The Carbon Footprint of Domestic Tourism

Technical report

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Author:
Dr. Susanne Becken
Associate Professor
Environment, Society & Design Division
Director of LEaP Research Centre
www.leap.ac.nz

LEaP
LAND ENVIRONMENT & PEOPLE

Commissioned by:
The Hikurangi Foundation
PO Box 25335
Panama Street, Wellington.
Aotearoa/New Zealand
+64 (0)4 905 2923
www.hikurangi.org.nz

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Foreword

Hikurangi is about enabling action for a better way of life for New Zealanders. We would like to see a prosperous economy and strong society underpinned by a thriving environment. Climate change is an extremely serious threat to all of these things. But it can be tackled. In fact, acting on climate change and sustainable development is probably the only way businesses and communities will prosper in the long run. But we need forward-thinking action, now.

We see the Tourism sector as critical, particularly domestic tourism, but we wanted to know more about the potential contribution to the solution that it could make. That's why we commissioned this work to help us understand the carbon footprint of domestic tourism in New Zealand. Recent events and trends in the sector point to a potentially greater dependence on local tourism, but with its comparatively high carbon footprint (as this research reveals) this could be problematic for New Zealand. Clearly an opportunity lies in being able to "de-carbonise" domestic (and international) tourism. It is unlikely to be as simple as asking tourists to do the right thing. We may need to look at product innovation, infrastructure investment, and market development. This action needs to go beyond the level of individual operators and work at a sectoral level.

We would like to contribute to a wide discussion about how this can be done. We will be catalysing practical pilots and action to help "learning by doing". We would warmly welcome any responses to this report or suggestions for action. Please don't hesitate to get in touch.

Liana Stupples

Executive Director of the Hikurangi Foundation

Contents

1. Introduction

Tourism is a major part of the New Zealand economy, contributing about 9.2% directly and indirectly to GDP and directly providing 108,000 jobs. At the same time tourism is a heavy user of energy, and as a result contributes to global greenhouse gas emissions. Worldwide, tourism has been estimated to constitute about 5% of global carbon dioxide emissions[1], and for the New Zealand situation this figure is in the order of 6% (excluding international aviation)[2].

It is important to distinguish the carbon footprint associated with tourism from a global perspective from that linked to a particular destination or nation. The global footprint includes all tourist activity ranging from international air travel to destination-based transport, accommodation and visitation of attractions, whereas the national footprint only focuses on emissions that occur within a country's borders. This means that a national carbon footprint analysis typically excludes climate impacts associated with international air travel, even though it is known that these are substantial. The reason for this lies in the current accounting framework under the Kyoto Protocol where nations are not accountable for emissions resulting from international transportation. Nationally, within New Zealand, tourism involves both people from overseas (i.e. so-called "international tourists") and New Zealanders travelling in their own country (i.e. so-called "domestic tourists). Domestic tourists may be on day or overnight trips.

This report focuses on domestic tourists and the definition of the United Nations World Tourism Organization (UNWTO) is followed for consistency. UNWTO defines tourism as the "*activities of persons travelling to and staying in places outside their usual environment for not more than one consecutive year for leisure, business and other purposes not related to the exercise of an activity remunerated from within the place visited*. UNWTO uses the term "visitors" to describe those persons travelling and also specifies that visitors are the sum of same-day visitors and overnight visitors (also called 'tourists'). The UNWTO definition is very broad based on the argument that a business traveller, for example, uses the same services as a leisure traveller: they require transport options, they stay at commercial accommodation and they go out for dinner. It is often useful to segment the whole tourism sector by travel purpose or by other variables of interest to obtain more specific insights and develop targeted management solutions.

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[1] Scott, D., Amelung, B., Becken, S., Ceron, J.P., Dubois, G., Goessling, S., Peeters, P. & Simpson, M. (2007). Climate Change and Tourism: Responding to Global Challenges. Madrid/Paris: United Nations World Tourism Organisation and United Nations Environment Programme.

[2] Turney, I., Becken, S., Butcher, G., Patterson, M., Hart. P. & Simmons, D. (2002). Climate change response. A report to establish the knowledge required for a TIANZ response and policy formulation with the Government post Kyoto Protocol ratification. Prepared for the Tourism Industry Association New Zealand (TIANZ), Landcare Research Contract Report, LC0102/107.

All tourists within New Zealand are key users of the transport sector, and this is the main reason for the carbon intensity of on-shore tourism as a whole. Current transport technologies and systems are almost exclusively based on fossil-fuels and it is very challenging to change this dependency in the short term, especially for air transport. Many organisations (e.g. the United Nations World Tourism Organisation, the International Civil Aviation Organisation and the Pacific Asia Travel Association) and businesses (e.g. Boeing, General Motors, Toyota, Virgin Atlantic, Air New Zealand) have recognised this problem, but possible solutions are sill in their infancy.

In New Zealand, greenhouse gas emissions from transport are substantial: 18% of national emissions or the equivalent of 14.3 Mt CO_2 in 2004[3]. The latest New Zealand Greenhouse Gas Inventory by the Ministry for the Environment shows that transport contributed 42.3% of energy-related emissions in 2006. Transport emissions have been increasing continuously, and with a growth of 64% between 1990 and 2006, very little progress has been made in reducing these. On the contrary, the Ministry of Transport predicts that transport demand will increase by 40% by 2040. Tourism has been identified as one key driver for this growth[4], and while the New Zealand Tourism Strategy 2015 explicitly addresses climate change, very few tourism-related initiatives have been implemented thus far to reduce the greenhouse gas emissions from tourism transport. A number of projects are on their way, for example the Tourism Energy Efficiency Project by the Tourism Industry Association and the Energy Efficiency and Conservation Authority, but it will be some time until tangible results will manifest.

Most research on climate change and tourism in New Zealand has focused on international tourists and their on-shore travel behaviour within New Zealand[5], but our understanding of domestic tourism as a whole is rather limited and confined to some core tourism statistics derived from the Domestic Tourism Study (DTS). The DTS data are the most comprehensive source of information on domestic tourists' travel behaviour, and they are collected quarterly by the Ministry of Tourism. The database provides travel information of about 15,000 New Zealanders every year. Detailed data on people's trips are collected by phone interview and summary results are presented on the Ministry of Tourism's website (www.tourismresearch.govt.nz).

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[3] http://www.transport.govt.nz/transport-overview-cabinet-paper/

[4] In 2006, the Ministry of Transport conducted an in-house analysis of various transport scenarios and identified tourism as an important driver. This analysis is not available publicly.

[5] Examples include:

- Becken, S. & Wilson, J. (2007). Trip planning and decision making of rental vehicle tourists – a quasi-experiment. *Journal of Travel and Tourism Marketing* 20 (3/4). 47-62.
- Becken, S. (2005). Towards sustainable tourism transport – an analysis of coach tourism in New Zealand. *Tourism Geographies* 7(1), 1-20.

About 15 million overnight trips are reported for domestic tourists in 2007, the majority of whom travel by car and to a lesser degree by air. Apart from overnight tourism, there are about 26 million day trips per year. The transport requirements for this are substantial. In addition to transport, domestic tourists also consume energy and produce emissions when using accommodation, eating out in restaurants and visiting tourist attractions. The overall carbon footprint is therefore larger than just transport.

This report provides an analysis of domestic tourism in New Zealand, its carbon footprint and the potential for reducing carbon dioxide emissions. The analysis is based on the DTS data provided by the Ministry of Tourism. The footprinting exercise will focus on transport and accommodation behaviour, as these two components are associated with the highest carbon dioxide emissions. Also, information on other aspects of domestic tourism is less robust in the DTS. It is possible to conduct more detailed analyses on leisure behaviour based on other data sources, for example recreational surveys undertaken by SPARC. Such an analysis goes beyond the scope of this current report.

A high-level comparison will be provided between the carbon footprint of domestic tourism and the on-shore carbon dioxide emissions produced by international tourists. This is considered useful as currently much of the attention is on international tourism (partially because it involves the earning of foreign exchange) and most of the strategies (e.g. the Framework developed by the Ministry of Tourism) that deal with climate change and tourism focus on New Zealand's 100% Pure image and ways for maintaining its integrity amongst international visitors.

2. An Overview of Domestic Tourism

2.1 Total trips undertaken by New Zealanders

<u>Within New Zealand</u>

Domestic tourism includes all trips over 40 km outside the 'usual environment'. In accordance with the UNWTO definition presented above, these trips can be day trips or overnight trips and they include a wide range of travel purposes.

Domestic tourism in New Zealand has declined from a high of over 59 million trips in 1999 to an all-time low of 42 million trips in 2007 (Figure 1). Some of this decrease is explained by an increased inclination to travel overseas (see outbound tourism, Figure 2). Anecdotal evidence also suggests that one of the 'key competitors' to day trip tourism are shopping malls.

Overnight trips make up 35% of trips; i.e. about half of the number of day trips. The 14.7 million domestic overnight trips in 2007 compare with 2.47 million international tourists. This means that 83% of all overnight trips undertaken in New Zealand are by domestic tourists. Note; that the length of stay differs between domestic and international tourists (see further below).

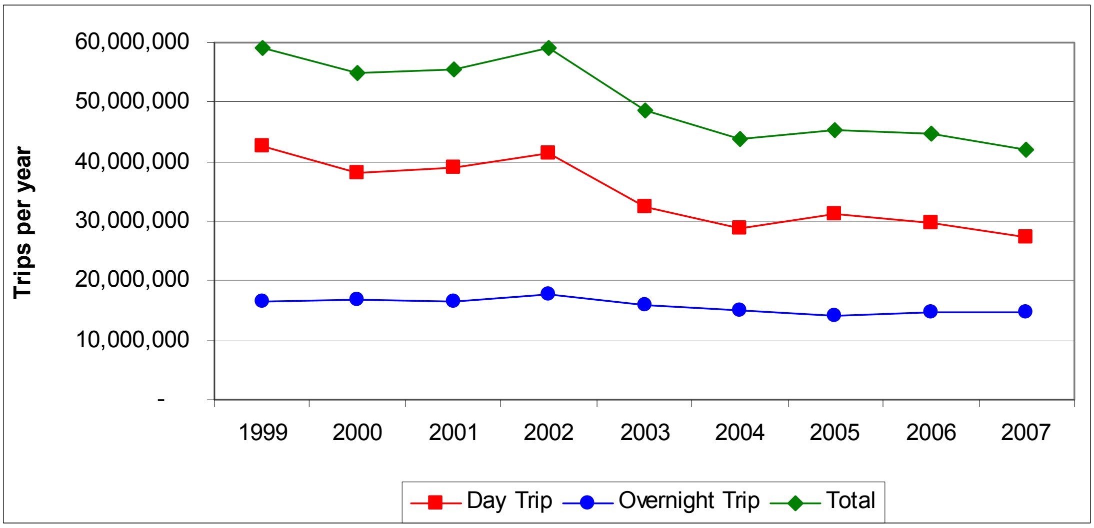

Figure 1 Domestic tourism trips by year and type of trip.

In line with the decrease in domestic trips, expenditure by domestic tourists dropped by 6.4% (or $507 million) to $7.39 billion for the year ended June 2008 compared with the previous year (Ministry of Tourism, 2008[6]). In comparison, international tourists spent $6.18 billion in the same period. In more detail, domestic overnight trip expenditure was down by 3.6% to $4.876 billion, and day trip expenditure was down by 11.5% to $2.512 billion. The average domestic tourist spent $97 on a day trip and $340 on an overnight trip.

Money not spent on domestic travel is lost to the New Zealand economy if it is spent overseas instead (e.g. in Australia); however, if it is spent on other consumer goods it can be seen as a redistribution from tourism to other sectors such as retail.

Outbound tourism

In 2007, about 1.98 million New Zealand permanent residents travelled overseas (Figure 2). The most popular destination was Australia with 978,000 trips (i.e. 49% of all trips), followed by Europe (177,000 trips) and Fiji (97,000 trips). Tourism Australia[7] reports that the average length of stay for New Zealand visitors was 13 nights in 2007. Travellers from New Zealand spent a total of $2.2 billion on trips to Australia, with an average expenditure of $2,130 per trip. Most tourists travel for holiday reasons, although a substantial number of trips relate to visiting friends/relatives markets, business and working abroad.

