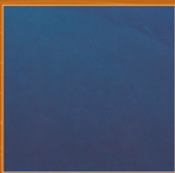


# The Carbon Footprint of Australian Tourism



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**Sustainable Tourism Cooperative Research Centre**  
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## EXECUTIVE SUMMARY

The focus of this report is on the ‘Carbon Footprint’ of the Australian tourism industry. Increasingly the shorthand term ‘Carbon Footprint’ is used to refer to the amount of greenhouse gas (GHG) emissions (CO<sub>2</sub> equivalent) associated with the production and consumption of goods and services at the level of an individual firm, industry or entire economy. Producing goods and services for tourism results in GHG emissions in both the home economy, Australia and abroad.

The measures presented here are comprehensive and include all the GHG emissions produced by Australian tourism globally. They include:

- GHG emissions which arise directly from tourism production—for example, from the fuel used by tour buses;
- indirect GHG emissions, for example, from electricity used by resorts; and
- GHG emissions from imports which are provided to tourists or the industry and from the transport of those imports—these emissions do not come from Australian production.

The objective is to present measures of global GHG emissions from tourism. These various components are presented separately, however.

This paper reports outputs from two approaches to estimating the direct and indirect carbon ‘costs’ of the Australian tourism industry for the year 2003–04. These Carbon Footprint estimates (in Mt, millions of tonnes), include the home (Kyoto) emissions and in addition, emissions from international aviation and overseas production, to gain an indication of the global emissions from Australian tourism.

### **Carbon Footprint of Australian Tourism**

The **production based estimates** are for the Carbon Footprint arising from production of the Australian tourism industry, as defined and measured by the Australian Tourism Satellite Account (ATSA).

The production based estimates include:

- GHG emissions directly produced by tourism industries;
- inbound and outbound aviation services of Australian airlines; and
- GHG emissions from imports used in producing goods and services for sale to the Australian tourism industry.

The production based estimates exclude:

- inbound or outbound services of non-Australian based airlines; and
- GHG emissions from imports directly purchased by tourists.

The **expenditure based estimates** are for the Carbon Footprint which arises from the expenditures by non-Australian based and domestic tourists on tourism in Australia.

The expenditure based estimates include:

- air travel by visitors provided by Australian and non-Australian based airlines.

The expenditure based estimates exclude:

- expenditure on outbound trips by departing Australian residents except for the part of this expenditure which relates to activities within Australia (e.g. for travel costs and hotels within Australia preceding or following an international flight); and
- expenditure on outbound air fares.

Using the **production approach** we estimate:

- Total direct GHG emissions 26.3 Mt
- Total indirect GHG emissions 28.1 Mt

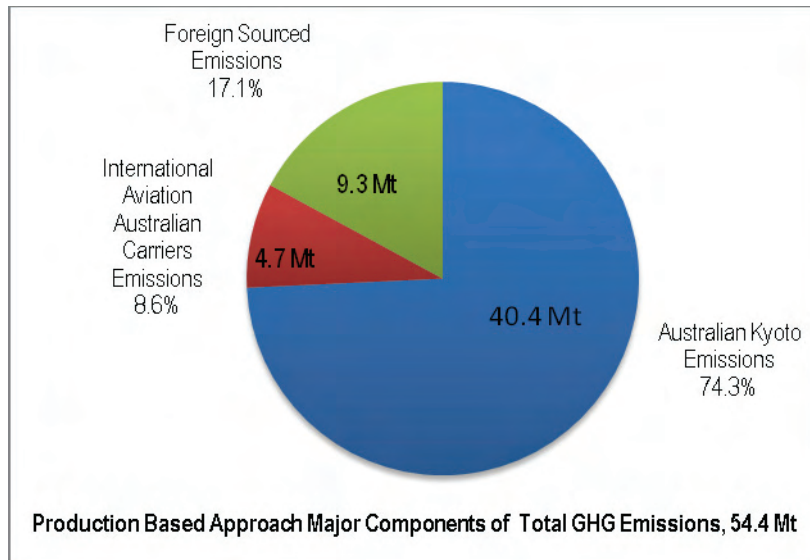
Total global (direct plus indirect) GHG emissions are estimated to be 54.4 Mt. Shares of direct and indirect GHG emissions in total GHG emissions were 48.3 per cent and 51.7 per cent respectively.

When our current ‘Kyoto’ emissions are considered the Australian figures are 21.6 Mt direct and 18.8 Mt indirect for a total of 40.4 Mt. Assessing and attributing the particular case of international aviation emissions is complex, largely because the ‘rules’ for attribution for global aviation emissions to individual economies are yet to be determined. To the present these remain outside of national Kyoto targets, but given Australia’s distance from markets it is important that the magnitude of this component (and future risk) be examined. Some alternative approaches to measuring the extent of the components of this issue are reported in this report.

Shares of GHG emissions by Australian Kyoto, foreign sourced and international aviation – Australian airlines in total GHG emissions were 74.3 per cent, 17.1 per cent and 8.6 per cent, respectively, as illustrated in Figure 1 below.

The major components are displayed below. These results are shown in detail in Table 1 in the main report.

**Figure 1 Production Based Approach Major Components of Total GHG Emissions**



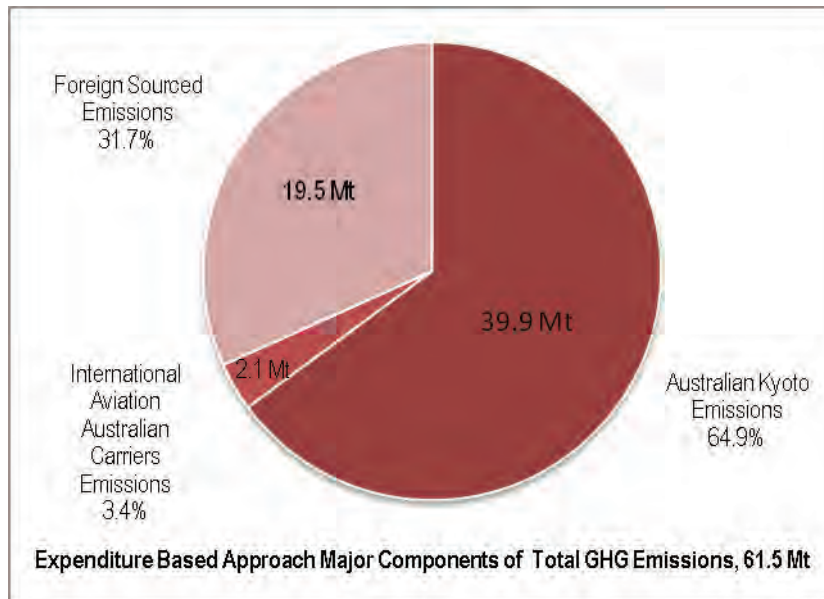
Using the **expenditure approach** we estimate:

- Total direct GHG emissions 29.5 Mt
- Total indirect GHG emissions 32.0 Mt

Total (direct plus indirect) GHG emissions are estimated to be 61.5 Mt. The major components are displayed below. The Australian Kyoto emissions are calculated as 39.9 Mt with an additional 21.6 Mt emissions produced by the global activity generated by tourists to and within Australia. As noted above, the international aviation components of these emissions are largely unattributed at the present but remain as a significant risk to the Australian tourism sector. Emissions from goods and services imported into Australia are the responsibility of

other countries, but would affect Australian tourism if their prices were to change due to implementation of climate change mitigation policies in supplier countries. These results are shown in detail in Table 2 in the main report.

**Figure 2 Expenditure Based Approach Major Components of Total GHG Emissions**

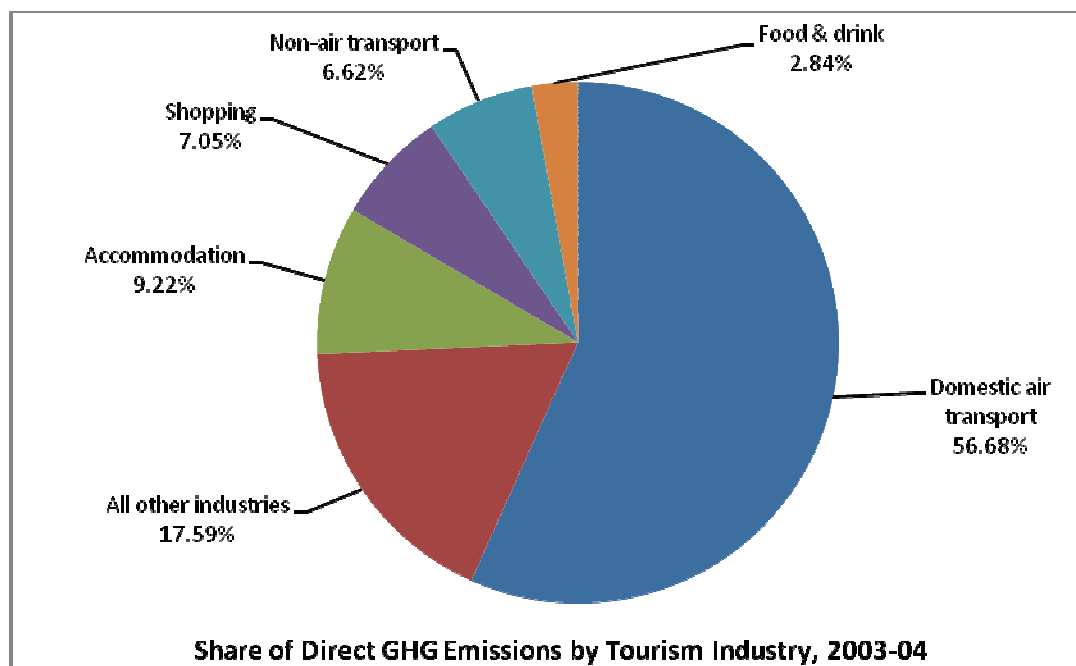


Production based total direct GHG emissions by the Australian tourism industry in 2003–04 was 10.5 Mt (see Table 1). These are estimates of GHG emissions directly produced by tourism industries, based on the model database (Adams, 2006). The tourism industry is as defined in the Australian Tourism Satellite Account (ATSA). This is an aggregation of the tourism components of other industries. They include domestic but not international aviation, and they do not include emissions from use of private motor vehicles for tourism. The detailed industry breakdown is given in Table A1.

Domestic air transport was the largest component of tourism industry GHG emissions at 56.68 per cent, followed by accommodation services (9.22%), shopping (7.05%), non-air transport (6.62%), and food and drink (2.84), as illustrated in Figure 3 opposite.

