ENERGY USE IN THE NEW ZEALAND
TOURISM SECTOR

A thesis
submitted in partial fulfilment
of the requirements for the Degree of
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At
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By

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**Energy Consumption in the New Zealand Tourism Sector**

by S. Beeken

Energy use associated with tourism has rarely been studied, despite a potentially considerable contribution to global or national energy demand and concomitant greenhouse gas emissions. In New Zealand, tourism constitutes an increasingly important economic sector that is supported by the Government to induce further economic growth. At the same time New Zealand is facing the challenge of reducing currently increasing fossil fuel combustion and carbon dioxide emissions.

As a response, this study investigated the contribution tourism makes to energy use in New Zealand. In particular it has examined the role of the three main tourism sub-sectors (transport, accommodation, and attractions/activities), and different domestic and international ‘tourist types’. Seven separate data analyses provided inputs for building a model based on ‘tourist types’ from which energy use in the New Zealand tourism sector could be estimated.

Tourism was found to contribute at least 5.6% to national energy demand, which is larger than its 4.9% contribution to GDP in 2000. Transport, in particular domestic air and car travel, was identified as the dominant energy consumer. Within the accommodation sub-sector, hotels are the largest energy consumers, both in total and on a per visitor-night basis. Of the three sub-sectors, attractions and activities contribute least to energy use, however, activities such as scenic flights or boat cruises were recognised as being energy intensive.
As a result of larger visitor volumes, domestic tourists contribute more to energy consumption than international tourists. Domestic and international tourists types differ in their energy consumption patterns, for example measured as energy use per travel day. Tourist types that rely on air travel are the most energy intensive ones, for example the domestic 'long air business' travellers or the international 'coach tourists'. The importance of international tourists’ energy use will increase, given current growth rates.

There are many options to decrease energy use of the tourism sector, with the most effective ones being within the energy intensive transport sub-sector. Increasing vehicle efficiencies and decreasing travel distances appear to be the most promising measures. This study argues that energy use depends largely on tourists’ travel behaviour. Changing behaviour is possible but is postulated to be very difficult, and further research is needed to better understand tourists’ motivations, expectations and decision-making. Only then, can strategies be developed and implemented to alter travel behaviours to better balance energy use, other environmental impacts and economic yield. Such a balance is a crucial consideration in the search for more sustainable forms of tourism.

**KEYWORDS:**

Sustainable tourism, energy use, climate change, tourist types, tourist behaviour, transport, New Zealand
ACKNOWLEDGEMENT

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In particular, I want to thank my supervisor Prof. David Simmons for helping me approach tourism-specific questions; for providing a critical audience for various ideas and outputs; and for being understanding and supportive in many other ways. His help extended to on-site guidance in enjoying and making most out of a conference on Tasmania. I sincerely thank David for convincing me that New Zealand is the place to be… and for making sure that I stay here for at least another three years!

Involving Dr. Chris Frampton from the Applied Management and Computing Division as my second supervisor proved a good step right from the beginning. Chris gave me advice on my statistical analysis, and also ensured that I used the different methods most effectively. I thank Chris for being my ‘natural scientist’ supervisor ‘from the other side’. To a large extent, the publications originating from my doctoral research owe their existence to Chris’ assistance.

My third supervisor, Dr. Adrian Walcraft, made it possible for me to use the @risk software for the sensitivity analysis in this thesis. I also thank Adrian for reviewing and providing useful comments to drafts of papers and chapters. Finally, I want to express my thanks to Dr. Phil Hart from Landcare Research, without whom I would not be where I am (first of all in New Zealand, and second, equipped with a doctorate). Phil awarded me with a Landcare Research doctoral scholarship for three years, and also looked after me very well during the time of my thesis (e.g. my visit to the Wuppertal Institute in 2000, and to Hobart in October 2001).

There are many other people who supported me throughout my research. I want to make particular mention of Vicky Martin, who helped me get started, in particular through sharing data and experience on collecting energy data from small businesses.
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Of course, none of the mentioned above comes close to the support I received from my husband, Axel. This is not only because Axel immediately agreed to accompany me to New Zealand, but also because he was there to listen and develop my ideas, discuss them until late in the night, read version ‘x’ or ‘y’ of my articles or chapters, and to serve as a ‘rock in the storm’. Axel made sure I did more than just thinking of energy use; we got Haile and the house, and realised some of our travel plans. Short, we are having a great time in New Zealand and elsewhere!

I want to finish by thanking my family for always being very supportive, even if it meant letting me go to the end of the world.
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### LIST OF ABBREVIATIONS

**International institutions**

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<th>Description</th>
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<tbody>
<tr>
<td>EIA</td>
<td>Energy Information Administration</td>
</tr>
<tr>
<td>EPA</td>
<td>Environmental Protection Agency</td>
</tr>
<tr>
<td>ICAO</td>
<td>International Civil Aviation Organization</td>
</tr>
<tr>
<td>IEA</td>
<td>International Energy Agency</td>
</tr>
<tr>
<td>IHEI</td>
<td>International Hotels Environment Initiative</td>
</tr>
<tr>
<td>IPCC</td>
<td>Intergovernmental Panel on Climate Change</td>
</tr>
<tr>
<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
</tr>
<tr>
<td>UNFCCC</td>
<td>United Nations Framework Convention on Climate Change</td>
</tr>
<tr>
<td>WCED</td>
<td>World Commission on Environment and Development</td>
</tr>
<tr>
<td>WMO</td>
<td>World Meteorological Organization</td>
</tr>
<tr>
<td>WTO</td>
<td>World Tourism Organization</td>
</tr>
<tr>
<td>WTTC</td>
<td>World Travel and Tourism Council</td>
</tr>
<tr>
<td>WWF</td>
<td>World Wide Fund for Nature</td>
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**New Zealand institutions and organisations**

<table>
<thead>
<tr>
<th>Abbreviation</th>
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<tbody>
<tr>
<td>AA</td>
<td>Automobile Association</td>
</tr>
<tr>
<td>DoC</td>
<td>Department of Conservation</td>
</tr>
<tr>
<td>EECA</td>
<td>Energy Efficiency and Conservation Authority</td>
</tr>
<tr>
<td>EHOA</td>
<td>Environmental Hotels of Auckland</td>
</tr>
<tr>
<td>FRST</td>
<td>Foundation for Research Science and Technology</td>
</tr>
<tr>
<td>MED</td>
<td>Ministry of Economic Development</td>
</tr>
<tr>
<td>MfE</td>
<td>Ministry for the Environment</td>
</tr>
<tr>
<td>MoT</td>
<td>Ministry of Transport</td>
</tr>
<tr>
<td>OTSp</td>
<td>Office of Tourism and Sport</td>
</tr>
<tr>
<td>RTO</td>
<td>Regional Tourism Organisation</td>
</tr>
<tr>
<td>TIANZ</td>
<td>Tourism Industry Association New Zealand</td>
</tr>
<tr>
<td>TNZ</td>
<td>Tourism New Zealand</td>
</tr>
<tr>
<td>TMT</td>
<td>The Ministry of Tourism</td>
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**Other abbreviations**

<table>
<thead>
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<th>Abbreviation</th>
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<tbody>
<tr>
<td>ANOVA</td>
<td>Analysis of Variance</td>
</tr>
<tr>
<td>CAM</td>
<td>Commercial Accommodation Monitor</td>
</tr>
<tr>
<td>DTS</td>
<td>Domestic Tourism Study</td>
</tr>
<tr>
<td>FIT</td>
<td>Free Independent Traveller</td>
</tr>
<tr>
<td>GCV</td>
<td>Gross Calorific Value</td>
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<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>GST</td>
<td>Goods and Services Tax</td>
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<tr>
<td>GWP</td>
<td>Global Warming Potential</td>
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<tr>
<td>IVS</td>
<td>International Visitor Survey</td>
</tr>
<tr>
<td>LSD</td>
<td>Least Significant Difference</td>
</tr>
<tr>
<td>SD</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>SNA</td>
<td>System of National Accounts</td>
</tr>
<tr>
<td>TSA</td>
<td>Tourism Satellite Account</td>
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Units of measurement

J       joule
kWh     kilowatt hour
g       gram
t       tonne
L       litres
m³      cubic metres
km      kilometre
vkm     vehicle-kilometre
pkm     passenger-kilometre

Multiples

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Symbol</th>
<th>Factor</th>
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<tbody>
<tr>
<td>Kilo</td>
<td>K</td>
<td>E3</td>
</tr>
<tr>
<td>Mega</td>
<td>M</td>
<td>E6</td>
</tr>
<tr>
<td>Giga</td>
<td>G</td>
<td>E9</td>
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<tr>
<td>Tera</td>
<td>T</td>
<td>E12</td>
</tr>
<tr>
<td>Peta</td>
<td>P</td>
<td>E15</td>
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Chemical compounds

C       carbon
CO₂     carbon dioxide
CH₄     methane
N₂O     nitrous oxide
NOₓ     nitrogen oxides
O₃      ozone
1 CHAPTER 1 – RESEARCH CONTEXT

1.1 Introduction

Recent years have witnessed increased attention on sustainability issues in the context of tourism. Concomitant with this, some discussion has also started about climate change and tourism (e.g. Walsh, 2001) and the interrelationship between the two phenomena. Although the efficient use of energy is a critical feature in achieving sustainable development\(^1\), little research has been done on the particular issue of energy use and greenhouse gas emissions resulting from tourism. It is undeniable that tourism requires energy inputs at various components, ranging from travelling to and from the destination and at the destination to the consumption of numerous services and products. Given the worldwide growth of tourism and increasing economical dependence on this sector it is timely to analyse energy requirements and identify potential to reduce energy use, ideally to an extent that outweighs growth rates.

In New Zealand tourism has been established as an important sector of the national economy, with an increase in contribution to the Gross Domestic Product (GDP) from 3.4% in 1995 to 4.9% in 2000 (Statistics New Zealand, 2001a). At the same time New Zealand has signalled its intention to engage in international agreements to protect the global climate and to ratify the Kyoto Protocol\(^2\) in August 2002. This involves decreasing the current CO\(_2\) emissions by 22% back to 1990 levels. Internally, New Zealand opts for achieving sustainability as for example declared in the New Zealand Tourism Strategy 2010 (Tourism Strategy Group, 2001). Significant work, however, needs to be done to bridge the gap between (economic) growth and good intentions to become sustainable and energy efficient. This gap exists because of conflict inherent in a shift of both thinking and practice from profit maximisation to sustainable business operations. The process of achieving sustainability of tourism is also hindered by lacking knowledge on current consumption and pollution patterns.

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\(^1\) For a discussion on sustainability and sustainable development refer to the 1987 “Brundtland report” *Our Common Future* (WCED, 1987) and more specifically to the Agenda 21 for the Travel and Tourism Industry (WTTC, WTO & Earth Council, 1995).

\(^2\) In the Kyoto Protocol, more than 160 nations established to limit their greenhouse gas emissions relative to 1990 levels. The Protocol enters into force when at least 55 Parties to the Convention that accounted for at least 55% of the total carbon dioxide emissions in 1990 have declared their ratification.
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This thesis contributes to this issue by providing answers to the following questions:

- How much energy is consumed by tourism in New Zealand?
- For what (tourist activities) is the energy used?
- Who uses the energy (i.e. what kind of tourists)?
- What could be changed to effectively decrease energy use?

Answering these questions and providing guidelines for implementing more energy efficient practice in tourism is an important step towards sustainable tourism in New Zealand and a sustainable economy in general.

This thesis is organised in six main chapters. Chapter 1 provides background information on energy use both in general and in New Zealand. Main features and trends of tourism in New Zealand are summarised to provide the necessary background for this study. Chapter 1 also provides a discussion of previous work on energy use and tourism. Chapter 2 introduces the general approach to answer the research questions and the methods used in this study. Furthermore, the research field is delineated in this chapter by clarifying key terms and concepts. Chapter 3 presents a comprehensive analysis of energy use in the tourism industry. This comprises analyses of three separate tourism sub-sectors: transport; accommodation; attractions and activities; and – as a supplement – international travel to New Zealand. A summary at the end of Chapter 3 emphasises key findings and provides concluding remarks about sustainability issues associated with tourism firms. The demand side of tourism is presented in Chapter 4, where travel patterns, and more specifically travel choices, are analysed with regard to energy use. Domestic and international tourists are analysed separately. The travel choice analysis is the basis for market segmentation with the purpose of identifying ‘tourist types’ that equate to a specific range of energy use. The applicability and implications of these ‘tourist types’ are discussed in an integrating section at the end of Chapter 4. The tourist types are also the basis for the integrating model to estimate total energy use in the New Zealand tourism sector developed in Chapter 5. Sensitivity analysis in this chapter provides insights into selected options to reduce total energy use. Finally, Chapter 6 combines results from the analysis in Chapter 3 to 5 and discusses limitations and implications of this research.
1.2 Energy use – background

1.2.1 Environmental impact

“Energy is one of the main factors that must be considered in discussion of sustainable development” (Dincer, 1999, p. 845). Energy is a fundamental measure in physics as each material can be characterised by its energy content, and each human activity requires a definite expenditure of energy. On this basis, activities can be compared with regards to their efficiency, which makes energy use a powerful quantitative indicator to gauge sustainability. Defining energy use as an indicator for sustainability is similar to the universal indicator MIPS (material intensity per service unit) developed by Schmidt-Bleek (1994). While all forms of energy generation and consumption induce environmental impacts, it is mainly the combustion of fossil fuel that gives most trouble in that it not only precipitates an irreversible decrease in the usefulness of the transformed resource, but also produces various pollutants (Stern, Dietz, Ruttan, Socolow & Sweeney, 1997). Environmental impacts from energy use are various, ranging from global warming, to acid rain and other air pollution, ozone generation in the lower troposphere and ozone depletion in the stratosphere, habitat destruction, and the emission of radioactivity (Dincer, 1999).

In this thesis, energy use is mainly seen as contributing to global warming, although it is important to understand that reducing energy consumption in general will decrease pressure on the environment in many areas. Air pollution, for example, constitutes a severe problem in major New Zealand cities, especially in winter. In these places, both decreasing energy use and switching to non-fossil fuels would improve air quality. Priority should be given to conserve energy, since even ‘green energy sources’ impact on the environment. For example, the generation of hydropower requires changes to the biosphere not only during the construction of the hydro-dam but also as a result of interfering with natural water flows during operation.

Literature on energy use, greenhouse gas emissions and climate change is abundant. This includes (physical) models to understand and forecast atmospheric conditions and changes, the assessment of climate change impacts on different geographical regions, and the contribution of human activity to climate change (anthropogenic
greenhouse effect). Carbon dioxide (CO₂) is the key greenhouse gas. It is formed in the combustion of all fossil fuels and the decomposition of other organic material, which is augmented as a result of land use change. Other greenhouse gases include nitrous oxide (N₂O), methane (CH₄), and ozone (O₃)³ (Intergovernmental Panel on Climate Change [IPCC]⁴, 2001).

Humans only interfere on a relatively small scale with the global carbon cycle, mainly by releasing greenhouse gases into the atmosphere and by changing land use (e.g. deforestation) (Figure 1). Human activities, however, have been sufficient to throw off the balance between the different carbon pools, with a clearly increasing atmospheric concentration of CO₂ (366 ppm at present compared with 280 ppm in pre-industrial times) (Noble & Scholes, 2001).

![Diagram of the global carbon cycle](image)

Figure 1: The global carbon cycle. The numbers show the sizes of the pools and fluxes in Gt (1000 million tonnes) of carbon. For example the gross flux from the atmosphere to the terrestrial pool is 62 Gt C per year mainly due to photosynthetic uptake. This is balanced by a gross flux of 60 Gt C per year from the terrestrial pool to the atmosphere due to respiration and decay. Land clearing activities release another 1.6 Gt C per year to the atmosphere (Nobles & Scholes, 2001, p. 6).

³ N₂O is formed in all combustion and agricultural activity, in particular as a result of the utilisation of nitrogen fertiliser; O₃ is a highly effective greenhouse gas, which production and destruction is influenced by NOₓ. CH₄ emissions are mostly anthropogenic, resulting from burning fossil fuels, landfills, rice fields and cattle. Other anthropogenic greenhouse gases include hydrofluorocarbons (HFCs), perfluorocarbons (PFCS), and sulfur hexafluoride (SF6), which are generated in various industrial processes.

⁴ The Intergovernmental Panel on Climate Change was established in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP). Its role is to assess the available information relevant for the understanding of the risk of anthropogenic climate change.
The latest information on climate change from a global perspective is compiled in the ‘IPCC Third Climate Change Assessment Report: Climate Change 2001’ by the IPCC (2001). The IPCC also provides special reports, such as ‘Aviation and the Global Atmosphere’ (Penner, Lister, Griggs, Dokken & McFarland, 1999), ‘Land Use, Land-Use Change, and Forestry’ (Watson, Noble, Bolin, Ravindranath, Verardo, Dokken, 2000), and ‘Special Report on Emissions Scenarios’ (Nakicenovic & Swart, 2000).

The significance of climate change for New Zealand is of particular interest for this study. Possible effects are outlined in the recently updated report on climate change impacts on New Zealand (Ministry for the Environment [MfE], 2001a), which was firstly undertaken in 1990. The expected impacts are among others:

- An increase in temperature, particularly on the North Island, which is, however, below the global average of an estimated 1.4 to 3.8 degrees Celsius to 2100;
- An increase in rainfall in the West and a decrease in rainfall in the Eastern parts of the country;
- More frequent heavy rainfall events, which increase the risk of flooding and erosion;
- A larger variability of rainfall;
- Fewer frosts during winter and more hot days in summer
- Possibility of international pressure on New Zealand as a result of environmental impacts on the South Pacific Islands (due to sea level rise in particular) and their consequently increased demand for foreign aid.

As indicated, this thesis focuses on energy use (rather than greenhouse gas emissions) and thus takes an input oriented approach (Lorek & Spangenberg, 2001) building on the fact that reducing inputs (energy, material and land use have been identified as key factors) will generally take pressure off the global environment (ibid). For New Zealand, there are three main incentives to engage in energy conservation and efficiency. First, New Zealand decided to comply with the Kyoto Protocol, and also has an interest in a stabilised climate (not at last for a stable tourism sector), second, New Zealand suffers air pollution problems at various locations (e.g. cities in winter, and key tourism bottlenecks such as Milford Sound), and third, the New Zealand economy depends considerably on the import of petroleum oils. It is also pointed out
in the National Energy Efficiency and Conservation Strategy (Energy Efficiency and Conservation Authority [EECA], 2001) that economic productivity could be considerably improved by increased energy efficiency.

1.2.2 Energy use in New Zealand

This chapter describes New Zealand’s energy profile, including trends in greenhouse gas emissions, and summarises the political attitude toward climate change in New Zealand in the last decades. This may help to understand current efforts and chances of achieving energy conservation and efficiency in New Zealand.

Energy data and trends

Information on energy use and greenhouse gas emissions in New Zealand is mainly available from three government institutions: the Ministry of Economic Development (MED), the EECA, an independent government agency to promote energy efficiency, and the Ministry for the Environment (MfE). Important sources of statistical data on energy use are the Energy data file, available twice a year, and the Energy Greenhouse Gas Emissions updated annually, both published by the MED. The MfE is the lead government agency dealing with energy issues. Four out of the identified eleven priority issues of the MfE’s ‘Environment 2010 Strategy’ deal directly or indirectly with energy use, namely ‘energy services’, ‘climate change’, ‘transport’, and ‘air quality’.

Energy supply and demand in New Zealand and the emission profile are characterised by the following key points (MED, 2000a and 2001):

- Total primary energy is 813.6 PJ, comprising gas (28.9% of all energy supply), imported oil (27.5%), geothermal energy (17.6%), hydropower (10.6%), other renewable sources (6.3%), coal (5.8%) and indigenous oil (3.3%);
- 63.8% of all electricity (137.4 PJ in 2000/2001) stems from renewable sources;
- Total consumer energy is 453 PJ (increase of 3.0% from 1999 to 2000);
- Transport is the largest energy consumer (41.1% of consumer energy) (Figure 2);
- Carbon dioxide emissions are 30,389 kilo tonnes per year - 22% more than in 1990. This increase results from increased thermal power generation (mainly gas) and the high demand for diesel and petrol for transportation end use;
Chapter 1 – Energy use - background

- Transport is the main contributor to CO₂ emissions with 44% of total emissions. Industry (23%) and thermal electricity generation (18%) rank second and third. Other sectors (household, agriculture and commercial) contribute 9% of energy use;

- The New Zealand CO₂ per capita emission of 8.1 tonnes is the 13th highest in all OECD countries.

![Pie chart showing energy by sector in 2000](image)

**Figure 2: Consumer energy by sector in 2000**  
(Source: MED, 2001).

New Zealand has a unique greenhouse gas emissions profile among industrialised countries, because of a large contribution of non-CO₂ greenhouse gases, namely CH₄ and N₂O. To compare different greenhouse gases, the Global Warming Potential (GWP) is used (IPCC, 2001). The GWP measures the global warming impact (both direct and indirect) of a gas relative to an equivalent mass of CO₂ (CO₂ equivalents). Methane and N₂O are both stronger greenhouse gases compared with CO₂. For this reason the considerable emissions of CH₄ (33,420 kilo tonnes of CO₂ equivalents) and N₂O (12,080 kilo tonnes of CO₂ equivalents) in New Zealand become even more important. In 1999, CO₂ made up 39% of New Zealand’s contribution to atmospheric warming, whereas CH₄ comprised 45% and N₂O 16% (MfE, 2000). Emissions of CO₂ are mainly resulting from energy consumption (fuel combustion), while the two other greenhouse gases are associated with agricultural activities. Over the last ten years, CH₄ emissions decreased and N₂O emissions remained stable, while CO₂ emissions increased considerably. Carbon dioxide emissions are responsible for the overall increase of New Zealand’s greenhouse gas emissions.

New Zealand’s CO₂ emissions are forecast to increase by 45% from 1990 to 2012, if no measures were to be taken to reduce emissions (MED, 2001). According to a report undertaken by the International Energy Agency (IEA), the overall energy

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5 Organisation for Economic Co-operation and Development  
6 The GWP measured over a 100-year time horizon of CH₄ is 21; and the GWP of N₂O is 310 (IPCC, 2001).
efficiency in New Zealand is lower than in many other countries, for example
Australia, Japan, and the Netherlands (Schipper, Unander, Marie-Liliou, Walker &
Murtishaw, 2000). This can be explained by a change in New Zealand’ s economy
towards a more energy intensive structure (e.g. enhancing aluminium production), and
also by an above average increase in energy use for transport (ibid). However, the
EECA (1999a) reported an optimistic trend of a decoupled growth in GDP and energy
demand, which manifests in the declining consumer energy to GDP ratio, reaching an
energy intensity of 4.76 TJ\(^7\) per million NZ$ in 1998. This is still higher than in 16
other IEA countries, but lower than in four other countries (EECA, 1999a, p.8).

The New Zealand paradox – political background

New Zealand has been described as a “paradox of a clean low-population
environment, with its inhabitants predisposed to environmental smugness, but with
very little motivation to take environmental action” (Basher, 2000, p.123). This is
proving particularly true for climate change issues, which do not appear to have
become established in New Zealanders’ minds. In fact, a recent report undertaken for
the New Zealand Climate Change Programme showed that New Zealanders have only
“moderate knowledge about Climate Change issues” (UMR Research Ltd, 2001).
Moreover, it was found that there is widespread scepticism with regards to scientific
certainty about climate change in general, and about the effectiveness of measures
against the background of natural weather events and business interests.

This was not always so. The mid 1980s to 1990 when the country was ruled by the
fourth Labour Government witnessed a promising start with regards to active climate
protection policy. With a change of Government in 1990, however, the emphasis
shifted to economic growth away from environmental issues thereby neglecting
policies to significantly decrease energy use and emissions (Basher, 2001). Despite
little support from the National Government the then Minister for the Environment
tried to continue the politics of reducing greenhouse gas emissions, and with pressure
from Greenpeace the Government committed itself to a reduction of emissions by
20% below 1990 levels by the year 2000 (ibid).