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[6] www.tourismresearch.govt.nz

[7] http://www.tra.australia.com/international.asp?sub=0150

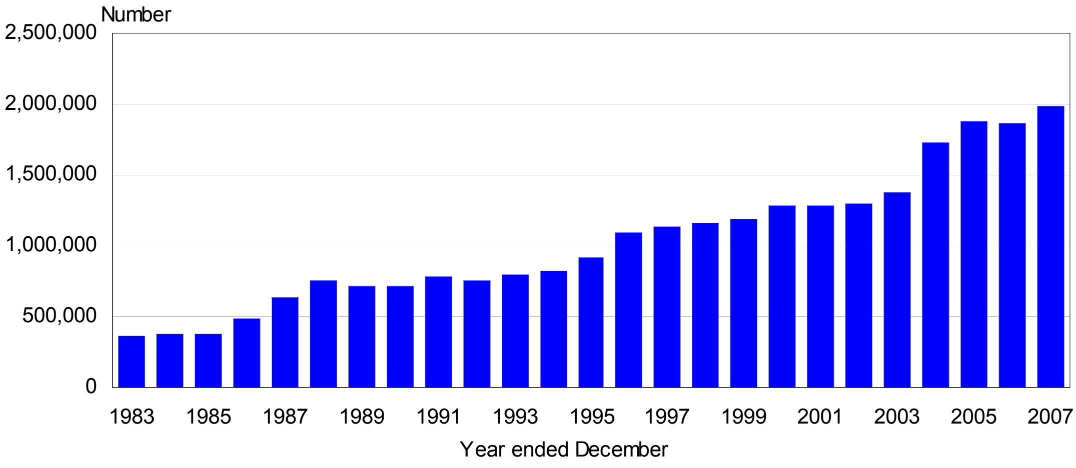

Figure 2 Outbound tourism by New Zealand residents (Ministry of Tourism, 2007).

2.2 Trip characteristics and demographic identifiers

Length of stay

Domestic tourists spent 42.6 million nights away from home in 2007 (Figure 3). This compares to 49 million nights spent by international visitors (with an average length of stay of around 20 days). The number of domestic nights in 2007 has dropped markedly compared with 1999 and 2004. The average length of stay has been 2.9 nights in 2007, slightly down from 3.0 the year before.

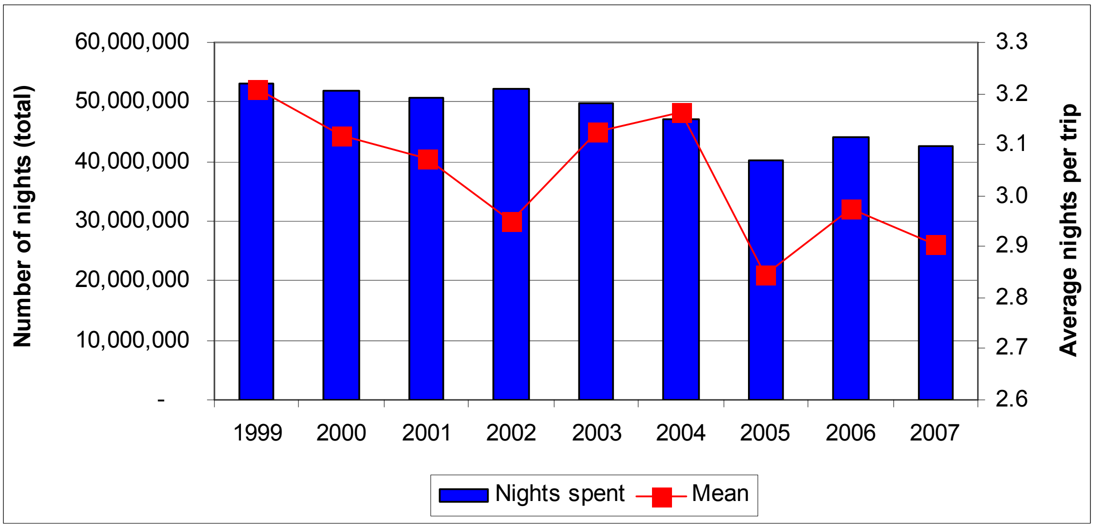

Figure 3 Number of trips by year and average length of stay (nights spent).

Travel party

Most New Zealanders travel as a family (30% in 2007), followed by ‘travelling alone’ (often related to business travel) and as a couple (21%) (Figure 4). The breakdown into different travel parties has remained relatively stable over the years and also differs little between day and night trips.

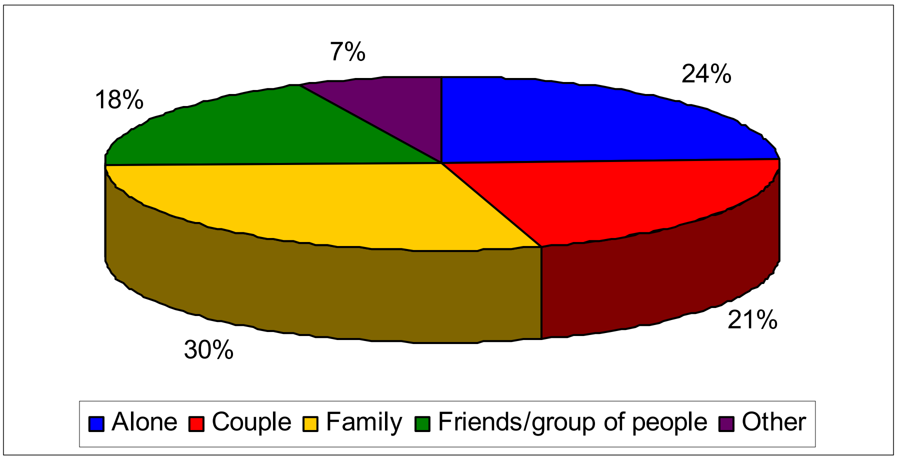

Figure 4 Proportion of different travel parties in 2007 (day and overnight trips)

Typically, there are about three people in a travel group. Numbers differ slightly by main transport mode (Table 1). Over the years, the average travel party in a car (assuming all travel together in one car) has fluctuated around three and this value will be taken into consideration when estimating vehicle emissions later in this report.

Table 1 Number of people in travel party by main transport mode (2005 – 2007)

	2007	2006	2005
Car	2.9	3.0	2.9
Air	2.7	2.8	2.6
Bus	22.9	25.6	22.7
Other	6.2	5.6	8.9

Note: the average size of a travel party in a bus is influenced by large groups, but also by individuals who travel on intercity coaches; i.e. the value provided in this table is not particularly meaningful and is only provided for completeness.

'Other' includes transport modes such as train, motorcycle, water transport etc.

Purpose of travel

The most common reason for travel is holiday (40% of all domestic trips in 2007). Just under one third of tourists travel to visit friends and relatives and 19% travel for business reasons or a conference (Figure 5). Business travel has remained fairly stable over the years, while VFR tourism has increased slightly. Domestic holidays dropped sharply in 2002 and have recovered at a relatively stable level in the last five years.

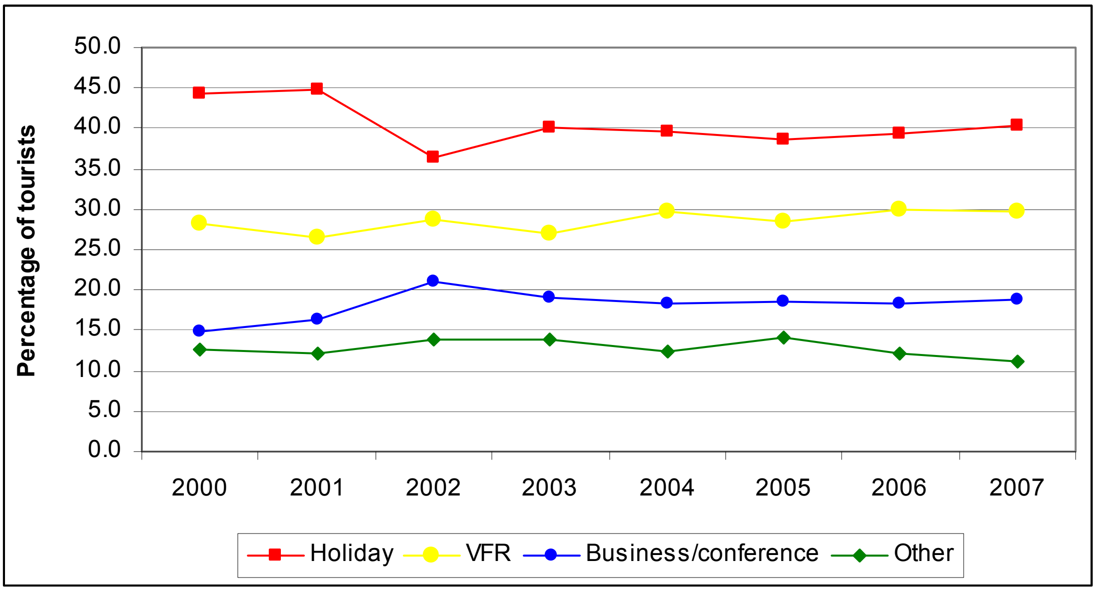

Figure 5 Proportion of tourists who travelled for holiday, visiting friends/relatives, business/conference or other reasons by year.

Income and travel

Disposable income is a prerequisite for travel. People with a household income of between $40,000 and $100,000 make up most trips (about 34% for each day and overnight trips). People in lower income groups are more likely to undertake day trips and those with a household income over $100,000 are more strongly represented amongst overnight trips (Figure 6).

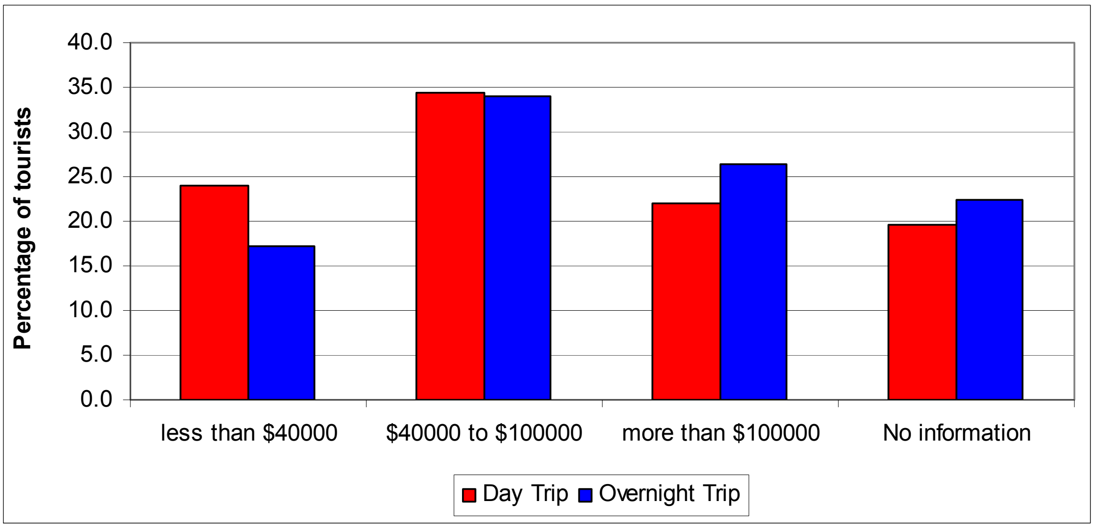

Figure 6 Proportion of tourists who undertook a day or overnight trip by household income group in 2007.

2.3 Overall patterns of domestic tourism

Geographic distribution

The Tourism Flows Model[8] developed by the Ministry of Tourism visualises where domestic tourists go and where they stay. Patterns of domestic air travel, for example, are largely centred on the main trunk routes, i.e. between Wellington and Auckland, Auckland and Christchurch, and Christchurch and Wellington. A substantial proportion of this travel is for business reasons, especially amongst day trippers. As can be seen in Figure 7 there are also other domestic air routes that are important to domestic tourism, for example Hamilton-Wellington and Christchurch- Dunedin.

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[8] http://www.tourismresearch.govt.nz/Data--Analysis/Tourism-Flows-Model/

Figure 7 Domestic overnight trips by air (2005).

The road tourism flows originate from the main population centres (see Figures 8 and 9), with the most pronounced flow leading from Auckland to the South towards Hamilton, Rotorua and Taupo. The flow maps also show that overnight trips spread further out than day trips. For example, the flow across the Central North Island is much more pronounced for overnight trips than day trips, which due to the far distance from both Auckland and Wellington are unlikely to reach these areas.