These estimates of the Carbon Footprint of the Australian tourism industry are, to our knowledge, the most accurate to date given the available data. The notes to the tables explain the differences between the production and expenditure based approaches and outline the difficulties and methods of calculating international aviation and foreign sourced GHG emissions. While these are not currently part of Australia’s Kyoto emissions they are nonetheless significant in the debate on global climate change and are subject to increasingly intense international scrutiny.

**Figure 3 Shares of Direct GHG Emissions by Tourism Industry 2003–04**



### ***Comparison with ‘Non-Tourism’ Industries – Direct Emissions***

The report compares the Carbon Footprint of tourism with that of other industries. Tourism direct emissions that include:

- emissions from tourism industries;
- household use of motor vehicles for tourism purposes; and
- Australian production of international aviation services

represent 4.74 per cent of the total emissions from Australian industry and households.

Tourism is the sixth-ranked industry in terms of emissions. Table A7 shows this for the *Production based carbon footprint* of tourism. Tourism direct emissions that include:

- emissions from tourism industries;
- household use of motor vehicles for tourism purposes; and
- Australian production of international aviation services **plus** emissions by non-Australian based international airlines servicing inbound tourists

represent 5.29 per cent of the total emissions from Australian industry and households.

This places tourism as the fifth-ranked industry in terms of emissions. Table A8 shows this for the *Expenditure based carbon footprint* of tourism.

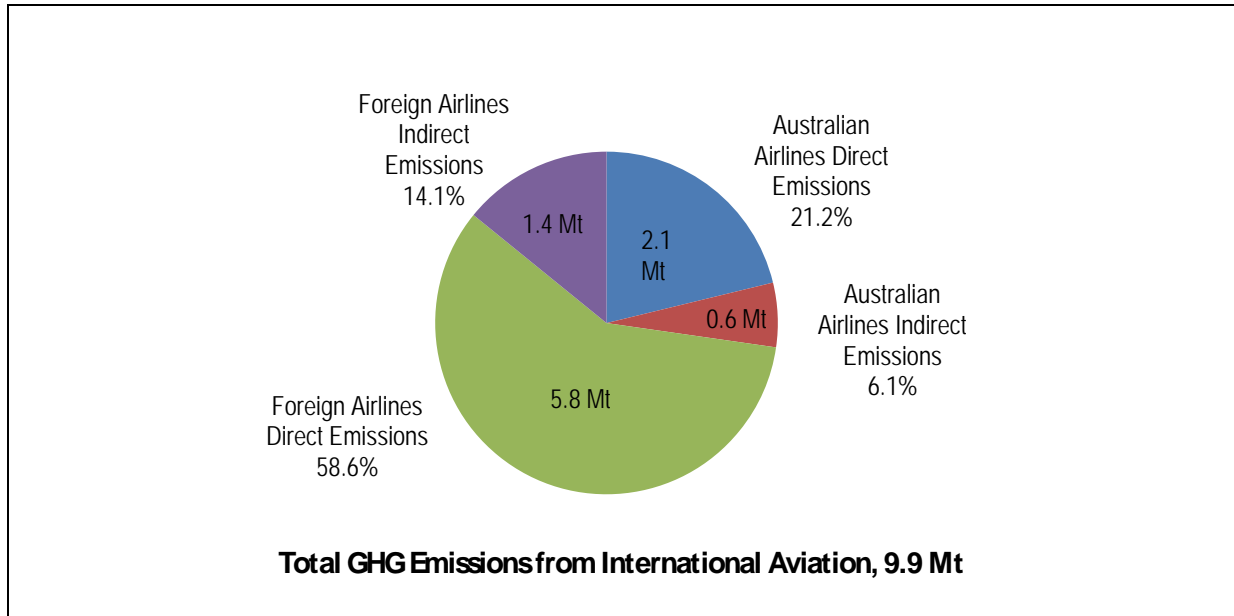
Users of this information need to be aware of the dangers of making comparisons with carbon emissions from other industries and against the economy as a whole, particularly as our estimates for tourism include non-Kyoto and indirect effects.

**Total Emissions from International Aviation**

The report estimates GHG emissions from inbound international passenger aviation, excluding freight.

Total direct and indirect GHG Emissions are 9.9 Mt. This comprises Australian airlines GHG emissions of 2.7 Mt and non-Australian based airlines GHG emissions of 7.2 Mt. Total GHG emissions from international aviation (both Australian and non-Australian based) in 2003–04 was 9.9 Mt. Shares of direct GHG emissions by non-Australian based and Australian based airlines were 58.6 per cent, 21.2 per cent respectively while indirect GHG emissions by non-Australian based airlines, and Australian based airlines were 14.1 per cent and 6.1 per cent, respectively.

**Figure 4 Total GHG Emissions from International Aviation**



Some of the emissions from Australian tourism are produced in Australia, and are GHG emissions which are included under Kyoto accounting rules. In addition there are GHG emissions from Australian firms producing in Australia which are not included under Kyoto rules—the main example of this is GHG emissions from Australian airlines’ international services. There also are GHG emissions which are produced overseas, for example, in the production of goods which Australia imports to supply tourists or the tourism industry. Australia has responsibility for its ‘Kyoto’ emissions and has committed to reduce them. It has no specific commitments to reduce GHG emissions from international aviation<sup>1</sup>, and GHG emissions from the production of goods which Australia imports to supply to tourists or the tourism industry—these are the responsibility of the countries which produce them. Whatever are the commitments of Australia at the present time, policies to mitigate and to adapt to climate change need to be based on as much detailed information as is available regarding the emissions of GHG associated with economic activity. The estimates contained in this report are intended to provide such information.

<sup>1</sup> It also makes no judgment on the ‘radiative forcing effect’ that some argue may arise from the emissions of GHGs at higher altitudes by aircraft—the science surrounding this effect is still uncertain.



*Chapter 1*

## INTRODUCTION

This report is the latest in a series of reports published by the Sustainable Tourism Cooperative Research Centre (STCRC) addressing the issue of climate change and tourism. Climate change, which has substantial capacity to affect Australia's destination competitiveness, is the result of a build up of greenhouse gases (GHGs), chiefly carbon dioxide (CO<sub>2</sub>) in the atmosphere. Policies to mitigate and to adapt to climate change need to be based on as much detailed information as is available regarding the emissions of GHG associated with economic activity. Increasingly, the shorthand term 'Carbon Footprint' is used to refer to the amount of GHG emissions associated with the production and consumption of goods and services at the level of an individual firm, industry or entire economy. The focus of this report is on the 'carbon footprint' of the Australian tourism industry.

In this Report we present a comprehensive measure of the Carbon Footprint of tourism, or, in other words, the CO<sub>2</sub> equivalent emissions associated with Australian tourism. The measures are for 2003–04, the latest year for which the data needed for a fully comprehensive measure were available. The footprint would have grown somewhat since.

The development of a Carbon Footprint for tourism is not straightforward, as there are several different interpretations given to what the Carbon Footprint is, and what it should encompass (for some discussion, see Patterson and McDonald, 2004; Becken and Patterson, 2006; Dick Sisman and Associates, 2007; Kelly and Williams, 2007; and Lundie, Dwyer and Forsyth, 2007). Here we have sought to be as all-inclusive as possible. Several measures of the Carbon Footprint for other countries are less inclusive, and simply focus on some key sectors. Details are given for the various components of the Footprint.

Another issue concerns the definition of tourism. In this Report, tourism consists of the economic activities included in the Australian Tourism Satellite Account (TSA). The TSA is widely used in Australia, and this Carbon Footprint is consistent with it. However, even within the TSA there are several measures of 'tourism'. One measure is the production by the Australian tourism industry—this includes services provided by Australian international airlines to inbound visitors and outbound Australian tourists. The TSA also measures tourism expenditure in Australia and this also includes expenditure on imports provided to tourists. Here we report on both a production based measure of the Footprint, and an expenditure based measure.

The measures presented here are comprehensive and include all the GHG emissions produced by Australian tourism globally. They include:

- GHG emissions which arise directly from tourism production—for example from the fuel used by tour buses;
- indirect GHG emissions, for example, from electricity used by resorts; and
- GHG emissions from imports which are provided to tourists or the industry and from the transport of those imports—these emissions do not come from Australian production.

The objective is to present measures of global GHG emissions from tourism. These various components are presented separately however.

Some activities in tourism pose particular difficulties. One of these concerns the use of motor vehicle fuel. The production of this fuel creates emissions, but in addition, the consumption or use of the fuel also generates emissions. The GHG emissions created by tourists' use of motor vehicles is included as part of the Carbon Footprint.

International aviation also produces emissions. In the TSA, output of Australian airlines producing international services is included. Thus, in the production based measures, GHG emissions from this source, both direct and indirect, are counted. In the expenditure based measures, international aviation is handled differently—the GHG emissions associated with carrying inbound visitors, travelling on Australian and non-

## ***THE CARBON FOOTPRINT OF AUSTRALIAN TOURISM***

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Australian based airlines, are included, but the GHG emissions from airlines carrying outbound Australian residents are excluded.

The objective has been to be as comprehensive as possible and to present the GHG emissions arising globally as a result of Australian tourism, though the various components can be identified. Different GHG emissions can be treated differently. Some of the emissions from Australian tourism are produced in Australia, and are GHG emissions which are included under Kyoto accounting rules. In addition there are GHG emissions from Australian firms producing in Australia which are not included under Kyoto rules—the main example of this is GHG emissions from Australian airlines' international services. Finally there are GHG emissions which are produced overseas, for example, in the production of goods which Australia imports to supply tourists or the tourism industry. Australia has responsibility for its 'Kyoto' emissions and has committed to reduce them. It has no specific commitments to reduce GHG emissions from international aviation, and GHG emissions from the production of goods which Australia produces are the responsibility of the countries which produce them.

Using the production based measure of the Carbon Footprint, the total global emissions associated with Australian tourism was 54.5 Mt in 2003–04, and of this, 40.4 Mt were Kyoto emissions. Using the expenditure based measure, the global footprint was greater, at 61.5 Mt, though the Kyoto emissions were slightly lower than those for the production based estimate, at 39.9 Mt. The expenditure based measures have higher global GHG emissions because they include more air transport, along with GHG emissions associated with imports provided directly to tourists.

In using these estimates, it is important to be aware of what they seek to measure and what they do not. A Carbon Footprint is essentially an accounting measure, to determine how GHG emissions intensive an industry is. It is not an impact model. Thus, it would not be correct to conclude that if the tourism industry were to expand by 10 per cent, global GHG emissions on a production base would increase by 5.44 Mt (10% of 54.4 Mt). Changes in the size of the tourism industry will induce changes in other industries, and these would need to be taken into account. Furthermore, it is not possible to use these estimates to obtain anything other than a rough measure of the impact that the introduction of an emissions trading scheme, as proposed by the Australian government, will have on tourism. This policy will have effects across the whole economy, and it is necessary to take these into account in a full modelling exercise to determine the impact of the scheme on Australian tourism.