\(^7\) TJ: terajoules (1,000,000 megajoules)
However, major reports that were written in 1990, for example by the Ministry for the Environment\(^8\) and the New Zealand Committee of the Royal Society of New Zealand\(^9\), and that contained a concrete list of actions that needed to be undertaken (e.g. carbon tax), were not implemented (Hamilton, 2001). Accordingly, the CO\(_2\) Reduction Action Plan in 1992 did not contain the 20% reduction target. Ironically, in the same year a power shortage demonstrated clearly the need for energy savings. While the public was sensitised, the government-owned electricity company \textit{Electricorp} pursued a strategy of ‘sell like hell’ (Hamilton, 2001, p. 154), which culminated in negotiations on the construction of a 400 MW gas power plant at Stratford. While electricity reforms in New Zealand laid the foundation for further increase in energy supply, international concern about climate change grew, manifested in diverse reports by the IPCC and also the foundation of the United Nations Framework Convention on Climate Change (UNFCCC) at the ‘Earth Summit in Rio’. In New Zealand, a lobby of ‘Anti-IPCC’ business and industry players was formed to prevent possible economic policies. These groups’ actions, such as the invitation of anti-global warming guest speakers, may have contributed to the Government’s declaration of two concepts in 1994, namely that climate policy should not interfere with the economy, and if necessary then only at ‘least costs’ (Gillespie, 2001). The carbon tax was one planned policy to fall victim to these.

In 1997, the year of the Kyoto summit, New Zealand was among the countries with the highest growth rate of carbon emissions (Gillespie, 2001). Despite good intentions earlier, New Zealand had failed to implement energy saving measures and to decrease carbon emissions. Furthermore, it was expected that emissions would continue to increase due to the availability of cheap energy, the lack of government support for energy efficiency, and few incentives to promote renewable energies. New Zealand’s situation and attitude towards climate change was reflected in their negotiations at Kyoto, where New Zealand was able to negotiate stabilising emissions at the 1990 levels instead of reducing them by 5% to the year 2010, on which most other countries agreed. Furthermore, it was New Zealand that pushed (supported by


\(^9\) This report is known as the ‘facts’ report.
Australia, Canada, Norway, Iceland, the United States and the Russian Federation)\textsuperscript{10} to include carbon sinks\textsuperscript{11} in the protocol to offset emissions by carbon sequestration. In response, New Zealand was treated with hostility (Gillespie, 2001) by many countries, especially the Pacific Island states, and raised issues of equity in that sense that not every country has the geographical opportunities to plant a large number of trees (i.e. to sequester carbon), while practising 'business as usual' (ibid, p. 176).

The so-called ‘net approach’ (offsetting emissions by enhancing carbon sinks) is considered by many as ‘scientifically highly uncertain’, while merely postponing impacts rather than dealing with the sources of emissions. It is important to note, that while forests planted after 1990 constitute a carbon sink and provide a carbon reservoir in their mature phase, the situation for indigenous forests is not yet clarified (Ford-Robertson, Maclaren & Wakelin, 2001). It is possible that mature indigenous forests constitute a net source for carbon emissions. In New Zealand, a large proportion of carbon is stored in soils, and a change in land use may result either in a loss of carbon or in additional uptake, which is the case of forest plantations on carbon-poor soils. The net-approach holds a range of complex issues, which has been demonstrated by Ford-Robertson et al. (2001), who calculated New Zealand's net emissions under various options to be between −3.5 and +3.5 million tonnes of carbon per year. Partly this arises from disagreement on definitions and exact meanings of such words as “afforestation, reforestation and deforestation” (Noble & Scholes, 2001, p. 8).

The present Labour Government decided to take an active step towards climate change policy and to show leadership in ratifying the Kyoto Protocol. This shall be at ‘least financial cost to New Zealand’, contribute to ‘other environmental objectives and sustainable development more generally’ and in the same time ‘provide business opportunities’ (Minister of Research, Science and Technology, 2001).

In New Zealand, in contrast to other industrialised countries, energy use is not due to a small number of large industrial consumers, but rather due to a large number of

\textsuperscript{10} This was strongly opposed by the European Union, Japan, Denmark, the United Kingdom, France, Kenya, the Marshall Islands, Nauru, Peru, Uzbekistan, China, Brazil and the Alliance of Small Island States (Gillespie, 2001).

\textsuperscript{11} Carbon sinks remove the CO\textsubscript{2} from the atmosphere into trees, through carbon sequestration. This sequestered carbon can be used to offset the equivalent amount of CO\textsubscript{2} emissions.
small and diffuse sources of energy demand, such as motor vehicles and households. This makes energy efficiency measures difficult and requires careful consideration of socio-economic issues. The now released first National Energy Efficiency and Conservation Strategy (EECA, 2001) therefore contains five programmes, namely for central and local government, energy supply, industry, buildings and appliances, and transport. The bottom line is clear: “Energy efficiency and renewable energy has finally come of age in New Zealand” (foreword from the Minister of Energy). This strategy aims to increase energy efficiency by 20% by 2012, and provide 25 to 55 petajoules (PJ) from renewable energy sources by 2012 (EECA, 2001, p. 6). Fundamental to achieving these targets is the participation of all New Zealanders, otherwise the statement by the then Minister for the Environment back in 1992 holds true ten years later, in 2001:

*Having seen the preliminary work that has now been done on the potential for achieving it (CO₂ reduction target) without economic damage, quite frankly it doesn’t lead me to believe that we can change people’s behaviour to the extent of a 40 per cent reduction before the year 2000* (quoted in Hamilton, 2001, p. 153).
1.3 Tourism in New Zealand

1.3.1 Destination New Zealand

Tourism statistics

Basic statistical information on tourism in New Zealand is derived from the Arrival and Departure Cards that every person entering or leaving the country has to fill out. These provide information on nationality, age, sex, occupation and purpose of travel. Another important source is the International Visitor Survey (IVS) continuously undertaken by Tourism New Zealand (TNZ) (2001a) that provides information on international tourist expenditures and travel itineraries (for more detail, see Chapter 4 – International tourists). A similar survey – the Domestic Tourism Study (DTS) – exists for domestic tourists for the years 1989/90 and 1999 (see Chapter 4 – Domestic tourists). Tourist-nights in different commercial accommodation categories are recorded through the Commercial Accommodation Monitor (CAM), which is a quasi-census (only businesses with a turn-over larger than $30,000 per year are considered).

All of these data sources are used among others for the construction of the Tourism Satellite Account (TSA) by Statistics New Zealand. The TSA measures tourism’s economic significance in a form that makes it comparable with other economic sectors.

According to these key data sources, tourism is increasingly important to New Zealand. In 2000, the base year for this thesis, Statistics New Zealand (2001b) recorded more than 1.7 million international visitors. Information on domestic tourists refers to the year 1999, where 16.6 million domestic tourists were estimated (Forsyte Research, 2000). Visitor numbers are projected to increase by more than 60% over the next six years (Vuletich & Fairgray, 2000a) and rise to 3.2 million visitors by 2010 (Tourism Strategy Group, 2001). According to the latest New Zealand TSA (Statistics New Zealand, 2001a), tourism’s direct contribution to Gross Domestic Product (GDP) in 2000 amounted to 4.9% (measured as direct value added). Goods and Services Tax (GST) paid by tourists was almost one billion dollars in the same year, having increased by 12.9% since 1997. Total expenditures within New Zealand (Figure 3) increased by 14.8% between 1997 and 2000, with the largest increase being in internal air passenger transport (22.6%).
Tourism growth, and resulting economic benefit depend highly on external events, such as the Asian crisis in 1997/98 and the terrorist attacks on the United States of America in September 2001. Both these events affected visitor arrivals considerably, at least in the short term. These occurrences indicate that tourism, and in particular long-haul tourism, depends on a generally favourable travel environment, and that disturbances could alter travel behaviour. Stable oil prices, for example, are an important factor for tourism-dependent countries. Previous research (Crouch, 1994) has shown that air travel, in particular long-haul air travel, is highly elastic in terms of price changes for airfares (i.e. changes in price cause even greater changes in demand) as well as for income. The same study also pointed out that long-haul tourism is more subject to changing fashions and popularity than short-haul destinations.

New Zealand’s image

New Zealand: “...a spectacular & refreshing world at the edge of the earth that surprises and enlivens you...”, where “...everything seems to be contained within such a small country – lakes, mountains, beaches, volcanoes, glaciers, etc” (TNZ, 2001b). It is obvious that New Zealand capitalises not only on its natural beauty and resources, but also on its regional diversity that offers the opportunity to develop regional marketing ‘themes’ that then could be embraced by a national overall image (Collier, 1999). This seems a very attractive and promising concept, offering tourists the opportunity to compose their trip around very different aspects, while visiting only a single country. However, it also appears that tourists are tempted by New Zealand’s variety and seek to experience as many themes as possible, resulting in a ‘beach – fire – ice’ touring circuit, associated with a considerable travel distance, despite the relatively small country. The high mobility of tourists is inevitably linked with a
considerable use of energy, which in turn, appears to be contradictory to the ‘clean and green’ image taken up by TNZ to promote the country.

1.3.2 Structure of tourism in New Zealand

Geographical structure - tourist flows

The diverse environment mentioned above induces a high mobility, which renders New Zealand a touring destination with few visitors focusing on a single destination or resort (Holt, Higham & Kearsley, 1998). New Zealand possesses relatively advanced knowledge about national visitor flows based on evaluating itineraries provided by the IVS (e.g., Oberdries & Forer, 1995). Tourist flow analysis is important for tourism, not only to market the destination effectively, but also to cater appropriately for tourists and to manage impacts resulting from their travel (Forer & Simmons, 1998; Forer & Simmons, 2002). The analysis of tourist flows therefore includes measuring tourist volumes on certain corridors, the spatial and temporal dispersion of tourists within the country, and analysing demand for specific tourism infrastructure (e.g., transport and accommodation). Previous analyses, for example, show that travel patterns of high mobility are enhanced by the ongoing trend towards individual travel rather than coach-based travel, resulting particularly in a growth in rental car and camper van travel (Pearce, 1992). Individual travellers increasingly disperse throughout the country and visit destinations off the traditional ‘blue ribbon’ route leading from Auckland to Rotorua, further on to Queenstown, and then to Christchurch (Forer & Simmons, 1998). Travel patterns may be linked to demographic characteristics, such as country of origin or age (Holt et al., 1998). These profiles are of importance when addressing specific market groups, for example through educational campaigns. Tourist flow analysis will also be crucial to analyse energy use.

Organisation of tourism

There are a number of organisational bodies involved in tourism in New Zealand. Knowledge about these bodies is important when trying to disseminate research results effectively to the responsible agencies or institutions. Providing adequate

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12 New Zealand’s green image is estimated to be valued at about NZ$1 billion per year (MFE, 2001b).
information is the first step towards inducing change in policy or planning processes. To this end the public sector is introduced first, followed by the private sector. Generally, the areas of government involvement in tourism are: marketing, research and information, and policy. Tourism New Zealand is the agency responsible for overseas marketing. While their main task is to promote New Zealand, they also initiate market research (e.g. IVS, country profiles and consumer needs) and publish reports on events of interest and ‘hot news’ (e.g. impact of the ‘Lord of the Rings’ movie). TNZ is the key body influencing the image tourists have of New Zealand before or when they decide to travel here, their expectations and possibly their travel behaviour.

The Ministry of Tourism (TMT), the former Office of Tourism and Sport (OTSp), provides policy advice to Central Government and other public sector stakeholders, for example Ministry of Transport and Ministry for the Environment. For example, in 1999 the OTSp recommended that the Government assist in the implementation of environmental accreditation programmes, such as Green Globe 21\textsuperscript{13} to ensure sustainability of the tourism sector. The TMT also identifies information gaps and takes action to fill these gaps, for example through allocating research funding.

Furthermore, the Department of Conservation (DoC) plays an important role in that it administers about a third of the country’s area, most of which includes key visitor attractions, for example Milford Sound, Mt Cook National Park or Tongariro National Park. Visitor management is an important – and resource intensive – responsibility of DoC. This provides opportunities in the context of decreasing energy use in and around protected areas. Through the granting of concessions DoC has a major influence on what activities take place in naturally sensitive areas.

At the regional level, there are 26 Regional Tourism Organisations (RTO) that promote their region, mainly domestically but also internationally. They play a key role in influencing travel behaviour once tourists have started their trip in New Zealand.

\textsuperscript{13} An international environmental awareness, benchmarking and certification programme, initiated by the WTTC in 1994.
For the private sector there are 12 corporate entities in New Zealand, among them Air New Zealand, Auckland International Airport, and Tranzrail. Although they exert considerable influence in the sector, it is the many small to medium enterprises that make up the tourism industry. About 80% of the 17,000 small businesses employ fewer than five workers (Collier, 1999). This means that economic benefits resulting from tourism are distributed to a large number of New Zealanders, often in remote areas where few alternatives other than tourism exist. However, the fragmentation of the sector also means that initiatives to improve business standards are difficult to implement. To induce change at the business level it is therefore essential to cooperate with the Tourism Industry Association of New Zealand (TIANZ), an umbrella organisation that co-ordinates and represents the industry. The TIANZ has started initiatives to render tourism in New Zealand more sustainable. An important step was the adoption of the environmental award scheme Green Globe 21 that supports businesses implementing sustainable practices. Green Globe 21 also provides an accreditation opportunity for tourism destinations that are on the pathway to developing a sustainable management plan.

1.3.3 From tourism marketing to tourism management

It has been commented that the New Zealand Government through its New Zealand Tourism Board (NZTB), now TNZ, pursued a strategy of growth with little thought being spent on sustainable tourism planning (Page & Thorn, 1997). As a result of the restructuring of the tourism sector in the 1990s, both tourism planning and management became responsibilities of regional or local authorities. This happened without clear guidance and, even more importantly, without financial assistance from Central Government. According to Page and Thorn (1997) this led to a failure of implementing sustainable tourism practices as required by the Resource Management Act. They conclude that the Government needs to “...prepare an integrative master plan or guidelines on the growth of tourism into the 21st century...” (Page & Thorn, 1997, p. 74).
Criticism and needs of this kind identified elsewhere, were met with the New Zealand Tourism Strategy 2010, released in May 2001 by the Tourism Strategy Group. Two keywords are management ("of destination elements") and sustainability ("issues"). Among others, the Tourism Strategy (page i.) is supposed to:

- "Assist the sector to manage growth in a way that ensures long-term sustainability."
- "Provide ways to manage conflict between increasing tourism growth and environmental, social and cultural values that are important to New Zealanders and our visitors."
- "Secure commitment and funding from central and local government."

To achieve the goals set in the strategy, so-called ‘enablers’ have been identified. These are “technology, people, research and development, infrastructure and investment, and quality”. It is hoped that this study through generating knowledge relevant to both industry and planners will contribute to some degree to implementation of this plan and its broad goals refocusing the sector on sustainable tourism development.
1.4 Previous research on energy use and tourism

This section reviews and discusses previous research at the interface of tourism and energy, and comments on existing gaps and future research needs. Discussion on tourism and energy is not new, although research in this field has undergone considerable changes within the last few decades. An historical review starting at the energy crises in the 1970s may help to understand the current state of research. By juxtaposing political developments with corresponding research, conclusions about the current attitudes towards tourism and environmental concerns can be drawn. Key studies are compiled thematically and chronologically in Figure 4 at the end of this section, along with influential global occurrences.

1.4.1 The energy crises in the 1970s

A peak time of research activity on how tourism and energy interact started in the late 1970s and early 1980s in response to the oil shocks occurring at that time. The energy crisis in 1974 with its fuel shortage, and the crisis in 1979 with dramatic price increases impacted highly on society and economies. This generated demand for research on energy use and tourism/recreation and, thus, initiated numerous studies. With regards to tourism, most studies focused on the consequences of energy scarcity for the industry, while fewer studies looked at the relationship the other way round, namely to what degree tourism contributes to the shortness in energy supply.

How vacation travel would be affected by limited energy supply was a main concern among researchers with many studies investigating impacts of both fuel shortages and higher prices (e.g. Corsi & Milton, 1979; Kamp, Crompton & Hensarling, 1979; Williams, Burke & Dalton, 1979). The findings of the diverse studies differed with regards to possible changes in travel behaviour. Some studies concluded that the energy crises will not alter behaviour, or only to a small degree (e.g. Moncrief, Mouser & Pitrak, 1977). However, most studies stated various shifts, such as a reduction in leisure travel (McCool et al., 1974), especially with the private car (Williams et al., 1979), trip chaining (linking several trips to one trip) (Jones, 1983), and the purchase of more economic, smaller vehicles (Landsberg, 1974). A study on Dutch tourism predicted an increase of shorter holidays based on camping, mainly within the own country (Knikkink, 1982). Generally, it was found that rationing of
energy has a more immediate effect than higher prices, for example with regards to a shift towards more public transport use (Williams et al., 1979). As stated by Converse and Machlis (1986), who reviewed literature relevant to energy and outdoor recreation in the mid-1980s, recreationists appeared to adapt to higher prices, by developing a higher tolerance to price level compared with the more direct restraint of having no fuel. Not surprisingly, households felt affected differently by the energy crisis, depending, for example, on income and the number of children (Corsi et al., 1979).

Facing the scenario of reduced availability of fossil fuels, the tourism industry also had to think about their own contribution, and ways to reduce energy use of tourists. Air travel was recognised as main energy consumer in the tourism industry, and the role of air transport was discussed at the International Conference on Tourism and Air Transport held in 1978 in Mexico. At this conference, Raben (1978) asked three key questions: First, how much fuel will be available in 15 to 25 years? Second, is there a substitution for fossil fuel, for example hydrogen? Third, what quantities will aviation need in the future? With a growing dependence on air transportation and only few alternatives to the plane for distances longer than 600 kilometres, Raben (1978) emphasised the growing responsibility of airlines to reduce fuel consumption. Apart from air travel, only few studies analysed effects of recreationists on energy use (Converse & Machlis, 1986). Armbruster, Brown and Thomas (1980), for example, investigated the fuel consumption of various recreational vehicles, estimating a contribution of three per cent to the consumption of all vehicle fuel in the United States. A more comprehensive approach analysed energy use involved in producing leisure equipment, transport to the activity, and the activity itself (Hershberg & Steinhart, 1978). It was also recognised that different travel styles would influence overall energy use of a holiday. Herendeen (1974) compared two fictitious families travelling with different types of vehicles (car versus pick-up truck) and undertaking different activities (backpacking versus motorboat cruises). However, being only speculative, this study did not provide realistic data on the energy use of popular holiday styles. When comparing travel patterns and their respective energy use, these need to be seen in a more general context. Tourists may consume less energy during their holiday than they would at home, especially when travelling to warmer climates.

14 The airlines industry managed to reduce fuel consumption by 15% between 1975 and 1990 (Greenpeace, 1996).
(Croize, 1978). Furthermore, tourists who suppress travel may use energy instead, for example for heating their home. Jones (1983) therefore warned, that firstly energy-related policies may be ineffective, or may encounter unexpected resistance, and secondly that an energy policy to reduce travel may lead to unintended side effects, that possibly lead to a net increase of energy use across the economy. Interactions of this sort are complex and have not been analysed yet. The first step for such a comprehensive analysis would be to estimate tourism’s contribution to the national energy use. In a simplified form this has been attempted for the Netherlands, where tourism was found to contribute 80 PJ (40% for car-based day trips) to the total national energy use (Knikkink, 1982). In this study, transport and accommodation were revealed as the main energy consumers.

Discussions on how to reduce energy use in tourism were only in their infancy in the 1970s, with Croize (1978) pointing out that alternatives to fossil fuels are still too expensive and require large investments. To reduce energy use, he suggested that air travel should be substituted by rail where possible, or by road transport, preferably by coach instead of the private car. In 1978, Croize described the current attitudes towards energy as being either one of dramatisation or ignorance. At least it appeared that academics were alarmed by the energy crises and expected considerable changes in the travel industry. In the 1980s, however, it became clear that the worst-case scenarios would not take place. In contrast, energy surpluses were achieved with falling energy prices. As a result, energy-related studies disappeared from the research agenda, and the 1980s were characterised by a clear lull in this field.

1.4.2 More recent research

Research on energy use and tourism was slowly reinitiated by increasing environmental degradation, and a resulting environmental awareness among industrialised countries. While already existent in the 1970s (Landsberg, 1974; Runyan & Wu, 1979), environmental thinking was made ‘official’ with the so-called Brundtland report Our Common Future in 1987. Here, the World Commission on Environment and Development (WCED) took up the concept of ‘sustainability’ already presented in the World Conservation Strategy in 1980 (Ding & Pigram, 1995). The United Nation’s ‘Earth Summit’ in Rio de Janeiro in 1992 incorporated the principles of sustainability in its main outcomes, Agenda 21, the Convention on
Biological Diversity, and the United Nations Framework Convention on Climate Change (UNFCCC). Particularly the Climate Convention and the subsequent Kyoto Protocol in 1997 constitute the core of ongoing political debate and dispute around the globe. This can be explained by some anticipated severe effects on national economies (e.g. emission tax and consequent increase of production costs), when ratifying the Kyoto Protocol, and thus curbing emissions.

The international agreements do not address tourism in particular, however, tourism as an industry is clearly concerned insofar as it strongly depends on the natural environment for its economic activities and also contributes to environmental impacts through its activities. Consequently, a World Conference on Sustainable Tourism was held in 1995 in Lanzarote where the ‘Charter for Sustainable Tourism’ was developed, and in the same year the World Travel and Tourism Council (WTTC), World Tourism Organisation (WTO), and the Earth Council developed an ‘Agenda 21 for the Travel and Tourism Industry’.

Following the events in the late 1980s to mid-1990s, research in the field of tourism and the environment mushroomed. Many studies directly investigated the concept of sustainable tourism (Berry & Ladkin, 1997; Hall & Lew, 1998; Hunter & Green, 1995) or sustainable tourism development (McIntyre, Hetherington & Inskeep, 1993), while others focused on the emergence of new concepts and products, such as ecotourism (Boo, 1990; Ceballos-Lascurain, 1996), or attempted to assess environmental impacts from tourism (Butler, 1993). Environmental auditing (Ding & Pigram, 1995), benchmarking (Issaverdis, 2001), and best practice (Pigram, 1996) are relatively recent initiatives in this context. The emergence of the ‘Journal of Sustainable Tourism’ in 1993 best reflects the incorporation of the sustainability concept into tourism researchers’ thinking. Despite an obvious recognition of the importance of the environment (both natural and cultural) for tourism, little research has been done at the interface of resource management and tourism (Carter, Baxter & Hockings, 2001). Only few researchers have developed interest in resource or pollution-related research with “specific resource management practices” (Carter et al., 2001, p. 274) when compared with the increase in descriptive or abstract studies from the traditional tourism disciplines (social science or economics).
Nevertheless, the consumption of energy has been recognised as an important source of environmental impacts, often in the form of congestion and pollution (e.g. Stabler & Goodall, 1997), particularly of air pollution. For example, energy consumption was identified as an important factor in a study on the effect of poor air quality on tourism in Hong Kong (Cheung & Law, 2001). Energy use has also been seen as a contributor to resource depletion (similar to studies originating in the 1970s), and in this sense, has often been discussed along with the use of materials and water (Commonwealth Department of Tourism, 1995; Lorek & Spangenberg, 2001). In studies on remote regions in developing countries, the demand for energy was recognised as a direct contributor to environmental degradation, as for example in the case of Nepal’s trekking tourism, where firewood is collected to satisfy tourists’ needs for hot water and cooking (Müller-Böker, 1996).