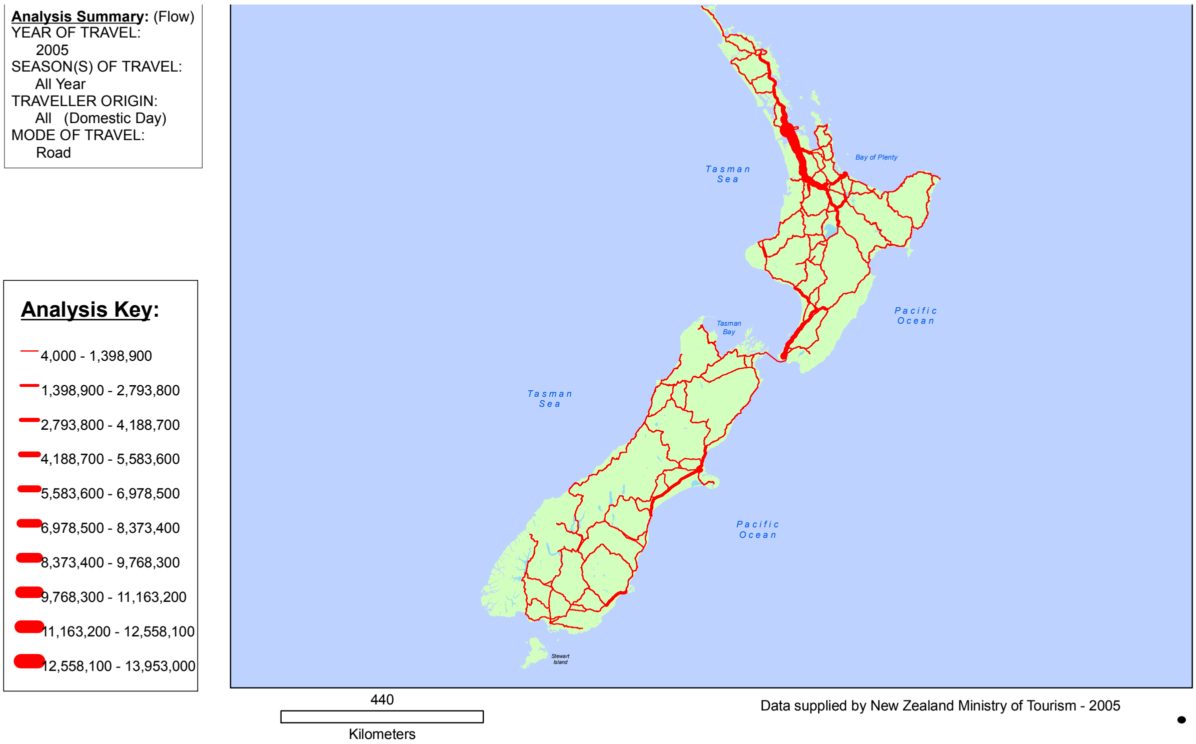

Figure 8 Domestic day trips by road (2005).

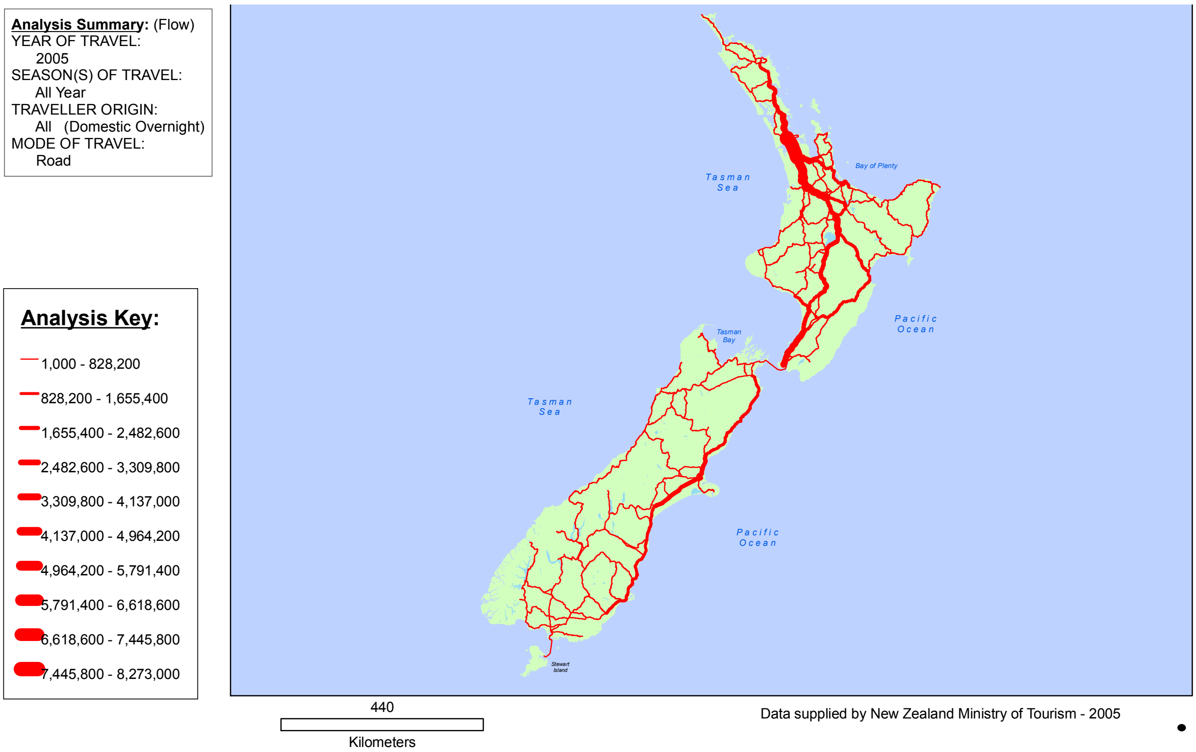

Figure 9 Domestic overnight trips by road (2007).

The Tourism Flows Model also provides information on the numbers of nights spent in each region. The areas symbolised in darker red in Figure 10 show the regions which receive the most domestic nights. For example Christchurch/Canterbury is a major receiver of domestic tourism, as well as Wellington and Auckland. Other regions, such as Fiordland and the West Coast are more important to international than domestic tourism.

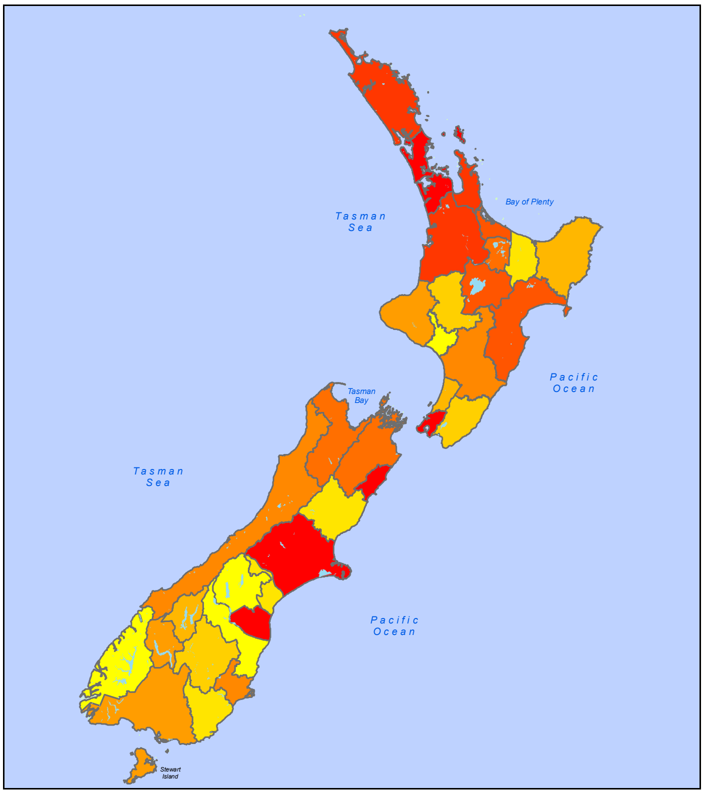

Figure 10 Domestic nights spent in regions (2005).

Seasonality

Domestic tourism has a peak in January and another one in April. There is also a small winter peak in July. The other months show slightly reduced travel numbers; however, compared with international tourism in New Zealand (focusing on December to February), domestic tourism is considerably less seasonal. Figure 11 shows the pattern for 2007 which roughly represents that of other years. At a more detailed level, each year displays some differences; for example while the 2007 pattern reveals a peak of day travel in February, this peak occurred in January the year before. It is possible that the finer patterns are determined by factors such as the exact dates of school holidays, weather and others.

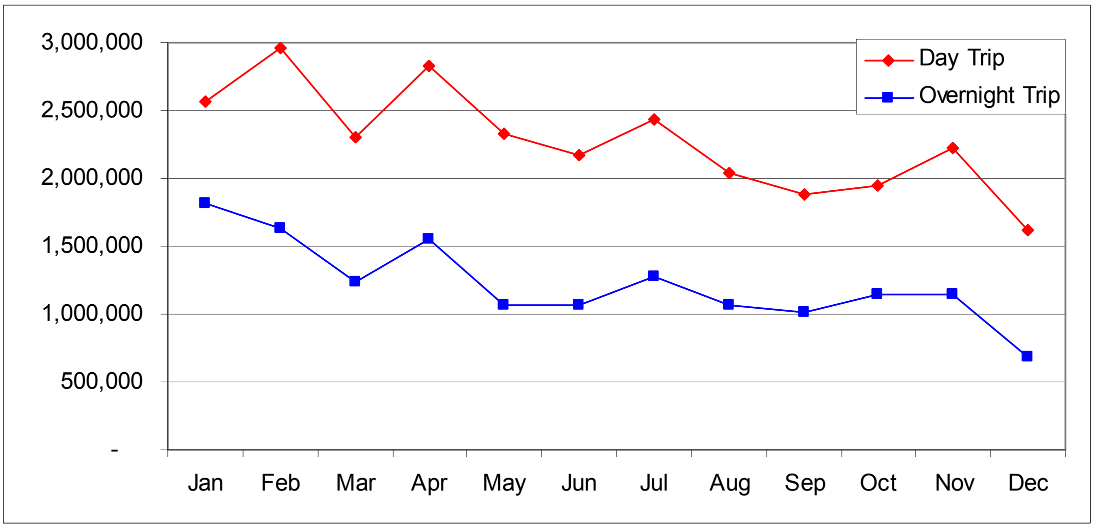

Figure 11 Number of trips in 2007 by month and by type of trip.

3. Estimating the Carbon Footprint of Domestic Tourism

3.1 Methodology

The data used in this analysis stem from the Ministry of Tourism's DTS. The data were provided in the form of a SPSS database. This database contained information on tourist itineraries (i.e. travel between points), transport modes, accommodation categories, trip related variables and other important demographic information. The carbon footprint of domestic tourism was estimated as follows:

<u>Transport:</u>

- Based on the itinerary information distances travelled for each tourist by transport mode were derived (transport modes were aggregated into four categories)
- 'Car' transport includes personal vehicles such as private cars, rental cars, company cars, campervans and also taxis; further categories are 'air', bus and coach, and 'other'. The other category includes modes such as train, ferries, motorcycles, bikes, as well as the responses of "don't know" or "refused"
- Only the 'main transport mode' was selected[9] (i.e. the 5% of tourists who used more than one transport mode for one leg, such as a combination of car and plane, were not given special treatment)
- Kilometres travelled were multiplied with transport mode specific emission factors (see Box 1 below)

[9] While the effect on overall travel distance is minor, the allocation of distance to transport modes would change slightly if secondary or tertiary transport modes were considered. For the purpose of this present analysis it was deemed sufficient to focus on the main transport mode.

- The emission factor for ‘water’ was applied to the ‘other’ transport category
- In the case of car travel an adjustment was made to take into account the average occupancy of three people.

Accommodation:

- The number of nights spent in different accommodation categories was determined for each tourist
- Accommodation responses were aggregated into seven categories
- Emission factors (see Box 1 below) were applied to each of the seven accommodation categories
- The emission factor for ‘private homes’ was applied to the ‘other’ accommodation category

No other tourist activities were included in the carbon footprint calculation due to a lack of robust data. Earlier analysis[10] indicates that emissions associated with activities such as shopping, restaurant, and recreational activities are relatively minor compared with transport and accommodation.

The carbon footprint of some tourist activities, such as jet boating, helicopter flights, and scenic boat cruises[11], is high and future analysis could include these carbon-intensive activities to enhance the picture gained in this present analysis.