*Chapter 2*

**APPROACH AND METHOD**

The estimates measure GHGs directly produced by the industries which make up the tourism industry – for example, the induced GHG emissions of the tourism component of industries in Australia such as domestic aviation, accommodation, cafes and restaurants and food outlets etc.

The tourism industry is as defined in the Australian Tourism Satellite Account (ATSA)<sup>2</sup>. This is an aggregation of the tourism components of other industries. Given the limitations of the databases used, the estimates provided in this report have been produced using the MMRF (Monash Multi-Regional Forecasting) – Green industry classifications<sup>3</sup>. This is similar, though not identical, to the classifications used in ATSA. Thus, when aggregated the estimates in this report correspond exactly with the ATSA definitions and measurements, although at the individual component industry level small differences may occur (see ‘Tourism Industry’ in Appendix B including Footnote 10).

GHGs from production of international airline services by Australian-based airlines have been included, reflecting the fact that such production is included in ATSA.

The Carbon Footprint has been estimated for 2003–04, the latest year for which detailed industry GHG emissions data are available in a form suitable for this type of estimate. The primary data sources for these estimates are the ATSA, the MMRF-Green database<sup>4</sup>, the Bureau of Transport and Regional Economics database<sup>5</sup>, and Department of Climate Change (DCC)<sup>6</sup> estimates of industry and household GHG emissions. Carbon dioxide equivalent (CO<sub>2</sub>-e), as measured by the DCC is used in these estimates.

**Direct GHG Emissions Estimates**

The estimate provided here for the Carbon Footprint of the tourism industry is directly comparable to the GHGs or Carbon Footprint of other industries as represented in the DCC statistics on industry GHG emissions with two notable exceptions. These are the handling of international aviation GHG emissions outside Australia, and inclusion of private motor vehicle use (see below) both of which pose particular problems for estimation of the tourism industry’s Carbon Footprint.

International aviation production by Australian airlines (e.g. Qantas carrying passengers from Sydney to Singapore or Singapore to London) is included as part of tourism production in ATSA. Hence, for consistency, GHGs resulting from this production need to be included in the estimates.

There are, however, no available estimates of GHGs from Australian airline international aviation services. The DCC excludes international aviation in its estimates, although it does include domestic aviation. It also includes estimates of GHGs from aviation fuel sold in Australia to international airlines (including Qantas, Singapore Airlines and Emirates). This is different from the GHGs resulting from international operations by Australian airlines and different from GHGs generated by international tourism to and from Australia.

The use of fuel in motor vehicles in Australia adds to GHGs produced in Australia. In the DCC data, however, these GHGs are included in the GHG emissions of the household sector and not of the industrial sector. Thus while tourism use of household motor vehicles is another source of GHGs, it is not strictly part of the ‘tourism industry’ when defined in production based terms. Because of the significance of this component of tourism generated GHGs (from both domestic and international visitor activity), they have been identified and included in this report. Tourism expenditure data from the ATSA were used to estimate tourism purchases and use of fuel, and these in turn were used to estimate GHGs.

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<sup>2</sup> Australian Bureau of Statistics (2007)

<sup>3</sup> Adams (2006)

<sup>4</sup> *Ibid*

<sup>5</sup> Bureau of Transport and Regional Economics (2007)

<sup>6</sup> Department of Climate Change (DCC), 2007a (formerly the Australian Greenhouse Office)

For the production based measures, an estimate of the GHG emissions resulting from Australian airlines' international services was obtained by multiplying the Qantas international passenger services by an estimate of the emissions per passenger kilometre from the German Aerospace Institute (DLR) (personal communication). These estimates allow only for the passenger component of flights and exclude air freight. In 2003–04 by far most Australian based international services were provided by the Qantas Group.

Estimates for international aviation using the expenditure measure include inbound passenger aviation only. Workings for the estimates are shown in Table A4. They are based on passenger kilometres from major inbound tourism markets as identified from Tourism Research Australia's International Visitor Survey (IVS), Qantas market shares, adjustments for non-direct flying (5%) and scaled down to allow for multiple destination visits (e.g. where a UK visitor makes a stopover in Hong Kong—see paragraph below). The non-Australian based aviation component includes an allowance for short haul connecting flights in origin regions. GHG emissions were estimated at 0.126 g per passenger km for short haul flights (Scheelhaase and Grimme, 2007) and 0.085g per passenger km for long haul flights (from German Aerospace Institute, DLR).

The multiple destinations adjustment factor was calculated as follows. Data on the proportions of visitors who visited another country en route to and from Australia were taken from the 2003–04 IVS for each of the recorded main origin markets. Estimates were made of the length of stay of visitors from each origin market. The proportions of the days spent on trips from each destination in Australia were estimated. Thus, for example, the proportion of the days spent in Australia on a trip from New Zealand was estimated at 0.96, and from the US (on which multiple destinations are common), was 0.81. Direct aviation GHG emissions from the whole trip were allocated according to the proportion of days spent in Australia. For details see Table A4. In total, this adjustment reduces the estimated GHG emissions from international aviation from 8.9 to 7.9 Mt (Table 3).

It should be noted that there is a considerable range of estimates of the carbon emissions from aviation. The estimates here are in the lower to middle of this range. The aircraft used on Australian international routes are large and relatively new, and thus their emissions per passenger km are relatively low. Australian routes are less congested than Northern hemisphere routes, and flights are more direct. As noted above, an allowance has been made for multiple trips, which are important for long haul destinations such as Australia.

There is also considerable global debate about the attribution of carbon 'debits' among multiple destinations on the same trip, and indeed to source or destination countries themselves. While these debates will take some time to resolve it is believed important that Australia be aware of its total range of potential liabilities.

### **Indirect GHG Emissions Estimates**

Indirect GHG emissions are estimated at 19.2 Mt. This includes 0.4 Mt from indirect use of aviation and since this has already been counted in the direct estimates, it is deducted from the 19.2 Mt, giving a total of 18.8 Mt. These estimates were derived from calculations of the outputs of each industry associated with supplying inputs to tourism. These calculations were based on the purchases by the air transport industry, as recorded in the database and input output structure of the Australian economy embodied in the Monash University Centre of Policy Studies (CoPS) MMRF model (Adams, 2006). Details for each industry are provided in Table A2.

The ATSA indicates that the tourism industry purchases \$36.3 billion of inputs (output less gross value added), and Table A3 indicates that gross indirect output was \$48.7 billion, of which it is estimated that \$25.4 billion represents indirect gross value added (GVA) produced in Australia (using figures which are consistent with the ATSA).

The difference between \$36.3 billion and \$25.4 billion is imports of 10.9 billion—this represents the total import content of Australian tourism production and sales.

GHGs from imports are emissions produced in other countries as a result of producing goods and services for export to Australia. The pattern of imports was estimated using the Australian Input-Output structure in the MMRF model, and it was assumed that GHG emissions from each product would bear the same ratio to output as it does in Australia (i.e. it is assumed that equally emissions intensive technologies are used in Australia and abroad). The direct GHG emissions are estimated to be 3.2 Mt, this estimate excludes indirect emissions. To get the total, it was assumed that the total GHG emissions from imports would bear the same proportion to value as

for the indirect GHG emissions from tourism. After scaling up the estimate to allow for indirect emissions, an estimate of 8.1 Mt of GHG emissions is obtained.

The estimate of emissions from shipping imports to Australia was based on an estimate of the total GHG emissions from shipping goods to and from Australia, and the tourism import share (4.8%) of total imports and exports in value terms.

Aviation produces GHG emissions indirectly through its purchases of goods and services. These are automatically included in GHG emissions indirectly produced by Australian airlines. The estimate for non-Australian based airlines is based on the same ratio of value of inputs purchased to GHG emissions as for Australian airlines. It is assumed (based on industry consultations) that non-Australian based airlines purchase 90 per cent of their inputs used for inbound passenger from foreign sources, and 10 per cent from Australian sources which are already accounted for in the estimates for the Australian tourism industry.

## *Chapter 3*

### **CARBON FOOTPRINT OF AUSTRALIAN TOURISM: RESULTS**

Carbon Footprint estimates (GHG emissions) are produced here on both a production base and on an expenditure base.

The production based estimates are for the Carbon Footprint arising from production of the Australian tourism industry, as defined and measured by the Australian Tourism Satellite Account (ATSA). They include inbound and outbound aviation services of Australian airlines, but not inbound or outbound services of non-Australian based airlines. They do not include GHG emissions from imports directly purchased by tourists, but do include GHG emissions from imports used in producing goods and services for sale to the Australian tourism industry.

The expenditure based estimates are for the Carbon Footprint which arises from the expenditures by foreign and domestic tourists on tourism in Australia as reported in the ATSA. These exclude expenditure on outbound trips by departing Australian residents except for the part of this expenditure which relates to activities within Australia (e.g. for travel costs and hotels within Australia preliminary to or following an international flight). They exclude expenditure on outbound air fares. But they include air travel by visitors provided by Australian and non-Australian based airlines.

The main differences between the two estimates are:

- the production based estimates *include* international inbound and outbound air travel supplied by Australian airlines, while the expenditure estimates only include inbound services of Australian airlines;
- the production based estimates *exclude* inbound air travel supplied by non-Australian based airlines, while the expenditure based estimates include this; and
- the production based estimates *exclude* imports directly purchased by tourists while the expenditure based estimates include this.

These differences in calculation give rise to consequential differences in some of the component measures of Australian tourism's Carbon Footprint. The results are displayed in Figures 5 and 6.

The tables below provide the results of a **production based calculation** (Table 1) and an **expenditure based calculation** (Table 2).

The Tables include five columns.

- The first column includes GHG emissions from Australian based production and consumption—these count as Australian emissions for Kyoto measurement purposes.
- The second column includes GHG emissions from Australian supplied international aviation. These are Australian sourced emissions, though they currently are not counted for Kyoto measurement purposes.
- The third column includes GHG emissions from foreign producers, either of aviation services, or imports used directly or indirectly by Australian tourism.
- A fourth column provides the total GHG emissions for each row which are expressed as percentages in the final column.

Table data record the estimates of CO<sub>2</sub> equivalent emissions in million tonnes (Mt).