The critical role of energy as an indispensable component of tourist activities became even more apparent with the increasing certainty about an anthropogenic greenhouse effect with unforeseeable changes to the global climate. Energy use, specifically the combustion of fossil fuels, is globally the most important source of human-induced greenhouse gases. The current scientific understanding of climate change is published every five to six years (1990, 1995 and 2001) by the IPCC (see previous section). In the latest ‘Third Assessment Report’ (2001), the IPCC states that as a result of growing greenhouse gas concentrations, the surface temperature has increased by 0.6°C in the last century, snow cover has decreased by about 10 per cent, precipitation has increased, and an increase in the frequency of heavy precipitation events is likely.

While global warming is doubted only by few (e.g. de Freitas, 2000), the full extent of climate change appears not yet to be realised. Globally, only very few researchers have taken up specifically the connection between tourism and climate change, mainly being concerned about how tourism may be affected by changing climate, landscapes and ecosystems. A comprehensive study on ‘climate change and its impact on tourism’ was initiated by the WWF (Viner & Agnew, 1999), focusing on major international holiday destinations visited by British tourists. While the most direct impacts will result from sea level rise, there are a vast number of other, sometimes more indirect, consequences that threaten the tourism industry. Examples are the emergence of illnesses (e.g. malaria) in previously cooler regions, extreme heat at
coastal resorts (e.g. Mediterranean), increased fire risk and desertification (e.g. Spain and Australia), coral bleaching (Australia) and a threat of the economic viability of winter sport resorts due to less snowfall in lower areas (e.g. Australia, Scotland, and parts of the European Alps). As a result of these impacts, tourists may alter their destination preferences (Maddison, 2001) or travel seasons, as for example for Scotland, where winter tourism is expected to lose importance, whereas summer tourism may benefit from climate change (Harrison, Winterbottom & Sheppard, 1999). Much interest in this direction developed in Canada, with several studies investigating the implication of global warming on tourism and recreation on the prairies (International Institute for Sustainable Development, 1997), in wetlands (Wall, 1998), and water-based recreation (Staple & Wall, 1996). In their study on Nahanni National Park Reserve, Staple and Wall (1996) concluded that no direct impacts on water-based recreation were to be expected, however, increasing temperatures may alter the ecosystem and along with this visitors’ experiences of the Park. To adapt to any such changes, the authors suggested monitoring both the ecosystem and visitor numbers. Despite some relatively recent studies on the effects of climate on tourism, not much has changed since Wall and Badke’s study in 1994 on the awareness and action of institutions concerned with either tourism or climate. The authors found that “...little serious thought has been given to issues of climate change and tourism...” (p. 194), however “...awareness appears to be greater among those whose countries depend on tourism” (p. 202). Interestingly, Wall and Badke did not discuss tourism’s contribution to the emission of greenhouse gases.

While some attention has been given to the effect of climate change on tourism, tourism’s role as contributor to climate change has largely been neglected. A picture of this contribution can only be gained by putting together separate studies that investigated energy use of tourism businesses, mainly with the aim of reducing costs, gaining marketing advantages and minimising resource use. Most such research dealt with the transport (Hoyer, 2000; Müller, 1992; Müller & Mezzalsama, 1992) or the accommodation (Buckley & Aranjo, 1997; Deng & Burnett, 2000) component of the tourism product, with only some addressing the reduction of greenhouse gas emissions as one favourable outcome of energy savings. Fewer studies explored tourists’ recreational activities (Powell, 2001; Stettler, 1997).
Chapter 1 – Previous research on energy use and tourism

Often neglected in sustainable tourism development studies, the air travel component of tourism has most often been analysed with regard to climate change (e.g. Olsthoorn, 2001). A number of studies investigated passenger air travel as a source of energy use and CO₂ emissions, although only rarely has a direct reference to tourism been made (Knisch & Reichmuth, 1996). The connection between tourists’ air travel and global warming has been made in political newspaper comments (e.g. Bunting, 2001) rather than in academic research. The obvious interest in air travel and climate change may be explained by the global reach of both phenomena. With a broader approach being necessary to study tourists’ impacts on global change, researchers appear to be reserved. Possibly, the drastic change in scale from local activities to global implications, and poor links between cause and consequence, impedes academics and business people from taking action. The exclusion of energy use and climate change from the broader discussion on tourism and the environment has been identified by Gössling (2000), who attempted a first discussion of energy use with regard to sustainable tourism development in developing countries.

1.4.3 Conclusion and future research

There is evidence that tourism researchers are increasingly attempting to analyse, assess or predict the impact of potential energy-related threats on the tourism industry. During the 1970s’ energy crises research focused on the alteration and suppression of holiday travel, and in more recent years research shifted to how climate change could affect tourism destinations. Consequently, there is an array of studies, where tourism is considered to be a victim rather than an instigator of impacts. This approach may be explained by stakeholders’ demand for such business-oriented studies that primarily seek to ensure a healthy business environment. A predominance of supply-related studies as opposed to demand-focused studies, along with projects’ dependence on financial funding (‘economic imperative of business’) was identified by Carter et al. (2001) as one among five impediments to the incorporation of resource management considerations into tourism research.

The energy crises in the 1970s provoked an immediate boost in research on energy and tourism, whereas knowledge about global warming appeared to generate a (at least) delayed research activity. One conclusion is that the impetus for research results from evident problems, such as the very realistic shortage of fuel, whereas climate
change is too abstract to be conceived as a real threat. In this sense, global climate change is somewhat different from other environmental impacts resulting from tourism. For example, water pollution, waste disposal, and wildlife extinction have been analysed carefully in a variety of settings. The same applies for tourism research on energy use, where it directly affects the business environment. Prevalent studies on energy performances in tourism buildings, mainly hotels, prove this fact, as well as studies on air pollution due to fossil fuel combustion. Hence, impacts resulting from tourism that are directly connected with a tourist activity and that are visible and harmful (to the environment, and thus to the business) have been examined with some interest. However, the general awareness of global warming is still low, and, hence, climate change plays a minor role in tourism research on the environment.

It is interesting, however, that climate change has had much bigger impact on research in other fields, for example in industrial or transport-related research. Possibly, due to its composite nature tourism is still a challenging ‘product’, ‘industry’ or ‘sector’ to analyse, especially with regard to complex research questions. Clearly, the analysis of tourism as energy consumer and greenhouse gas producer is a complex and many-sided subject. Researchers who investigated the climate change potential in other fields may be deterred by this complexity, which is confounded by the nature of tourists’ travel behaviour.

The situation is precarious: the IPCC leaves little doubt that climate change has the potential to severely affect large parts of the Earth, often those geographical regions that rely particularly and increasingly on tourism, for example small islands, tropical regions, and mountain areas. It is hoped that research will not only investigate the extent to which tourism destinations will have to adapt to new conditions, but that it will also determine tourism’s role in this process and identify ways to minimise energy use and greenhouse gas emissions. This study aims to provide a basis on which energy use associated with tourism within one geographically distinct tourist destination (New Zealand) can be assessed and reduced where possible. The study shall not only provide solid information on energy consumption patterns for New Zealand decision-makers but also constitute an example for other destinations or countries interested in improving energy efficiency and reducing greenhouse gas emissions.
Figure 4: Research on tourism and energy use in the course of time. The boxes symbolise in a simplified way the relative attention given to this field in the different political contexts. The position of the boxes represents the core of research; single studies have been undertaken outside the time-frame specified by the box.
1.5 Research objectives

The previous discussion on increasing energy use (and greenhouse gas emissions) in New Zealand, continuous growth in tourist numbers and a general lack of knowledge on how tourism contributes to energy use and climate change both within New Zealand and elsewhere demonstrate the need for research in this direction.

This study has the following research objectives:

- Analysis of energy consumption patterns in key tourism industries, namely transport, accommodation, and attractions/activities, to reveal key areas of energy demand and increase understanding of industry-specific energy saving potentials.
- Analysis of tourist travel patterns to understand what part of the ‘trip package’ is mostly related to energy consumption and what single travel choices are related to an overall energy-intensive travel style.
- Use of tourist travel patterns to group tourists into similar types that help to simplify the complexity and abundance of real-world travel behaviour for modelling purposes.
- Identification of energy use associated with different ‘tourist types’ to allow for scenario analyses of how various parameter affect energy use and to estimate the reduction potential of different policy, marketing, education and technology measures.
- Estimation of total energy use associated with international and domestic tourism in New Zealand and comparison with other sectors of the economy.
2 CHAPTER 2 – METHODOLOGY

2.1 Delineating tourism

There is much debate about the definition of a tourist and what the difference between a tourist, a traveller, a visitor, or an excursionist is (e.g. Collier, 1999). This discussion is not repeated here; instead the definition of the WTO (1999), used by Statistics New Zealand, is employed. Accordingly, a visitor (WTO) or a tourist (Statistics New Zealand) is “…any person travelling to a place other than that of his/her usual environment for less than 12 months and whose main purpose of the trip is other than the exercise of an activity remunerated from within the place visited” (WTO, 1999, p. 14). Furthermore, ‘excursionists’ who travel for a day only and tourists who travel for more than 24 hours can be distinguished (Collier, 1999). Excursionists are not considered in this study. For analytical purposes tourists are broken down into domestic and international tourists.

Traditionally, energy reduction potentials have been examined using a sectoral approach, for example within the ‘household or residential’ sector (Biesiot & Noorman, 1999). Tourism is a ‘composite’ sector in the System of National Accounts (SNA), and determining the composition of the tourism sector constitutes an obvious problem for many analyses, including comprehensive analyses of energy use. Tourism is special, because it is not defined by a specifically delivered product, but by those who consume the product or service (Statistics New Zealand, 2001a). For example, tourists demand service from the commercial sector by visiting tourist attractions. Tourists are also key users of the transport sector. It has been argued that tourism is a product that consists of five elements, namely a built plant, service provided (often in combination with the plant), hospitality, the freedom of choice and the tourist involvement (Smith, 1994). It is the freedom to choose and the tourist involvement, which ‘refine’ a delivered service or product to make it part of tourism (ibid).

The consumer-based approach has been used by the WTO to define tourism as a sector in its own right, standing outside the traditional sectors in the form of a satellite account. The fundamental idea of the Tourism Satellite Account (TSA) is to allow comparison between tourism as a sector and other sectors of the economy. The
quantitative approach used in the TSA does not include qualitative human dimensions, such as tourist experience (Smith, 1994). Since the purpose of this study is to quantify energy use (as opposed to the economic perspective in the TSA) it is practical to use an unambiguous and workable definition of tourism.

When applied to the context of energy consumption, the consumer-based definition of tourism allows clear allocation of all energy demanded by tourists to tourism. In contrast, a supply-based perspective would be ambiguous, since not all energy demanded by tourism characteristic industries is necessarily for tourism purposes. For this reason, this thesis considers the tourist to be the centre of the analysis. However, an industry analysis is undertaken first to provide essential background information to assess energy use of tourists. It is believed that the industry analysis alone would not enhance an understanding of the travel patterns and the required energy input of tourists. Knowledge of travel patterns, however, is crucial to provide answers as to how to promote energy conservation and increase efficiency in the sector.

The sub-sector composition of the tourism sector (also referred to as industries)\textsuperscript{15} is accounted for in this study by independent sub-sector analyses of destination-based transport; accommodation; and attractions and activities (Chapter 3). Accordingly, a tourist’s journey was disaggregated into these three key components (Chapter 4). The disaggregation of a trip into the three sub-sectors therefore underlies the whole study, both within the sub-sector (industry) analyses and the tourist analyses.

This study takes a ‘bottom-up’ approach, in that energy use is accounted for at the business level; and individual tourists’ travel patterns are used to estimate total energy demand. The results of this thesis can be juxtaposed and complemented by a ‘top-down’ approach using ‘Integrated Environmental Accounting’ currently undertaken in New Zealand (Patterson & McDonald, 2002).

\textsuperscript{15} Tourism described as a sector with sub-sectors reflects a perspective of economic accounting, while tourism as an industry emphasises the business (productivity) side of tourism. Both terms are used in this study, depending on the context.
2.2 General approach

This section outlines the general approach taken in this study. The idea was to analyse separately the tourism industry and tourists’ travel choices, and to then link results gained from both analyses to assess and model energy use by ‘tourist types’ in New Zealand. The key steps undertaken in this analysis are outlined in Figure 5 and described below.

![Diagram showing the approach to analyse energy use of tourism in New Zealand.]

Figure 5: Approach to analyse energy use of tourism in New Zealand.

1. **West Coast pilot-study**

A pilot-study on the West Coast of New Zealand’s South Island was first undertaken in December 1999 to January 2000 to collect information on tourists’ travel patterns and tourists’ behaviour. The knowledge provided by the West Coast pilot-study was used to derive a preliminary classification of so-called travel choices within transport, accommodation, and attraction/activities. A bundle of
travel choices makes up the travel pattern of an individual tourist. Further
information collected through the West Coast study comprised tourism-specific
data not available elsewhere, such as vehicle occupancies.

2. **Industry analysis (supply side)**

Following the pilot-study, a detailed industry analysis was undertaken. To obtain
information on the energy intensities associated with different travel choices, a
bottom-up approach was taken. This guaranteed sufficient detail at the level of the
individual business. The transport sub-sector was analysed mainly using existing
data sources, while accommodation and attraction/activities required specifically
designed operator surveys (June to October 2000).

International air travel (based on existing data) was also analysed for a later
comparison of energy use associated with travel to New Zealand and energy use
within New Zealand. This component, however, stands alone\(^2\) and is not linked to
any subsequent analysis of travel patterns.

3. **Tourist analysis (demand side)**

Tourists' travel patterns were first analysed by univariate techniques to understand
the relationship between energy use and specific travel choices. Also, the average
'energy bill' of individual tourists was determined. This analysis was first applied
to the West Coast sample, and then to the Domestic Tourist Study (DTS) (Forsyte
Research, 2000) and the International Visitor Survey (IVS) (Tourism New
Zealand 2000). The travel choice analysis provided background information on
how tourists make up their trips (i.e. what travel choices they make) and how this
in turn affects energy use.

The West Coast sample was further used to develop a methodology for identifying
tourist types. The applicability and validity of multivariate techniques (e.g.
multiple discriminant analysis) were first tested on the West Coast data and then
applied to the two other samples (DTS and IVS). Cluster analysis was used to
produce distinct groups of tourists based on their travel choices within each
sample. The resulting tourist types are plausible market segments with value for

\(^2\) Energy use associated with international travel is currently not regulated by international law and
therefore of minor interest to New Zealand's energy accounting (more detail in Chapter 3 –
**International travel**).
marketers and planners but also provide the basis for the analysis of energy use. At this stage, the energy intensities gained from the sub-sector analyses were applied to each tourist type's characteristic travel choices. This process is named energy-labelling in Figure 5. It is important that tourist types do not depend on energy figures at an earlier stage to allow for future changes in energy intensities. For example, the updating of energy intensities through future industry analysis (assuming the provision of better data) will improve estimates of energy use without affecting the model of the tourist types. Also, technological improvements that decrease energy intensities of travel choices can be considered.

4. Model of energy use in the New Zealand tourism sector
The distinct tourist types (both within domestic and international) and their associated energy use constitute the basis for a model on which projections for total energy use in the New Zealand tourism sector were made. To this end it was necessary to estimate tourist volumes for all domestic and international types. This was undertaken separately for domestic and international tourist types. Since both a tourist type's total energy use and its associated volume are dynamic parameters, a sensitivity analysis was undertaken. This type of analysis allows assessment of possible changes and their impacts. For this purpose Risk Analysis computer software (Palisade Corporation @risk, 1994) was used. The model was also applied to calculate CO₂ emissions for the year 1999 (domestic tourists) and 2000 (international tourists).
2.3 Methods used in this study – overview

2.3.1 Time and location of study

The base years of this study are 1999 and 2000, when data were collected (see below). Due to limited data availability it was not possible to refer to one base year only. The data on domestic tourists refer to 1999, the West Coast pilot study was undertaken in the 1999/2000-summer season, and the data on international tourists refer to the year 2000. While the estimation of total energy use in New Zealand for the year 2000 (where domestic tourist travel patterns and volumes from the base year 1999 were used) is subject to some inaccuracy, it is generally believed that the model of tourist types is not affected by the reference to two consecutive years. There is no obvious reason (e.g. major political event or crisis in New Zealand or globally) why data from 1999 and 2000 should not be combined. It is also assumed that the model should be valid in the short or medium-term, unless major changes in the energy or tourism sector occur. The ratification of the Kyoto Protocol in 2002 could be such an event that has potential effects on energy consumption patterns.

The study is limited to tourist movements and activities within New Zealand; however, to obtain a more complete picture, the energy use of international travel to New Zealand is examined separately. International travel is not included in any subsequent analysis of tourist types, but will be considered in the integrating analysis presented in Chapter 5.

2.3.2 Data collection

This study is primarily empirical and is based on the collection and analysis of quantitative data. These data originate either from secondary sources (previous research in this field) or were collected specifically for this study. This study contains seven separate data analyses (a number of them published as stand-alone papers). Three industry analyses (transport; accommodation; attractions/activities) plus international air travel are presented in Chapter 3 – Industry analysis; and three separate tourist analyses (West Coast pilot-study; domestic tourists; international tourists) are presented in Chapter 4 – Chapter 4 – Travel choices, energy use and tourist types. The respective results are integrated in the model of energy use in the New Zealand tourism sector presented in Chapter 5. Table 1 provides an overview of
the seven data sets used in this study. The shadowed rows indicate the data sets that were collected by the author, while the remaining data sets originate from secondary (raw) data sources. Transport energy use was mainly extracted from existing data sources, for example the fuel consumption figures of different vehicles published by the Ministry of Transport in various years.

Table 1: Data sources used in this study

<table>
<thead>
<tr>
<th>Study topic</th>
<th>Study subjects</th>
<th>Method</th>
<th>Sample size N</th>
<th>Reference year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport</td>
<td>Transport companies</td>
<td>Communication with key personal; literature review</td>
<td></td>
<td>1995 to 2001</td>
</tr>
<tr>
<td></td>
<td>Tourists on the West Coast</td>
<td>Selected West Coast pilot-study results</td>
<td>456</td>
<td>1999/2000</td>
</tr>
<tr>
<td>Accommodation</td>
<td>Accommodation operators</td>
<td>Mail-back and face-to-face survey; analysis of secondary data provided by Johnson and BECA</td>
<td>120</td>
<td>1999/2000</td>
</tr>
<tr>
<td>Attractions/</td>
<td>Tourist attraction/activity operators</td>
<td>Mail-back and face-to-face survey</td>
<td>107</td>
<td>2000</td>
</tr>
<tr>
<td>Activities</td>
<td>International tourists</td>
<td>Analysis of Arrival Card data&lt;sup&gt;1&lt;/sup&gt; aggregated by nationality (=census)</td>
<td>1,591,650</td>
<td>1999</td>
</tr>
<tr>
<td>West Coast</td>
<td>Tourists on the West Coast</td>
<td>Self-administered mail-back survey</td>
<td>273</td>
<td>1999/2000</td>
</tr>
<tr>
<td>pilot-study</td>
<td></td>
<td></td>
<td>183 dom.</td>
<td></td>
</tr>
<tr>
<td>Domestic tourists</td>
<td></td>
<td>Analysis of secondary data (DTS, telephone survey)&lt;sup&gt;2&lt;/sup&gt;</td>
<td>5,455</td>
<td>1999</td>
</tr>
<tr>
<td>International</td>
<td></td>
<td>Analysis of secondary data (IVS, exit survey)&lt;sup&gt;2&lt;/sup&gt;</td>
<td>5,437</td>
<td>2000</td>
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<tr>
<td>tourists</td>
<td></td>
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</tbody>
</table>

<sup>1</sup> Provided by Statistics New Zealand  
<sup>2</sup> Initiated by Tourism New Zealand, collected by Forsyte Research and accessed through the University of Auckland

It can be seen from Table 1 that each of the empirical studies required a specific methodology, research methods and data analysis. For this reason, there is no detailed description of methodologies and methods in this chapter. It was considered more appropriate to describe these within their respective sections (Table 2), along with a topic-related introduction, the research results, discussion and conclusion (the questionnaires are compiled in Appendix A). In Chapter 4 this structure is modified slightly to avoid repeated descriptions of methods that are common to all three data sets. Chapter 4, therefore, starts with a general methodology section that is followed by separate sections analysing the three tourist data sets.
Table 2: Guide to topic-specific methodologies and analyses presented in this study

<table>
<thead>
<tr>
<th>Methodology</th>
<th>Applied to</th>
<th>Chapter/ section</th>
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<tbody>
<tr>
<td>Data collection</td>
<td>Transport</td>
<td>3.1</td>
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<td></td>
<td>Accommodation</td>
<td>3.2</td>
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<td></td>
<td>Attractions/Activities</td>
<td>3.3</td>
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<td></td>
<td>West Coast tourists</td>
<td>4.2</td>
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<tr>
<td>Data preparation</td>
<td>International air tourists</td>
<td>3.4</td>
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<td></td>
<td>General explanation</td>
<td>4.1</td>
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<td></td>
<td>West Coast tourists</td>
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<td>Domestic tourists</td>
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<td></td>
<td>International tourists</td>
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<tr>
<td>Data analysis (general)</td>
<td>Accommodation</td>
<td>3.2</td>
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<td>Attractions/Activities</td>
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<td>International air tourists</td>
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<td>General explanation</td>
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<td>International tourists</td>
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<td>Cluster/discriminant analysis</td>
<td>General explanation</td>
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<td>International tourists</td>
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<td>Sensitivity/scenario analysis</td>
<td>Domestic and international tourists</td>
<td>5.1</td>
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2.3.3 Overview of statistical analysis

All data sets were summarised using descriptive statistics to characterise the samples and to assess their representativeness. Within the industry analyses, benchmarks for different categories were defined by calculating measures of centrality (mean/median) as well as measures of dispersion (standard deviation, range). In the case of a positively skewed distribution, the data were transformed by taking the logarithms of the data points (logarithm transformation) to obtain a normal distribution and to stabilise variances for comparisons.

The distribution of one or several variables was preferably presented in the form of boxplots (also referred to as box-and-whiskers plots). Boxplots summarise data based on the median, quartiles, outliers and extreme values. An example is provided in Figure 6, presenting travel distances of international tourists by train (IVS data analysed further in Chapter 4 – International tourists). The box represents the
interquartile range containing half of the values, while the whiskers are lines that show the range from the highest and lowest values, excluding outliers. A line across the box indicates the median. Outliers (1.5 to 3 box lengths from the upper or lower end of the box) are symbolised by circles, and asterisks show extreme values (more than 3 box lengths away from the box). On the x-axis, the sample size (N) can be displayed.

![Box plot](image)

**Figure 6: Example of a box plot based on IVS data for train travel (distance).**

Group means of metric variables were compared using Analysis of Variance (ANOVA). If the ANOVA was significant, *post hoc* tests (the least significant difference test [LSD]) for pair-wise comparisons between means were carried out to explore these associations further. Differences between non-metric variables were tested with the Chi-square test.

Simple linear regression analysis was used to test for relationships between pairs of metric variables, where variation in the dependent variable was assumed to be explained by variation in the explanatory variable. An important measure in this context was the $R^2$-value that gives the proportion of the variance in the dependent variable that is explained by the regression (model). Multiple regression was used when more than one explanatory variable was assumed to predict the dependent variable.
Tourists' travel patterns were analysed using multivariate analysis techniques to account for a number of (possibly interrelated) variables that may potentially characterise travel patterns. First, for the data on attractions and activities factor analysis was used to replace a larger set of interrelated variables with a smaller set of so-called dimensions that still reflect qualitatively the same information as provided in the original set. Cluster analysis was then employed to group tourists based on their travel choices. The final number of clusters was derived through informed interpretation and practical considerations of several computed cluster solutions. Finally, discriminant analysis was employed to evaluate and assess the cluster solutions. Statistical analysis techniques are described in the respective sections.