Emission factors for tourism (see Box 1) are composed of two inputs: one is the energy associated with the activity in question (e.g. one night in a hotel) and the other one is the emissions resulting from the use of energy in a particular form (e.g. electricity, diesel or petrol). The former factors are based on earlier research on the energy use in New Zealand’s tourism sector[12]. This research has been incorporated into the carbon footprint calculator provided by carboNZero. The data are the best available at the time, but they are partly dated (in particular the activity data). A more accurate picture of tourism’s energy use and footprint could be gained with more up-to date energy data. Also, improvements could be made if energy analyses considered factors such as seasonality, occupancy rate and so forth. The carbon emission factors, however, reflect the latest factors used in New Zealand and they are therefore the same as any other emission factors used in similar work, for example the Ministry of Tourism’s Carbon Footprint tool or any other footprinting tool developed by the Ministry for the Environment or Ministry of Economic Development.

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[10] Patterson, M.G. & McDonald, G. (2004). *How green and clean is New Zealand Tourism? Lifecycle and Future Environmental Impacts*. Lincoln: Landcare Research.

[11] Becken, S. & Simmons, D. (2002). Understanding energy consumption patterns of tourist attractions and activities in New Zealand. *Tourism Management* 23 (4), 343-354.

[12] For example: Becken, S., Frampton, C. & Simmons, D. (2001). Energy consumption patterns in the accommodation sector – the New Zealand case. *Ecological Economics*, 39 (3), 371-386.

Emission factors for tourism:

Emission factors were taken from carboNZero (www.carbonzero.co.nz), which is based amongst others on Becken et al., 2001 and Becken & Cavanagh, 2003[13]. The factors represent carbon dioxide equivalent (CO_2-e), which means that greenhouse gases other than CO_2 are included as well.

The factors are in line with footprinting analysis undertaken elsewhere in New Zealand[14], see also Appendix A for a detailed table on factors.

The emission factor for cars was based on information provided by the Ministry for the Environment (see Appendix B). It represents the emissions per vehicle-kilometre rather than passenger-kilometre as for the other modes.

Transport emission factors:

- Domestic air: 0.29 kg CO_2-e/pkm
- Cars (private/ rental etc.): 0.241 kg CO_2-e/vehicle-km
- Water: 0.24 kg CO_2-e/pkm
- Bus/coach: 0.04 kg CO_2-e/pkm

Accommodation emission factors:

- Hotel: 7.97 kg CO_2-e/night
- Motel: 2.56 kg CO_2-e/night
- Backpackers hostel: 2.12 kg CO_2-e/night
- Private home and 'other': 1.58 kg CO_2-e/night
- Camping/huts: 1.36 kg CO_2-e/night
- B&B/hosted accommodation: 4.14 kg CO_2-e/night

Box 1 Emission factors used in this analysis.

3.2 Transport emissions

Most of domestic tourism is undertaken by car. Individual road transport (i.e. largely private cars) made up 81% of all passenger-kilometres travelled by domestic tourists. Domestic air travel is the second largest category (14%), whereas bus/coach travel and other transport only play a minor role (Figure 13).

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[13] Becken, S., Frampton, C., Simmons, D. (2001). Energy consumption patterns in the accommodation sector – the New Zealand case. *Ecological Economics,* 39, 371–386.

Becken, S. & Cavanagh, J. (2003). *Energy efficiency trend analysis of the tourism sector*. Research Contract Report: LC02/03/293. Prepared for the Energy Efficiency and Conservation Authority.

[14] Barber, A., Campbell, A., Hennessy, W., 2007. Embodied Fossil Energy and Net Greenhouse Gas Emissions from Biodiesel Made From New Zealand Tallow. Report prepared for the Energy Efficiency Conservation Authority. CRL Energy Ltd, Wellington.

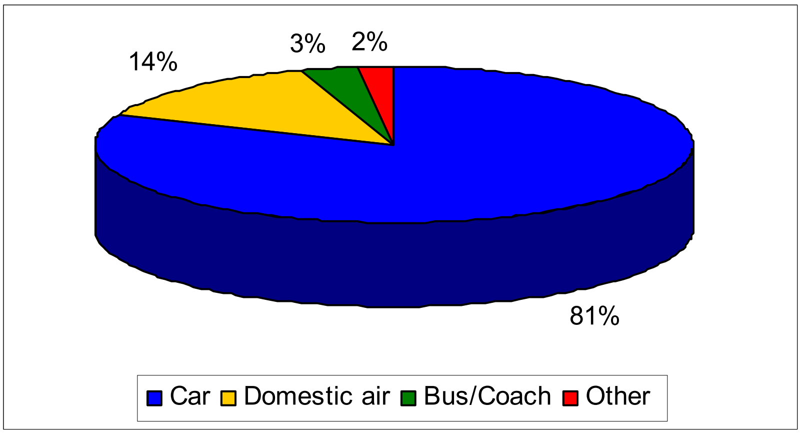

Figure 12 Proportion of passenger-kilometres travelled in 2007 by transport mode.

The average distance travelled by car (including private cars, rental cars, campervans, company cars and taxis) is 481 km for overnight trips and 242 km for day trips (Figure 12). The lower average distance travelled by air is largely explained by the fact that only a small proportion of domestic tourists use this transport mode.

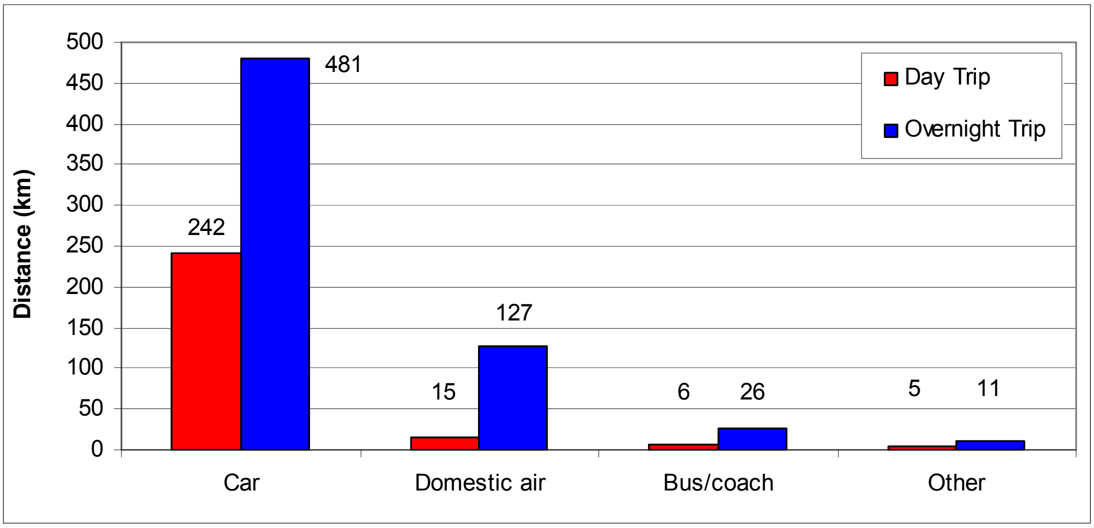

Figure 13 Average distance travelled by transport mode and trip type in 2007.

The total emissions from domestic tourism transport totalled 1.85 million tonnes of CO_2-e in 2007. For the year 2004, domestic tourism transport (2.04 million tonnes of CO_2-e) would have contributed about 14.3% of national transport emissions.

Figure 14 shows that car transport is the main contributor (59%) to overall emissions from domestic tourism, however, compared with passenger-kilometres, air travel now plays a much bigger role with a contribution of 36%. This is due to the higher emissions related to air travel (i.e. 0.29 kg CO_2-e per passenger-kilometre) compared with car travel at an occupancy rate of 3 people (0.08 kg CO_2-e per passenger-kilometre).

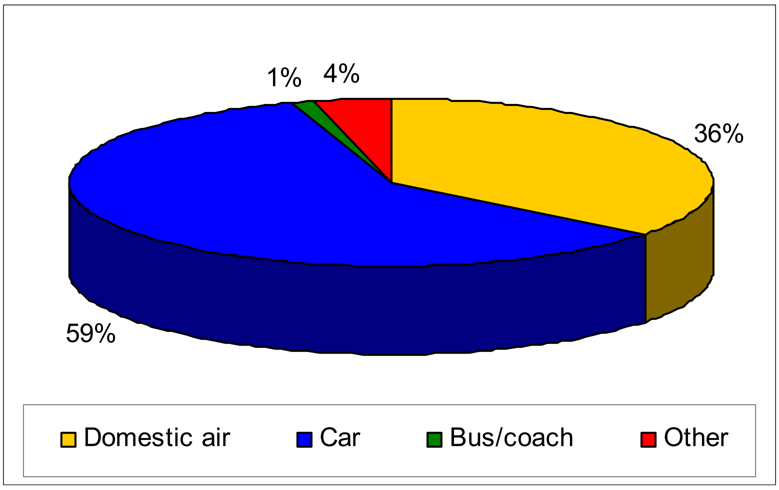

Figure 14 Contribution of different transport modes to total domestic tourism transport CO_2-e emissions.

3.3 Accommodation emissions

The most popular form of accommodation for domestic overnight trippers is ‘other accommodation’ (24 million nights) which includes the category of ‘rental accommodation’. It is assumed that this relates largely to rented baches (cribs), holiday homes and apartments. Second most important are campgrounds and Department of Conservation huts (5.7 million nights) (Figure 15). Other commercial accommodation, such as hotels and motels, plays a relatively minor role for domestic tourism in terms of visitor nights.

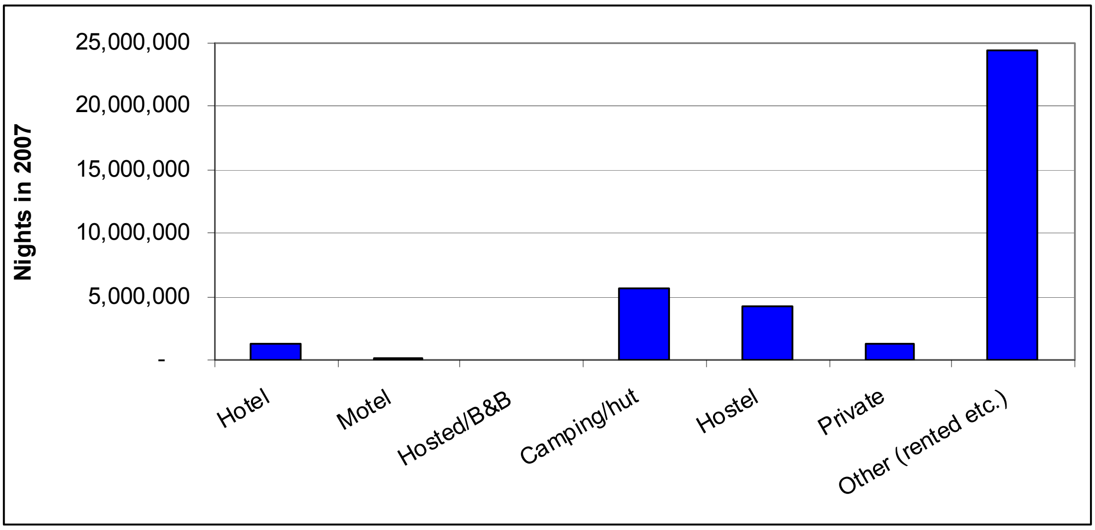

Figure 15 Number of nights spent in different kinds of accommodation categories in 2007 (6.3 million nights reported in the DTS for student accommodation were excluded).

Greenhouse gas emissions related to accommodating domestic tourists were 0.68 million tonnes of CO_2-e in 2007. In line with the number of nights spent in different accommodation categories, the ‘other’ category (57%) is the largest contributor to emissions from the accommodation sector. The second largest contributor was the hotel sector with 15% of all emissions. This is a result of the high energy intensity associated with hotels.

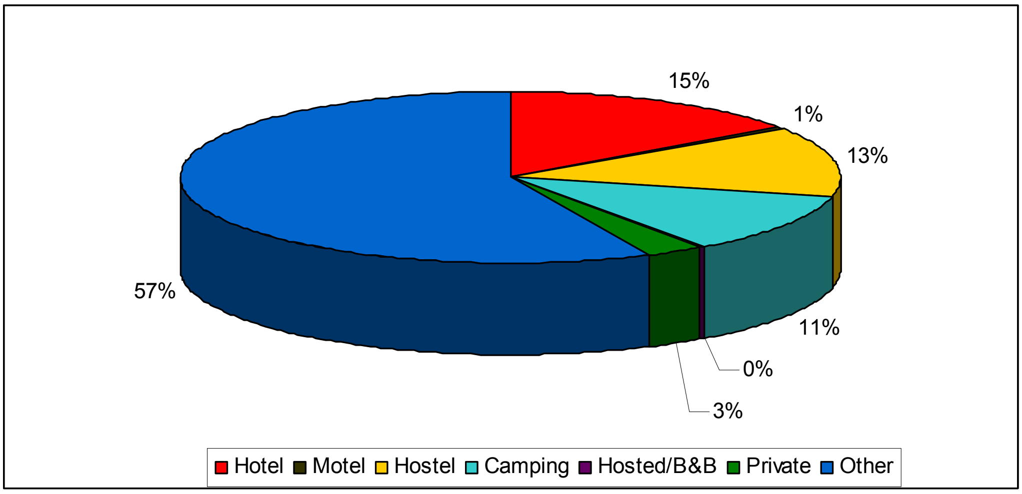

Figure 16 Proportion of accommodation emissions in 2007 by category.