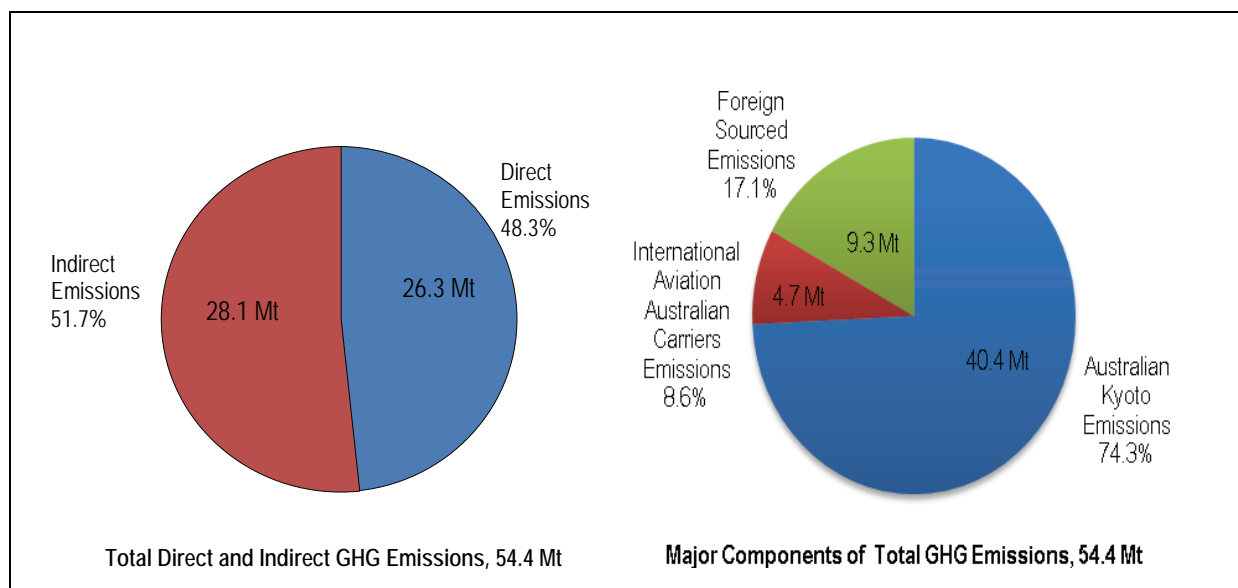
## Production Based Carbon Footprint

**Table 1 Production Based Carbon Footprint (GHG in Mt), 2003–04**

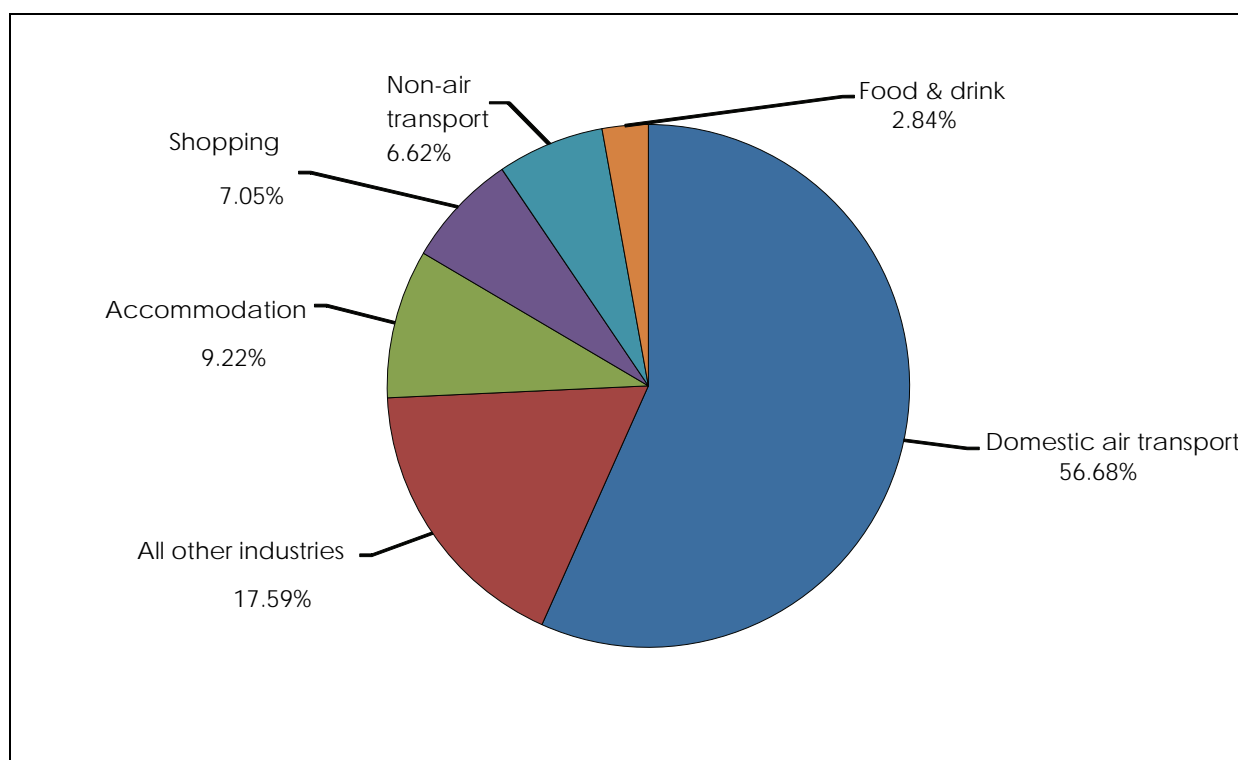
Source	<b>Kyoto</b>	<b>Non-Kyoto</b>		Total GHG <b>(Kyoto+non-Kyoto)</b> Emissions	% Share of Total Direct & Indirect GHG Emissions
	Australian Kyoto Emissions	International Aviation Australian Airlines Emissions	Foreign Sourced Emissions		
1. Direct Emissions from Tourism Industries	10.5			10.5	19.30
2. Emissions from Tourism-related Private Motor Vehicle Use	11.1			11.1	20.40
3. Emissions from International Aviation		4.7		4.7	8.64
<b>4. Total Direct GHG Emissions</b>	<b>21.6</b>	<b>4.7</b>		<b>26.3</b>	<b>48.35</b>
5. Indirect Emissions from Tourism Inputs	18.8			18.8	34.56
6. Emissions from Imports			8.1	8.1	14.89
7. Emissions from Transport of Imports			1.2	1.2	2.21
<b>8. Total Indirect GHG Emissions</b>	<b>18.8</b>		<b>9.3</b>	<b>28.1</b>	<b>51.65</b>
<b>9. Total Direct and Indirect GHG Emissions</b>	<b>40.4</b>	<b>4.7</b>	<b>9.3</b>	<b>54.4</b>	<b>100.00</b>

Production based total direct and indirect GHG emissions by Australian tourism in 2003–04 was 54.4 Mt. Shares of direct and indirect GHG emissions in total GHG emissions were 48.3 and 51.7 per cent, respectively. GHG emissions by Australian Kyoto (40.4 Mt), foreign sourced (9.3 Mt) and international aviation – Australian airlines (4.7 Mt) in total GHG emissions were 74.3, 17.1, and 8.6 per cent respectively, as illustrated in Figure 5.

**Figure 5 Shares of Tourism GHG Emissions – Production Based, 2003–04**



**Figure 6 Shares of Direct GHG Emissions by Tourism Industry, 2003–04**



Production based total direct GHG emissions by Australian tourism industry in 2003–04 was 10.5 Mt. Domestic air transport was the largest component of tourism industry GHG emissions at 56.68 per cent, followed by accommodation services (9.22%), shopping (7.05%), non-air transport (6.62%), and food and drink (2.84%), as illustrated in Figure 2. Food and drink refers to animal food (meat and dairy), other food and drink; non-air transport refers to road transport, rail transport, water transport and other transport; and shopping refers to textile, clothing and footwear (TCF), wood products, paper products, chemical products, and non-metal and mineral products as reported in Table A1.

**Notes: Table 1**

***Direct GHG Emissions from Tourism Industries (Row 1)***

These are estimates of GHG emissions directly produced by tourism industries, based on the model database (Adams, 2006). They include domestic but not international aviation. The detailed industry breakdown is given in Table A1.

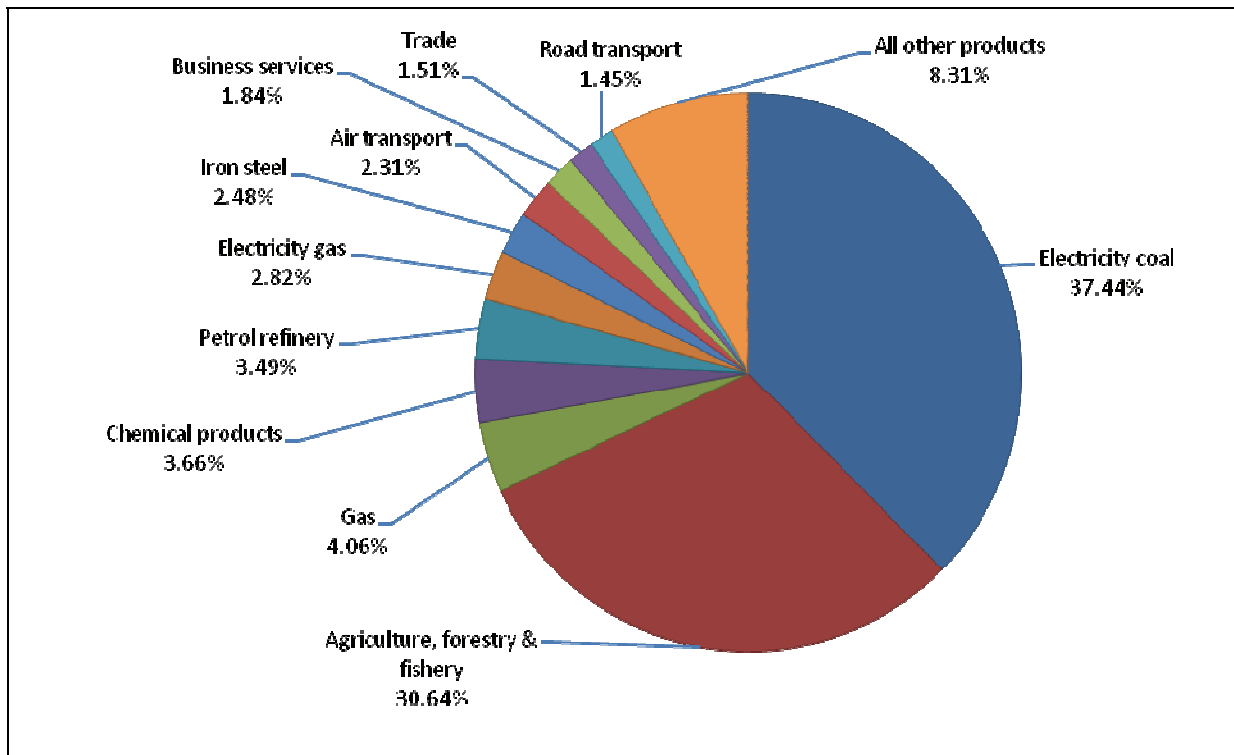
***Emissions from Motor Vehicles (Row 2)***

From the ATSA we can estimate vehicle fuel purchases, from which GHG emissions can be derived, while Department of Climate Change (DCC) data has been used to identify household use of motor vehicles for tourism related travel. The estimate of GHG emissions from use of motor vehicles for tourism is based on the average of estimates derived using estimates of the total GHG emissions associated with motor vehicle travel and the proportion of this travel represented by tourism. These differ by less than 10 per cent.