2.3.4 Model of energy use in the New Zealand tourism sector

Total energy use in New Zealand is determined by the energy intensities of travel choices within the different sub-sectors (here: transport, accommodation and attractions/activities), the degree to which tourists engage in these travel choices, and finally the composition (total tourist numbers) of different tourist types. These factors were considered in a Microsoft Excel spreadsheet model that was analysed using @risk software package. This allowed for an assessment of the risk associated with the final output of total energy use and CO₂ emissions. Furthermore, this model allowed undertaking scenario analyses for possible technological and behavioural changes.
2.4 Energy analysis

2.4.1 Direct and indirect energy use

The most obvious and direct consumption of energy by tourists is the purchase of petrol or diesel for transport. Tourists also consume energy when travelling on aircraft or public transport, and when utilising service products, such as accommodation, catering, and various tourist attractions and activities. Providing a service product generally requires energy input from various sources, most often gas, coal, petroleum products, or electricity.

The questions of where, when and for what reason tourists consume energy is complex, and the borders of what is specifically allocated to tourism are not clearly defined. The tourism industry purchases products from other industries, for example furniture, appliances, or vehicles, all of which require energy input to be produced or delivered. Previous studies drew a clear line between energy directly consumed through petroleum products, electricity, gas and so forth and energy ‘embodied’ in consumer items. In a study on household energy consumption in the Netherlands, Biesiot and Norman (1999) accounted for both categories of energy use, namely direct and indirect. They found that the aggregated energy use embodied in import and production (indirect) is larger than the direct energy consumption (916 PJ compared with 812 PJ per annum). Similarly, Weber and Perrels (2000) using household expenditures identified different direct and indirect energy requirements of various household types. They found, for example, that young single households are characterised by a large direct energy use for transportation.

The analysis of indirect energy use requires a comprehensive database of the embodied energy of a large range of goods. This is often provided through input-output analysis, as for example in Lenzen’s study on direct and indirect energy requirements of Australian transport (1999). Life-cycle assessment is another, more process-oriented, means of producing a database for ‘embodied’ energy (Van den Vate, 1997). In New Zealand there is no database that would allow the estimation of

17 Embodied energy is also often referred to as ‘grey energy’.
the indirect energy requirements of the tourism industry\textsuperscript{18}, and the development of such a database goes beyond the scope of this study. For this reason only the direct energy use of tourists and the tourism industry is examined.

The scheme displayed in Figure 7 shows the scope of energy use analysed in this study. The tourism system in the centre of the scheme is simplified to consist of the tourists and the tourism industry. The tourists demand energy directly from the energy system. The energy system comprises all industries that are involved in providing energy, for example coalmines, power plants, and petrol stations. Tourists also demand energy through tourism providers in that they buy tourism services or products. As stated above, the tourism sector comprises industries providing ‘tourism characteristic products’, as defined in the TSA 1998-2000 (Statistics New Zealand, 2001a). The energy input required by the tourism industry to provide services or products is catered for by the energy system, for example in the form of electricity. Both forms of direct energy consumption by the tourism system, namely tourists purchasing ‘energy carriers’ and tourism businesses consuming energy to provide a service or product are considered in this study. Energy flows other than these are excluded, because of their indirect nature. For example, energy consumed to produce (intermediate) goods (or services) is symbolised by the arrows between the energy system and the non-tourism industries. The demand for energy by the energy system itself symbolises the loss of primary energy to produce secondary energy as discussed below.

\textsuperscript{18}Work in this area, currently undertaken at Massey University and Landcare Research Ltd New Zealand, is expected to be available by the end of 2002.
Figure 7: Energy use in the tourism system; the demand-related arrows are highlighted to demonstrate the focus of this study.
2.4.2 Primary and secondary energy

Energy comes in many forms (e.g. chemical, thermal, kinetic, or potential), and one form can be converted into another. In conversion processes energy cannot be ‘used up’, i.e. the total quantity of energy remains constant (First Law of Thermodynamics). Conversion or transformation is often necessary to generate a form of energy that can be used for a specific purpose (e.g. for mechanical work), however, parts of the original quantity of energy may simultaneously be transformed in a form of energy that is not wanted (e.g. heat) and therefore considered ‘wasted’ or ‘lost’.

A series of conversions and transformations of energy in its original forms is common to provide useful energy (Figure 8). The energy chain starts with primary energy, which is energy available in natural resources. Examples of primary energy sources are crude oil, natural gas, coal, geothermal energy, solar energy and hydro energy. The primary energy is processed, converted and transformed to secondary energy, which is then distributed to consumers (Regional Wood Energy Development Programme [RWEDP], 1997). In the case of fossil fuels the provision of consumer energy is generally associated with a loss of about 10% (Enquête Komission, 1994), i.e. one MJ of consumer energy is commensurate to 1.1 MJ of primary energy. The consumer (final) energy is used for various purposes with different degrees of efficiency. The useful energy at the end of the energy chain is the amount of energy eventually used for the desired work (e.g. driving a car).

Figure 8: The energy chain (Source: RWEDP, 1997).
Identifying energy use of a business or across an industry is called energy accounting, whereby an energy audit is the central tool of energy accounting to measure energy flows systematically (RWEDP, 1997). An energy audit considers energy inputs and outputs as described above in the energy chain. A common unit of measure in energy audits is often based on the heat content of the energy source (in joules) or on fuel equivalence values, such as coal or oil equivalents. The fuel equivalents estimate the amount of coal or oil that has the same energy (heat) content as the used fuel source.

It has been argued that an energy audit should account for the quantity of primary energy consumed to produce a desired output (Biesiot & Norman, 1999; Greenpeace Schweiz & Verkehrsclub der Schweiz, 1992; Maibach, Peter & Seiler, 1995; Weber & Perrels, 2000), because primary energy accounts for the full life-cycle (and total embodied energy) of an energy carrier. This is particularly important for electricity, because the input of primary energy to generate electricity may be considerably larger than the electric energy available to the consumer. The transformation of fossil fuels into electricity, for example, results in a ‘loss’ of energy (heat), with thermal power plants having a thermal efficiency of about 30% (between 27% and 36% in New Zealand) (Baines, 1993, p. 13). Additionally, there are transmission losses through distributing electricity to end consumers. These are equivalent to energy costs associated with transporting other fuels to the consumer, for example petrol to the petrol station. In the case of New Zealand, the electricity mix consists mainly of hydropower and gas-generated power, in varying proportions (see Chapter 1). When electricity is generated from renewable sources (e.g. hydro, geothermal, or biomass) there is still some ‘loss in energy’ in that generation plants need to be constructed and maintained, renewable sources have to be cultivated (in the case of biomass) and electricity needs to be transmitted to consumers. This loss, however, is small compared with that of thermal generation.

In New Zealand, energy consumption of individuals, businesses or sectors is usually accounted for as consumer energy (see for example EECA, energy-wise quarterly publications). Also, the Energy Data File by the MED provides energy statistics for the different sectors of the economy in the form of consumer energy. For the reason of consistency and comparability, this study therefore analysed energy use by the tourism sector as consumer energy, thus ignoring energy input necessary to provide
the different forms of energy. It is acknowledged that a consideration of primary energy would particularly increase the relative and absolute significance of electricity consumption.\(^{19}\)

In the energy analyses of the tourism sub-sectors, information on energy use was collected in the physical measures of kilogram (kg), litres (l), cubic metres (m\(^3\)), cords of wood (3.6 m\(^3\)), and kWh, and transformed into the common unit of MJ by using New Zealand specific conversion factors (Baines, 1993) (Appendix D). This procedure measures the quantity of consumer energy input based on the heat content of the respective energy source. The heat content measures a maximum available quantity of energy and does not consider the energy ultimately used for the desired output (Patterson, 1993). This approach therefore ignores the different quality of energy sources that results in a different efficiency of energy output compared with energy input. It has been argued that due to different levels of energy quality, energy use in heat equivalents cannot be added up without adjusting for the varying qualities (Patterson, 1996). This applies particularly for electricity – a high-quality energy source. These measures are important when energy analysis seeks to optimise the use of energy, by considering both different qualities of energy input and output and by using the most efficient fuel source in combination with the most appropriate technical device to achieve a specified output (e.g. space heat).

This study acknowledges the importance of such considerations, however, the inclusion of different energy qualities into the analysis of energy use associated with tourism goes far beyond the scope of this study. It is furthermore believed, that the level of detail gained from a pure thermodynamic analysis (i.e. measuring energy use as heat equivalents) is sufficient for the purpose of this study, and provides the required (see research question) benchmark for tourism’s contribution to national energy use. To this end, the consumption of different energy sources is added up based on the heat content in MJ. The use of electricity is mainly associated with accommodation and tourist attraction buildings. In these analyses it is important to keep in mind both the large input of primary energy (which is not accounted for in the

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\(^{19}\) Based on information provided by the MED, it is estimated that the primary energy input to generate electricity is twice as big as the consumed electricity.
final use) and the high quality of electricity, which makes its use more valuable (weighted with a larger quality factor) compared with other sources.

In Chapter 5, energy consumption is converted into CO₂ emissions through energy source specific conversion factors (Baines, 1993). In New Zealand, there is no constant conversion factor for electricity (kWh), due to the variation in thermal generation. For the purpose of this study, a coefficient was estimated based on data provided in the June 2001 Energy Data File (MED, 2001). Total electricity generated in the year ended March 2000 was 131.8 PJ, of which 119.6 PJ were consumed (transmission and distribution loss make up for the difference). In 2000, CO₂ from electricity generation (including gas, liquid fuels, and coal) were 5,051 kilo-tonnes (MED, 2000a). An estimate for emitted CO₂ per average MJ (including both thermal generation and electricity from renewable sources) can be obtained by dividing total consumer electricity by total emissions (assuming zero emissions from power generated from renewable sources). This results in a coefficient of 42 g/MJ (152 g/kWh) of CO₂. This is comparatively low compared with other developed countries where a larger proportion of electricity is generated based on fossil fuels (coefficients between 500 and 740 g/kWh of CO₂ referring to primary energy input to generate one kWh) (Van den Vate, 1997). In the case of hydro-power previous research found that when accounting for the ‘full energy chain’ (which is not attempted in this study), emissions amount to about 20 g of CO₂ equivalent per kWh (including among others emissions resulting from the construction of the dam, and the decay of flooded biomass) (Gagnon & Van den Vate, 1997).

The calculation of greenhouse gas emissions in Chapter 5 is based on consumer energy, and therefore refers to on-site emissions. Electricity is an exception, because emissions result from the off-site transformation and transmission process (see calculation of emission factor above). This study includes these off-site emissions, which is in accordance with guidelines for CO₂ reporting published by the Ministry of Commerce (1995, p. 6), where electricity is “…treated as though the electricity supply company’s generation was on-site”.
3 CHAPTER 3 – INDUSTRY ANALYSIS

The Tourism Satellite Account (TSA) identifies tourism characteristic industries that taken together comprise the tourism sector. Similarly, Collier (1999) lists key industries, namely (inbound) transport, accommodation and attractions/activities, sales and ancillary services. The first three are analysed and discussed in this chapter with regard to energy use. The sub-sectors sales and ancillary services are not analysed because it is assumed they do not contribute as much to a tourist’s energy use as the selected industries, and also their analysis would be very complex. Within the concept of tier 1 (tourism ratio larger than 80%) and tier 2 tourism industries developed by Smith (1995), the transport modes analysed in this study (except the taxi), belong to the tier 1 industries, as well as accommodation and most tourist attractions and activities. Travel agency services, which were identified to be tier 1 industries (ibid), are not analysed here, because their overall impact on energy consumption is believed to be small.

The industry analysis is mainly undertaken to provide energy consumption data that will be necessary to estimate energy use of tourists and in the whole New Zealand tourism sector. Apart from that, however, the analyses shall provide some insight into business operation practices and possible problems associated with collecting data in the first instance and implementing energy efficiency measures in the second.

It is believed that tourism businesses (in particular small businesses) should hold some interest in being energy-efficient or generally sustainable for the following reasons: i) cutting costs, ii) gaining a marketing advantage, iii) conserving nature (on which most of them depend), iv) meeting customer expectations and v) complying with laws (Carlsen, Getz & Ali-Knight, 2001, p. 282). This study addresses these issues only peripherally.

The analysis of energy use associated with the key sub-sectors is supplemented by an analysis of energy use associated with international air travel to New Zealand. The focus is on retracing tourist flows to New Zealand and estimating energy use on a per capita, per country, and per travel sector basis. Since the main concern of air travel is its effect on the global climate and since CO2 emissions can be readily calculated
from energy use these will be presented as well. Although not being an industry analysis in the sense of examining and comparing different components (in this case different air lines), international air travel is included in this industry analysis chapter. Not only is it a clearly definable sub-sector of the tourism sector, but it also is characterised by specific energy use patterns, practices and policies, that will be relevant in discussions elsewhere in this analysis.
Chapter 3 - Transport

3.1 Transport

3.1.1 Introduction

Previous research showed that an impediment to achieving sustainable tourism is the heavy use of transport by tourists and the environmental impacts resulting from this travel (Müller, 1992; Gössling, 2000). The associated energy use is a major concern, since it does not only undermine the goal of efficient resource use as outlined by the New Zealand Tourism Strategy 2010, but it also contributes to the failure of New Zealand in achieving its goals set by the Kyoto Protocol. This chapter discusses previous research in this field, describes the present transport sector’s greenhouse gas emissions in New Zealand, discusses the supply of tourism transport infrastructure, and provided energy intensities of main New Zealand transport modes. Different transport modes are hypothetically juxtaposed on an analysis of a journey from Christchurch to Dunedin. Suggestions for reducing transport energy use are discussed.

1.1.1 Transport in tourism studies

Transport has long been part of tourism studies. In a tourism system approach, for example, transportation connects the tourist generating and the destination region via transit routes (Leiper, 1990a). Hall (1999) distinguished four different roles of tourism transport: 1) transport to get to the host destination, 2) transport to ensure mobility within a destination, 3) mobility within a tourist attraction, and 4) travel along recreational routes. Clearly, transport is not only a means to get from one place to another, but it also constitutes an attraction in itself as in the case of cruising trips, scenic flights, and railway journeys (Page, 1999). Despite the existence of tourism research related to transport, Page (1999) argued that attempts to build a framework for transport and tourism, with the aim of understanding the tourist’s need for transportation and the significance of transport for the tourist experience, have so far been unsuccessful.

Previous research on transport and tourism reflects different disciplines and viewpoints. For example, geographical studies on the travel behaviour of tourists analysed the spatial movement with different transports modes (e.g. Oberdries & Forer, 1995; Oppermann, 1995). Technological innovations in transport have strongly influenced travel behaviour, and, by reducing travel times and costs, led to a physical
and psychological “shrinking” of the world (Tolley & Turton, 1995). In particular the
development of jet aircraft has supported the steady growth of tourism. Consequently,
the field of air travel has attracted both transport and tourism researchers. The main
areas of interest are global and regional passenger or tourist flows (Oppermann &
Cooper, 1999; Schafer & Victor, 1999), air travel demand now and in the future
(Crouch, 1994), economic impacts associated with air travel (Raguraman, 1997) and
regional (tourism) development (Bowen, 2000; Prideaux, 2000).

While air travel is seen as important facilitator for tourism, it is also criticised for its
environmental impacts and contribution to climate change (Janić, 1999; Olsthoorn,
2001). Air transport has often been linked to environmental impacts, while other
modes of tourist transport seem to be neglected in this context. However, sustainable
tourism development can only be achieved by complying with principles of
sustainable mobility, which for example demands a decrease in the use of both air and
car travel and a shift to non-motorised or public transport modes (Høyer, 2000). Many
attempts to implement public transport systems have failed so far, partly because
traditional measures (e.g. passengers carried or amount of subsidies per passenger) do
not measure the achievement of environmental objectives, such as a change in modal
split. Also, public transport needs to be integrated into larger traffic strategies or
“green programmes” to be successful (Eaton & Holding, 1996, p. 64). The promotion
of cycle tourism and the establishment of cycle networks have been identified as
potential facilitators of sustainable development (Lumsdon, 2000).

Tourist’s attitudes are an important factor in travel behaviour and choice of transport
mode. In a study on environmental attitudes in Australia, Knight (1992) found that
people were generally aware of environmental impacts due to transport and
considered saving fuel to be an important issue. However, it appeared that
environmentally concerned people tended to buy more economic cars rather than
switching to public transport, to avoid inconveniences and problems associated with
non-individual transport modes. The transport behaviour of tourists is complex and it
seems likely that different socio-economic groups (Carlsson-Kanyama & Linden,
1999) and different activities (Stettler, 1997) induce a different demand of energy.
Interdisciplinary questions on tourism and transport have rarely been analysed. This may be explained by uncertainties about an unknown range of impacts due to tourists’ travel behaviours, along with the general constraint of differentiating between tourists, recreationists, and non-tourists. Hall (1999) identified the lack of such a discriminatory policy as an important obstacle to introduce policies, such as road pricing, carbon taxes or other restrictions on road usage. This has often inhibited discussions on environmental problems and the internalisation of adverse effects.

3.1.3 The New Zealand transport sector

Energy use

Transport is the dominant sector in terms of energy consumption in New Zealand, accounting for 40.1% of the total energy use (453.3 PJ) in 2000 (MED, 2001). Total CO₂ emissions from fuel combustion were 28 million tonnes in 1999, with transport making up 43.2% of this figure. This makes transport the single largest source of CO₂ emissions in New Zealand. This is not only critical with regard to climate change and New Zealand’s international agreements, but also in terms of dependence on imported fossil fuels. Of the 767.3 PJ total primary energy supplied in New Zealand in 1999, 223.1 PJ (29.1%) stem from imported oil (MED, 2001). Most of this imported oil (89%) is used by transportation.

The energy use of the transport sector is increasing at an annual rate of 3.8% and is expected to make up about 52% of the total consumer energy by 2020 (EECA, 1999a). These figures include passenger and freight transport, whereby passenger transport accounts for 66% of all transport energy use. Passenger transport breaks down into a share of 89% (99 PJ) for cars, 7.4% for domestic air travel (8 PJ), 2.9% for buses (2.1 PJ), and 0.3% for rail transport (0.3 PJ) (EECA, 1999b, p. 4). New Zealand has the second highest car ownership in the world with 69 vehicles per 100 people (Gillespie, 2001). New Zealand is furthermore characterised by an inefficient and ageing fleet of cars that is not subject to any emission controls (ibid.).

The New Zealand TSA 1997 reports industry tourism ratios, which give the proportion of an industry’s gross output that is consumed by both domestic and international tourists (Statistics New Zealand, 2001c). From these ratios, it can be seen that tourism contributes considerably to the transport industries. Tourists
consume 23% of the products supplied by the (aggregated) ‘Road passenger and Rail Transport’ industry, 17% of the ‘Water Transport’ industry, and 81% of air transport. In addition, tourism induces demand for commodities that are transported to tourism resorts. This kind of transport is reflected in the share of 29% within the ‘Other Transport, Storage and Transport Services’ industry (Statistics New Zealand, 2001c, p. 15). According to the TSA 1998-2000, 45% of all tourist expenditures (international and domestic) are on transport, with air transport making up 23% of total expenditures, other transport 12%, and retail of fuel and automobile products 10% (Statistics New Zealand, 2001a).

Supply of transportation – a tourism perspective

In the year ended 2000, almost a third of all international visitors travelled by domestic air at some stage during their stay in New Zealand. All together, Air New Zealand transported 4.46 million passengers within New Zealand. The network of Air New Zealand National and Air New Zealand Link (Air Nelson Limited, Eagle Airways Limited, Mount Cook Airline Limited) provides more than 430 flights a day to 26 destinations throughout New Zealand (Air New Zealand, 2000). Additionally, there are several locally operating airlines, such as Sounds Air (Picton to Wellington) or Mt Aspiring Air. Air New Zealand’s revenue from domestic passenger sales increased by 21% in 2000, accompanied by an increase in total domestic seat capacity of 4.7%. The load factor (average passenger occupancy) increased to 67%, which almost equals the factor of international flights (70%) (Air New Zealand, 2000). The connection between air travel and public road transport is relatively good, with all but five of the airports linked to scheduled transport to and from the airport.

Road transport is the most frequent form of travel for tourists, with private and rental cars, camper vans, and coaches being the most popular modes. New Zealand’s road network offers 57,772 km of sealed roads, of which 18.5% are State Highways, 27.0% are urban and the remaining 54.4% are rural roads. In addition, there are 34,281 km of unsealed roads (Transit New Zealand, 2001). Some of the roads are built or sealed particularly for tourism purposes, such as the Milford Sound road. The currently ongoing discussion about the construction of roads in the Hollyford Valley and the Kahurangi National Park also has a strong tourism link. The transport network is a large cost producer, with one kilometre of sealed road costing the country between
$3,030 (local roads) and $24,370 (State Highways) per year for maintenance (Transit New Zealand, 2001).

Rental cars are used by 32.8% of all international tourists (TNZ, 2001a). Telecom New Zealand’s Yellow Pages list 919 rental car and 16 rental motorcycle companies in New Zealand. Along with the rental car or motorcycle, companies often offer so-called self-drive holidays with a suggested itinerary and pre-booked accommodation. An example of such an itinerary starts in Christchurch, leading to Franz Joseph (West Coast), Queenstown, Te Anau and Milford Sound, Dunedin, and back to Christchurch. This itinerary covers 1,930 km in seven days, with the first and fifth day being stationary. ‘Fly and Drive’ packages include the international flight and a hired vehicle, and also offer tour suggestions, such as the ‘Kiwi Grand 23 Days and 22 Night Tour’, a “monster holiday in NZ featuring top tourist spots in the North - Paihia, Rotorua and Coromandel, and a complete South Island circuit - lakes, mountains, wilderness, forests, and glaciers” (Wings’n Wheels, 2001).

Another increasingly popular mode of road transport is the camper van or motor home. At least 36 companies (Telecom New Zealand’s Yellow Pages) offer camper van hire, with the Australian-based Britz being the largest. The daily cost ranges between $67 and $303, depending on size (two to six persons) and season. Britz has operated in New Zealand since 1994. During this time it has continued to expand, with the company having recently ordered (for purchase) more than 200 new Mercedes vans (Britz Camper van Rentals, 2001). Besides self-driven, individual tours, there is a broad spectrum of organised tours and public transport. Classical organised tours offer a complete package of transport, accommodation, and activities, and can be booked both overseas and in New Zealand. A more casual form of organised coach travel is the backpacker bus, used by 3.3% of all international visitors (TNZ, 2001a). Kiwi Experience, for example, offers ‘Backpacker Passes’, ranging from $284 (min. 8 days, North Island) to $1013 (min. 28 days, complete New Zealand circuit), and serves about 30,000 backpackers per year with 18 buses (pers. comm. Kiwi Experience, May 2001).

New Zealand offers an extended network of public transport with scheduled buses, mainly InterCity and Newmans Coachlines (Figure 9). Several discounted and
flexible coach passes have been developed to suit the needs of independent travellers. InterCity offers eight passes on the North Island (e.g. Coromandel Trail Pass, Twin Coast Discovery) and seven on the South Island (e.g. West Coast Passport, Milford Bound Adventurer). Passes cost for example $119 (North Island Value Pass from Auckland to Wellington) or $142 (East Coast Explorer, from Picton to Dunedin). The ‘Travelpass New Zealand’ combines bus, ferry, and/or rail and air.

In addition to the large networks there are smaller coach and shuttle operators that often operate on a local level, which allows them to adapt to diverse travellers’ needs. For example, Abel Tasman Coachlines operates regularly between Nelson and Abel Tasman National Park, offering both transport-only options and one-day packages including a water taxi cruise (New Zealand Tourism Online, 2001). The New Zealand train network is another transport option, comprising eight long-distance trains (Figure 9), some of them with “panoramic wagons” (Tranz Rail Holdings Ltd., 2000). However, due to financial restrictions there is currently debate to what extent the existing network will be maintained.