3.4 Total emissions

The Ministry for the Environment reports that New Zealand's greenhouse gas emissions totalled 77.9 million tonnes of CO_2-e in 2006[15]. Carbon dioxide contributed the most to 2006 emissions at 36.4 million tonnes of CO_2-e or 47 %. When accounted for at a sector level, the energy sector (which is where tourism is located) was the source of 44 % (34.1 Mt CO_2-e) of all emissions in 2006. Within the energy sector, transport is the largest contributor with 14.41 million tonnes of CO_2-e.

Domestic tourism emitted over 1.9 million tonnes of CO_2-e in 2007. This figure represents a minimum as only tourist transport and accommodation were included in this analysis. It is possible that other tourist activities could increase tourism's emissions in the order of 5 to 10%. This means that domestic tourism contributes[16]:

- At least 2.4% to all national greenhouse gas emissions;
- At least 5.2% to national carbon dioxide emissions;
- At least 5.6 % to the emissions attributed to the energy sector;
- About 12.3% to transport emissions (only the transport component of domestic tourism).

The carbon dioxide equivalent emissions from domestic tourism are larger than the energy-related emissions from the commercial sector (1.32 Mt CO_2-e), the

[15] New Zealand's Greenhouse Gas Inventory 1990–2006: An Overview. http://www.mfe.govt.nz/publications/climate/greenhouse-gas-inventory-overview-apr08/html/index.html

[16] Note that the national-level data refer to 2006 (and 2004 for transport) and the tourism-specific data relate to 2007; the percentages still give an indication of the contribution that domestic tourism makes.

residential sector (0.64 Mt CO_2-e) and agriculture/forestry/fishery (1.28 Mt CO_2-e).

The largest contributor to the carbon footprint of domestic tourism is transport related to overnight trips (1,160,700 tonnes of CO_2-e), followed by day trip transport (690,210 tonnes of CO_2-e) and overnight trip accommodation (68,030 tonnes of CO_2-e) (see Figure 17). This means that transport makes up 96% of the domestic tourism carbon footprint.

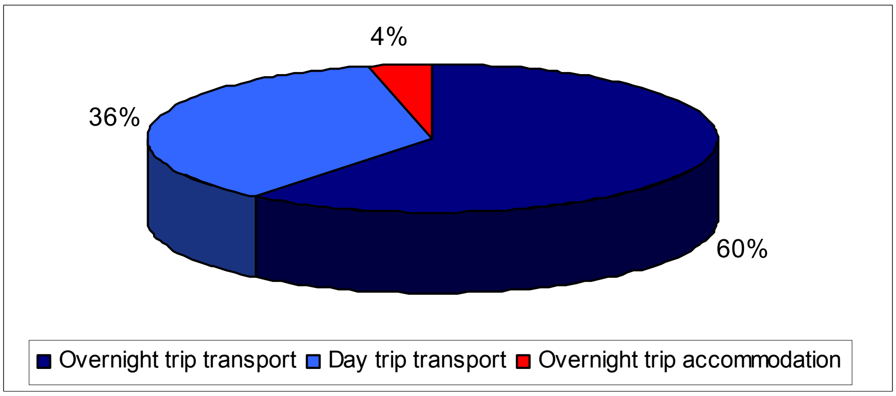

Figure 17 Proportion of total domestic tourism emissions by transport and accommodation in 2007.

It is important to understand some of the key drivers of domestic tourism emissions. In the following, the transport and accommodation emissions of overnight tourists are analysed in more detail. Purpose of travel, for example seems related to the size of a tourist's carbon footprint (Figure 18). In general, business/conference travellers have higher transport emissions than other tourists. This is driven in particular by a significant air travel component: the average business tourist travels 346 km by air, compared with 104 km for visiting friends/relatives tourists. All other tourists travel even less by air.

As a result of a shorter stay (2.35 nights for business travellers), their accommodation emissions are somewhat lower than those of, for example, holiday travellers (3.23 nights on average). When interpreting Figure 18 note that transport emissions are on the left hand y-axis and accommodation emissions are measured on the right hand y-axis. The scales for the axes differ by a factor of 10, which shows the much greater importance of transport emissions compared with those from accommodation.

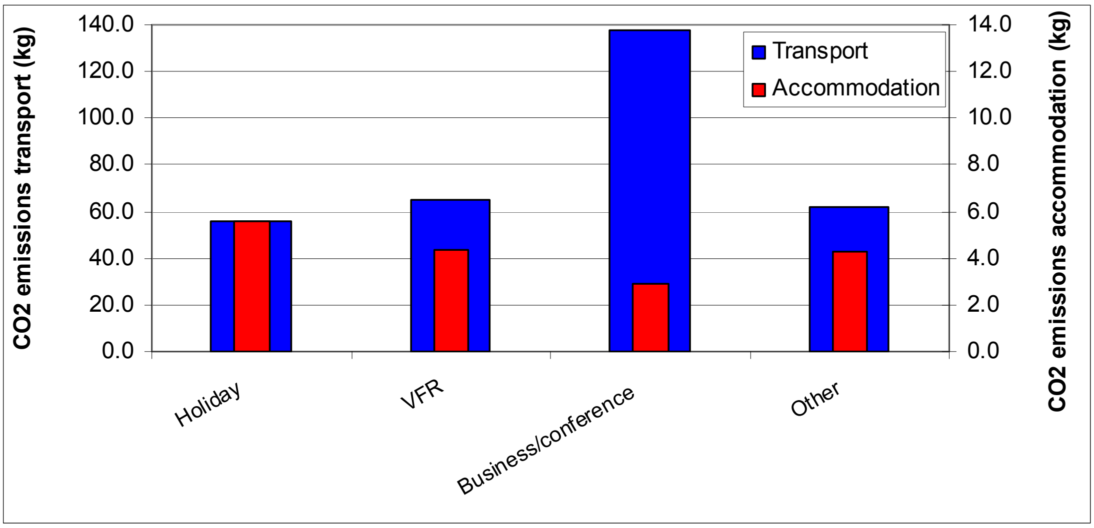

Figure 18 Transport and accommodation emissions per person by travel purpose (only overnight trips are included) in 2007.

When considering all forms of domestic tourism (i.e. overnight and day trips), the largest contributor to total emissions is 'holiday travel' (34% of emissions). Business/ conference and visiting friends also play a very important role with a contribution of 30% and 28% respectively (Figure 19). The overall contribution is a result of number of trips (i.e. volumes) and per-trip carbon footprint (as outlined above).

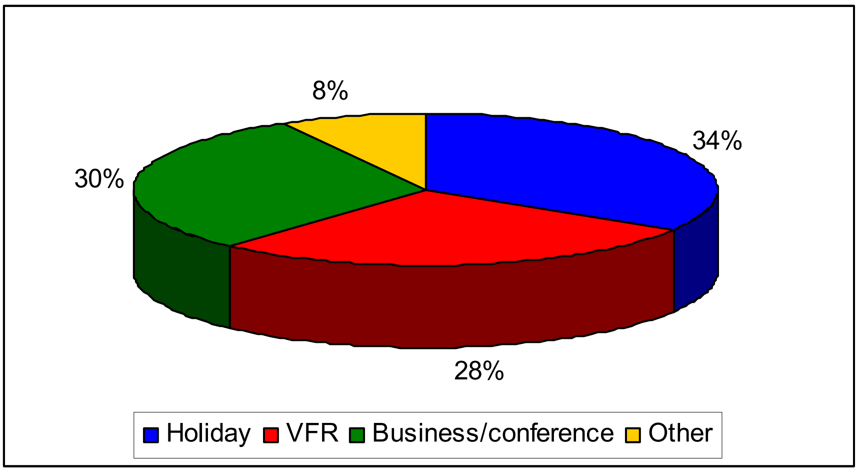

Figure 19 Contribution of each travel purpose to the total carbon emissions from domestic tourism in 2007.

Income is also likely to influence travel behaviour and as a result carbon emissions. The following analysis is based on reported household income for overnight tourists. It can be seen that household income is positively correlated to the size of the transport footprint (Figure 20). Tourists on a high income are more likely to travel by air (191 km on average) compared with low-income tourists (only 62 km by air). On the other hand, tourists from lower income households stay slightly longer than other tourists which results in a relatively larger per person footprint for accommodation in total (although transport emissions are quite low). Many low-income tourists travel to visit friends and families (50.1%), whereas higher income tourists are more likely to be travelling for business purposes (see above). The drivers of carbon emissions are therefore inter-related.

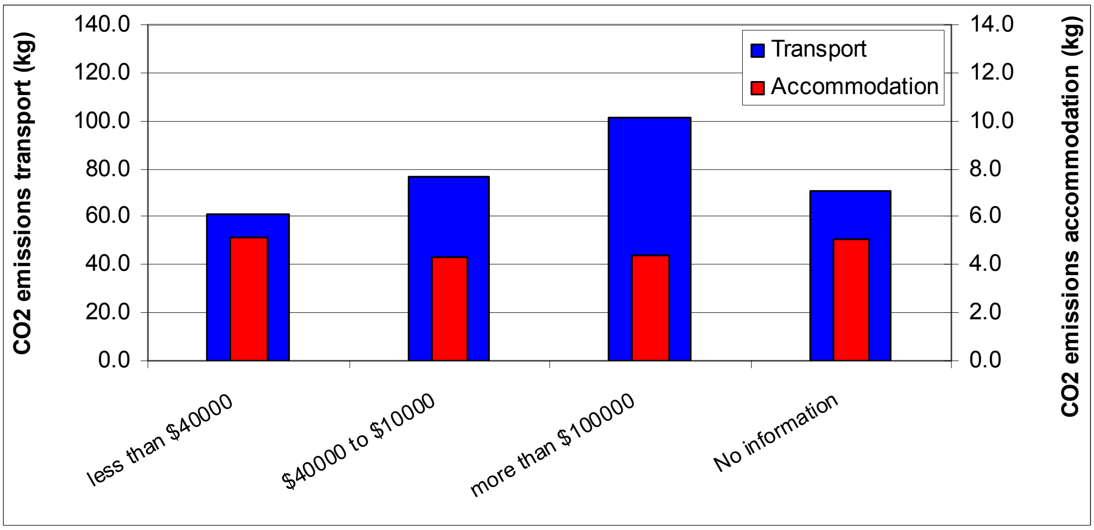

Figure 20 Transport and accommodation emissions per person by household income group (only overnight trips are included) in 2007.

The emissions from transport and accommodation are also related to travel party (Figure 21). Tourists who travel on their own and in the company of ‘other’ emit more for transport than other tourist groups. Again, these patterns are likely to relate to the above analysed drivers of purpose and income. For example, 48.7% of overnight tourists who travel alone travel for business purposes. This proportion is even higher for the travel party ‘other’ (63.3% are business travellers).

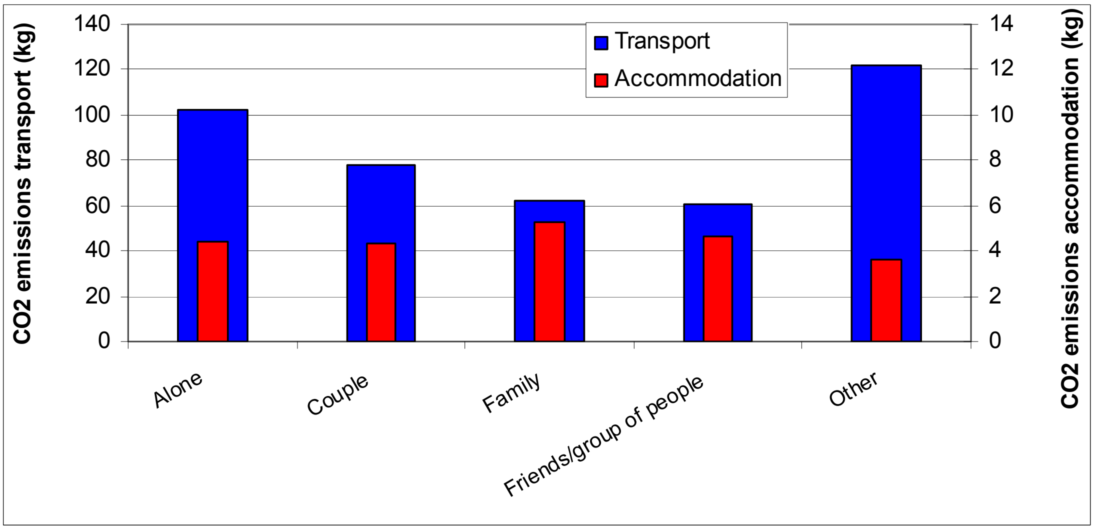

Figure 21 Transport and accommodation emissions per person by travel party (only overnight trips are included) in 2007.