***Emissions from International Aviation (Row 3)***

Qantas provided 55,395 million passenger kilometres (pkm) of international services in 2003–04 (Qantas Annual Report 2003–04). The largest share of GHG emissions (assume 80%) would have been produced by Boeing 747s, which produce an average of 0.09 kg/pkm and a smaller share (assume 20%) by Airbus A330s (or equivalents) at 0.065 kg/pkm. These estimates are from the German Aerospace Institute (DLR). This gives an average of 0.085 kg/pkm. In 2003–04 nearly all international services by Australian airlines were operated by Qantas and its subsidiaries. This gives an estimate of 4.709 Mt of GHG emissions in 2003–04. This estimate does *not* include freight, as this activity is not counted as tourism.

**Figure 7 Shares of Indirect GHG Emissions from Tourism Purchases, 2003–04**



***Indirect Emissions from Tourism Inputs (Row 5)***

Indirect GHG emissions from tourism purchases excluding outbound international aviation in 2003–04 was 18.8 Mt. Details for each industry are provided in Appendix Tables A2 and A3. Electricity coal was the largest component of indirect GHG emissions at 37.44 per cent, followed by agriculture, forestry and fishery 30.64 per cent, gas (4.06%), chemical products (3.66%), petrol refinery (3.49%), electricity gas (2.82%), iron steel (2.48%), air transport (2.31%), business services (1.84%), trade (1.51%) and road transport (1.45%), as illustrated in Figure 7.

***Emissions from Imports (Row 6)***

As described in text.

***Emissions from Transport of Imports (Row 7)***

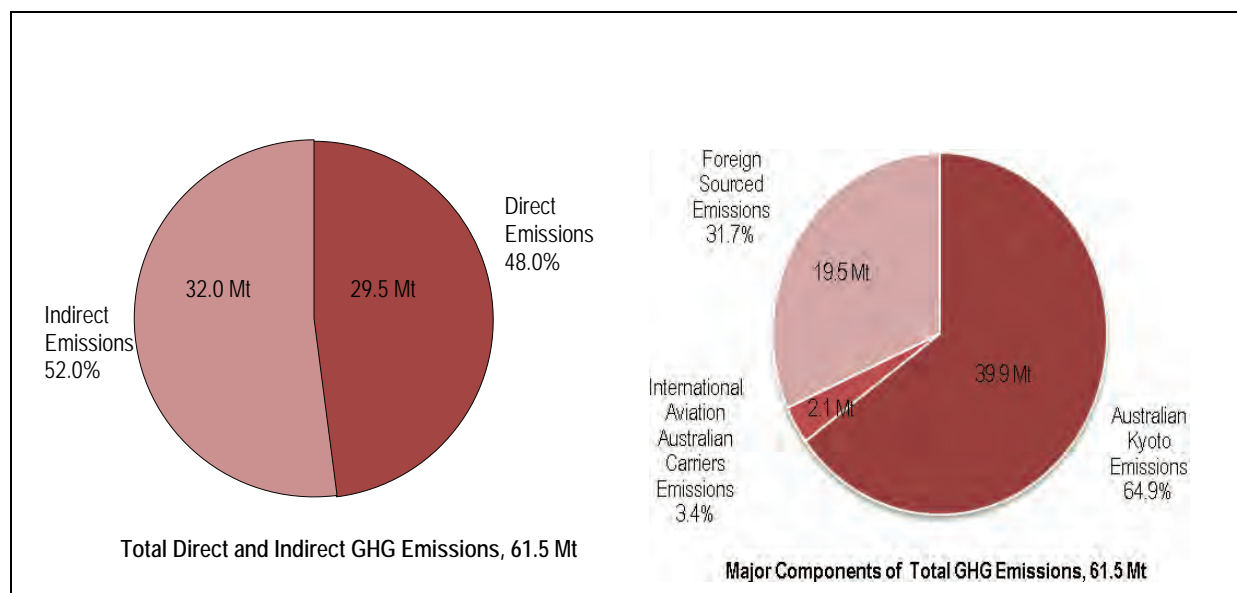
As described in text.

## Expenditure Based Carbon Footprint

**Table 2 Expenditure Based Carbon Footprint (GHG in Mt), 2003–04**

Source	Kyoto	Non-Kyoto		Total GHG (Kyoto + non-Kyoto) Emissions	% Share of Total Direct and Indirect GHG Emissions
	Australian Kyoto Emissions	International Aviation Australian Airlines Emissions	Foreign Sourced Emissions		
1. Direct Emissions from Tourism Industries	10.5			10.5	17.07
2. Emissions from Tourism-related Private Motor Vehicle Use	11.1			11.1	18.05
3. Emissions from International Aviation – Australian		2.1		2.1	3.41
4. Emissions from International Aviation – non-Australian Based			5.8	5.8	9.43
<b>5. Total Direct GHG Emissions</b>	<b>21.6</b>	<b>2.1</b>	<b>5.8</b>	<b>29.5</b>	<b>47.97</b>
6. Indirect Emissions from Tourism Inputs (excluding outbound aviation)	18.3			18.3	29.76
7. Emissions from Imports			7.7	7.7	12.52
8. Emissions from Imports Directly Purchased			3.2	3.2	5.20
9. Emissions from Transport of Imports			1.6	1.6	2.60
10. Emissions from International Aviation – Non-Australian Based			1.2	1.2	1.95
<b>11. Total Indirect GHG Emissions</b>	<b>18.3</b>		<b>13.7</b>	<b>32.0</b>	<b>52.03</b>
<b>12. Total Direct and Indirect GHG Emissions</b>	<b>39.9</b>	<b>2.1</b>	<b>19.5</b>	<b>61.5</b>	<b>100.00</b>

**Figure 8 Shares of Tourism GHG emissions – Expenditure based, 2003–04**



Expenditure based total direct and indirect GHG emissions by Australian tourism in 2003–04 was 61.5 Mt. Shares of direct and indirect GHG emissions in total GHG emissions were 48.0 and 52.0 per cent, respectively. GHG emissions by Australian Kyoto (39.9 Mt), foreign sourced (19.5 Mt) and international aviation – Australian airlines (2.1 Mt) in total GHG emissions were 64.9 per cent, 31.7 per cent and 3.4 per cent, respectively, as illustrated in Figure 4.

**Notes: Table 2**

***Direct GHG Emissions (Rows 1 and 2)***

These are the same as those in Table 1 for tourism industries and motor vehicles.

***Emissions from International Aviation (Rows 3 and 4)***

As described in text.

***Indirect Emissions from Tourism Inputs and Imports (Rows 6 and 7)***

These are slightly different from those in Table 1 because outbound international aviation services by Australian airlines are excluded. The industry breakdown of the indirect emissions estimates is given in Table A3.

***Emissions from Directly Purchased Imports (Row 8)***

These are estimated on the same basis as emissions from imports used indirectly.

***Emissions from Transport of Imports (Row 9)***

GHG emissions relating to transport of imports is estimated to be 3.2 Mt. This is higher than in Table 1 (1.2 Mt) because it includes an estimate for imports directly purchased by tourists (Row 9).

***Indirect Emissions from Non-Australian Based Aviation (Row 10)***

As described in text.

## **Comparisons with ‘Non-Tourism’ Industries – Direct GHG Emissions**

Given the different measures of what constitutes tourism there is no one ideal measure to compare tourism's emissions with those of other industries. Tourism is unlike other industries in that it produces both Kyoto and non-Kyoto emissions.

Tables A5 to A8 in the Appendix provide indications of tourism's direct contribution to GHG emissions, relative to those of non-tourism industries. Indirect emissions for other industries are not currently available. Since tourism is a part of other industries, there is double counting, and percentages do not sum to 100 per cent.

Table A5 shows that direct tourism industry emissions, *excluding* emissions from use of motor vehicles and from international aviation, represent 2.11 per cent of the total emissions from Australian industry and tourism is the ninth ranked ‘industry’ identified in terms of emissions.

From Table A6 it can be seen that tourism direct emissions *including* emissions from tourism industries and household use of motor vehicles for tourism purposes represent 3.93 per cent of the total emissions from Australian industry and households, and tourism is the seventh ranked industry in terms of emissions.

Table A7 shows that tourism direct emissions *including* emissions from tourism industries, household use of motor vehicles for tourism purposes, and Australian production of international aviation services represent 4.74 per cent of the total emissions from Australian industry and households, plus international aviation, and tourism is the sixth ranked industry in terms of emissions. This table corresponds to the *Production based carbon footprint* of tourism.

In Table A8, tourism direct emissions *including* emissions from tourism industries, use of motor vehicles and the production of both Australian and non-Australian based international aviation services for inbound tourists represent 5.29 per cent of the total emissions from Australian industry and households, and international aviation, and tourism is the fifth ranked industry in terms of emissions. This Table corresponds to the *Expenditure based carbon footprint* of tourism.

The measures which are most relevant for comparison purposes are Tables A6 and A7. However, Table A6 understates the full production and emissions from tourism as it is formally defined in the TSA by excluding some production which is included in the TSA (production associated with international air services by Australian airlines. Table A7 on the other hand, includes the same production as the TSA, but some of this produces non-Kyoto emissions (production associated with producing international aviation services).

Thus, if the objective is to compare the proportion of tourism's total contribution to output, as defined by the Australian TSA, with the proportion of its contribution to emissions, then Table A7 provides the most relevant measure. However, if the intention is to count only Kyoto emissions, then Table A6 is the more relevant table. The two alternative sets of data cannot be compared with one another, however, because of the different definitions of the industry which have been used in each case.