Figure 9: Routemap of the Travel Pass New Zealand (InterCity Coachlines, 2001).
3.1.4 Method to determine energy intensities of transport modes

Energy consumption varies considerably between different modes of transport. Although international literature on vehicles’ energy consumption is abundant (e.g. Waters, 1992; Maibach et al., 1995), country specific factors need to be taken into account. Moreover, energy figures vary due to different research frames, for example the consideration of primary energy instead of consumer (secondary) energy. The extension from consumer energy to primary energy consumption can result in an increase of more than 20% (Lenzen, 1999). In New Zealand data on energy are generally reported as consumer energy. The energy figures used in this study are mainly derived from reports of the New Zealand Ministry of Transport (MoT) (1995, 1997 and 1998a) and EECA (1999b). Some modal components (camper vans, motorcycles, recreational boats) required additional investigations to determine respective energy intensities.

Energy intensities are either expressed as energy use per vehicle kilometre (MJ/km) or per passenger kilometre (MJ/pkm) depending on the availability of passenger load factors. Another parameter would be energy use per available seat kilometre, which reflects the maximum potential for energy intensity of a vehicle. The fuel consumption for a specific mode of transport depends on several factors (Van den Brink & Van Wee, 2001):

- Vehicle-specific fuel consumption (L/km)
- Fleet composition (e.g. age of vehicles, fuel source, vehicle types)
- Calorific value of fuel
- Other factors (e.g. load, driving behaviour, road type distribution)

The vehicle fleet composition is an important factor, as for example the introduction of modern cars or a change in the diesel to petrol car ratio alter the average fuel consumption. Therefore, the energy intensity (MJ/km) of a specific transport mode is calculated by multiplying each vehicle type’s share within the fleet (e.g. number of diesel and petrol cars) with the specific consumption and the energy content of the fuel (e.g. diesel and petrol cars). Consequently, the vehicle types’ shares of the energy intensity are added up for all types within a mode (Equation 1). The energy content is based on Gross Calorific Values (GCV) (Baines, 1993).
Energy use/km = Σ GCV (MJ/L) * fuel consumption L/km * proportion of vehicle type

Equation 1: Energy intensity of a specific transport mode

3.1.5 Energy intensities: road transport

A study on road transport in New Zealand by the MoT (1995) compiled data on the average fuel consumption of commonly used road vehicle types (Table 3). These figures appear to be low compared with the average fuel consumption of 9.65 L/100 km for New Zealand cars in 1997 (EECA, 1999b) and the average fuel consumption of the Australian fleet of 11.5 L/100 km (Lenzen, 1999). Nevertheless, the MoT figures were applied in this study, since they constitute the most comprehensive and disaggregated data source available in New Zealand.

Table 3: Average fuel consumption per 100 kilometres (MoT, 1995)

<table>
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<th>Type</th>
<th>Fuel cons. rate 1) L</th>
<th>9.2 L</th>
<th>9.5 L</th>
<th>9.0 L</th>
<th>6.7 L</th>
<th>6.6 L</th>
<th>47.9 L</th>
<th>62.3 L</th>
<th>3.5 L</th>
<th>8.2 kg</th>
<th>7.7 kg</th>
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<tr>
<td>Petrol car</td>
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<td>Ex-overseas</td>
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<td>Petrol bus</td>
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<td>Diesel car</td>
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<td>Motor-cycle</td>
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<td>CNG car</td>
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<td>LPG car</td>
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</table>

1) L: Litres per 100 kilometres, kg: kilogram per 100 kilometres

Private and rental cars

Generally, diesel cars use less fuel than petrol cars, which can be explained by the more efficient combustion technology (Van den Brink & Van Wee, 2001). Moreover, the New Zealand fleet of diesel vehicles is younger on average (7.6 years compared with 10.6 years for all cars) (MoT, 1998a). Vehicles previously registered overseas made up 16% of the fleet in 1992 (MoT, 1995, p. 53). Considering the greater energy use of these ex-overseas cars compared with other petrol cars, the average consumption of a petrol car was assumed to rise from 9.2 to 9.3 L/100 km (Table 3).

According to the MfE (2000), the New Zealand car fleet consisted in 1999 of 93.7% petrol and 6.2% diesel cars. The alternative fuel sources CNG, LPG and electricity contributed less than 1%, and are therefore not considered in the following calculations. By applying Equation 1 (see above) for private cars, the average energy use was calculated to be 3.16 MJ per km. The Automobile Association (AA) (pers. com., April 2000) reports an oil consumption of 1 litre per 2,500 km for petrol cars.
This was assumed to be similar for diesel cars. The energy use per kilometre thus increased slightly to 3.18 MJ per km. This compares to the range of 3-4 MJ per km in other OECD-countries (EECA, 1999b).

Rental cars are on average 2.8 years old, explaining the more efficient energy use. However, it is argued that despite the technically more advanced rental car fleet, increasing use of technical extras, such as air condition, possibly outweighs or encompasses this effect (EECA, 1999a). The fleet of rental cars comprises a larger proportion of diesel vehicles (11.2 %) compared with petrol cars (88.6 %). Only 0.21% of all rental cars use gas (either CNG or LPG) or other energy sources (MoT, 1997) and, therefore, are not considered any further in this analysis. As there is no information on the consumption of rental diesel cars, it was assumed that it is similar to the one of private diesel cars. Hence, the energy consumption of rental cars was calculated to be 2.33 MJ per km or 2.35 MJ, including both fuel and oil.

**Camper vans**

Most camper vans are diesel fuelled (approximately 80 %), with the remaining vans using petrol (20 %) (pers. com. Maui, Kea Campers and Kiwi Campers, February 2000). The average fuel consumption for diesel vans is 11.8 litres per 100 km and for petrol vans 13.4 litres per 100 km. According to the three companies interviewed, oil is consumed with a rate of one litre per 2,000 km. Considering the proportion of diesel and petrol camper vans, the average energy intensity is 4.52 MJ per km including fuel, and 4.54 MJ per km including fuel and oil. No previous research on the energy use of camper vans could be found to support these figures.

**Coaches (tour buses and scheduled buses)**

Coaches comprise a variety of vehicles either classified by weight or by number of seats. EECA (1999b) reports an average fuel consumption of 30-50 litres per 100 km for buses over 12 tonnes in OECD countries. Buses in Great Britain, consume 42 litres per 100 km for 46-seaters and 44 litres per 100 km for 53-seaters Waters (1992). For consistency reasons, this study refers to the New Zealand figures (Table 3), although they seem somewhat elevated. New Zealand buses mainly use diesel (91.7%, compared with 8.3% petrol) (MoT, 1998a, p. 47). Electric buses in Wellington were excluded, as they are not particularly tourism related. The oil consumption of coaches was assumed to be one litre per 5,000 km (pers. com., Coach Service Centre
Christchurch, March 2000). Consequently, an average coach consumes 23.1 MJ per km for fuel and 23.2 MJ per km for fuel and oil.

This energy intensity as energy use per vehicle km is employed for organised coach tours and backpacker buses, when the passenger number is known. Since, however, it is difficult to obtain data on occupancies of scheduled coaches (e.g. InterCity), it is practical to use average passenger numbers and, hence, energy use per passenger-kilometre (pkm). The New Zealand intensity of 0.75 MJ per pkm (EECA, 1999b) compares to 0.85 MJ per pkm for Australian public country buses (Lenzen, 1999), and to 0.65 MJ per pkm for public transport in Scandinavia (Carlsson-Kanyama & Linden, 1999).

Motorcycles
Motorcycles use 3.5 litres of petrol per 100 km (Table 3). This is consistent with information obtained from Christchurch companies stating a consumption of 4.5 litres of petrol per 100 km and one litre of oil per 5,000 km (pers. com. motorcycle retailer, March, 2000). Based on a consumption of 3.5 litres per 100 km and the oil use above, the energy use of a motorcycle equals 1.22 MJ per km. This broadly compares with 1.88 MJ per km ‘primary’ energy use for motorcycle in Great Britain (Waters, 1992).

Shuttle buses and vans
Some assumptions were necessary to calculate the energy use of shuttle buses and vans. A shuttle bus or van is a vehicle, which is licensed to carry a maximum of 12 passengers, including the driver. In the absence of primary data, the fuel consumption was presumed to be that of light goods vehicles of 9.7 litres per 100 km for petrol vehicles and 7.9 litres per100 km for diesel vans (MoT, 1997). The total fleet of light commercial vehicles consisted in 1998 of 58.8% petrol and 41.2% diesel vehicles (MoT, 1998a). Therefore, an average shuttle van consumes 3.21 MJ per km.
Assuming the same oil consumption as for cars, the energy use is 3.22 MJ per km.

Hitchhiking
Hitchhiking involves stopping vehicles that are already ‘en route’. In this study, hitchhiking was considered to be a form of car-pooling, which results in an increased vehicle occupancy (namely one additional passenger compared with the average) and, thus, decreased energy use per passenger. Since the average occupancy of cars in New
Zealand is 2.15 persons (EECA, 1999b), a hitchhiker enhances this to 3.15 passengers. Building upon the calculated energy consumption for private cars of 3.23 MJ per km an average energy use of 1.03 MJ per pkm for hitchhikers was calculated.

1.1.5 Rail, sea and air transport

Rail transport

Rail transport in New Zealand is mainly freight transport, as only eight passenger trains exist. The energy intensity of rail transport is 1.44 MJ per pkm (EECA, 1999b). This is relatively high compared with other OECD countries, mainly due to low occupancy rates, and hilly terrain that only allows for short trains.

Sea transport

Sea transport comprises inter-island transport (Cook Strait), other ferries (e.g. Great Barrier Island or Stewart Island), and transport with recreational boats. The vessels serving Cook Strait use diesel and heavy marine diesel. The average energy consumption of a vessel for the 96 km-one way trip is 275,340 MJ (based on Tranz Rail 2000 figures). Except for the Lynx, all vessels carry freight and passengers. A weighting of freight (tonnes) and passengers (numbers) was undertaken by applying a similar procedure as used to calculate energy intensities of aircraft, where one passenger accounts for 90 kg multiplied by a factor of 1.7 (considering on-board equipment and staff) (Knisch & Reichmuth, 1996). Energy use was calculated per tonne and, thus, allocated to freight and passenger service. Since each vessel transports different loads of freight in relation to passengers, the calculated energy use per passenger ranges between 8.10 MJ/pkm (passenger vessel) and 0.52 MJ/pkm (vessel with dominantly freight transport). By weighting the actual passenger numbers on each vessel in 1999, the average energy use resulted in 2.40 MJ/pkm.

Other ferries operate to connect off-shore islands with the main land. The most important ones are Stewart Island and Great Barrier Island. The energy use of 8.70 MJ/pkm for a ferry ride to Stewart Island is known from previous research (Becken, 1999). Other ferries are assumed to be similar to vessels operating in Australian transport systems, such as Sydney harbour ferries (3.53 MJ/pkm) (Lenzen, 1999).
According to a Christchurch boat retailer (pers. com. J. O’Grady, April 2000) an ‘average family boat’ with a 90 hp outboard motor and a cruising speed of 55 km/h consumes approximately 15 litres of petrol per hour. Consequently, the fuel consumption is 0.27 litres/km, translating into an energy use of 9.4 MJ per km or 9.6 MJ per km including oil (considering a petrol to oil ratio of 50:1).

**Domestic air transport**

The total aviation turbine fuel supply in 1992 amounted to 823 million litres plus an additional 5.1 million litres of aviation gas. This is equivalent to 30.5 PJ of energy, shared between international air (71%) and domestic air (29%) (MoT, 1995). Technological improvements lead to a continuous decrease in fuel consumption, which is at present at 2.75 MJ per pkm (EECA, 1999b).

**3.1.7 Comparison between alternative modes**

A direct comparison of the different transport modes’ energy intensity was made based on per passenger energy use (Table 4). This was calculated by using average load factors extracted from the tourist survey undertaken on the South Island’s West Coast (see Chapter 4). Caution needs to be exercised due to the small sample sizes for calculating load factors (e.g. 11 for recreational boats, 29 for backpacker buses). The occupancies need to be validated for further research.

Sea and air transport appeared to be high-energy modes, and the camper van was the most energy intensive vehicle in the medium energy use category. Low energy modes are collective or public transport vehicles (coaches and shuttles), the motorcycle and backpacker buses. It can be seen that the energy intensity depends strongly on the vehicle occupancy, which, for example, leads to the efficient use of mostly fully booked backpacker buses, compared with other organised coach tours.
### Table 4: Energy consumption for different vehicle types in New Zealand

<table>
<thead>
<tr>
<th>Transport mode</th>
<th>Energy use per vehicle kilometre (MJ/vkm)</th>
<th>Average load factor (passenger) 1)</th>
<th>Energy use per passenger kilometre (MJ/pkm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High energy modes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stewart Island Ferry</td>
<td>NA</td>
<td>NA</td>
<td>8.70</td>
</tr>
<tr>
<td>Helicopter</td>
<td>NA</td>
<td>NA</td>
<td>4.68</td>
</tr>
<tr>
<td>Other Ferries</td>
<td>NA</td>
<td>NA</td>
<td>3.53</td>
</tr>
<tr>
<td>Domestic Air</td>
<td>NA</td>
<td>NA</td>
<td>2.75</td>
</tr>
<tr>
<td>Cook Strait Ferry</td>
<td>NA</td>
<td>NA</td>
<td>2.40</td>
</tr>
<tr>
<td><strong>Medium energy modes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Camper van</td>
<td>4.54</td>
<td>2.20</td>
<td>2.06</td>
</tr>
<tr>
<td>Recreational boat/yacht</td>
<td>9.62</td>
<td>5.49</td>
<td>1.75</td>
</tr>
<tr>
<td>Train</td>
<td>NA</td>
<td>NA</td>
<td>1.44</td>
</tr>
<tr>
<td>Private car</td>
<td>3.25</td>
<td>3.16</td>
<td>1.03</td>
</tr>
<tr>
<td>Hitchhiking</td>
<td>3.25</td>
<td>3.16</td>
<td>1.03</td>
</tr>
<tr>
<td>Coach (tour bus)</td>
<td>23.10</td>
<td>22.9</td>
<td>1.01</td>
</tr>
<tr>
<td>Rental car</td>
<td>2.35</td>
<td>2.50</td>
<td>0.94</td>
</tr>
<tr>
<td><strong>Low energy modes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scheduled coach</td>
<td>NA</td>
<td>NA</td>
<td>0.75</td>
</tr>
<tr>
<td>Motorcycle</td>
<td>1.22</td>
<td>1.40</td>
<td>0.87</td>
</tr>
<tr>
<td>Shuttle bus, van</td>
<td>3.22</td>
<td>5.46</td>
<td>0.59</td>
</tr>
<tr>
<td>Backpacker bus</td>
<td>23.10</td>
<td>39.8</td>
<td>0.58</td>
</tr>
</tbody>
</table>

1) Load factors from West Coast pilot-study. NA = not applicable/available

When planning a trip, tourists probably consider mainly two aspects: convenience and cost. Environment could be a third aspect in future planning. Convenience may be measured as travel time along with other factors, such as transfers and baggage allowance. In a study on snow sport recreationists travelling to ski fields in Switzerland, the number of transfers was used to measure ‘comfort’ associated with different transport modes (Trösch & Messerli, 2000).

A journey from Christchurch to Dunedin was analysed to compare transport alternatives with regard to convenience, cost, and energy use (Table 5). This example was chosen because it represents a commonly travelled route, which is equally served by a wide range of different modes. The travel distance from Christchurch to Dunedin is 362 km (329 by air), and can be travelled in between three and a half hours (by air including time spent on transfer and check-in) and seven hours (by train or public bus). The car is convenient in that it is readily available and allows for larger amounts of luggage. Since the shuttle service offers a free pick-up, no transfer is necessary. However, this pick-up system may increase the travel time, if many passengers are picked up and dropped off at very different places. The remaining transport modes all
require additional transport (or walking) to and from the terminal. Luggage restrictions apply mainly for the plane. Transport costs depend on the travel time, the time booked in advance, discount fares (e.g. student), and special offers. The aircraft is the most costly option, whereas bus travel is comparatively cheap. The per capita cost for the rental car depends on the number of passengers. The cheap train fare refers to a ‘backpacker fare’, whereas the $89 fare represents a standard adult fare. The highest energy use is associated with air travel. However, a car with a single person consumes almost as much energy. The shuttle bus operates efficiently, since it is usually well occupied. With three passengers in a rental car, the per capita energy use is lower than that of train passengers.

Regression analysis between travel cost and energy use for the alternatives shows that 92% (F=45.6, p= 0.003) of the variation in energy use can be explained by the (respective cheaper) travel fares (66% for the standard fares with F= 8.1 and p= 0.046). This means that expensive transport modes are also likely to be energy intensive ones. Saving energy is often equivalent with saving money.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Travel time</th>
<th>Cost (New Zealand$)</th>
<th>Energy use (MJ)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rental car (1 person)</td>
<td>5 hrs</td>
<td>$60$^{31} (car) + $38 (petrol) = $98</td>
<td>851</td>
<td>Pick up/ drop off car</td>
</tr>
<tr>
<td>Rental car (3 persons)</td>
<td>5 hrs</td>
<td>$20 (car) + $13 (petrol) = $33</td>
<td>283</td>
<td>Pick up/ drop off car</td>
</tr>
<tr>
<td>Train</td>
<td>6 hr 45 min (train) + 15 min (transfer)= 7 hrs</td>
<td>$40 - $79 (train) + transfer (0-10) = $40 - $89</td>
<td>521</td>
<td>Transfer, baggage limit</td>
</tr>
<tr>
<td>InterCity/ Newman’s Coachlines</td>
<td>6 hr 45 min (bus) + 15 min (transfer)= 7 hrs</td>
<td>$24 - $48 (bus) + transfer (30 - $10) = $24 - $58</td>
<td>272</td>
<td>Transfer, baggage limit</td>
</tr>
<tr>
<td>Shuttle$^1$ (5.5 persons)</td>
<td>5 hrs</td>
<td>$35</td>
<td>214</td>
<td>Free pick-up</td>
</tr>
<tr>
<td>Domestic Air$^2$</td>
<td>2 hrs (flight inc. check in) + 30 min (check out) + 1 hr (transfer) = 3 hrs 30 min</td>
<td>$96 - $224 (flight) = $10 - $40 (transfer to and from airport) = $106 - $264</td>
<td>905</td>
<td>Transfer, baggage limit</td>
</tr>
</tbody>
</table>

1) South Island Connections
2) Air New Zealand one-way fare
3) Fare for a small rental car for one day

For many other trips between two locations in New Zealand the chosen transport mode depends to a stronger degree on the origin and destination. For example, for trips between the North and South Islands, air travel gains some advantage in travel
time and cost when compared with the alternative of car and ferry travel. Furthermore, connections between main centres are considerably shorter when travelled by plane compared with road travel. In contrast, remote locations often lack a connection to the public transport network, and the private car appears to be the single possible travel mode.

3.1.8 Options to reduce energy use and emissions

Efficient use of vehicles

The most efficient use of an independent vehicle is the one that is adapted to actual needs of the traveller. Often these needs are 'over-matched', as for example in the case of hired four-wheel drive vehicles, solely because of fashion reasons and a greater flexibility that most tourists won't ever exploit. It appears that rental companies promote hiring powerful vehicles to increase revenue. Not only type or make can be chosen wisely, but also the size. The choice should consider the actual number of people who will travel with the vehicle. An increase in passenger number for a given vehicle, for example by ride share or car-pooling, will improve its efficiency. A current practice in backpacker hostels, for example, is the informal advertisement of rides on black boards, mostly on the basis of expense sharing. It is conceivable to establish a formal, generally accessible (via the Internet) database for tourists, similar to the rideshare programme developed by EECA for Lincoln and Canterbury University (EECA, 2000a) to connect tourists with similar itineraries or travel lags. This may appeal to free independent travellers (FITs).

Driving behaviour can effect the fuel consumption considerably. For example, 'aggressive driving' as compared with 'restrained driving' increases the specific fuel consumption by about 30% (Van den Brink & Van Wee, 2001). The use of air-conditioning increases the fuel bill by 10 to 15%, and an extra load of 100 kg increases the fuel consumption by another 7 to 8% (ibid). Changing driving behaviour and increasing public awareness were found to be among the most promising measures to reduce passenger transportation emissions in Canada (Transportation Association of Canada, 1999). Information brochures with fuel saving tips are already distributed by Budget Rent-a-Car in Europe (Green Globe Asia Pacific, 2000). Optimising driving behaviour does not only concern tourists, but also operators who offer transport services as part of their tourism business. A number of case-studies
report on possible measures, such as driving at a constant speed (95 km/h), adjusting tyre pressure, and driver training (Green Globe Asia Pacific, 2000). Reducing the fuel bill is a win-win-win situation for the tourist, the company and the environment.

An interesting idea are so-called ‘City Centre Car Clubs’ or ‘Pay-as-you-use personal transport’ developed in Europe, which offer flexible rental options for commuters or other users in cities. Cars are hired for as little as an hour and are charged on a time and mileage basis. These systems were designed to work hand in hand with public transport systems and the hire of cycles (Green Globe Asia Pacific, 2000). Obviously, the reason behind such programmes is to reduce pollution, congestion and parking problems. These arguments are not as viable in the New Zealand context, especially in rural and remote areas where many tourist attractions are located. Nevertheless, the introduction of more flexible rental systems based on the city examples could benefit rental companies by increasing customer numbers, tourists by offering adapted rental schemes, and the environment by a wiser use of rented vehicles. The current system, which is based on daily (unlimited kilometres) rental fares, does not encourage tourists to reduce travel distances or to refrain from the car for a whole day. A fare-system, which puts more emphasis on the mileage, would provide a more realistic prize for car usage and constitute an incentive for travelling less.

Time efficiency should not be the major issue in travel (Høyer, 2000), and it could be argued that slow means of transport that often stop on the way are more popular. Often, the recreational tourist does not gain much by travelling fast to a destination and missing out points of interest en route. A ‘gain in time’ leads to the need for further activities or entertainment at the destination. By considering travel as an attraction in its own right, slower transport modes offer a greater chance to relax and enjoy the environment. In this sense, energy for transport is used more efficiently, the longer it takes to travel. For example, cyclists travel at a slow pace, motivated by exploring the area in more detail and experiencing nature and scenery (Ritchie, 1998). In fact, cycle tourists spend 75% of their time on cycling (ibid), and consequently have a lower demand for other, potentially energy consuming, activities. In contrast, air travellers reach their destination quickly at the expense of a large amount of energy, and have additional time to participate in other activities (e.g. jet boating).
Modal shift

A modal shift from individual motorised transport to public or non-motorised transport would reduce overall energy costs for transport. The modal share is strongly influenced by the broader transport policy and planning and the allocation of funds and labour. In New Zealand, the strong emphasis on road transport and the neglecting of public transport have supported the trend towards increasing use of private vehicles. A study by Transit New Zealand found that the sealing of the Milford Sound road caused a shift from bus travel to individual car travel (Travers Morgan New Zealand Ltd, 1995). A similar study in Waipoua Forest on the North Island showed that the sealing of roads increased visitor numbers, particularly those of holiday-makers (Booz•Allen & Hamilton New Zealand Ltd, 1997). In terms of planning for public transport, Eaton and Holding (1996) emphasise that national targets need to be complemented by localised targets.

Public transport

Public transport is often rejected of several reasons, among them inconvenience, cost, and inflexibility. To overcome these barriers, the Transportation Association of Canada (1999) identified the following factors for inter-city travel with public transport: 1) increasing the price of car and air travel, 2) subsidising public transport, 3) improving speed and convenience of bus and rail, 4) improve terminals, 5) co-ordinate carriers, and vi) adequate information on the systems (p. 67-68).