4. Comparison between Domestic and International Tourism in New Zealand

As outlined earlier in this report, domestic tourism volumes are much bigger than those of international tourism. This is particularly true if day trips are included in tourism statistics. On a visitor-night basis, however, the two are comparatively similar with 42.6 million nights spent by domestic tourists and 49 million nights spent by international tourists. Also, the total spending of domestic and international tourists is of the same magnitude. It is therefore understandable that international tourism has received a lot of interest by New Zealand policy makers, marketers and researchers. However, this should not explain the lack of interest in domestic tourism, especially in relation to environmental issues such as climate change. The comparison below will highlight the importance of domestic tourism relative to international tourism, and serve as a basis for management strategies. The analysis presented here only includes the on-shore component of international tourism to allow for a direct comparison of national carbon impacts of domestic versus international tourists within New Zealand.

4.1 Footprints within New Zealand

The carbon footprint of international tourism has been calculated at a high level, building on earlier work undertaken in this field[17] and on most recent research in a government funded project called "Tourism & Oil" (a 3-year FRST funded project undertaken. A brief description of how the footprint was derived is provided in Appendix C. Domestic tourists only spend an average of three nights away from home, and as a result their travel is characterised by a high transport component. In contrast, international tourists who stay on average for about 20 days (depending on the year) travel comparatively less per day and their transport footprint is therefore somewhat smaller. In addition, there are a large number of international tourists who tend to travel very little. These are, for example, educational visitors, conference attendees who fly straight into the destination of their conference, and visiting friends and relatives tourists.

As a result of the above factors, the transport carbon footprint of domestic overnight tourism is higher than that of international tourists (1.16 Mt of CO_2-e compared with 0.64 m tonnes), despite a comparable number of visitor nights. Overnight tourism by domestic tourists makes up 48% of tourism's total carbon

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[17] The emissions of international tourism had been calculated for the year 2001 in a 2003 EECA report: Becken, S. & Cavanagh, J. (2003). Energy efficiency trend analysis of the tourism sector. Research Contract Report: LC02/03/293. Prepared for the Energy Efficiency and Conservation Authority. The methodology was similar to that presented in this report, and information was extracted from the Ministry of Tourism's International Visitor Survey. The latest analysis of international tourist behaviour as provided through the Tourism & Oil project has been used to recalculate the footprint for 2007, using the same emission factors as shown in Box 1 in this report.

footprint of 2.56 million tonnes of CO_2-e (Figure 22). Day trips (i.e. their transport component) are the second largest contributor at 27%, while international tourism (transport and accommodation) contributes 25%. When adding up domestic day and overnight tourism the total share of domestic tourism is 75%, and international tourism is 25%.

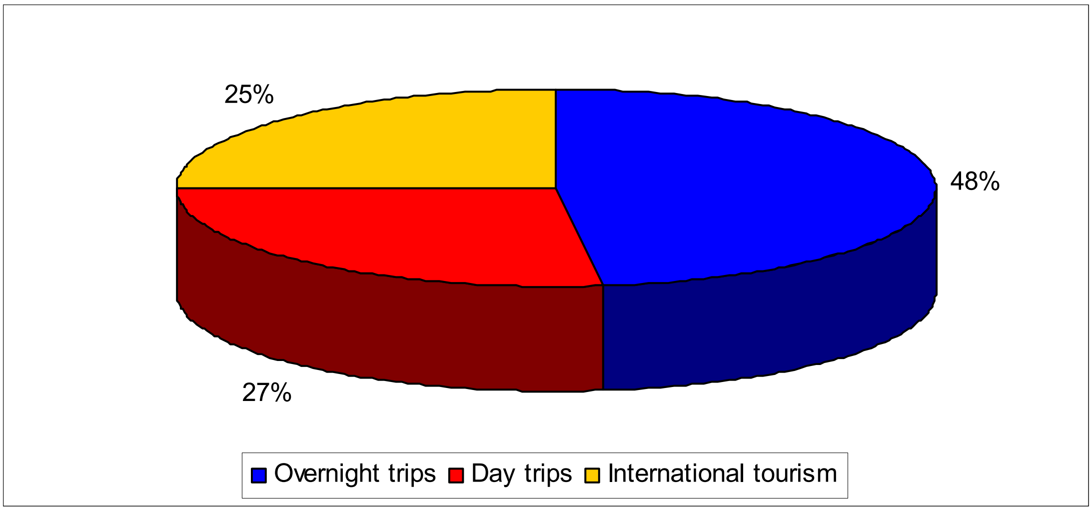

Figure 22 Contribution to total emissions by domestic and international tourism.

The main cause of domestic tourisms' emissions is the car (or similar forms of individual vehicles) with 1.1 million tonnes of CO_2-e emitted in 2007 (Table 2). The emissions caused by domestic tourists' car travel make up 42% of the total tourism carbon footprint (i.e. both domestic and international tourism, and both transport and accommodation). Air travel by domestic tourists contributes another 26% to the total footprint. This means that by addressing the car and air transport components of domestic tourists alone, one would deal with 68% of all tourism's emissions.

Hotels are the most important emission source amongst the accommodation types, both for domestic and international tourists. For international tourism, the main emissions source is internal air travel, followed by car transport (largely rental vehicles). Hotels also play a major role in the emission profile of international tourism.

Table 2 Emission profile for domestic and international tourism in 2007

	Domestic tourism (t CO2-e)	International tourism (t CO2-e)
Domestic air	657,456	211,490
Car	1,098,675	215,905
Bus/coach	21,774	34,410
Other transport	73,004	54,616
Hotel	10,113	43,855
Motel	486	8,895

Hostel	8,908	9,676
Camping	7,719	-
Hosted/B&B	176	-
Private	1,940	44,853
Other	38,686	14,117
TOTAL	1,918,937	637,820

4.2 Footprints associated with international travel

As mentioned in the introduction, the biggest concern about tourism and climate change at a global level relates to air travel. A recent study commissioned by the UNWTO[18] shows that CO_2 emissions from global tourism transport are in the order of 981 Mt CO_2, and more than half (52%) of these are estimated to be caused by air travel. Much of this air travel is international in nature. Several studies have been undertaken on international aviation and there is general agreement that emissions from air travel will continue to increase. Major changes would be required to decouple the growth of international tourism from an increase in emissions from aviation, and further research into both technological and behavioural changes is required to address this challenge. This is particularly important given that sectors other than aviation have been more successful in reducing emissions, and if aviation fails to address its greenhouse gas emissions it will put an additional burden on other economic sectors to meet national or international targets.

At present, greenhouse gas emissions associated with international air travel are not formally part of a country's emissions inventory (or more specifically they are measured through the sales of bunker fuels at the airport but do not form part of national reduction targets), and it is the International Civil Aviation Organisation that is charged under the Kyoto Protocol to develop mechanisms for dealing with aviation's emissions. So far, very little progress has been made. An often cited reason is that the Chicago Convention and about 3000 bilateral agreements prevent the taxation of aviation emissions. The European Union is of the view that including aviation emissions into their Emissions Trading Scheme is legally possible, but some countries try to challenge this position. Difficulties also arise in terms of accounting methodologies. The New Zealand Ministry of Transport, for example, has recently carried out a study to account for the emissions of international tourists to New Zealand under different scenarios (e.g. allocation by country of origin, air space, carrier etc.).

The average international tourist travelling to New Zealand flies for about 13,000 km one-way and the emissions associated with this amount to about 1.6 tonnes CO_2 per person. There is ongoing discussion on how to account for non-carbon

[18] Scott, D., Amelung, B., Becken, S., Ceron, J.P., Dubois, G., Goessling, S., Peeters, P. & Simpson, M. (2007). Climate Change and Tourism: Responding to Global Challenges. Madrid/Paris: United Nations World Tourism Organisation and United Nations Environment Programme.

greenhouse gases and experts suggest that a factor of at least 1.9 to 2.7 should be applied to the CO_2 emissions to arrive at CO_2-equivalents. The total amount of CO_2 emissions associated with international tourists' travel to New Zealand (one-way) had been calculated for 1999 at 1.9 million tonnes[19]. This referred to 1.59 million arrivals and when extrapolated to the 2.47 million international tourists in 2007, the emissions would be in the order of 2.1 million tonnes of CO_2 (this would assume a static market mix between 1999 and 2007, which is not quite accurate). The footprint of international tourists' air travel to New Zealand is therefore of a similar order to the in-country footprint of 2.56 million tonnes of CO_2 – not accounting for non-carbon greenhouse gases and not considering tourists' return flights.

No calculations have been undertaken to estimate the greenhouse gas emissions associated with New Zealand outbound tourism. From the analysis provided earlier in this report we know that volumes are substantial (1.98 million in 2007). A large proportion of these trips are to Australia and the flight distance is therefore expected to be shorter on average than for incoming tourists. Notwithstanding this, the footprint of outbound tourism could be substantial and add at least another million tonnes of carbon dioxide per annum.

At present, the policy situation is too uncertain to provide an assessment of what this means for New Zealand and what kinds of emissions a country might be responsible for in the future. It is important, however, to understand that the carbon footprint measured within a country is potentially only a small proportion of the total.

5. Reduction potentials

5.1 Policy background

The New Zealand Government through its Transport Strategy[20] has outlined a set of (ambitious) targets for reducing greenhouse gas emissions from transport. The following three are relevant for tourism:

- Halve per capita greenhouse gas emissions from domestic transport by 2040 (relative to 2007);
- Become one of the first countries in the world to widely use electric vehicles;
- Reduce the rated CO_2 emissions per kilometre of combined average new and used vehicles entering the light vehicle fleet to 170 grams CO_2 per kilometre by 2015.

One of the cornerstones of former Labour-led Government policy to achieve these targets was the Emissions Trading Scheme. The ETS in its present form

[19] Becken, S. (2002). Analysing international tourist flows to estimate energy use associated with air travel. *Journal of Sustainable Tourism*. 10 (2), 114-131.

[20] http://www.transport.govt.nz/assets/Downloads/NZTS-final-PDF.pdf

(changes are possible under the new Government) is expected to increase the costs of fossil fuels and therefore make transport more costly and incentivise carbon-free alternatives. It is known, however, that for transport in general and for tourism specifically, price elasticities are low and minor increases in prices are unlikely to change behaviours at a broad scale. A wide range of international studies have illustrated how challenging it is to reduce transport emissions partly because mobility and car ownership are commonly associated with substantial psychological and social benefits. As a result, most mitigation measures are focused on new technologies or traffic management rather than the reduction of demand. A number of studies have shown, however, that technological changes alone will be insufficient to reduce emissions to required levels, and more fundamental transformations are required for transport to make a real contribution to global climate change mitigation[21].

In more detail, the New Zealand Transport Strategy therefore outlines further areas for action:

- Managing demand for travel;
- Shifting to more efficient and/or lower impact means of transport;
- Improving fuel efficiency of the vehicle fleet;
- Developing and adopting future fuels;
- Ensuring the security of short-term oil supplies and a diverse supply of transport fuels.

The reduction potential that is expected from the above measures by 2020 is shown in Figure 23. For the light vehicle fleet it is believed that demand management will achieve 2% of savings. Improvements in the efficiency of vehicle fleets are supposed to yield 5% and biofuels will save another 5% of emissions. In the following, the reduction opportunities will be discussed for tourism.

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[21] For example:

- Kwon, TH. (2005). A scenario analysis of CO2 emission trends from car gravel: Great Britain 2000-2003. Transport Policy 12(2), 175-184.
- Moriarty, P. & Honnery, D. (2008). The prospects for global green car mobility. Journal of Cleaner Production, 16, 1717-1726.