## **Total GHG Emissions from International Aviation**

The question of assessing GHG emissions from international aviation is the most difficult component of this exercise, and the one that will inevitably strike most debate on the international stage. It is possible to view the model both with, and without, international aviation emissions. Notwithstanding the temptation to do the former, aviation emissions are at present too complex to be incorporated into the Kyoto framework. Given Australia's distance from markets it is important that the magnitude of this component (and future risk) be examined as mitigation policies to be enacted to meet the challenges of climate change may well have serious consequences for long haul travel.

GHG emissions from international aviation are summarised in Table 3. These are based on the expenditure estimates which allow for multiple destination trips.

**Table 3 Direct and Indirect GHG Emissions from International Aviation (in Mt), 2003–04**

	<b>Australian Airlines GHG Emissions</b>	<b>Non-Australian Based Airlines GHG Emissions</b>	<b>Total Airlines GHG Emissions</b>	<b>% Share of Total Direct and Indirect GHG Emissions</b>
Direct	2.1	5.8	7.9	79.80
Indirect (from indirect production in home country and Imports)	0.6	1.4	2.0	20.20
<b>Total Direct and Indirect GHG Emissions</b>	<b>2.7</b>	<b>7.2</b>	<b>9.9</b>	<b>100.00</b>

Total GHG emissions from international aviation (both Australian and non-Australian based) in 2003–04 was 9.9 Mt. Shares of GHG emissions, generated as follows:

- non-Australian based airlines direct emissions 58.6 per cent;
- Australian airlines direct emissions 21.2 per cent;
- non-Australian based indirect emissions 14.1 per cent; and
- Australian airlines indirect emissions 6.1 per cent, respectively.

This is illustrated in Figure 9.

**Figure 9 Shares of Direct and Indirect GHG Emissions from International (Australian and Non-Australian Based) Airlines, 2003–04**

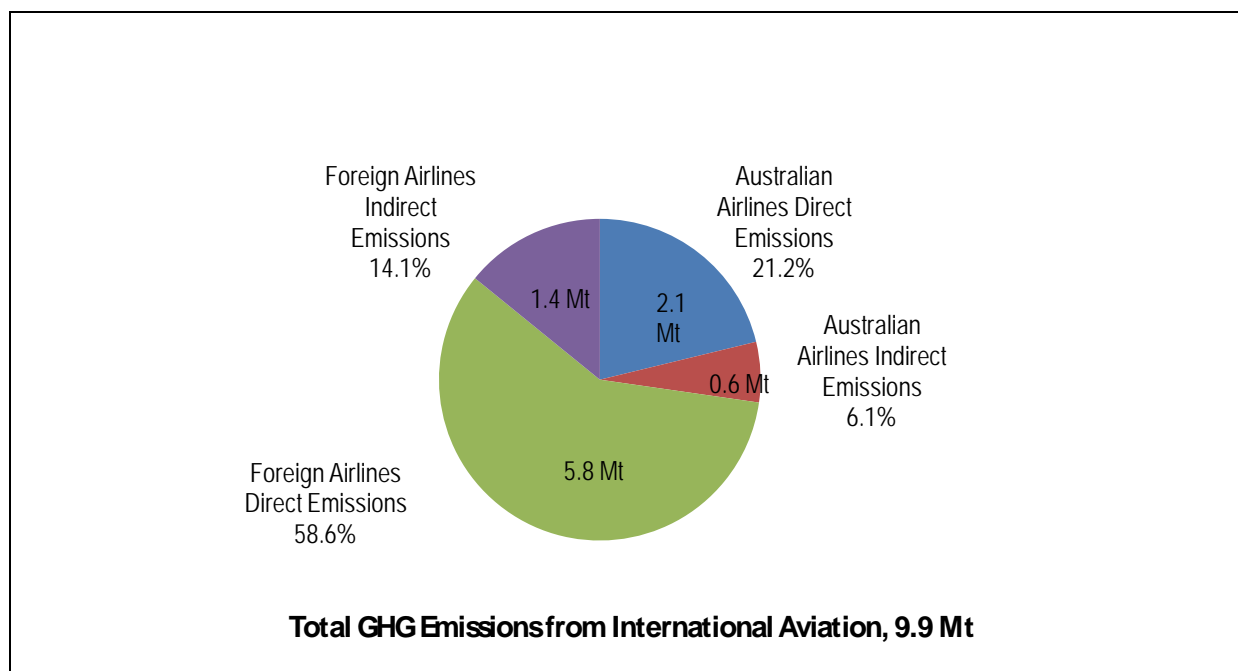


Table 3 shows that direct GHG emissions from international aviation are significantly larger than the indirect GHG emissions, though the latter are moderately significant. The shares of Australian and non-Australian based airlines in GHG emissions reflect their shares of traffic. The percentage of total emissions from international aviation, at around 20 per cent, is as expected, given Australia's distance from its markets and the fact that aviation is a relatively GHG emission intensive industry.

Table A4 shows the Expenditure based GHG emissions associated with inbound one way and return travel. Of the countries included in this table, travel to Australia from the UK, with 0.926 Mt CO<sub>2</sub> for a one way trip, generates the highest emissions. This is followed by other Europe (0.519 Mt) and Japan (0.469 Mt). The least GHG emissions are associated with Malaysia (0.102 Mt), Indonesia (0.040 Mt) and Thailand (0.052 Mt). As discussed in Note 2 under Table 2, the estimates of GHG emissions from international aviation do not depend upon distance only, but allow for market volume and transit destinations en route to Australia.

***Chapter 4***

**FURTHER DIRECTIONS**

It would be feasible to expand on, and further develop, this Carbon Footprint in several directions. Some of these are:

- Development of State Carbon Footprints based on the State TSAs which have been developed by the STCRC Centre for Economics and Policy for 2003–04, and which are currently being updated for 2006–07.
- The Carbon Footprint is estimated for 2003–04, the latest year for which the full data set necessary was available. It would be feasible to update this work, though with some loss of accuracy. Updating would be able to take into account changes in the outputs of the tourism industry by relying on recent ATSAs. Recent information on emissions intensities of industries, and improvements in efficiency would be more difficult to obtain, though projections can be made, enabling a more up to date Carbon Footprint to be estimated.
- The present Carbon Footprint presents detail on the industry composition of emissions in the Appendices, but further analysis of the data contained in these would be feasible.
- A logical further development of this work is a study of how the proposed emissions trading scheme (ETS) for Australia will impact on the tourism industry. This would take into account impacts on tourism costs, prices and international competitiveness, impacts on individual industries, and impacts on tourism flows and industry output and employment. This would require a full computable general equilibrium modelling exercise, of the sort that the STCRC Centre for Economics and Policy has done for other tourism issues. While it would be possible to obtain a first pass at an estimate of how the ETS will directly impact on tourism costs by using this Carbon Footprint and suggested carbon prices, the ETS will have impacts on a wide range of industries and prices and these, in turn would impact on tourism. In addition, different variants of the ETS will have different impacts on tourism—for example, if major emissions intensive export industries are shielded from the ETS, as is proposed, this will impact more severely than if these industries are not given such treatment. Thus an accurate assessment of how tourism will be affected by the ETS requires a full modelling study.

*Chapter 5*

## SUMMARY

Deriving a Carbon Footprint for the tourism sector is a particularly complex task which parallels the challenges of developing robust tourism satellite accounts over the past two decades.

This paper reports outputs from two approaches to estimating the direct and indirect carbon ‘costs’ of the Australian tourism industry. These are basically the same, though they reflect slightly different definitions of what constitutes the ‘tourism industry’.

Using the **production approach** we estimate:

- Total direct GHG emissions 26.3 Mt
- Total indirect GHG emissions 28.1 Mt
- Total (direct plus indirect) GHG emissions 54.4 Mt

Using the **expenditure approach** we estimate:

- Total direct GHG emissions 29.5 Mt
- Total indirect GHG emissions 32.0 Mt
- Total (direct plus indirect) GHG emissions 61.5 Mt

The above estimates of the Carbon Footprint of the Australian tourism industry are, to our knowledge, the most accurate to date given the available data.

Among the various activities that support tourism the data highlight the significant role that transport/tourist distribution plays in the Australian tourism sector. While aviation emissions are currently in the global spotlight, for Australia the use of private motor vehicles for regional travel contribute close to half of all industry emissions. A carbon constrained future economy could significantly challenge the current distribution patterns seen within Australian tourism.

Assessing and attributing the case of international aviation emissions is more complex, largely because the ‘rules’ for attribution for global aviation emissions to individual economies are yet to be determined. To the present these remain outside of national Kyoto targets, but given Australia’s distance from markets it is important that the magnitude of this component (and future risk) be examined. Total direct and indirect GHG Emissions are 9.9 Mt. This comprises Australian airlines GHG emissions of 2.7 Mt and non-Australian based airlines GHG emissions of 7.2 Mt. Some alternative approaches to measuring the extent of the components of this issue were reported herein.

For international aviation emissions, 4.7 Mt are estimated when Australian based airlines (international outbound and inbound) are included, but this figure is reduced to 2.1 Mt under the assumptions of the expenditure model which include the international services of Australian airlines’ to inbound tourists but not to outbound tourists. In the expenditure estimates, foreign supplied inbound aviation services are included. Under such considerations non-Australian based airlines bringing visitors to Australia also bring into focus 5.8 Mt of GHG emissions.

The report also compares the Carbon Footprint of Australian tourism with that of other industries.

Tourism direct emissions *including* emissions from tourism industries, household use of private motor vehicles for tourism purposes, and Australian production of international aviation services represent 4.74 per cent of the total emissions from Australian industry and households, plus international aviation, and tourism is the sixth ranked industry in terms of emissions. Table A7 shows this for the *Production based carbon footprint* of tourism.

## ***THE CARBON FOOTPRINT OF AUSTRALIAN TOURISM***

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Tourism direct emissions *including* emissions from tourism industries, use of private motor vehicles for tourism purposes and the production of both Australian and non-Australian based international aviation services for inbound tourists represent 5.29 per cent of the total emissions from Australian industry and households, and international aviation, and tourism is the fifth ranked industry in terms of emissions. Table A8 shows this for the *Expenditure based carbon footprint* of tourism.

The dangers of making comparisons with carbon emissions from other industries and against the economy as a whole are acknowledged, particularly as our estimates for tourism include non-Kyoto and indirect effects.