In terms of tourism, locals often resist the substitute of individual travel by collective forms because they fear that tourists chose another destination instead of adapting to public transport systems (Eaton & Holding, 1996). In fact, it was found that public transport to National Parks is only accepted if the transport constitutes an experience in its own right, for example as in the case of “novelty vehicles” (Eaton & Holding, 1996, p. 63). Following this idea, the development of special packages at various locations is conceivable. National Parks that are accessed from a centre and not from a transit route are best suited for such projects. While, for example, Milford Sound, Mount Cook, and Urewera National Park, are situated at a ‘dead end’ in terms of main tourist trunks, Arthur’s Pass, Paparoa, Tongariro and Westland National Park are likely to be transited by tourists in their own vehicle anyway. Packages could take several forms. First, a scheduled bus without any interpretation provides a basic and
cheap transport option. Second, guided one-day tours with interpretation of the
surrounding natural or cultural environment could attract people with special interest,
who join an organised tour for the sake of ‘learning something’. Third, bus passes or
packages for several days with a ‘hop-on hop-off system’ constitute a flexible
alternative to explore one region or National Park (e.g. ‘Magic Bus’, Northland Pass).

Cycle tourism

Although little research has been done on cycling in relation to tourism, there is
potential of growth, especially in the market of FIT’s (Free Independent Travellers)
(Ritchie, 1998). The key element of tourist cycling seems to be that it is perceived as
an integral part of the holiday (Lumsdon, 2000). In New Zealand, it was found that
cycle tourists belong mainly to the group of ‘extreme cyclists’ whose main travel
purpose is cycling. Only 50% of them use or intend to use a mode of transport other
than the bike. Moreover, the cycle market consists of backpacker-like, individual
travellers staying for a long time (Ritchie, 1998). This is different in Europe, where
cycle tourism is often experienced by families as a short break holiday.

The implementation of cycle networks seems crucial for the successful promotion of
cycle tourism. As noted by Lumsdon (2000), isolated cycle trails tend to stimulate day
visitation, which is often car based and does not lead to a reduction in motorised
transport. The successful UK National Cycle Network, for example, offers 5000 miles
of connected cycling routes on traffic-free trails, traffic-calm roads, and minor roads
(Lumsdon, 2000). Besides a connection between cycle paths, the access to a cycle
route or network from urban centres is a critical point. The Danube Cycle Route in
Austria is a good example of the successful integration of a cycle route in public
transport systems. The route, which goes from Passau to Vienna, is linked to bus, boat
and train services, and recorded an increase of almost 50% from 1987 to 1991 (ibid).
In New Zealand the development of such routes is in its infancy, with many road
controlling authorities perceiving cycling not to be an important mode of transport
(Cambridge & Francis, 2000). There is both a lack of understanding of cyclists’ needs
and consistent guidelines for designing cycle paths (ibid). Consequently, the main
drawbacks perceived by cycle tourists are quality of driving, overall road safety, and
biking services (Ritchie, 1998). Isolated initiatives in urban centres such as
Christchurch and Hamilton, and the establishment of scenic or historic cycle routes,
such as the Otago Central Rail Trail, are first steps in this direction. The Otago
Central Rail trail opened in 2000 and offers 150 km of trail and 60 bridges to cyclists and walkers (EECA, 2000b). Despite not being part of a network, there is a service offering collective transport from Dunedin. The ongoing existence of such projects, however, depends strongly on their promotion as tourist attractions, as was found for the alternative Catlins Southern Scenic Route, which serves as an example of effective marketing (Ritchie, 1998).

Apart from the obvious benefits resulting from cycling and cycle tourism, such as health issues, reduced congestion and pollution, cycling is also a promising means of dispersing tourists and their expenditures into more rural, peripheral areas. Finally, cycling appears to be a very cost-efficient alternative to motorised road transport: an 8000-mile network would cost the same as three miles of urban motorway (EECA, 2000b).

**Regional promotion**

New Zealand is often promoted as country, where very different scenery and attractions can be visited within a short holiday time. The average travel distance of international tourists is estimated to be between 3,000 and 4,000 km. Camper van companies, in particular, engage in promoting freedom and flexibility with slogans, such as “for people who are going places” (Paradise Motorhome Rentals) and “where the journey is the adventure” (Britz Camper van Rentals). This counteracts the objective of decreasing travel distances. Instead, a longer stay within a region could be promoted to: 1) reduce vehicle usage, 2) provide the tourist with an in-depth experience on a smaller scale, and 3) disperse tourist spends more widely on a local level.

The idea of regional promotion fits well in the objective of improving regional management as declared by the New Zealand Tourism Strategy 2010. Marketing and attracting a large number of tourists to a region are not the overarching goal any longer, but sustainably managing tourists at one destination. For example, the supply of a large variety of activities that are accessible by a collective shuttle transport from a centre (as for example in the case of Queenstown) could satisfy tourists’ needs for experience and excitement, while keeping them ‘off the road’. Along these lines, TNZ suggest on their web-page “100% Pure New Zealand” to travel only one island, when
being in New Zealand for a limited time (2000). Moreover, this site offers a regional-wise description of New Zealand with a range of options for activities within each region. Not only it is important to keep touring tourists more local or regional, but also to attract new groups that arrive explicitly for the attributes of a specific region. This happens currently with the Australian marketing strategy, where it was found that New Zealand’s image is more attractive, when selected features are promoted separately (e.g. beach holiday in the Bay of Islands or tramping in Fiordland). Ski tourism is probably the one product, where regional marketing is already in place.

Economic mechanisms

Economic mechanisms to manage fuel consumption have been described by the ‘carrots and sticks’ analogy (Holding, 2001). Incentives for sound travel alternatives (‘carrots’) are often favoured by the public and politicians, but are considered insufficient, while ‘sticks’, being more efficient, are unpopular and opposed by the public. A possible ‘stick’ is the full cost pricing, that would include costs already charged to the use (e.g. insurance), costs met by direct government subsidies (e.g. highway construction), external costs (e.g. pollution and accidents) (Transportation Association of Canada, 1999).

The Transportation Association of Canada (1999) identified different views on fuel taxes. Supporters of fuel taxes think that currently low fuel prices neither provide an incentive to develop more efficient technologies, nor encourage people to change their travel behaviour. The pricing of fuels would be a step towards the consideration of external environmental costs in transportation, and could be used to fund environmentally more sound (public) transport projects. However, opponents argue that fuel taxes do not guarantee changes in consumer behaviour and are the source of inequity in several aspects. The trucking business and sectors that depend strongly on trucking are put at a competitive disadvantage. Also, exports could suffer from price increases. Both lower-income earners and the rural population are hit harder than high-income earners or urban dwellers. Finally, the study suggests that fuel taxes could harm tourism, and lack a general political and public support (Transportation Association of Canada, 1999, p. 116). In Canada fuel prices would have to more than double to decrease emissions to the level targeted by the Kyoto Protocol. New Zealand had already started thinking about petrol taxes in the early 1990s and already
had suggested implementing taxes by 2000 if the Kyoto targets were not reached (MfE, 1997a and 1998). This has not happened so far, however, in a recently released discussion document, the New Zealand Government suggests an emission charge of not more than $25 per tonne of CO2 equivalent after 2007 (New Zealand Climate Change Project, 2002).

**Alternative technologies**

There are several reasons for switching to cleaner fuels. First, increasing carbon dioxide emissions jeopardise the stability of the global climate. Second, other pollution, including the formation of ground-level ozone, hydrocarbons, and sulphur dioxide decreases the air quality of humans' living space. Finally, alternative fuels or technologies offer new choices for consumers and decrease their dependency on oil (EPA, 2001).

When comparing alternative technologies and fuels it is critical to analyse the complete life-cycle, since some fuels may emit little or no carbon dioxide during vehicle use, but during vehicle manufacture or other upstream activities (Transportation Association of Canada, 1999). The use of electricity, for example, has the potential of zero emissions when generated from renewable energy sources. When, however, generated in thermal power plants (e.g. coal or gas) emissions can be high, in particular as a result of the poor efficiency of electricity generation of approximately 30% (MED, 2001). It is argued by the German Office of Technology Assessment at the German Parliament (Büro für Technikfolgen-Abschätzung beim Deutschen Bundestag [TAB] (2000) that emissions other than carbon dioxide can be more effectively controlled at power plants than at a large number of mobile sources.

The same applies for fuel cells that run on hydrogen, which is produced using energy from renewable sources or from petroleum fuels. Fuel cells generate electricity through a chemical reaction of hydrogen and oxygen to water. This is a highly efficient mean to store and generate power, compared with traditional combustion engines. Hydrogen is considered a long-term perspective for transportation (TAB, 2000). Hydrogen fuel cells based on renewable energy sources are favourable with regard to all parameters, while those based on fossil fuels are still cleaner with regard to acidification and photo-smog than conventional engines (ibid). Fuel cell vehicles
cost about NZ$2,000 more than present diesel vehicles, and NZ$ 5,000 more than petrol vehicles in a high production rate scenario (TAB, 2000). While hydrogen fuelled public transport is already in place (e.g. Canada and Germany), cars will be produced for the general market by 2004 (EECA, 2000a). EECA (2000a) argues that, based on the availability of renewable sources and the growing dependence on imported oil, New Zealand has a great potential and need for the use of fuel cells.

Another alternative is the hybrid-electric-drive vehicle, which has two power sources (electricity and petrol or diesel), and shows reductions in carbon dioxide emissions of between 20 and 25% (Transportation Association of Canada, 1999). After being introduced in Japan and Germany, the hybrid car entered the New Zealand market (WWF, 2000). Hybrid cars are seen as an intermediate step to the mass production of fuel cells (EECA, 2000b)

The use of compressed natural gas (CNG) and liquefied petroleum gas (LPG) reduces carbon dioxide emission by about 25%. The gases contain less carbon, the recovery and processing are less energy intense (Transportation Association of Canada, 1999), and other emissions (e.g. carbohydrates) are less toxic (EPA, 2001). A clear drawback is the inconvenience of accommodating the heavy high-pressure tanks. Propane is a by-product of petroleum refining and is widely used as transport fuel. Bio-diesel (e.g. ethanol) can be extracted from corn and blended in gasoline with different results in emission reductions for different mix ratios. E85 (ethanol blended in petrol up to 85%) achieves reductions of about 40%. The advantage of lower mix ratios (e.g. 10%) is that cars do not require changes in the fuelling system (Transportation Association of Canada, 1999).

The Transportation Association of Canada identified several barriers to the introduction of alternative fuels. First of all, new technologies tend to have a higher purchase price, since mass-production is still to develop. Furthermore, public refuelling stations for alternative fuels are lacking, and people are restricted in their travel flexibility. In addition, the range of the vehicle is shorter compared with traditional combustion engines. There is also concern about the reliability and utility of alternative vehicles (e.g. luggage space) (1999). In New Zealand the trend of LPG vehicles is declining. However, cities seem to be increasingly interested in low-
emission vehicles, mainly to reduce pollution problems. Christchurch, for example, introduced three electric buses (backed up by a diesel engine) that circle the city centre and allow free travel for everyone.

3.1.9 Conclusion

Transport is a crucial requirement for tourism, since the key characteristic of tourists is their mobility. This mobility, however, has increased dramatically in the last decades; mainly as a result from technological progress and an increase in disposable incomes. While high mobility in itself is the main reason for environmental concern, it is also the popularity of energy inefficient transport modes that results in increasing energy use and the emission of greenhouse gas emissions. Despite a considerable increase in efficiency, air travel is still a large energy consumer, when compared with other transport modes on a per passenger per kilometre basis. Only water transport, especially on the open sea, consumes more energy per passenger than air travel. This, however, is of less concern, since overall passenger numbers of water transport are comparatively small and travel distances are generally short. Clearly, individual transport modes, such as the car and the camper van, are other important sources of energy use. The energy intensity is strongly dependent on the vehicle occupancy. A fully occupied car is competitive with public transport, while offering additional convenience with regards to availability, transfer, and luggage.

It has been discussed that the New Zealand infrastructure is strongly concentrated on road transport, with an extended network and a considerable amount of money spent on sealing of new roads and road maintenance. As opposed to European countries, New Zealand does not provide a competitive rail network. Moreover, New Zealand trains are not superior to other transport modes due to their relatively large energy intensity, and inconveniences for travellers associated with additional transfers to and from railway stations.

A strategy to reduce tourists’ energy use for transport will have to address stakeholders at different levels, as well as the tourists themselves. Tourists can contribute by travelling wisely and changing transport behaviour toward a more efficient use of their vehicles, shifting to public transport or zero energy modes (at least for parts of their holiday) and reducing overall mobility by staying longer at one
destination. Governmental and industrial actions have to encourage and support these behavioural shifts. Incentives (‘carrots’) to travel smaller distances and use alternative means of transport are conceivable, as well as penalties (e.g. taxes) for non-efficient travel. Government action should also be directed towards supporting new and energy-efficient technologies. To reduce travel distances, a shift from New Zealand’s promotion as ‘touring destination’ to a more regional focus seems an unavoidable step. Travel passes for an ameliorated network of public transport could support this trend. TNZ (2001b) identified the need for “city guides that outline public transport routes” that encourage tourists to explore local activities, events, and sights. It is important to keep in mind that “...a tourism which is developed detached from the restrictions implied in a sustainable mobility, will not be in accordance with demands for sustainable development” (Høyer, 2000, p. 156).
3.2 Accommodation

3.2.1 Introduction

The accommodation sub-sector comprised 9.2% of the total expenditure of tourists in New Zealand in 2000. International tourists spent considerably more on accommodation (18.2% of their total travel costs in New Zealand), than domestic tourists (5.2%) (Statistics New Zealand, 2001a). The accommodation industry constitutes a vital part of the tourism product and will play a critical role in achieving sustainable tourism.

According to Statistics New Zealand (2000a), New Zealand offers tourist accommodation in more than 3,000 businesses. Motels are the most prevalent accommodation type, with approximately 1,600 businesses, and they also rank first in terms of visitor-nights, with a market share of 35%. Hotels and campgrounds rank second (31%) and third (22%) in terms of total visitor-nights. Hostels and Backpackers comprise 10% of all visitor-nights, with the remaining nights being spent in hosted accommodation. This small segment includes farmstays, homestays and Bed & Breakfast (B&B).

As other industries, the accommodation faces increasing need to improve environmental standards. This may be achieved by “greening Goliaths”, or by “multiplying Davids”, where Goliath represents the large, conventional businesses or chains and David the small, environment-oriented forerunner of the industry (Wüstehagen, 1998, p. 2). Previous studies on both categories offer guidance on energy saving techniques and sustainable management tools. This is generally known as ‘best practice’ and is documented mainly for hotels (Pigram, 1996; CADDET, 1997). Also, there is a growing number of initiatives for sustainable practice, such as the ‘International Hotels Environmental Initiative’ (IHEI) (1993), ‘Environmental Hotels of Auckland (EHOA) and ‘Green Globe 21’ (2001). Despite these initiatives and some organisational support, a gap between good intent and practice was identified in a study on hotels in London (Knowles, Mcmillan, Palmer, Grabowski & Hashimoto, 1999).
Additionally, comprehensive inventories of the actual resource and energy use in different types of accommodation have not been undertaken. One exception is the *Commercial Buildings Energy Consumption and Expenditure 1995* study undertaken by the U.S. Energy Information Administration (EIA) (1995). However, this study includes hotels, motels and restaurants in a very aggregated form without sector specific analysis. Isaacs and Crocker (1996) investigated energy use in the New Zealand hotel sector; and based on this, the EECA (1996) published the 'energy-wise monitoring quarterly: hotel sector', the most comprehensive guideline on this topic available in New Zealand.

There is a clear lack of information on energy use in various commercial accommodation categories. For this reason, empirical research was undertaken in the New Zealand accommodation sector. The aim was to clarify whether accommodation categories are characterised by a different and distinct energy use and on what factors this depends. The results of this research constitute an important benchmark for planners and single businesses against which to measure increasing energy efficiency. Recording the present state is a crucial step for the implementation of any measures to enhance sustainable development. The results of this study will also be used for a projection of the total energy consumption of the New Zealand accommodation sector. At the end of this chapter a discussion of energy use in private homes is provided.

### 3.2.2 Methodology

**Data collection**

The data presented in this study are based on three separate surveys; all involve whole building energy measurements on an annual basis, thus avoiding seasonal effects. The first survey was undertaken on the West Coast of the South Island (Johnson, 1999). The experience gained from this was incorporated in a subsequent nation-wide survey. EECA supplied a third set of data on ‘top class’ hotels in Christchurch and Queenstown, which they had collected in 1998.

For the West Coast and the National Survey, a stratified random sample (based on category) of accommodation businesses was obtained, mainly by using the Automobile Association (AA) directory (2000). The AA segments the
accommodation sector into similar categories used by Statistics New Zealand and gives additional information on different levels of service and quality. Both surveys were undertaken in the off-season and after the end of the financial year. For the West Coast Survey and the National Survey the operators were first contacted either by telephone or by e-mail and asked if they would participate in the survey. If the operator agreed, the survey was either mailed or faxed to the respondent. While in the West Coast Sample the questionnaires were collected by the researcher and in most cases filled out face-to-face, in the National Sample operators were asked to mail the survey back without personal contact with the researcher. The response rate for the West Coast Sample was 98%, with 91% usable questionnaires. For the National Sample, follow up calls or e-mails were made after a period of three weeks. Due to an initial low response rate to the National Survey of only 13%, an additional random sample of Christchurch businesses and ones from the North Island was undertaken. Here, the procedure of the West Coast survey was repeated and the researcher visited operators to enhance the response rate. The response rate in the additional sample of personal contact with operators was 43%, resulting in an overall response rate for the National Survey of 19%. Overall hotels achieved the lowest rate of 10%. This compares with a response rate of 3.8% achieved by a study on hotels in Great Britain (Lawson, 1983) and to 25% of an Australian telephone survey of hotels in 1995 (Energetics Ltd., 1995).

The Hotel Survey undertaken by EECA involved direct contact and visitation of ‘top class’ hotels in Christchurch and Queenstown (pers. com. R. Tromop, June 2000). The achieved sample of 15 such hotels represents 29% of the 52 international hotels in New Zealand (EECA, 1996), covering this hotel type (international is assumed to be ‘top class’) sufficiently.

Despite practical difficulties associated with collecting data of the complex accommodation sector, the different sources of data (regional data of the West Coast, local data on ‘top class’ hotels, and a two-step, national random sample) allow for a wider application of the results and ensure an increased representativeness of the combined sample compared with each separate sample. Table 6 records the sample sizes of the three surveys. The bold printed labels are used hereafter.
Table 6: Sample size resulting from the three accommodation surveys

<table>
<thead>
<tr>
<th>Category</th>
<th>West Coast Sample</th>
<th>National Sample</th>
<th>EECA</th>
<th>Total</th>
<th>% of total business number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hotel, lodge, motor inn</td>
<td>11</td>
<td>4</td>
<td>15</td>
<td>30</td>
<td>3.3% (of 912)</td>
</tr>
<tr>
<td>B&amp;B, farmstay, hosted</td>
<td>13</td>
<td>9</td>
<td>-</td>
<td>22</td>
<td>4.4% (of 502)</td>
</tr>
<tr>
<td>Motel (no restaurant)</td>
<td>10</td>
<td>10</td>
<td>-</td>
<td>20</td>
<td>1.3% (of 1,600)</td>
</tr>
<tr>
<td>Campground</td>
<td>4</td>
<td>9</td>
<td>-</td>
<td>13</td>
<td>3.2% (of 409)</td>
</tr>
<tr>
<td>Backpacker, hostel</td>
<td>4</td>
<td>31</td>
<td>-</td>
<td>35</td>
<td>8.7% (of 401)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>42</td>
<td>63</td>
<td>15</td>
<td>120</td>
<td>3.1% (of 3,824)</td>
</tr>
</tbody>
</table>

1) Estimated number of establishments based on Statistics New Zealand (2000a), NZTB (quoted in EECA, 1996), AA directory (1999), and brochures.

The survey and data quality

Energy consumption in an accommodation business comprises energy directly consumed in running the accommodation building. Other activities, such as business vehicles are excluded. Energy use is defined as consumer (secondary) energy in this context and therefore any losses for transformation, transmission or distribution of primary energy are excluded. All surveys asked for the annual consumption of electricity, fossil and other solid fuel in the most commonly used unit (e.g. litres). This consumption was converted into energy content (MJ) (Baines, 1993).

Additionally, information on the business, such as the operating time period, capacity (beds and bedrooms), size, and amenities (e.g. swimming-pool, laundry, restaurant, bar) was collected. A further key parameter, the number of visitor-nights in the year corresponding to the energy figures, was also collected. Occupancy is a derived parameter and is defined as the number of visitor-nights per year divided by the number of beds available in one year. This differs from the widespread calculation of occupancy on a room-night basis (Collier, 1999). The occupancy rate as defined in this study allows for a direct comparison between the visitation level and the energy use on a per capita basis, which is a commonly used measure of energy intensity. In the case of owners (mainly of Bed & Breakfasts) permanently living in the accommodation business, these were treated as guests, weighted with a factor of 0.5. This assumes that half of the owners’ energy use is related to the business, while the other half relates to private, guest-like activities (e.g. cooking, shower).

A number of operators could not provide information on energy use, such as power bills, or only record consumption as dollars spent. In this case the average price for
the relevant energy source was applied to estimate the actual energy use (MED, 2000b). Firewood is particularly problematic, as it is mostly collected by those who burn it. Occasionally, other parameters, such as visitor-nights or floor space had to be estimated. Thus, parts of the data are subject to a non-quantifiable error.

**Comparison of the samples**

To verify the comparability of the three surveys the key characteristics capacity, visitor-nights, floor space, and occupancy were analysed. The surveys produced generally comparable results within each category, although there were differences. For example, the EECA hotels generally tended to be larger in terms of capacity, visitor-nights and floor space. This was tested with ANOVA and multiple comparisons (LSD test) showing a significant difference in size of ‘top class’ hotels (EECA sample) compared with hotels of the National and the West Coast Sample. An analysis of the other accommodation categories sampled in the National and the West Coast survey did not reveal significant differences with regard to capacity ($t= -0.144$, $p= 0.886$), visitor-nights ($t= 1.533$, $p= 0.128$), or floor space ($t= -1.331$, $p= 0.187$).

The occupancy rate of hotels for the EECA sample was highest (50.8 %) and matched well with the average occupancy of 51.3% for hotels as recorded by Statistics New Zealand (2000a). Generally, the hotel occupancy was lower for the West Coast Sample (25.0 %) than for the National Sample (29.0%) ($t= 3.376$, $p= 0.001$), resulting from the remote and seasonal situation of the West Coast. The West Coast and National Sample were broadly similar for the other categories, B&B, motel, backpacker, and campground. Figure 10 shows the available floor space per bed (total indoor floor area divided by number of beds) and is generally representative of the other characteristics, capacity, visitor-nights, and floor space.

The three data sets used were generated in close co-operation so there is a strong consistency in them. This is reflected in the comparisons of key variables, which identified no major disparities. The three different samples were therefore combined for further analysis. Other potential sources of bias, such as a possible overestimation of visitor-nights, an underestimate of the use of cost-free energy sources (e.g. drift wood collected on the West Coast), or regional differences (e.g. building type, amenities) are not likely to confound the key analyses that follow.
Figure 10: Available floor space per bed (square meters) for different accommodation categories and samples.

The final sample included 91 businesses from New Zealand’s South Island and 29 from the North Island. These 120 businesses are generally representative for the range of sizes within each category. Main features of the sample (medians) are set out in Table 7.

