects of the flight as long as the money is spent directly on climate-related measures (IVM 2007). The findings lend support to the Dutch government’s plan to collect 350 million euros from passengers or approximately 25 euros per ticket (IVM 2007).

Strategies that can potentially reduce the carbon footprint from aviation include carbon trading and offset programs. Carbon or greenhouse gas offsets are certified emission reductions or sequestration that can be purchased to offset emissions (Brouwer et al. 2007). A number of voluntary carbon offset programs currently exist in Australia and internationally. At present the international community is on the verge of moving from voluntary offset schemes for aviation and other tourism related emissions to regulated government schemes. An example of a current voluntary scheme is the Virgin Blue carbon offset program. Monies from the Virgin Blue networks flights go towards the Australian Greenhouse Office's (AGO) Approved Greenhouse Friendly™ Abatement Projects, which include forest sinks, traditional landfill gas flaring plants and avoiding deforestation (AGO 2007b).

Due to increased prices, international tourists could choose to travel closer to home as Australia is a long haul destination for most developed countries. Australia is ranked number five in the world for domestic tourism (in terms of number of trips) per capita (Bigano et al. 2006), therefore these same potential environmental levies may have a positive effect on domestic tourism as more people may decide to travel within Australia rather than overseas, however research is needed to ascertain reliable forecasts under a variety of scenarios.
8.0 THE IMPACT OF CLIMATE CHANGE POLICIES

Scott and McBoyle (2006) propose that one of the key strategies in addressing climate change is to address consumers’ consumption pattern of energy in general but in particular consumption of fossil fuel based energy.

8.1 Key Policies that Aim to Combat Climate Change in Australia

Greenhouse gases are the atmospheric gases responsible for causing global warming and climate change. The major GHGs are carbon dioxide (CO$_2$), methane (CH$_4$), nitrous oxide (N$_2$O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF$_6$). CO$_2$ is a naturally occurring gas; however it is also a by-product of burning fossil fuels and biomass, as well as land-use changes and other industrial processes. It is the principal anthropogenic GHG that affects the earth’s temperature, hence the terms ‘Global Warming’ and ‘Climate Change’ (DPMC 2007a). Australia produces approximately 550 million tonnes of GHGs per year, contributing 1.5% of total global emissions. Australia on its own will have little impact on global warming. However, Australian policymakers believe if the nation can develop a successful local carbon-trading system, it will lead the world in such institutions (Dusevic 2007). Already, the annual cost of various government schemes to limit GHGs and promote renewable energy is approaching $A1 billion, according to Dusevic (2007). As a result of such measures, Australia is on target to reduce 87 million tonnes of GHGs per year by 2010. It is anticipated that current GHGs produced in Australia will fall by 45% by 2010 (DPMC 2007a).

According to the joint government-business Task Group on Emissions Trading the warning signs of climate change cannot be ignored (DPMC 2007b). While the debate continues regarding the precise scale, consequences and costs of climate change, and the scope for long-term adaptation to global warming, there is an increasing acceptance that governments, individually and collectively, should act to mitigate the emission of GHGs. The current suite of climate change policies in Australia includes a large number of measures with a variety of objectives. Some programmes are targeted directly at reducing emissions, including purchasing abatement. While a range of regulatory requirements and grant programmes provide significant support to renewable energy technologies in various applications, including mandating the use of renewable energy (DPMC 2007a). Some of the key policies found in most current literature, which aim to reduce GHG emissions are:

- Abatement programs: This refers to reducing the level or intensity of GHG emissions.
- Carbon tax: A surcharge on the carbon content of oil, coal, and gas that discourages the use of fossil fuels and aims to reduce carbon dioxide emissions.
- Emissions trading: A market-based approach to achieving environmental objectives that allows those reducing GHG emissions below what is required, to use or trade the excess reductions to offset emissions at another source inside or outside the country. In general, trading can occur at the domestic, international and intra-company levels.
- Carbon offset: Is an activity that compensates all or part of the CO$_2$ emissions of a party, by reducing the emissions or increasing the carbon dioxide absorption of another party. For example, planting trees or funding alternative energy deployment. Offsets are commonly raised in relation to emissions trading schemes as they allow low-cost abatement outside the capped sector to be recognised.
- Carbon sequestration: The long-term storage of carbon or carbon dioxide in forests, soils, ocean, or underground in depleted oil and gas reservoirs, coal seams and saline aquifers. Examples include: the separation and disposal of CO$_2$ from flue gases or processing fossil fuels to produce hydrogen and carbon rich fractions; and the direct removal of CO$_2$ from the atmosphere through land-use change, afforestation, reforestation, ocean fertilization, and agricultural practices to enhance soil carbon (DPMC 2007a).
Prime Minister John Howard is convinced Australia should move towards a domestic emissions trading scheme (Howard 2007). If polluters are required to hold tradable permits allowing them to emit defined amounts of GHGs, the market will put a price on carbon. Over time, emissions trading may lead to abatement in the level of GHGs without huge job losses and high costs to industry and consumers (Dusevic 2007). According to DPMC (2007a) with the right settings, a carbon market will curb energy demand and lead to the up-take of new energy technologies (e.g. clean coal, gas, nuclear power and renewable sources).

### 8.2 The Impact of Climate Change Policies on the Australian Tourism Industry

The biggest proportion of energy consumed in the tourism industry is travel, which is seen as the biggest contribution to GHG emissions (Tol 2007). According to the World Tourism Organization (WTO 2003), 42% of international tourists arrive by air. Air travel demands are substantial in the consumption of fuel, and therefore emissions of carbon dioxide. Emissions by the airline industry are predicted to increase 140% by 2020 (AGO 2006). With the pressure to reduce global GHG emissions along with increasing oil prices, the airline industry is set to experience uncertainty in regards to maintaining future growth and the impact on tourism as it affects the cost of travel (Tol 2007). Road travel is another major form of transport for tourism industries. According to the WTO (2003), there is clear evidence that road transport by tourism contributes significantly to GHG emissions. In recognising the impact of tourism on climate change, the WTO (2003) called for the ratification of the Kyoto Protocol. The Kyoto Protocol is an international agreement negotiated under the auspices of the United Nations Framework Convention on Climate Change (UNFCCC), negotiated in 1997 and entered into force in 2005. The Protocol sets binding targets for the reduction of GHG emissions by industrialised countries and includes emission reduction commitments to be met within the first commitment period of 2008 to 2012 (DPMC 2007a).

However, current research and literature regarding tourism declare, policies aimed at reducing GHG emissions in the transport sector will affect tourism globally, not just in industrialised countries. According to Tol (2007), a carbon tax on aviation fuel would predominantly affect long haul flights because of high emissions and short haul flights because of greater emission during take-off and landing. Medium distance flights would be least affected. This implies that tourist destinations that rely heavily on short haul flights or on intercontinental flights will see a decline in international tourist numbers, while other destinations may see international arrivals increase. If carbon tax is applied to the European Union only, then tourists would stay closer to home and European tourism would grow at the expense of other destinations (Tol 2007). In reviewing current literature regarding global carbon tax, it is evident that countries with long haul inbound tourism will be affected the most. Australia is one of these countries as most of Australia’s top ten inbound markets are the UK, USA and Germany (see Figure 1).

According to the WTO (2003), one of its objectives is to increase awareness of climate change in order to change tourist and industry consumption behaviour. Research in Australia and New Zealand by Becken (2004) demonstrates that 36% of tourists believe tourism is a contributor to climate change and are willing to take part in carbon offset programs. With the increasing exposure to the debate on climate change, it is anticipated that tourists’ behaviour towards consumption of tourism products will change due to the concern of contributing to climate change (Barret 2007). Barret (2007) also points out that some industries have created offset programs in order to offer consumers environmentally ‘guilt free’ products. In order to satisfy a term used in tourism industries, ‘Jet Guilt’, a consumer can choose to carbon offset a flight on the Virgin Blue Airline network, through a financial contribution which goes towards the Australian Greenhouse Office’s (AGO) Approved Greenhouse Friendly Abatement Projects (AGFA). Examples of the types of abatement activities, which may be approved under AGFA, include energy efficiency measures, waste diversion and recycling, generation of renewable energy and avoided deforestation projects (Virgin Blue 2007). There is limited research on tourist behaviour and the consumption of tourism products which may impact on climate change in Australia, however this could be a significant factor, considering that most of Australia’s inbound tourists come from countries where climate change is widely recognised as an environmental concern (Becken 2004).
9.0 NEED FOR FURTHER RESEARCH AND PLANNING