## APPENDIX A: GHG EMISSIONS TABLES A1 – A8

Table A1 Direct GHG Emissions by Tourism Industry (in Mt), 2003–04

Industry	Total Direct GHG Emissions (Mt) <sup>7</sup>	Tourism Share of Output	Tourism's Direct GHG Emissions (Mt)	Share of Total Direct GHG Emissions by Industry, %
Animal food	0.547	0.066	0.036	0.34
Other food	2.368	0.077	0.181	1.72
Drink	0.430	0.189	0.081	0.77
Textile, clothing, footwear (TCF)	0.473	0.117	0.055	0.52
Wood products	0.369	0.007	0.002	0.02
Paper products	1.278	0.050	0.064	0.61
Petrol refinery	4.996	0.113	0.567	5.40
Chemical products	22.318	0.025	0.558	5.32
Non-metal and mineral products	2.509	0.024	0.061	0.58
Other equipment	0.378	0.023	0.009	0.09
Trade	6.723	0.041	0.278	2.65
Accommodation services	2.160	0.448	0.967	9.22
Road transport	5.279	0.104	0.549	5.23
Rail transport	0.448	0.091	0.041	0.39
Water transport	0.776	0.055	0.043	0.41
Domestic air transport	7.080	0.840	5.947	56.68
Other transport	0.834	0.074	0.062	0.59
Communication services	1.770	0.071	0.126	1.20
Ownership of dwellings	0.134	0.028	0.004	0.04
Business services	4.655	0.006	0.027	0.26
Government administration & defence	0.980	0.001	0.001	0.01
Education	0.594	0.060	0.036	0.34
Health	0.651	0.091	0.059	0.56
Other government	0.210	0.037	0.008	0.08
Other services	12.663	0.058	0.731	6.97
<b>Total</b>	<b>80.623</b>	<b>0.130</b>	<b>10.493</b>	<b>100.00</b>

<sup>7</sup> Source: MMRF-Green database (Adams, 2006).

## ***THE CARBON FOOTPRINT OF AUSTRALIAN TOURISM***

**Table A2 Indirect GHG Emissions from Tourism Purchases (in Mt), 2003–04**

<b>Product</b>	<b>Tourism Indirect Output (\$m)</b>	<b>GHG Emissions (Mt)</b>	<b>Share of Total Indirect GHG Emissions by Industry, %</b>
Agriculture, forestry and fishery	2675.7	5.767	30.05
Coal	33.0	0.051	0.27
Oil	770.0	0.183	0.95
Gas	279.5	0.785	4.09
Mining	323.1	0.099	0.52
Food	1584.6	0.097	0.51
Drink	513.8	0.027	0.14
Textile clothing and footwear (TCF)	262.6	0.011	0.06
Wood products	170.6	0.008	0.04
Paper products	1220.6	0.101	0.53
Other manufactures	673.2	0.010	0.05
Petrol refinery	1812.2	0.766	3.99
Chemical products	588.4	0.704	3.67
Plastic rubber products	626.3	0.082	0.43
Non metal mineral products	169.1	0.057	0.30
Cement	53.7	0.090	0.47
Iron steel	340.1	0.486	2.53
Aluminium	73.8	0.103	0.54
Metal products	833.6	0.089	0.46
Transport equipments	1105.1	0.020	0.10
Other equipments	667.8	0.010	0.05
Electricity coal	307.3	7.158	37.30
Electricity gas	43.4	0.540	2.81
Electricity oil	3.0	0.006	0.03
Electricity hydro	36.0	0.002	0.01
Electricity biomass	4.1	0.000	0.00

**THE CARBON FOOTPRINT OF AUSTRALIAN TOURISM**

**Indirect GHG Emissions from Tourism Purchases (in Mt) cont.**

<b>Product</b>	<b>Tourism Indirect Output (\$m)</b>	<b>GHG Emissions (Mt)</b>	<b>Share of Total Indirect GHG Emissions by Industry, %</b>
Electricity biogas	2.3	0.000	0.00
Electricity wind	2.0	0.000	0.00
Electricity supply	752.8	0.018	0.09
Gas supply	135.6	0.001	0.01
Water supply	364.7	0.026	0.14
Construction	405.9	0.022	0.11
Trade	7413.0	0.291	1.52
Hotels cafes	1228.3	0.067	0.35
Road transport	1369.9	0.279	1.45
Rail transport	301.6	0.014	0.07
Water transport	61.3	0.018	0.09
Air transport	504.5	0.441	2.30
Other transport	2539.9	0.080	0.42
Communication	2332.8	0.111	0.58
Finance services	3261.9	0.004	0.02
Owner dwelling	0.0	0.000	0.00
Business services	11475.6	0.360	1.88
Government administration & defence	412.2	0.007	0.04
Education	121.3	0.002	0.01
Health	42.0	0.001	0.01
Other government	82.8	0.001	0.01
Other services	740.3	0.199	1.04
<b>Total</b>	<b>48721.1</b>	<b>19.192</b>	<b>100.00</b>

***THE CARBON FOOTPRINT OF AUSTRALIAN TOURISM***

**Table A3 Indirect GHG Emissions from Tourism Purchases Excluding Outbound International Aviation  
(in Mt), 2003–04**

<b>Product</b>	<b>Tourism Indirect Output (\$m)</b>	<b>GHG Emissions (Mt)</b>	<b>Share of Total Indirect GHG Emissions by Industry, %</b>
Agriculture, forestry and fishery	2662.8	5.740	30.64
Coal	32.2	0.050	0.27
Oil	705.1	0.168	0.90
Gas	270.3	0.760	4.06
Mining	312.9	0.096	0.51
Food	1580.4	0.097	0.52
Drink	511.8	0.027	0.14
Textile clothing and footwear (TCF)	260.2	0.011	0.06
Wood products	167.1	0.008	0.04
Paper products	1196.1	0.099	0.53
Other manufactures	660.1	0.010	0.05
Petrol refinery	1546.3	0.654	3.49
Chemical products	573.5	0.686	3.66
Plastic rubber products	608.7	0.079	0.42
Non metal mineral products	165.7	0.056	0.30
Cement	52.6	0.088	0.47
Iron steel	325.3	0.464	2.48
Aluminium	71.7	0.100	0.53
Metal products	814.3	0.087	0.46
Transport equipments	970.6	0.017	0.09
Other equipments	656.2	0.010	0.05
Electricity coal	301.0	7.013	37.44
Electricity gas	42.5	0.529	2.82
Electricity oil	2.9	0.006	0.03
Electricity hydro	35.3	0.002	0.01
Electricity biomass	4.0	0.000	0.00

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**Indirect GH Emissions from Tourism Purchases Excluding Outbound International Aviation (in Mt) cont.**

<b>Product</b>	<b>Tourism Indirect Output (\$m)</b>	<b>GHG Emissions (Mt)</b>	<b>Share of Total Indirect GHG Emissions by Industry, %</b>
Electricity biogas	2.2	0.000	0.00
Electricity wind	1.9	0.000	0.00
Electricity supply	737.5	0.017	0.09
Gas supply	133.6	0.001	0.01
Water supply	355.9	0.025	0.13
Construction	399.0	0.022	0.12
Trade	7182.1	0.282	1.51
Hotels cafes	1182.2	0.064	0.34
Road transport	1329.0	0.271	1.45
Rail transport	290.7	0.013	0.07
Water transport	57.6	0.016	0.09
Air transport	494.3	0.432	2.31
Other transport	2262.7	0.071	0.38
Communication	2264.8	0.107	0.57
Finance services	3155.7	0.004	0.02
Owner dwelling	0.0	0.000	0.00
Business services	11014.1	0.345	1.84
Government administration & defence	401.2	0.007	0.04
education	115.6	0.002	0.01
Health	41.1	0.001	0.01
Other government	80.7	0.001	0.01
Other services	722.3	0.194	1.04
<b>Total</b>	<b>44377.9</b>	<b>18.732</b>	<b>100.00</b>



**Table A5 Tourism (production only) Compared to ‘Non-Tourism’ Economic Sector Direct GHG Emissions, by Economic (ANZSIC) Sector, Australia, 2003–04, Mt**

<b>Economic Sector</b>	<b>GHG Emissions, Mt (a)</b>	<b>Share of Total GHG Emissions by Industry %</b>
Electricity and gas supply	194.00	39.11
Agriculture, forestry, fishing	130.06	26.22
Metal products	33.88	6.83
Road transport	26.92	5.43
Mining	23.06	4.65
Petroleum, coal and chemical	18.82	3.79
Accommodation, cultural and personal	15.96	3.22
Oil and gas extraction	15.03	3.03
<b>Tourism (b)</b>	<b>10.49</b>	<b>2.11</b>
Non-metallic mineral products	10.35	2.09
Mining non-energy	5.86	1.18
Air transport	4.79	0.97
Food, beverages, tobacco	3.50	0.71
Water transport	2.22	0.45
Wood, paper and printing	2.15	0.43
Railway transport	1.69	0.34
Government administration and defence	1.57	0.32
Water, sewerage and drainage	1.33	0.27
Other transport, services and storage	1.23	0.25
Education, health and community services	1.15	0.23
Wholesale and retail trade	0.86	0.17
Machinery and equipment	0.48	0.10
Communication	0.46	0.09

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<b>Economic Sector</b>	<b>GHG Emissions, Mt (a)</b>	<b>Share of Total GHG Emissions by Industry %</b>
Textile, clothing, footwear and leather	0.45	0.09
Finance, insurance, property and business	0.20	0.04
Other manufacturing	0.02	0.004
<b>TOTAL</b>	<b>496.04 (c)</b>	<b>100.00 (d)</b>

Note: 'Tourism' is not an ANZSIC economic sector and, to avoid double counting, is consequently not counted in the total.

(a) Source: Department of Climate Change (2007a), *Australian Greenhouse Emissions Information System*, accessed on 4 December 2007.

(b) STCRC CEP estimate which contains emissions from tourism production including domestic aviation (Table 1, Row 1).

(c) Total includes GHG emissions from all economic (ANZSIC) sectors except Residential (transport and non-transport) sector.

(d) Percentages subject to rounding.