Table 7: Median characteristics for accommodation categories of the aggregated sample

<table>
<thead>
<tr>
<th>Category</th>
<th>Capacity (beds)</th>
<th>Visitor-nights/year</th>
<th>Occupancy (%)</th>
<th>Floor space (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hotel</td>
<td>165</td>
<td>15,017</td>
<td>37</td>
<td>3,950</td>
</tr>
<tr>
<td>B&amp;B</td>
<td>6</td>
<td>474</td>
<td>27</td>
<td>175</td>
</tr>
<tr>
<td>Motel</td>
<td>38</td>
<td>4,568</td>
<td>41</td>
<td>542</td>
</tr>
<tr>
<td>Backpacker</td>
<td>37</td>
<td>7,495</td>
<td>53</td>
<td>340</td>
</tr>
<tr>
<td>Campground</td>
<td>156</td>
<td>7,769</td>
<td>25</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>
3.2.3 Results

Total energy use for the different categories

The total annual energy consumption of the surveyed accommodation businesses varied substantially, and was generally positively skewed (Figure 2). To stabilise variances and normalise distributions the data were loge-transformed prior to analysis.

![Graph showing energy use for different categories](image)

Figure 11: Total annual energy consumption for different accommodation categories

There was a significant difference between categories in terms of total energy use as evidenced by ANOVA (F= 36.3; df= 4, 115; p< 0.001). The geometric means for the annual energy use are shown in Table 8. Multiple comparison of the transformed means (LSD test) revealed that hotels were the largest energy consumers, while the B&B category is characterised by the lowest annual energy consumption.

<table>
<thead>
<tr>
<th>Category</th>
<th>Total energy use (GJ/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hotel</td>
<td>2,254&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>B&amp;B</td>
<td>57&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Motel</td>
<td>145&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Backpacker</td>
<td>253&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Campground</td>
<td>176&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

1) Means followed by the same letter are not significantly different on the 5% level.
Presumably, much of the variation both between and within categories are simply due to different business sizes. To test this hypothesis, key variables representing the size of a business, such as capacity, floor space, and visitor-nights were related to energy consumption using regression analysis.

Firstly, the dependence of energy consumption on the key size variables could be identified across the whole accommodation sector regardless of category. The $R^2$ -values for the parameters capacity and floor space are 0.70 (df= 106; p<0.001) and 0.77 (df= 90; p<0.001, respectively, and indicated strong relationships between these two parameters and energy consumption. Campgrounds were excluded from this analysis, as it is difficult to determine a maximal capacity and floor space. The analysis of visitor-nights and energy consumption also showed a strong relationship ($R^2$= 0.67; df= 119; p<0.001, including campgrounds).

As could be seen from Table 7 the five accommodation categories differed considerably with regard to the parameters capacity, floor space, and visitor-nights. A complete regression model was used to explain energy use using the accommodation categories as dummy variables and including visitor-nights, capacity, and floor space. This model confirmed the high level of energy use in hotels (F= 5.3, df= 1, 86, p= 0.023) and indicated that over the accommodation categories capacity was the single best size predictor of energy use (F= 4.1, df= 1, 86, p= 0.047). There were clearly different patterns in the size variables among the accommodation categories (e.g. backpacker hostels with low floor space and capacity, yet high visitor-nights) and these variables were highly collinear within the accommodation categories. This means that the form and strength of the relationships between these key size variables and total energy use is also likely to be dependent on the accommodation category. To examine these relationships, separate stepwise multiple regression analyses were conducted for the hotel, motel, B&B, and backpacker categories. Campgrounds were analysed with regard to visitor-nights only. Visitor-nights and floor space were the best predictors of total energy use of hotels. The regression explains 79.6% of the variance in energy use (F= 42.8, df= 2, 22, p<0.001). Visitor-nights was the best predictor of energy use of motels ($R^2$= 0.89, F= 95.4, df= 1, 12, p<0.001), whereas the energy use of B&Bs was best explained by the capacity and floor space ($R^2$= 0.94, F= 153.0, df= 2, 19, p<0.001). The analysis of backpacker hostels resulted in a regression
model based solely on the capacity, explaining 69.6% of the variance (F= 64.2, df= 1, 28, p<0.001), and for campgrounds the model was based on visitor-nights (R²= 0.45; df= 1, 11; p<0.01). The high degree of collinearity (r= 0.778 for visitor-nights and floor space to r= 0.898 for visitor-nights and capacity) between the candidate predictors means that for most of these multiple regression results, variables other than those selected could be used in the model with little reduction in explanatory power.

**Energy intensity**

More information on differences between categories and influencing factors can be gained after removing the effect of business size. For that purpose the energy intensities ‘energy use per square meter’ and ‘energy use per visitor-night’ were calculated. This shows whether different categories use energy more or less efficiently. The geometric means are displayed in Table 9.

<table>
<thead>
<tr>
<th>Category</th>
<th>Energy use per square meter (MJ/m²*year)¹</th>
<th>Energy use per visitor-night (MJ/visitor)¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hotel</td>
<td>571ₐ</td>
<td>155ₐ</td>
</tr>
<tr>
<td>B&amp;B</td>
<td>300ₑ</td>
<td>110ₐ</td>
</tr>
<tr>
<td>Motel</td>
<td>250ₐ</td>
<td>32ₐ,₉₉</td>
</tr>
<tr>
<td>Backpacker</td>
<td>617ₐ</td>
<td>39ₐ</td>
</tr>
<tr>
<td>Campground</td>
<td>NA</td>
<td>25₉₉</td>
</tr>
</tbody>
</table>

1) Means followed by the same letter are not significantly different on the 5% level.

Complete models were again used to explore the effect of accommodation category and relevant size variables on these two measures of energy intensity. The results from this indicating that over all categories energy use per visitor-night was related to capacity (F= 7.4, df= 1, 87, p= 0.008) and floor space (F= 10.8, df= 1, 87, p= 0.001) and energy use per square meter was dependent on visitor-nights (F= 7.9, df= 1, 88, p= 0.006) but not capacity (F= 1.3, df= 1, 88, p= 0.253). These models again showed clear and different patterns between the accommodation categories for different energy intensities.

Multiple comparisons amongst the means for the two energy intensities indicated two accommodation types (hotel/backpacker; and B&B/motel) in terms of energy use per square meter. As indicated in Table 9, hotels and backpackers showed larger intensities than B&Bs and motels. A different set of groupings emerged for energy
use per visitor-night (Figure 11), with B&Bs joining the large energy intensities of hotels and backpackers joining the lower per visitor energy use group of motels and campgrounds.

![Energy use per visitor-night for different accommodation categories.](image)

Despite the key differences between categories, there was considerable variation within the categories. To demonstrate possible explanations for varying energy intensities, six individual hotel and backpacker businesses were explored. These represented two above-average and below-average energy use per visitor-night hotels and two above-average energy use backpackers. Clearly, they are examples of businesses whose energy consumption pattern is influenced by factors other than size.

For example, hotel ‘1’ (308 MJ/visitor-night) is a large, exclusive hotel in Christchurch in the South Island, offering a broad range of amenities, including restaurants and bars. Hotel ‘2’ (289 MJ/visitor-night) is a 28 year-old building located on the West Coast with an occupancy of 26%. It accommodates a restaurant, bistro, laundry, staff and manager flats and is partly heated with wood. The two selected hotels (hotel ‘3’ and ‘4’) featuring a more favourable energy use (42 and 35 MJ/visitor-night, respectively) also show individual factors, such as relatively high
occupancy levels (44% and 41%), particularly in summer, and the organisation in chalet-like, separate units. For example, hotel 4 is situated in the more northern Nelson area and, thus, is likely to spend less energy on heating than, for example, hotels in Christchurch or Queenstown. The two backpackers with an extreme energy use per visitor-night both cater for winter tourists, and therefore consume more energy for heating and drying. However, in most cases deviation from the mean could not be readily explained, indicating that a complex mix of factors is a general characteristic of this industry. There were no consistent patterns for the location of a business (North Island or South Island), the facilities, such as restaurants, laundry, and swimming pools, although some influence is assumed.

**Energy efficiency**

Energy intensity provides a valuable parameter to measure energy efficiency. Energy efficiency means using less energy while maintaining the same or even better level of service (Lovins & Hennicke, 1999). In this sense and for the sake of simplicity, the ‘energy service’ is initially defined to be one ‘visitor-night’ and the parameter ‘energy use per visitor-night’ expresses the energy required to provide this service. Through following this reasoning energy efficiency could be achieved either by decreasing total energy use or by increasing the number of visitor-nights per unit of energy consumed. Based on studies of households (Biesiot & Noorman, 1999), it could be assumed that the per capita consumption decreases with increasing numbers of visitors. Theoretically, this results from common utilization of facilities (e.g. foyer, restaurants, bars) and equipment. The scatter-plot shown in Figure 13 and regression analysis within each category indicate the extent to which energy use per visitor-night depended on the level of occupancy.

The trend displayed in Figure 13 indicates a declining energy consumption with higher levels of occupancy. However, the $R^2$-values were weak for all categories, with only the backpacker category ($R^2 = 0.26; df= 34; p<0.002$) and the B&B ($R^2 = 0.15; df= 21; p<0.081$) showing a statistically significant or nearly significant relationship. Therefore, a clear dependence between these variables was not seen.
Figure 13: Energy intensity and level of occupancy for different accommodation categories.

**Fuel types**

Fuel types used to satisfy energy demand were another source of variation of energy use. Except for one hotel, which employs its own hydropower plant, every business consumes electricity, with 28% of all businesses using it as the single energy source. This percentage is highest for motels (75%). Coal usage in accommodation businesses is mainly for heating and gas for cooking, whereas petroleum fuels are occasionally used for water heating. Closely linked with the source of energy is the variety and standard of technical equipment. As the analysis of this variable would require a high level of detail and a considerable amount of time, this study did not systematically examine this aspect. Moreover, the actual usage of fuels and electricity are strongly influenced by price movements, which make it difficult to determine the underlying reasons for consumption patterns (Haas & Schipper, 1998). However, to demonstrate the range of various fuel types currently used in the different categories, an average energy mix for the surveyed businesses was determined (Figure 14).
Based on the information presented in Figure 6 and the total number of establishments (Statistics New Zealand, 2000a), the energy mix for all accommodation categories was estimated. This identified electricity as main source over all categories (75% of energy use). While coal (12%) and LPG (9%) were frequently used energy sources, petroleum fuel (3%), natural gas, and wood (1%) played only a minor role.

![Energy Mix Diagram](image)

**Figure 6**: Proportion of the average energy use by fuel type for the five accommodation categories (the category 'fuel' means petroleum fuel).

**National projection of the total energy use in the accommodation sector**

For any further planning or policy development, information on energy consumption in the accommodation sector at the individual business level is not enough. A complete picture of the sector's aggregated energy use can be estimated from the above samples. The average energy use per visitor-night (Table 7) and the visitor-nights recorded by Statistics New Zealand\(^1\) (2000a) through the Commercial Accommodation Monitor constitute the basis upon which to estimate the total energy.

\(^1\) A comparison of Statistics New Zealand's data (CAM) with other sources (e.g. AA, EECA) shows that only about 60% of all businesses are recorded. It is therefore assumed that the number of visitor-nights is underestimated considerably. The data provided through the CAM is still used because it represents the 'official' monitoring of the accommodation sub-sector.
Accommodation Monitor constitute the basis upon which to estimate the total energy use of each category and the whole accommodation sector. As Statistics New Zealand only considers businesses with a minimum turnover of NZ$ 30,000 per annum and therefore excludes small businesses, it is assumed that particularly the B&B category is underrepresented. Furthermore, the inventory of Statistics New Zealand excludes establishments running an accommodation function as a secondary commercial activity. For these reasons the estimate of the total energy use is considered conservative.

Multiplying the geometric means of the transformed data for energy use per visitor-night with the visitor-nights in the financial year ending 31 March 2000 resulted in a point-estimate for the energy use of each category. Figure 15 displays each category’s share of the total estimated energy use of 1.74 PJ in the year 1999/2000. Hotels were the overwhelming users of energy comprising over two thirds of the energy use.

Figure 15: Relative and absolute contribution of the five categories to total energy use within the commercial accommodation sector.
3.2.4 Discussion of commercial accommodation

In their study on the hotel sector, EECA (1996) reported an energy use of 2,520 GJ per year for an average New Zealand hotel. The present study calculates an average total energy use for hotels of 2,254 GJ and does confirm this earlier recording. The commercial building study undertaken by the EIA (1995) reports an average energy use of 3,060 GJ per annum per building.

Total energy use differs significantly among the five accommodation categories (hotel, B&B, motel, backpacker, campground) with hotels being the largest and B&Bs the lowest energy consumers. Part of the difference between and within categories can be explained by business size, as shown by regression analysis for capacity, visitor-nights, and floor space. However, the difference in the relationships between these size-related variables and energy use for the five categories indicates the need and usefulness of models distinct to the accommodation categories.

To ensure comparability of establishments differing in size, energy intensities were calculated. Energy use per floor area is a common parameter in the commercial sector to report energy consumption. Hotels’ energy use of 517 MJ per square meter in this study is less than the energy usage reported in Europe (860-1,080 MJ/m², Brunotte, 1993) and Canada (900 MJ/m², Marbek Resource Consultants, 1997). It appears that energy consumption in New Zealand hotels is slightly lower than in other countries, possibly due to the relatively mild climate. Hotels and backpackers use energy more intensively per floor space than the other categories. While hotels are generally characterised by an elevated energy use, backpackers demonstrate a high use intensity presumably as a result of efficient catering for numerous guests within a limited business area. This can be seen from the small space available for each visitor in backpackers (11 m²/bed) compared with hotels (34 m²/bed).

A second measure of energy intensity, energy use per visitor-night, was also calculated for the five categories. As a result of this analysis, the categories can be aggregated in two distinct types, namely ‘comfort or service-oriented accommodation’, including hotels and B&Bs, and ‘budget or purpose-oriented accommodation’, comprising the three remaining categories motels, backpackers, and
campgrounds. Again, the energy use per visitor-night for hotels of 155 MJ is lower than results obtained in Europe (200 MJ/visitor-night, Brunotte, 1993). It is not surprising that hotels consume most energy per visitor, as the general feature of this up-market accommodation is the supply of energy intense facilities, such as bars, restaurants, and pools, combined with a generous provision of space. A hotel customer, therefore, pays a higher ‘energy bill’ than a visitor of other accommodation types. More surprising is the large energy intensity of 110 MJ per visitor-night in B&Bs. This might be due to small capacities and low occupancies combined with relatively high floor space. Old-fashioned heating systems and the widespread use of coal and wood are further attributes. B&Bs and hotels seek to provide individual service and a feeling of indulgence (Johnston-Walker, 1999), which is reflected in the higher energy cost. The ‘comfort or service-oriented accommodation’ of hotels and B&Bs consumes approximately three times the amount of energy per visitor-night than more basic alternatives. It is important to note that visitors staying in budget accommodation may satisfy their needs in other locations (e.g. restaurants), increasing the energy use in other industries. Motels appear to be an efficient accommodation category with an energy intensity of 32 MJ per visitor-night. This can partly be explained by the fact, that motel operators adapt to varying demand by closing single units, and, thus, decouple business area and energy use. Also, motels do not offer extended indoor areas for common use, as do hotels and B&Bs. Consequently, energy use is mainly restricted to basic individual activities (e.g. shower, cooking), which is also reflected in the constant per capita consumption for increasing occupancy rates (Figure 4). There are no comparative data of other studies for the ‘budget categories’. However, the average per capita consumption of 40.8 MJ per night in a New Zealand household (EECA, 2000c), offers an interesting benchmark. This is larger than the energy use of all ‘purpose-oriented accommodation’ (25 to 39 MJ per visitor-night).

The apparent difference in energy use among the five categories has important implications. The unit of service is not adequately defined by one ‘visitor-night’, but needs to be specified according to the accommodation category and the associated level of comfort. Only then, can energy efficiency be measured as decreasing energy use for a given service level. Comparing hotels with campgrounds based on energy use per visitor-night does not provide a sound basis for implementing efficiency measures. From a cost-benefit viewpoint, however, it may be interesting to compare
the energy demand of a hotel guest with the one of a budget traveller and relate this to the revenue gained (for example in monetary units).

Aside from differences in size and category, a number of other factors influence the energy consumption pattern for each individual business. The most important ones seem to be the facilities, age and condition of the building, heating and hot water system, energy mix, seasonality, location, occupancy, awareness of owner and staff, and the targeted market segment. However, it remains a challenge to extract the most relevant factors for each business. Some insight can be gained from various studies that aim to model energy demand by integrating geographical, social, and economic factors (e.g. Poyer, Herson & Teotia, 1997). Although, climate was not reported as relevant (Energetics Ltd, 1995; Isaacs & Crocker, 1996), it seems to exert a certain influence, especially in areas where neither heating nor air conditioning are substantial. In a study of energy performance of hotels in Hong Kong no clear relationships could be found between energy intensity and year of construction, total gross floor area, class of hotel, and occupancy level. It was suggested that an adequate assessment of energy performance requires a separation in guest floors and non-guest floors, to overcome the problem of various functions provided (e.g. restaurant, kitchen, retail outlets) (Deng & Burnett, 2000).

The high variability among individual accommodation businesses in energy use supports the need for further detailed environmental audits and analysis of the tourism industry (Ding & Pigram, 1995). Environmental audits are seen as an important management tool to document and evaluate the performance of the firm with the aim of complying with environmental standards, achieving cost savings and gaining marketing advantages (Goodall, 1995).

The main energy source for the accommodation industry is electricity (75% of total energy use), which is above the average for the whole commercial sector. The clear domination of electricity in accommodation businesses was also reported by Deng and Burnett (2000), who found that 73% of total energy consumed in Hong Kong's hotels is electricity. In the New Zealand context this is considered positive in terms of greenhouse gas due to the dominant generation from renewable resources (MED, 2000a). It is important to note, that the generation of hydropower is also responsible
for direct and indirect emissions of greenhouse gases (see Chapter 2). The increasing electricity demand in New Zealand results in higher proportions of thermally produced electricity, which is characterised by large CO\textsubscript{2} emissions. However, other fuels, such as coal and LPG, also play an important role. The high proportion of gas is desirable, because CO\textsubscript{2} emissions are comparatively low. In contrast, coal is characterised by large emissions of CO\textsubscript{2} and other pollutants (MED, 2000a). While motels rely mainly on electricity, B&Bs consume other fuel types as well. The location of a business influences the fuel types used, as for example Natural Gas is mainly consumed on the North Island and coal on the South Island (Isaacs & Crocker, 1996). The energy mix of accommodation businesses could be influenced by either implementing taxes (e.g. carbon tax) or by giving incentives to switch from a highly polluting fuel type to environmentally more sound alternatives.

The projection of the total energy use in the accommodation sector shows the relative share of each accommodation category. Hotels account for most of the energy consumption. As a result of the large number of visitors, motels also contribute substantially to energy use. Although only 2\% of all guest nights are spent in hosted accommodation such as B&Bs, this category increases its proportion to 3\% of total energy use due to the high consumption per visitor. In total, commercial accommodation constitutes (at least) 4.4\% of the commercial sector’s energy use and 0.4\% of the total energy use in New Zealand. In the United States the lodging industry consumes about 9.4\% of the total energy use in commercial buildings (Davies & Cahill, 1999).

In addition to the quantitative results, this research provided informal feedback on the level of interest and consciousness of resource management issues. As found in a study undertaken by Kearsley et al. (1999), the awareness of sustainability in the tourism industry is low. Thompson and Mooney (1998) also found in their study on resource use in the accommodation industry, that a very low percentage of managers are monitoring their energy consumption. For implementation of energy efficiency programmes in the accommodation sector it is important to be aware of these psychological and organisational obstacles. These have already been analysed for small and medium-sized enterprises in Europe by Hennicke and Ramesohl (1998).
1.2.5 Energy use in private homes

Tourists often stay with friends or relatives and do not require commercial accommodation. In fact, both for international and domestic tourists private homes are the most popular place to stay, with 34.3% and 58.3%, respectively, of all guest nights being spent there. This ‘category’, although not included in the survey on commercial accommodation businesses, therefore, needs some attention with regard to energy use. The energy use in the residential sector is recorded through the MED in the Energy Data File, and analysed and monitored in more detail through the Household Energy End-Use Project (HEEP)² by EECA, which started in 1995 as a long-term and ongoing research project. In 2000, the residential sector contributed 59.4 PJ (13.1%) to the national energy demand (MED, 2001). EECA (2000) found that in 1999, the average New Zealand home was occupied by 2.7 persons, and consumed 38.8 GJ per house or 14.9 GJ per person per annum. This is comparatively low with regards to other countries, for example Switzerland, where residents consume about 36 GJ per person per year (Greenpeace Schweiz, 1992).

Not surprisingly, the total annual energy use of a private home is considerably lower than the one for all commercial accommodation categories (due to fewer persons living in a private home compared with commercial accommodation) as reported in Table 6. The energy intensity of 40.8 MJ per person-night, as reported by EECA, however, is larger than the one of ‘purpose-oriented’ accommodation categories, namely, motel, backpacker, and camp ground. The energy use per square metre in private homes of 350 MJ (EECA, 2000c) is also slightly larger than the one in B&B’s and motels, but considerably lower than the intensity of the remaining categories. This is explained by the fact that ‘space per bed’ (and accordingly energy use for space heating) is considerably larger in private homes compared with for example backpackers where the intensity of space usage is extremely high.

The energy use per person-night in a New Zealand private home has been derived by EECA by simply dividing the annual energy use of 14.9 GJ by 365 days.

This statistical average may be insufficient when looking at private homes.

² Year Three Analysis available (Camilleri, Isaacs, Pollard, Stoecklein, Tries, Jowett, Fitzgerald, Jamieson & Pool, 1999).
from a tourism perspective, i.e. as ‘accommodation providers’. The applicability of the EECA figure hence needs to be verified. Clearly, the 3.8 million New Zealanders do not spend 364 nights in their respective private homes. Temporary absence from home (overseas holiday), shift of energy use between homes (stay with friends or relatives), and additional persons consuming energy (overseas visitors in private homes) need to be accounted for in the average energy intensity. It is known, that in 1999 New Zealanders spent some 53 million nights away from home on a domestic holiday (Forsyte Research, 2000). Out of these, some 31 million domestic tourist-nights were spent at private homes or holiday homes (ibid). Furthermore, some 1.24 million New Zealanders depart for an overseas trip (year ended August 2000, Statistics New Zealand, 2001b), however, with an unknown number of nights away. For the purpose of this study, it is estimated that New Zealanders spent some 12 million nights overseas. Hence, when domestic and overseas trips are combined, New Zealanders spend almost 65 million nights away from their homes. In exchange, there are a considerable number of international tourists, who visit friends or relatives and therefore stay at private New Zealand homes. In 2000, international visitors spent more than 12 million nights at private or rented homes (TNZ, 2001a). From the figures above, it can be concluded that in total (New Zealanders and international tourists) approximately 1,361 million nights are spent at private homes in a year. When allocating the total energy use of 59.4 PJ in the residential sector to these nights, the energy use per person is derived to be 41 MJ per night. Hence, this figure will be applied in the analysis of tourists’ travel patterns (Chapter 4) for one person-night in a private home.
3.2.6 Conclusion

A review of the literature revealed the lack of a systematic approach for investigating resource use and particularly energy use in the accommodation sector. This may reflect the complex and heterogeneous nature of this sector, which manifests not only in different categories, but also in varying business sizes and other individual features. Notwithstanding this variability, the results of this study constitute an insight into the industry and provide benchmarks for the different accommodation categories. The desegregation of the sector into hotels and lodges, motels, B&Bs, backpackers and hostels, and campgrounds emerges as a useful tool for understanding energy use patterns. The total energy use per annum, and the energy intensities and efficiencies are substantially different for the various categories.