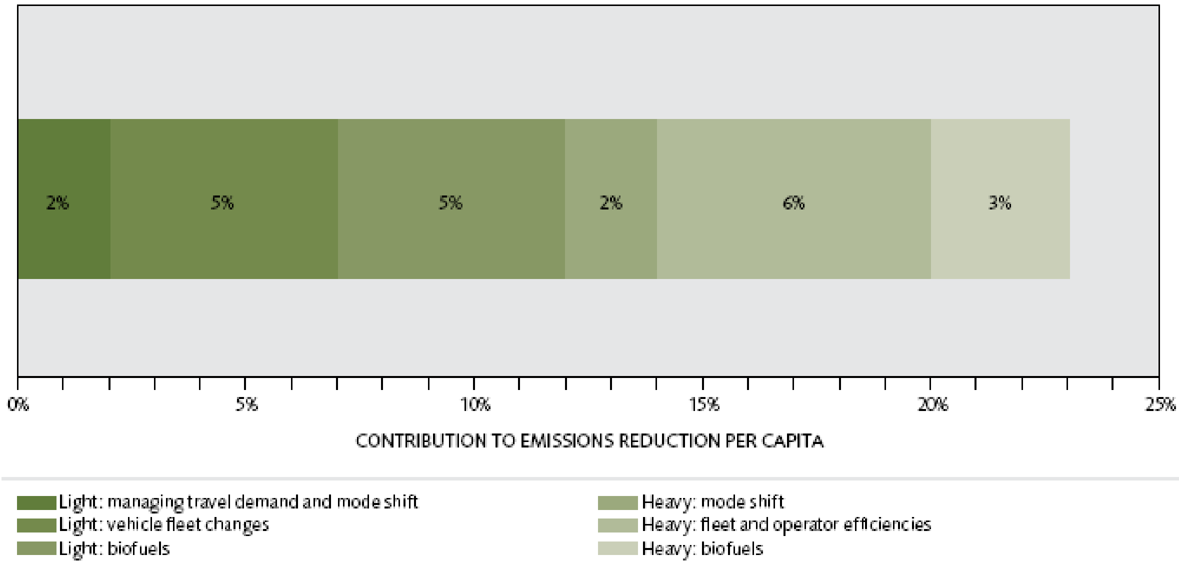

Figure 23 Reduction potentials for transport in New Zealand by 2020 (Transport Strategy, 2008: 50)

5.2 Tourism specific assessment

The analysis presented in this report highlights some key challenges:

- The high usage of private cars, largely for family travel and holiday trips
- The high usage of air travel amongst business travellers
- Short stays for domestic overnight trips
- An increasing popularity of outbound travel at the expense of domestic tourism.

The latter point is highly relevant from two perspectives. One is an economic one, where outbound tourism is considered as a loss of 'income' to the local tourism industry. The other one is related to global greenhouse gas emissions (as opposed to national ones), where international travel is producing more emissions than domestic trips and reductions could be achieved by shifting travel patterns back towards more domestic tourism. It is important to understand, however, that such a shift will increase national emissions within New Zealand. Once international emissions are included in international agreements, for example a post-Kyoto treaty, this situation might change as countries will be partly responsible for international travel by their residents, as well as incoming tourists (see also section earlier in this report). Further economic analysis on the impacts of 'avoided' outbound tourism would be useful and should focus on a) the climate change impact, b) economic benefits for New Zealand and c) other impacts on New Zealand such as infrastructure bottlenecks, social and environmental impacts from increased tourist volumes. The concept of 'eco-efficiency', i.e. contrasting economic benefits with environmental impacts would be useful in such analyses.

Technological change

The Ministry of Transport aims to reduce emissions from currently 241 g CO_2-e (or 238 for just CO_2, see Appendix B) to 170 g CO_2/vehicle-km. This represents an improvement of almost 30%. While this seems possible for rental vehicle companies (largely catering to international tourists)[22], it is challenging for the private vehicle fleet as a whole. It is likely that holiday travel is predominantly undertaken with larger cars, especially given the high occupancy rates of three people per travel party (2.9 in 2007).

If the carbon emission intensity for private vehicles (assumed for domestic car travel) could be reduced by 20% and that for rental vehicles by 30% (assumed for travel by international tourists), and no other changes were made, the overall carbon footprint could be reduced from 2.57 to 2.27 m tonnes of CO_2-e. This represents a reduction of 11%.

Other technological improvements could be promoted for tourism, for example electric cars and plug-in hybrid cars. In the first instance, it is more likely that rental vehicle companies engage in such innovate technologies than individuals, as they can see a marketing and branding benefit. Already, there are companies that developed a niche product based on greener vehicle technology, such as the Green Cabs now operating in Auckland, Wellington and Christchurch. The domestic vehicle fleet is likely to lag behind business initiatives and incentives are required to encourage New Zealanders to adopt new technology. Rental car companies, however, could act as a leader in this area.

A similar argument is likely to apply to the use of biofuels. Kea Campers in Auckland, for example are currently negotiating options for running their airport shuttle bus on biofuel. There are numerous examples from the tourism sector worldwide that illustrate the operation of ethanol-run busses or other alternatives such as tourist boats running on coconut oil. Also, a number of airlines in partnership with aircraft manufacturers are testing the use of biofuels in the aviation industry. However, it has also been demonstrated that the role of biofuels will always be insignificant compared with the amount of liquid oil that is required to meet the demand for transportation. While New Zealand may have favourable conditions for producing biofuel, the target of 5% (see Figure 23) seems ambitious. It will also focus on road transport and not solve issues related to air travel.

A promising technology on a small scale is the increased use of GPS systems for navigation. While only anecdotal at this point it is likely that GPS reduces travel distances by tourists searching for certain locations (e.g. accommodation, attractions). Further research in this area would be useful.

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[22] Rental cars are already more fuel efficient than the average car in New Zealand, because they are newer with more modern engines and they also tend to be smaller in engine size.

Finally, this report has highlighted the carbon intensity of business travel, especially since it is undertaken to a large extent by the means of air transport. Further technological improvements in telecommunication would help reduce the carbon footprint of business tourism. The increased uptake of existing technology might be aided by increased costs of transport under future oil price scenarios.

Changing travel demand

A recent survey[23] on the attitudes of New Zealanders towards the environment showed that just over half of respondents were deeply concerned 'that we are not doing enough to protect our environment', and three quarters claimed that they do 'a lot' or 'a reasonable amount' to protect the environment. Surveys on environmental attitudes – as opposed to real behaviour – have to be treated with caution as people tend to answer in a positive way with good intentions that are not necessarily backed up by good practice. Notwithstanding this, the above survey indicated high awareness and willingness to engage in environmental issues, however, it also identified that New Zealanders were least willing to be sustainable in the area of transportation. Maybe this is why the Ministry of Transport sees an emissions reduction potential of only 2% through demand management. Notwithstanding the obvious challenge related to transport, the opportunities for tourism are potentially substantial. These would, however, require substantial investments in infrastructure.

For example, it has been shown in highly populated countries that trains offer a viable alternative to air transport on short routes, as for example demonstrated by the Eurostar which operates through the Channel Tunnel, connecting the UK with mainland Europe. More than 70% of trips between London and Paris are now undertaken by train, and about 64% of trips between London and Brussels (Johnson and Cottingham, 2008[24]). It is acknowledged that the geography of New Zealand does not necessarily lend itself for an extensive rail network, however, there are opportunities for extending existing railway lines or reconverting freight lines into passenger corridors. The Green Party is currently exploring such options and some tourism destinations in New Zealand have started to look into the revitalisation of existing railway lines. Expanding the rail network for tourism purposes would also assist in maintaining the integrity of the 100% Pure brand that is so important for international tourism. Coastal shipping could also have potential for tourism, but further investigations would be required.

Abandoned railway tracks have been successfully turned into cycle paths. The Otago Railtrail is a prime example, and the majority of users are domestic

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[23] Fryer, K., Kalafatelis, E. & Lee, M. (2008). Household Sustainability Benchmark Survey. Prepared for Ministry for the Environment, February 2008.

[24] Johnson, V. & Cottingham, M. (2008). Plane Truths: Do the economic arguments for aviation growth really fly? Nef (the new economics foundation) Report. London. Available at (10/10/08) www.neweconomics.org

tourists. There are many other examples in the tourism literature of successful cycle tourism projects. For example, Lumsdon (2000)[25] discusses the United Kingdom National Cycle Network, which offers connected cycling routes on traffic-free trails, traffic-calm roads, and minor roads. Expanding cycle networks requires substantial investment by the public sector and its partners; however, compared with roading projects, the establishment of cycling routes appears to be a very cost-efficient alternative. At present very little has been done to actively develop and promote cycle tourism in New Zealand, although the latest Government initiative of developing a national cycleway is a great step in this direction. It is not known at this stage to what degree cycle tourism would be accepted as a viable holiday alternative for domestic tourists and given the $50 million investment on the above cycleway this warrants further research.

Internationally, there is an increasing advocacy for "slow travel[26]", which relates to travelling less per day and undertaking more localised activities. Such new forms of travel might be difficult to implement for those domestic tourists who travel to a specific point, for example to visit a friend or relative, to undertake a very specific activity (e.g. skiing) or to stay at a holiday home. But there is still opportunity to influence those domestic tourists who are undertaking 'touring holidays', just like their international counterparts. Moreover, slower travel could also be achieved by increasing length of stay and therefore making travel distance more worthwhile.

Transport behaviour could also be changed at a more local level. Tourist destinations have an opportunity to improve transport systems for tourist whilst at the destination. This is particularly true for resort destinations where tourists stay for several nights. Better transport systems, such as those based on public transport, electrically run vehicles, and good walking and cycling systems, are also likely to increase the attractiveness of a destination. Key to successful local transport networks is the supply of easy-to-read information and a good integration of transport modes, such as park and ride, or bus and walk. At this stage very little is known about domestic tourists' willingness to accept transport systems that shift away from individual transport options.

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[25] Lumsdon, L. (2000). Transport and Tourism: Cycle Tourism – A Model for Sustainable Development? *Journal of Sustainable Tourism,* 8 (5), 361-376.

[26] e.g. http://www.slowplanet.com/travel

6. Critical Issues and Recommendations

Domestic tourism is extremely important to New Zealand society and economy. Tourist volumes are larger than those of international tourism; yet our understanding of domestic tourism is limited. This report is the first comprehensive analysis of the carbon footprint associated with domestic tourism in New Zealand. The total amount of greenhouse gas emissions was estimated and key drivers were analysed.

Moreover, domestic tourism has been contrasted with international tourism in New Zealand and key areas of concern emerged (see summary Table 3 below). The main results are:

- There are about 42 million domestic tourists trips (2007), of which 14.7 million are overnight trips with an average length of stay of 2.9 nights. Most trips are for holiday reasons (40%) but a substantial number is due to business (18%).
- Most trips are generated in the key population centres and preferred destinations are therefore in proximity to these centres (depending on the nature of the trip).
- Personalised transport (i.e. the car and similar forms) makes up 81% of all passenger-kilometres but only 59% of greenhouse gas emissions. Air travel, due to its higher per-passenger-kilometre carbon intensity, makes up 36% of emissions.
- Domestic tourism contributes 12.3% to all transport emissions in New Zealand. Transport is the fastest growing sector in terms of emissions in New Zealand, but tourism’s share has been declining somewhat as a result of reduced tourist volumes and increased outbound travel.
- Amongst accommodation, ‘other’ is the most important category contributing 57% to accommodation emissions (other includes rented accommodation). Hotels are the most important commercial accommodation category (15% of emissions).
- The total carbon footprint of tourism is 1.9 million tonnes of CO_2-equivalent. Of this, 60% are due to tourist transport related to overnight trips, 36% is from day trip transport, and 4% is due to tourist accommodation. The key contributor is therefore transport.
- Business travel only makes up 18% of all domestic trips, but it contributes 30% to greenhouse gas emissions from domestic tourism. Much of this is related to business travellers’ propensity to use domestic air.
- The bigger picture of tourism’s carbon footprint (i.e. domestic plus international tourism in New Zealand) shows that domestic tourism contributes 75% and international tourism makes up the remaining 25%. On a per-day basis, domestic tourism is more carbon intensive than international tourism.
- The car (especially by domestic tourists) is by far the largest contributor to the carbon footprint (51% of all emissions), followed by air travel (34%) and other transport (5%).

- The analysis of the tourism carbon footprint does not consider emissions associated with international aviation, but further analysis would be useful, especially when shifts between outbound and domestic tourism are possible (e.g. due to the financial crisis or higher oil prices).