**Table A6 Tourism (production and private motor vehicle use) Compared to ‘Non-Tourism’ Economic Sector Direct GHG Emissions, by Economic (ANZSIC) Sector, Australia, 2003–04, Mt**

Economic Sector	GHG Emissions, Mt (a)	Share of Total GHG Emissions by Industry %
Electricity and gas supply	194.00	35.26
Agriculture, forestry, fishing	130.06	23.64
Residential (transport)	44.50	8.09
Metal products	33.88	6.16
Road transport	26.92	4.89
Mining	23.06	4.19
<b>Tourism (b)</b>	<b>21.60</b>	<b>3.93</b>
Petroleum, coal and chemical	18.82	3.42
Accommodation, cultural and personal	15.96	2.90
Oil and gas extraction	15.03	2.73
Non-metallic mineral products	10.35	1.88
Residential (non transport)	9.72	1.77
Mining non-energy	5.86	1.07
Air transport	4.79	0.87
Food, beverages, tobacco	3.50	0.64
Water transport	2.22	0.40
Wood, paper and printing	2.15	0.39
Railway transport	1.69	0.31
Government administration and defence	1.57	0.29
Water, sewerage and drainage	1.33	0.24
Other transport, services and storage	1.23	0.22
Education, health and community services	1.15	0.21
Wholesale and retail trade	0.86	0.16

## ***THE CARBON FOOTPRINT OF AUSTRALIAN TOURISM***

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<b>Economic Sector</b>	<b>GHG Emissions, Mt (a)</b>	<b>Share of Total GHG Emissions by Industry %</b>
Machinery and equipment	0.48	0.09
Communication	0.46	0.08
Textile, clothing, footwear and leather	0.45	0.08
Finance, insurance, property and business	0.20	0.04
Other manufacturing	0.02	0.004
<b>TOTAL</b>	<b>550.25 (c)</b>	<b>100.00 (d)</b>

Note: 'Tourism' is not an ANZSIC economic sector and, to avoid double counting, is consequently not counted in the total.

(a) Source: Department of Climate Change (2007a), *Australian Greenhouse Emissions Information System*, (accessed on 4 December 2007).

(b) STCRC CEP estimate which represents emissions from tourism production including domestic aviation and private motor vehicle use (Table 1, Row 4 and Column 1).

(c) Total represents GHG emissions from all economic (ANZSIC) sectors.

(d) Percentages subject to rounding.

**Table A7 Tourism (production, private motor vehicle use and Australian based international aviation)  
Compared to 'Non-Tourism' Economic Sector Direct GHG Emissions, by Economic (ANZSIC) Sector,  
Australia, 2003–04, Mt**

Economic Sector	GHG Emissions, Mt (a)	Share of Total GHG Emissions by Industry %
Electricity and gas supply	194.00	34.96
Agriculture, forestry, fishing	130.06	23.44
Residential (transport)	44.50	8.02
Metal products	33.88	6.10
Road transport	26.92	4.85
<b>Tourism (b)</b>	<b>26.30</b>	<b>4.74</b>
Mining	23.06	4.16
Petroleum, coal and chemical	18.82	3.39
Accommodation, cultural and personal	15.96	2.88
Oil and gas extraction	15.03	2.71
Non-metallic mineral products	10.35	1.86
Residential (non transport)	9.72	1.75
Mining non-energy	5.86	1.06
Air transport	4.79	0.86
International air transport - Australian airlines (c)	4.70	0.85
Food, beverages, tobacco	3.50	0.63
Water transport	2.22	0.40
Wood, paper and printing	2.15	0.39
Railway transport	1.69	0.30
Government administration and defence	1.57	0.28
Water, sewerage and drainage	1.33	0.24
Other transport, services and storage	1.23	0.22

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<b>Economic Sector</b>	<b>GHG Emissions, Mt (a)</b>	<b>Share of Total GHG Emissions by Industry %</b>
Education, health and community services	1.15	0.21
Wholesale and retail trade	0.86	0.15
Machinery and equipment	0.48	0.09
Communication	0.46	0.08
Textile, clothing, footwear and leather	0.45	0.08
Finance, insurance, property and business	0.20	0.04
Other manufacturing	0.02	0.004
<b>TOTAL</b>	<b>554.95 (d)</b>	<b>100.00 (e)</b>

Note: 'Tourism' is not an ANZSIC economic sector and, to avoid double counting, is consequently not counted in the total.

(a) Source: Department of Climate Change (2007a), *Australian Greenhouse Emissions Information System*, accessed on 4 December 2007.

(b) STCRC CEP estimate which consists of emissions from tourism production including domestic aviation, Australian based international aviation and private motor vehicle use (Table 1, Row 4).

(c) Source: Table 1, Row 3.

(d) Total includes GHG emissions from all economic (ANZSIC) sectors plus emissions from international air transport by Australian airlines.

(e) Percentages subject to rounding.

**Table A8**

**Tourism (production, private motor vehicle use and Australian and non-Australian based inbound international aviation) Compared to ‘Non-Tourism’ Economic Sector**

**Direct GHG Emissions, by Economic (ANZSIC) Sector, Australia, 2003–04, Mt**

Economic Sector	GHG Emissions, Mt (a)	Share of Total GHG Emissions by Industry %
Electricity and gas supply	194.00	34.76
Agriculture, forestry, fishing	130.06	23.30
Residential (transport)	44.50	7.97
Metal products	33.88	6.07
<b>Tourism (b)</b>	<b>29.50</b>	<b>5.29</b>
Road transport	26.92	4.82
Mining	23.06	4.13
Petroleum, coal and chemical	18.82	3.37
Accommodation, cultural and personal	15.96	2.86
Oil and gas extraction	15.03	2.69
Non-metallic mineral products	10.35	1.85
Residential (non transport)	9.72	1.74
International air transport – Australian & non-Australian based airlines (c)	7.90	1.42
Mining non-energy	5.86	1.05
Air transport	4.79	0.86
Food, beverages, tobacco	3.50	0.63
Water transport	2.22	0.40
Wood, paper and printing	2.15	0.39
Railway transport	1.69	0.30
Government administration and defence	1.57	0.28

## ***THE CARBON FOOTPRINT OF AUSTRALIAN TOURISM***

<b>Economic Sector</b>	<b>GHG Emissions, Mt (a)</b>	<b>Share of Total GHG Emissions by Industry %</b>
Water, sewerage and drainage	1.33	0.24
Other transport, services and storage	1.23	0.22
Education, health and community services	1.15	0.21
Wholesale and retail trade	0.86	0.15
Machinery and equipment	0.48	0.09
Communication	0.46	0.08
Textile, clothing, footwear and leather	0.45	0.08
Finance, insurance, property and business	0.20	0.04
Other manufacturing	0.02	0.004
<b>TOTAL</b>	<b>558.15 (d)</b>	<b>100.00 (e)</b>

Note: 'Tourism' is not an ANZSIC economic sector and, to avoid double counting, is consequently not counted in the total.

(a) Source: Department of Climate Change (2007a), *Australian Greenhouse Emissions Information System*, accessed on 4 December 2007.

(b) STCRC CEP estimate which consists of emissions from tourism production including domestic aviation, Australian based international aviation and private motor vehicle use (Table 2, Row 5).

(c) Source: Table 2, Rows 3 and 4).

(d) Total includes GHG emissions from all economic (ANZSIC) sectors plus emissions from international air transport by Australian and non-Australian based airlines. (e) Percentages subject to rounding.

## **APPENDIX B: DEFINITIONS OF SELECTED TERMS USED IN THIS REPORT<sup>8</sup>**

### **Australian International Airlines**

Australian International Airlines for the year 2003–04 consist of Qantas, Australian Airlines, Pacific Blue and Jetstar.

### **Emissions**

Emissions refer to greenhouse gas emissions.

### **Greenhouse Gas (GHG)**

The most common greenhouse gases are carbon dioxide, methane, nitrous oxide and the synthetic greenhouse gases [the hydro fluorocarbons (HFCs), sulphur hexafluoride and the per fluorocarbons (PFCs)]. Emissions from these gases are aggregated into carbon dioxide equivalents (CO<sub>2</sub>-e) using a factor called global warming potentials (GWPs). GWP represents the relative warming effect of a unit of mass of greenhouse gas compared with the same amount of mass of CO<sub>2</sub> over a specific period.

### **Mt**

‘Mt’ is millions of metric tonnes of emissions. Technically a tonne of emissions is 1 tonne of carbon dioxide equivalent, which measures all the greenhouse gases.

### **Tourism Industry<sup>9</sup>**

Tourism industry is as defined in the Australian Tourism Satellite Account (ATSA). ATSA classifies the tourism industry as comprising the following ‘tourism characteristic’ and ‘tourism connected’ industries.

#### *Tourism characteristic industries*

- Travel agency and tour operator services
- Taxi transport
- Air and water transport
- Motor vehicle hiring
- Accommodation
- Cafés, restaurants and food outlets

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<sup>8</sup> These definitions are based on the Explanatory Notes to ABS TSA, Australian National Account, 5249.0, 2005–06 (ABS, 2007), National Greenhouse Gas Inventory 2005 (DCC, 2007b) and Australian Methodology for the Estimation of Greenhouse gas Emissions and Sinks 2005: Energy (Transport) (DCC, 2006), with adjustment where necessary to reflect the focus of this report.

<sup>9</sup> Industry definitions in the MMRF-Green database (Adams, 2006) used for this study do not coincide precisely with those used in the ATSA. It was thus necessary to develop a concordance with MMRF-Green industries. As a result, while the overall tourism industry total is the same the component figures by industry are not necessarily identical.

***Tourism connected industries***

- Clubs, pubs, taverns and bars
- Other road transport
- Rail transport
- Food manufacturing
- Beverage manufacturing
- Transport equipment manufacturing
- Other manufacturing
- Retail trade
- Casinos and other gambling services
- Libraries, museums and arts
- Other entertainment services
- Education
- Ownership of dwellings

\* \* These definitions are based on the Explanatory Notes to ABS TSA, Australian National Account, 5249.0, 2005–06 (ABS, 2007), National Greenhouse Gas Inventory 2005 (AGO 2007) and Australian Methodology for the Estimation of Greenhouse gas Emissions and Sinks 2005: Energy (Transport) (AGO 2006).

Adjustment has been made where necessary to reflect the focus of this report.

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## **LIST OF ABBREVIATIONS**

ABS	Australian Bureau of Statistics
ANZSIC	Australia and New Zealand Industrial Classification
ATSA	Australian Tourism Satellite Account
AusF	Australian Flight
CGE	Computable General Equilibrium
CO <sub>2</sub> -e	Carbon dioxide equivalent
CEP	STCRC's Centre for Economics and Policy
DCC (/AGO)	Department of Climate Change (/formerly the Australian Greenhouse Office)
GHG	Greenhouse Gas
GVA	Gross Value Added
ICAO	International Civil Aviation Organization
IVS	International Visitor Survey
kg/pkm	Kilogram per passenger kilometre
LH	Long Haul
Mt	Million tonnes
MMRF	Monash Multi-Regional Forecasting model
NonAusF	Non-Australian Based Flight
SH	Short Haul
STCRC	Sustainable Tourism Cooperative Research Centre
TCF	Textile, clothing and footwear
TSA	Tourism Satellite Account

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