It is important to be able to predict the effect of climate change on international and domestic tourism flows throughout the next 20, 50 and 100 years (Amelung et al. 2007). An understanding of the effects of climate change on tourism seasonality in regional areas of Australia is also important to strategic planning (Amelung et al. 2007). Planning for factors such as restrictions on tourism development due to limited fresh water supplies and increased cases of tropical diseases within varied spatial and temporal frames are examples of the pragmatic approach that strategic tourism research and planning must take.

The STCRC has a number of research outcomes that are relevant to climate change and tourism issues. Furthermore the STCRC makes recommendations for tools and solutions that focus on three levels: National Actions; Regional or Destination Based Actions; and Business and Enterprise Actions, as well as for overarching national policy initiatives and stakeholder engagement (STCRC 2007). National actions suggested by the STCRC include the establishment of a national Climate Change Steering Committee and advisory group, in addition to a research program. The development of a Carbon Footprint for Tourism, a National Carbon Calculator, and a Tourism Sustainability Portal are also considered important national actions. The STCRC recommends the development of a modelling program to map climate change impacts on biogeographic regions and a national carbon offset program (STCRC 2007).

Destination Based Actions recommended by the STCRC include the implementation of Destination Risk Management Strategies, the preparation of Destination Management Plans focusing on climate change with National Best Practice Models, and to assist regions to implement sustainable tourism benchmarking. The STCRC also recommends Business/Enterprise actions including supporting environmental performance training programs for small businesses throughout Australia and supporting local governments to apply appropriate precinct planning and design (STCRC 2007).

The following additional recommendations for further research and planning are considered essential to the sustainability of Australian tourism industries through the coming period of significant climate change:

1. Short, medium and long term strategic planning is required for Australia and for risk management for tourism industries.
2. Development of long term water plans to allow for population and tourism growth.
3. Identification and analysis of trigger points, thresholds, predictions, models, and seasonal risk assessments for tourism industries.
4. Preparation of hazard maps of vulnerabilities, e.g. predicted SL rise and inundation zones (Jones 2003).
5. Research and development of appropriate strategies for infrastructure protection from SL rise and coastal erosion: retreat, adapt or protect?
6. Future development planning should be above accepted Probable Maximum Flood levels (Boyd 2005) and above SL rise encroachment allowing for storm surge and wind-waves (Ash 2005; Tomlinson 2005).
7. Research into tourists’ potential reactions to both the perceived and actual impacts of climate change and the impacts on travel patterns (Amelung et al. 2007).
10.0 CONCLUSIONS

The most effective method of avoiding the impacts of climate change is through mitigation of climate change, by decreasing CO₂ levels in the atmosphere and reducing GHG emissions. The reduction of GHG emissions can be achieved through key mitigation technologies, such as renewable energy systems, fuel efficiency and changes in behaviour patterns. However, the scenarios modelled by the IPCC indicate that if all GHG emissions were to cease immediately, climate change would still occur, therefore preparing for adaptation to climate change is essential. The sustainability of Australia’s tourism industries through the impending period of significant climate change is dependant upon actions taken now to reduce risk and plan for change.

Existing scientific evidence indicates that impacts from climate change will vary across regions. The implications for tourism in Australia are that industry and government need to improve their understanding of how these impacts will affect tourism flows, seasonality, assets and growth. Tourism industries can expect to be economically impacted by climate change and adaptation is crucial to reducing vulnerability to climate change (Stern 2006). The effects of changes on seasonality and other aspects of tourism will depend on the flexibility demonstrated by institutions, tourism industries and tourists as they react to climate change (Amelung et al. 2007). The potential impacts of climate change require management at destination level, regional level and national level. Effective impact mitigation and adaptation strategies developed specifically for tourism can be expected to secure a sustainable future for Australia’s tourism industries. With appropriate support from research and supportive policy making, Australian tourism industries can adapt to climate change and be sustainable well into the future.
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