Table 3 Summary of carbon emissions related to domestic and international tourism, using a range of metrics

METRIC	DOMESTIC TOURISM	INTERNATIONAL TOURISM
Total CO2-e emissions (tonnes)	1,918,937	637,820
CO2-e emissions per tourist trip (kg)	45.7	258.2
CO2-e emissions per tourist day* (kg)	27.5	13.0

* For domestic tourism the 27.3 day trips were added to the 42.6 million 'nights' spent by domestic tourists; and for international tourists the total number of 49.0 million nights was used in the calculation.

Reducing emissions from transport is challenging and the discussion provided in this report indicated that domestic tourism might be even harder to address than international tourism. One key challenge lies in the need to decouple tourism growth from growth in transport emissions. This is true for international tourism, which is still predicted to grow annually in the order of 3-5%, but also for domestic tourism, if future shifts led to increased levels of domestic travel activity (possible at the expense of outbound travel). Careful planning for such growth in tourism is required now to avoid lock-in into existing ways of travel and risking ongoing growth of tourism transport emissions.

It is recommended that initiatives focus on two areas initially:

1. Car travel by domestic holiday and visiting friends/relatives tourists
2. Air Travel by business tourists.

Both areas present challenges, but there are clear reduction potentials – both technological and in relation to demand management – that have not been exploited so far. It was shown in this report that the majority of domestic tourist flows are around the main population centres and this provides a great opportunity to develop sustainable transport networks that cater for shorter trips, without having to develop a full nation-wide transport network. Key tourist destinations such as Coromandel, Rotorua, Taupo, the Kapiti Coast, Hanmer Springs, Akaroa and so forth could form part of alternative and carbon-efficient transport networks. Given domestic tourism's contribution to national transport emissions, any successful reductions are likely to have a noticeable impact overall. Improvements in transport networks will also have positive spin-off effects for international tourism and the clean green image that New Zealand capitalises on.

Clearly, tourism is embedded in the wider context of infrastructure planning, technological development and societal trends in New Zealand. As such, initiatives in the tourism sector depend to some degree on national, cross-sectoral initiatives (e.g. the modernisation and expansion of a rail network) and policies, for example in relation to vehicle fuel efficiency. It is very important for New Zealand tourism that the country improves sustainability as a whole and reduces emissions through a broad range of measures. On the other hand, tourism has an important role to play in terms of lobbying for particular initiatives (e.g. cycle networks), promoting tourism-specific technology (e.g. modern campervan fleets or innovative rental vehicles), and shifting perceptions of New Zealanders about sustainability and quality of live (e.g. slow travel). The fact that tourism is exposed to international trends, both as a result of international visitors using the same facilities as domestic travellers and also because of international competition that forces operators to lift environmental standards, provides a real opportunity for tourism to become a leader within New Zealand's economy.

There are already a number of successful initiatives and programmes that deal with the sustainability, or more specifically the carbon intensity, of tourism in New Zealand. Examples include Qualmark Green, Green Globe 21, carboNZero, the Ministry of Tourism's STAR (Sustainable Tourism Advisors in Regions) programme and several initiatives on energy efficiency by the Tourism Industry Association. Often, these focus on the very 'visible' parts of tourism, namely domestic tourists on the demand side and tourism-specific businesses on the supply side (e.g. hotels or ecotourism operators). This analysis has demonstrated, that it is domestic tourism that contributes most to the overall carbon footprint of tourism (75%), and within that it is the personal vehicle that dominates the emission profile. Too little attention has been paid to these 'more subtle' components of tourism in New Zealand and initiatives are required that directly address domestic tourists' transport emissions. Improvements in this key area will then also reflect positively on the 100% Pure brand.

Appendix

Appendix A – overview of emissions associated with different fuel sources

FUEL TYPE	UNIT	CONSUMER ENERGY (MJ/UNIT)	GHG (GCO2EQ/ MJ)	GHG (GCO2EQ/ UNIT) 2ND IPCC	GHG (GCO2EQ/ UNIT) 4TH IPCC	LCA GHG2 (GCO2EQ/ UNIT)
Mobile Use						
Diesel	litres	38.3	69.9	2,676	2,675	3,108
Petrol (regular unleaded)	litres	34.9	66.5	2,320	2,322	2,735
Aviation gasoline	litres	33.9	65.9	2,231	2,230	2,608
Jet fuel	litres	37.2	68.4	2,540	2,539	-
LPG	kg	49.5	60.6	2,999	3,004	-
LPG	litres	26.5	60.6	1,608	1,611	-
Biodiesel (tallow) 1	kg	40.0	0.0	0.0	0.0	1,750
Stationary Use						
Diesel	litres	38.3	68.8	2,634	2,634	-
Natural gas	MJ	1.0	53.0	53.0	52.9	53.36
Natural gas	m3	40.0	53.0	2,118	2,117	2,124
LPG	kg	49.5	60.0	2,971	2,970	-
LPG	litres	26.5	60.0	1,592	1,592	-
Coal (sub-bituminous)	kg	22.4	90.0	2,012	2,012	2,147
Coal (lignite)	kg	15.9	93.9	1,489	1,489	1,594
Wood	kg	12.1				
National electricity grid average (2007)	kWh	3.6	49.9	179.5	179.9	201.9
National electricity grid average (2006)	kWh	3.6	61.5	221.5	221.8	245.0

1. Barber, A., Campbell, A., Hennessy, W., 2007. *Embodied Fossil Energy and Net Greenhouse Gas Emissions from Biodiesel Made From New Zealand Tallow*. Report prepared for the Energy Efficiency Conservation Authority. CRL Energy Ltd, Wellington.

2. These are GHG emissions using life cycle assessment methodology. They include down stream as well as combustion emissions.

Appendix B –Transport emission factors provided by the Ministry for the Environment[27]

The Ministry for the Environment provides estimates of greenhouse gas emissions for transport where no fuel data is available. They note that factors such as individual vehicle fuel efficiency and driving efficiency mean that kilometre based estimates of CO_2-e emissions are less accurate than calculating emissions based on fuel use data. The emission factors in the table below should therefore only be used if information on fuel use is not available. In the analysis presented in this report the value of 0.241 kg CO_2 -e/vehicle-km was used for tourists car travel.

Vehicle size class**	Unit	Real world petrol fuel use estimate (L/100km)	Emission factor total CO2 -e* (kg CO2 -e/unit)	Emission factor CO2 (kg CO2 /unit)	Emission factor CH 4 (kg CO2 -e/unit)	Emission factor N2O (kg CO2 -e/unit)
Car – small (<1600 cc)	km	7.67	0.179	0.176	0.00104	0.00119
Car – medium (1600–<2500 cc)	km	10.4	0.241	0.238	0.00141	0.00160
Car – large (≥2500 cc)	km	14.2	0.330	0.326	0.00193	0.00219
Car – default***	km	10.4	0.241	0.238	0.00141	0.00160

* Use the total CO_2-e emission factor for calculating total CO_2-e emissions, rather than summing the totals for CO_2, CH_4 and N_2O.

** Example (representative) vehicle models for each of the size classes are: Small = Toyota Echo, Medium = Honda Accord, Large = Holden Commodore.

*** The default emission factor should be used if vehicle size class cannot be determined.

[27] **h**ttp://www.mfe.govt.nz/publications/climate/guidance-greenhouse-gas-reporting-apr08/html/page3.html

Appendix B –Calculating the carbon footprint of International Tourism in New Zealand

In a forthcoming report[28] on tourist consumption, a detailed analysis of international tourist behaviour is provided for 18 visitor segments. The analysis is based on the International Visitor Survey – undertaken by the Ministry of Tourism and involving about 5000 tourists per year. The Tourism & Oil project carried out by Lincoln University analysed transport and accommodation behaviour in detail and these results can be used to calculate the emissions of carbon dioxide equivalents.

The following two tables show the results for 2007 for travel distances (by mode) and accommodation behaviour. These results can be used with the emission factors shown in Box 1 in this report. Some modifications were necessary. In the transport sector, the modes water, taxi and train were aggregated into 'other' and an emissions factor of 0.24 kg CO_2-e/passenger kilometre was applied. For campervans a factor of 0.24 kg CO_2-e/pkm was used. Car travel was assumed to involve two people on average (not three as in the case of domestic tourism) and the emission factor per passenger-kilometer was therefore 0.12kg CO_2-e. For accommodation, an emission factor of 2 kg CO_2-e was applied to 'other nights' and the factor for 'private homes' was applied to all 'non-commercial nights'.

Emissions were calculated for an 'average tourist' in each segment and then multiplied by the number of arrivals in 2007 in the respective segment. This is an aggregated approach (and not fully bottom up as undertaken for domestic tourists) but provides a very good indication of the carbon emissions association with international tourist transport and accommodation within New Zealand.

The total emissions from international tourist transport in New Zealand amount to 637,820 tonnes of CO_2-e. Eighty-one percent of these are due to transport (516,420 tonnes of CO_2-e) and the remaining 19% are related to accommodation (121,400 tonnes of CO_2-e).

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[28] Becken, S., Carboni, A., Vuletich, S. & Schiff, A. (2008). Analysis of tourist consumption, expenditure and prices for key market international tourism segments. Report No 7. Available at www.leap.ac.nz

	Visitor arrivals 2007		Average kms travelled per tourist by Transport Mode						
Segment	Adults Arrivals	Length of Stay	Air	Car	Bus	Camper	Water	Taxi	Train
Australia FIT Holiday	291,087	14.2	262	1135	842	434	96	13	29
Australia FIT VFR	286,005	11.8	326	803	87	48	28	14	15
Australia FIT Other	195,029	10.1	564	1126	389	218	113	24	28
Australia Tour	86,823	9.9	531	662	171	5	47	14	9
UK Holiday	141,995	31.6	724	307	952	8	419	21	33
UK VFR and Other	126,081	38.4	376	544	465	14	46	33	20
USA FIT Holiday	93,247	16.8	414	346	239	0	8	35	6
USA FIT VFR and Other	64,537	25.7	883	56	871	0	8	63	15
USA Tour	35,032	11.1	444	412	690	13	207	11	14
Japan FIT Holiday	30,509	15.3	328	550	183	8	13	9	3
Japan FIT VFR and Other	26,957	46.1	110	47	531	2	11	0	0
Japan Tour	56,418	8.5	195	1407	702	606	112	7	11
South Korea All	85,592	22.6	267	798	308	156	48	16	12
China FIT	27,000	42.0	542	294	1348	47	72	18	18
China Tour	82,995	3.5	110	47	531	2	11	0	0
Germany All	55,082	42.8	113	1079	232	216	39	12	24
Rest of World FIT	503,736	32.9	115	472	45	8	9	4	8
Rest of World Tour	55,862	21.9	136	177	26	0	5	23	0

	Visitor arrivals		Accommodation (nights) per person and category				
Segment	Adults Arrivals	Length of Stay	Hotel	Motel	Back-packer	Other	Non-com-mercial
Australia FIT Holiday	291,087	14.2	2.1	2.6	1.6	2.7	5.2
Australia FIT VFR	286,005	11.8	0.5	0.8	0.1	0.3	10.1
Australia FIT Other	195,029	10.1	2.3	0.8	0.3	0.7	6.0
Australia Tour	86,823	9.9	5.1	2.0	0.2	2.5	0.2
UK Holiday	141,995	31.6	3.3	3.4	7.3	5.4	12.2
UK VFR and Other	126,081	38.4	1.6	1.4	1.4	1.7	32.2
USA FIT Holiday	93,247	16.8	3.3	2.3	2.3	4.4	4.4
USA FIT VFR and Other	64,537	25.7	2.4	1.0	1.2	3.0	18.1

USA Tour	35,032	11.1	5.3	0.6	0.6	3.3	1.3
Japan FIT Holiday	30,509	15.3	2.5	0.8	2.8	2.4	6.8
Japan FIT VFR and Other	26,957	46.1	1.9	2.1	0.4	20.6	21.1
Japan Tour	56,418	8.5	4.9	0.1	0.0	3.1	0.4
South Korea All	85,592	22.6	4.4	0.3	1.0	2.7	14.2
China FIT	27,000	42.0	2.5	1.4	0.8	2.8	34.5
China Tour	82,995	3.5	3.0	0.1	0.0	0.2	0.2
Germany All	55,082	42.8	3.2	2.0	12.7	10.8	14.0
Rest of World FIT	503,736	32.9	1.9	1.7	3.0	4.2	22.1
Rest of World Tour	55,862	21.9	5.4	1.5	0.9	5.3	8.7