Hotels are the largest energy users, both in terms of total annual usage and use per visitor-night, making up 67% of the total energy use in New Zealand’s accommodation sector. With their broad range of services hotels have the potential to achieve energy savings across a number of functions. Motels are the second largest energy consumers, which is a result of the large number of visitor-nights rather than the energy use per visitor-night. Generally, motels appear to constitute an efficient accommodation type. The remaining categories, B&Bs, backpackers, and campgrounds contribute less to the total energy use, but this should not impede an effort in energy savings. Particularly, the energy intense B&B category could achieve further improvements.

It should be noted that the wide range of energy use within a given category is an indicator for energy saving opportunities, as businesses above the average may be expected to reduce their energy costs. However, individual characteristics need to be considered when implementing energy efficiency measures. An energy audit is the one procedure for an energy inventory and determining possible modifications of business practices. The regression between size and total energy use may help planners or owners to establish norms for energy use for a given business size.

It appears that the accommodation sector does not contribute substantially to the total energy use in New Zealand. However, when considered as part of the commercial
sector, its role as a potential target for energy saving increases. Particularly, taking into account the growing trend of tourism and its sub-sectors and the image of New Zealand as a 'clean and green' tourist destination. Tourist destinations that seek to perform sustainable tourism, and, for example, apply for international awards, such as the Green Globe 21, the 'greening' of accommodation businesses is an integral part in achieving this goal. The lack of awareness and interest on environmental issues within the accommodation sector should be a major aspect of further environmental programmes.

Private homes are another important aspect of tourism accommodation. When applying the consumer-based definition of tourism, energy consumption in private homes clearly has to be allocated to tourism. However, it is unlikely that the tourism industry will take responsibility for this energy use, and it is expected that energy use in homes will be included in broader household energy saving programmes, for example through EECA.
3.3 Attractions/activities

3.3.1 Introduction

In a sense, tourist attractions and activities constitute the core of the tourism product. No tourist travels to a destination only for the sake of it, but to experience attractions and destination-typical features. Pigram (1983, p. 193) summarised this by saying “…without such attractions, tourism as we know it, would not exist”. Swarbrooke (1995) defined four categories of attractions, namely natural attractions, man-made attractions built for other purposes than attracting tourists, those built to attract tourists, and special events.

Some previous studies on resource use, energy saving techniques and sustainable management tools have included tourist attractions and activities. The Australian Commonwealth Department of Tourism (1995), for example, released a guide on how to achieve energy efficiency and waste minimisation. A brief section also discussed the energy use of (recreational) water transport. Quantitative and comparative studies on different tourist attractions and their energy consumption are scarce. This lack was addressed by a pilot study titled “2000 Watt Society” in Switzerland that elaborated ten project suggestions in the area of recreation and energy consumption to provide energy data and improve efficiency (Müller, 1999). Some information on energy use of different activities was published in a study on environmental education and ‘ecological rucksacks’ in Finland (Motiva, 1999). A German study on Centre Parks, large holiday resorts, which include accommodation and recreation facilities, presented data on energy and water consumption on a per visitor basis (Strasdas, 1992). Another German study investigated potential environmental impacts of tourism and identified the energy use of motorised activities (e.g. motor boats), skiing (lifts and artificial snow) and catering associated with these activities (Ifeu, 1997). The examination of other studies on energy use is relevant, because they constitute energy benchmarks for specific tourist attractions and activities.

Tourist attractions and activities have not been systematically analysed with regard to their energy use. The empirical research presented in this chapter provides a first step
in this direction. Options to better manage the energy use will be highlighted.
Therefore, the main objectives were:

- To collect energy relevant information on the tourist attraction and activity sub-sector
- To compare different tourist attractions and activities in terms of energy use
- To give implications for planning and the industry.

New Zealand constitutes a suitable study area for this topic, as it offers a vast range of recreational opportunities for various types of tourists. Clearly, each tourist destination is characterised by a different set of tourist attractions and activities, and the general applicability of results obtained for the New Zealand context needs to be verified. However, despite possible differences, it is believed that this study provides both a useful framework and benchmarks to study energy use of tourist attractions and activities within tourist destinations other than New Zealand.

3.3.2 Categorisation of attractions and activities

Tourist attractions are composed of diverse products and services and, therefore, there exists no clear-cut definition of what constitutes a tourist attraction. According to Stevens (1991), a central feature of an attraction is the permanent establishment of a point of interest that is open to the public for entertainment, interest or education. These can be either man-made or natural. Constructed attractions are often sights that are visited and viewed by tourists and do not require active involvement (e.g. museums, historic buildings, theme parks). The same accounts for establishments that are not tourist attractions in the true sense of the word. These tourism-connected attractions include entertainment, such as cinemas, theatres, bars and casinos. Shopping, which is undertaken by half of all international visitors (TNZ, 2001a), is another example in this category. These constructed attractions are important in destinations that focus on culture tourism (e.g. city tourism) rather than on nature tourism as in the New Zealand context, where nature attractions often constitute the basis for a variety of recreational activities.

In New Zealand, major natural attractions are the 14 National Parks and two World Heritage Areas (Te Wahipounamu in the south west of the South Island and Tongariro in the central North Island), where the main activities comprise walking and trekking,
scenic boat and flight trips, mountain biking, and kayaking. According to the IVS, more than half of all international tourists visit at least one of the National Parks during their stay in New Zealand (TNZ, 2001a). The increasing interest in nature and the request for (physical) activities led to the diversification and emergence of new products. Ecotourism in general (Cater & Lowman, 1994) or niche products, such as wildlife tourism (e.g. MacLellan, 1999), are only two examples among many.

New Zealand is not only well known for its unspoilt nature and the opportunity to recreate in the outdoors, but also for its adventure market that developed in the 1980s and now forms a vital part of the product. Adventure activities, such as rafting, jet boating, and bungy jumping, often take place in ‘wild and scenic places’ and satisfy thrilling experiences, while offering minimal personal risk (Berno & Moore, 1996). In fact, in New Zealand the line between nature and adventure activities is blurred, since the natural component often constitutes an integral part of the adventure experience.

The diversity of attractions and activities highlights the need for a systematic categorisation, particularly with regard to a comparative analysis of energy consumption (Table 10). Firstly, a distinction between traditional tourist attractions and entertainment attractions is undertaken (Collier, 1999). Recreational activities form a third category. These three categories initially allow for an analysis of energy use, but need to be split into sub-categories to achieve a sufficient level of detail. The publication by Deloitte Ross Tohmatsu (1992) on New Zealand tourist attractions helped to define attraction sub-categories. The activity sub-categories are based on a study by Page (1997) on adventure tourism in New Zealand. Finally, each sub-category is further disaggregated into similar types of operators or establishments. These are mainly taken from the IVS questionnaire (NZTB, 1996). The attraction or activity-types constitute the smallest organisational unit and are often represented by an association (e.g. New Zealand Rafting Association).
Table 10: Tourist attractions and recreational activities organised in categories, sub-categories and operator/establishment types

<table>
<thead>
<tr>
<th>Generic categories</th>
<th>Sub-categories</th>
<th>Types of operators/establishments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attractions</td>
<td>Building</td>
<td>Art gallery, Historic building, Museum, Visitor centre</td>
</tr>
<tr>
<td></td>
<td>Park</td>
<td>Aquarium, Botanical garden, Wildlife park, Zoo Experience centre, Gondola ride, Sporting complex, Theme park</td>
</tr>
<tr>
<td></td>
<td>Amusement</td>
<td>Brewery, Farm show, Wine trail and tasting</td>
</tr>
<tr>
<td>Industry</td>
<td>Nature Attraction</td>
<td>Geothermal attractions (hot pools), Glow worm caves</td>
</tr>
<tr>
<td>Entertainment</td>
<td>Performance</td>
<td>Cinema, Live theatre or concert, Maori cultural performance</td>
</tr>
<tr>
<td>attractions</td>
<td>Other entertainment</td>
<td>Bar/night club, Casino, Shopping</td>
</tr>
<tr>
<td>Activities</td>
<td>Air activity</td>
<td>Scenic flight, Air sports (skydiving, ballooning, parapenting), Whale watching by air, Heliskiing</td>
</tr>
<tr>
<td></td>
<td>Motorised water activity</td>
<td>Diving, Dolphins/ Whale watching, Jet boating, Sailing, Scenic boat cruise, Sea/coastal fishing</td>
</tr>
<tr>
<td></td>
<td>Adventure activity</td>
<td>Adventure (e.g. bungy), Kayaking, Mountain biking, Mountain, rock climbing/caving, Rafting, Skiing, Surfing</td>
</tr>
<tr>
<td></td>
<td>Nature activity</td>
<td>Cycling, Golf, Horseriding, Lake/river fishing, Tramping, Viewing wildlife in natural setting, Walking (guided)</td>
</tr>
</tbody>
</table>

This *a priori* segmentation reflects a thematic examination of the sub-sector and is not based on possible energy use of different attractions or activities. This approach is in accordance with previous categorisations and provides a valid basis for future resource management and policies.

3.3.3 Methodology

**Data collection**

A survey of New Zealand tourism businesses was conducted in the winter (June – September) of 2000. The ‘off season’ was chosen to ensure that most operators could more readily allocate time to supply the required information. The survey included general questions on the business, such as the activities offered and visitor numbers during the operating time, and questions on direct energy use, specified as electricity, gas, coal, wood and fossil fuels. The survey approached commercial operators that offer products or services for tourists’ recreation. ‘Informal’ activities that are undertaken without involving an operator, such as individually organised tramping trips, were not included in the study.
Chapter 3 – Attractions/Activities

Sampling procedure
Information from guidebooks, brochures, the telephone directory, and the internet provided a comprehensive list of businesses in the attraction and activity sub-sector. It is assumed that operators, who did not employ at least one of these media for marketing, can be neglected with regard to their significance within the sub-sector. The aim was to achieve a representative sample size of at least three for each attraction and activity type recorded in Table 10. Randomly chosen operators were asked by phone, email or fax if they would supply information on their business and energy use, and, if possible to identify the business purpose of each energy use. For this purpose, a concise, one-page questionnaire along with an introducing letter and a prepaid envelope was posted or faxed. In addition to this random sample, businesses representing major attractions in terms of visitor numbers were approached by phone and mail. Also, a data set of 13 operators obtained in previous studies (Becken, 1999; Johnson, 1999) was available. To ensure an adequate response rate and to verify the information provided, additional operators were visited in the Christchurch area and during a trip across the North Island. In most cases, the questionnaire was filled out face to face with the researcher. This combined approach of random sampling, along with purposely chosen businesses was employed to achieve a representative sample. However, during the sampling process, it was found that a ‘typical’ or representative business for a specific attraction or activity was difficult to identify.

Response
From the 276 businesses contacted (both random and the 11 major attractions), 58 valid responses were received, representing a response rate of 21%. The face-to-face part of the data collection achieved a response rate of 71% (36 out of 51). Of these operators and the 13 businesses from the previous studies (total sample size 107), 42% were of the attraction category (building (25), park (5), amusement (7), industry (5), nature attraction (3)), 10% were entertainment establishments (performance (6), other entertainment (5)), and 48% were of the activity category (air (7), motorised water activity (14), adventure (14), nature (16)). It appeared to be easier for some categories to respond than for others. For example, buildings, such as museums and visitor centres, answered more reliably, presumably because in most cases electricity was the only energy source used. Fewer operators with a more complex structure of energy use responded to the survey. The likelihood of a response and the data accuracy also seemed to be influenced by the business size and the professionalism of
the manager. While large establishments kept very detailed records, smaller operators generally were only able to provide estimates. Some of the larger operators were too busy or expressed concern about data confidentiality.

Overall, the sample covers a broad range of New Zealand’s main tourist attractions and operators of activities. The mixture of big and popular operators with smaller and less frequented ones (often in more remote regions) is believed to represent the attraction and activity sub-sector sufficiently. Operator types (see Table 1) with a sample size smaller than three were verified with regard to their significance in terms of international visitor numbers. All operator types with such small sample sizes were not among the top 30 attractions/activities reported by TNZ (2001a). It is unknown whether the proportions of the sample sizes in the different categories, sub-categories or operator types reflect the national numbers of operators, since there is no complete list of operators in this sub-sector available. Since many businesses are operated as part-time or second business, an inventory is difficult to obtain. However, an informal list of 22 operator types (pers. com. TIANZ, May 2001), however, shows that coverage of about 8.4% was achieved (ranging from 1% to 40%). Table 11 compiles a list of the surveyed operator types by regions.

<table>
<thead>
<tr>
<th>Region</th>
<th>Types of operator/establishment (number of operators)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northland</td>
<td>Museum (1), Historic site (2), Visitor centre (1), Botanical garden (1), Diving (2), Sailing (1), Horseriding (1)</td>
</tr>
<tr>
<td>Auckland</td>
<td>Museum (2), Botanical Garden (1), Experience centre (1), Wine trial (1), Theatre (1), Sailing (1), Golf (1)</td>
</tr>
<tr>
<td>Waikato</td>
<td>Museum (1), Historic site (1), Visitor centre (1), Zoo (1), Farm show (1), Glow worm caves (1), Scenic boat cruise (1), Horseriding (1), Rafting (2)</td>
</tr>
<tr>
<td>Bay of Plenty</td>
<td>Museum (1), Farm show (1), Geothermal attraction (1), Maori cultural performance (1), Shopping (1), Adventure (1), Horseriding (1)</td>
</tr>
<tr>
<td>Hawkes Bay/Gisborne</td>
<td></td>
</tr>
<tr>
<td>Wanganui</td>
<td>Farm show (1), Jet boating (1), Rafting (1)</td>
</tr>
<tr>
<td>Tongariro</td>
<td>Visitor centre (2), Adventure (1), Mountain biking (1)</td>
</tr>
<tr>
<td>Wellington</td>
<td>Museum (1), Sea fishing (1), Adventure (1)</td>
</tr>
<tr>
<td>Nelson/Marlborough</td>
<td>Visitor centre (1), Historic site (1), Scenic flight (1), Scenic boat cruise (1), Whale watching (1), Scenic boat cruise (2), Lake fishing (1), Kayaking (1)</td>
</tr>
<tr>
<td>West Coast</td>
<td>Art gallery (1), Visitor centre (3), Experience centre (1), Mountain climbing (1), Rafting (1), Viewing wildlife (1)</td>
</tr>
<tr>
<td>Canterbury</td>
<td>Art gallery (1), Museum (1), Historic Site (1), Visitor centre (1), Botanical garden (1), Wildlife park (1), Experience centre (4), Funicular (1), Wine trail (1), Geothermal attraction (1), Theatre (2), Shopping (2), Bar (1), Casino (1), Scenic flight (1), Air sports (1), Jet boat (1), Adventure (1), Mountain biking (1), Skiing (1), Guided walk (2), Cycle tour (2), Golf (2), Viewing wildlife (2), Kayaking (1), Horseriding (1)</td>
</tr>
<tr>
<td>Otago</td>
<td>Visitor centre (1), Maori cultural performance (1), Air sports (1), Heliskiing (1), Scenic flight (1), Jet boat (2), Viewing wildlife (1)</td>
</tr>
<tr>
<td>Southland</td>
<td>Visitor centre (1), Scenic boat cruise (3)</td>
</tr>
</tbody>
</table>

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The surveyed operators are located from the far North to Stewart Island in the South with a large proportion operating in Canterbury. This again confirms that the sample is representative, in particular because there is no obvious reason for a systematic difference in the energy consumption of specific categories between different locations within New Zealand. According to the EECA (1996), climate is not a major influencing factor on the energy use of New Zealand hotels. This applies for buildings corresponding to tourist attractions or activities.

*Data quality and analysis*

Tourist attractions and activities consume a considerable amount of energy at various stages. The tourist experience itself is only one source of energy demand and there are many direct business activities up- and down-stream that are relevant to an energy audit. These include, for example, running an office, marketing the product, and transport associated with the attraction or activity. Thus, all these business activities need to be considered to obtain the total energy use.

A number of operators could not provide information on energy use, such as power bills, or only recorded consumption as dollars spent. In this case the average price for the relevant energy source was applied to estimate the energy use (MED, 2000b). As a considerable number of businesses were home operated, an allocation of power usage for business purpose was undertaken. Also, the energy use had to be split when an operator offered different activity packages. These procedures produce an unknown degree of inaccuracy. The energy consumption figures were then converted into megajoules (Baines, 1993).

Visitor numbers also suffer a lack of accuracy due to different methods of counting or no systematic counting at all (Johnson & Thomas, 1991). Attractions usually count manually, by tickets sold, or by some form of estimation (Deloitte Ross Tohmatsu, 1992), whereas activity operators (particularly small ones) often do not keep any records and generally estimate the number of trips or tourists. The most vague estimate for visitor numbers occurred for attractions that are free of charge, such as art galleries, parks, and shopping facilities, or that have other counting methods, such as the number of memberships and visitors at golf courses. The inaccuracy of the visitor
numbers is problematic as this parameter strongly influences the energy use per tourist of a specific attraction or activity.

After estimating missing data and normalising the supplied information, further transformation of the data was necessary. The key variables of visitor numbers and energy use showed a positively skewed distribution and, therefore, were all logarithmic (log_{10}) transformed. Generally, this procedure stabilises variances and the sample distribution. The obtained means are geometric means. To compare the means of the different categories and sub-categories, ANOVA was performed. Residual plots after transformation confirm that the standard assumptions for parametric ANOVA are met. Consequent multiple comparison with the (LSD) test provided details on differing means. The data are analysed and discussed in a hierarchical order from categories to sub-categories and selected key operator types. It is important to note that the sample sizes are small for some of the sub-categories and operator types and caution needs to be exercised when generalising the results of this study.

3.3.4 Results

A main characteristic of New Zealand’s attraction and activity sub-sector is the large diversity of businesses. Such diversity stems from factors, such as the attraction or activity type, business size, management style, attitude towards the environment, location, and operating time. To examine this variety from different viewpoints, results are structured in four parts: visitor volumes, energy consumption patterns of the categories and the sub-categories, and, finally, a combined presentation of visitor numbers and energy use.

Visitor Volumes

Visitor numbers of the sample ranged from a minimum of 100 (one fishing operator) to a maximum of 6.8 million visitors (one shopping mall) for the year 1999. The median was 29,050 visitors per annum, and 25% of the surveyed operators received less than 3,800 visitors per year. Only 25% counted more than 99,000 tourists in the last year. This indicates that the majority of operators attract relatively low visitor volumes with only a few exceptions (e.g. experience centres, theme parks, and entertainment establishments). Conversely, nature based activities, such as horse riding or walking were typically visited less. Attractions that can differ in size substantially (e.g. gardens, museums) were represented at all visitation levels.
The geometric means provide an estimate of the categories’ visitation levels. These were 65,815 visitors for attractions, 170,843 for entertainment, and 5,328 for activities. ANOVA revealed that the means were significantly different (F= 30.3; df= 2,100; p<0.001). Multiple comparisons showed that visitor numbers for activities differed significantly from the two other categories. Figure 15 displays the range of the sample for the three main categories.

![Visitor numbers for attractions, entertainment, and activities.](image)

*Figure 16: Visitor numbers for attractions, entertainment, and activities. The reference line displays the mean of the whole sample.*

**Energy consumption patterns of the three categories**

*Total annual energy use and energy use per tourist*

The total energy use per annum of businesses varied considerably from a minimum energy use of 4 GJ (one shop) to the maximum of 77,020 GJ (one popular bar and entertainment venue). The geometric means, minima and maxima are presented in Table 12. Entertainment establishments were the largest energy consumers on an annual basis, however, ANOVA showed no significant difference between the three means (F= 2.0; df= 2, 100; p= 0.141). The range identified attractions and entertainment establishments to be more heterogeneous in terms of total annual
energy use than activities. The maximal energy use in the activity category (29,208 GJ) represents a large jet boat operator.\footnote{A jet boat is a New Zealand invention that uses an internal propulsion unit to navigate at high speed on shallow waters (Collier, 1999).}

The total energy use depends on visitor numbers, as well as on the attraction or activity’s specific energy demand, and, therefore, prevents any useful comparison between businesses. To overcome the influence of varying business types and sizes, it is more practical to define a ‘per capita (tourist) energy consumption’. As there is no distinction between tourists and other participants, the energy use was allocated evenly to each person participating in the activity or attraction. For the sake of simplicity this parameter will be referred to as ‘energy use per tourist’ (Table 12).

| Table 12: Energy use per year and per tourist for the three attraction/activity categories |
|---------------------------------|-----------|-----------|-----------|
| Energy use per year (GJ) | Attraction | Entertainment | Activity |
| Mean (GJ) | 411\textsubscript{a} | 1,599\textsubscript{b} | 495\textsubscript{a} |
| Min (GJ) | 4 | 36 | 9 |
| Max (GJ) | 53,223 | 77,020 | 29,208 |

| Energy use per tourist (MJ) | Attraction | Entertainment | Activity |
| Mean (MJ) | 6.2\textsubscript{a} | 9.4\textsubscript{a} | 96\textsubscript{a} |
| Min (MJ) | 0.6 | 0.8 | 0.6 |
| Max (MJ) | 174 | 39 | 290 |

1) Means followed by the same letter are not significantly different on the 5% level.

The resultant picture for the energy use per tourist is noticeably different compared to size based measures. The attraction and entertainment categories showed a similar, relatively low per tourist energy use, whereas activities consumed considerably more energy per tourist. The means were significantly different in terms of energy use per capita (ANOVA: F= 46.1; df= 2,104; p<0.001). Interestingly, the minimum values for each of the categories were very similar. This demonstrates that regardless of the category, there exist businesses that operate at an almost zero-energy level. The lowest energy use per tourist of the attraction, entertainment, and activity categories represent a visitor centre (0.6 MJ/tourist), a tourist shop (0.8 MJ/tourist), and a horse riding operator (0.6 MJ/tourist), respectively. The maximal value in the attraction category represents a wine trail (174 MJ/tourist), which offers a vineyard and wine tasting tour with a minibus, and, thus, is rather organised like an activity. The other
maximum values correspond to a fishing operator offering helicopter trips (2,903 MJ/tourist), and an entertainment complex (39 MJ/tourist).

**Energy consumption patterns of the sub-categories**

**Comparison of energy use per tourist**

As already presented in Table 10, the different categories comprise a diverse selection of sub-categories. It is likely that the broad range for the total energy use and the consumption per tourist stems from this diversity. Also, the skewed shape of the sample distribution might be due to the aggregation of very different sub-categories. A closer examination of the sub-categories revealed more distinct energy consumption patterns in terms of energy use per tourist (Figure 17).

![Energy use per tourist for the eleven attraction/activity sub-categories](image)

**Figure 17: Energy use per tourist for the eleven attraction/activity sub-categories (not all outliers and extreme values are covered by the y-axis).**

The sub-categories of the attraction and entertainment category appeared to be rather homogenous in terms of energy use per tourist with generally low energy use. The amusement sub-category and the two entertainment sub-categories consumed slightly more energy per tourist. Activities were clearly more energy demanding than
attractions, and were also characterised by a much larger variation between and within the different sub-categories. For example, air activities consumed on average 442 MJ per tourist compared with adventure recreation activities, which consumed 35 MJ.

**Energy sources**

Various fuel types are used to satisfy energy demand. Their analysis provides further insight into energy use patterns. Moreover, the proportion of each fuel type (Figure 18) is crucial with regard to further calculations of greenhouse gas emissions and energy policies (see Appendix D).

![Figure 18: Proportion of fuel types for the eleven attraction/activity sub-categories. The vertical lines separate the attraction, entertainment, and activity categories. The numbers on the x-axis in brackets indicate the energy sources.](image)

It can be seen that electricity constitutes the most important energy source for attractions and entertainment establishments. While attractions generally accounted for only little diesel or petrol, botanical gardens and zoos used these fuels more extensively, mainly for maintaining the attraction (mowing, digging, transporting material). The utilisation of gas (mainly natural gas) in buildings was for heating end-use. Interestingly, coal appeared to be an important fossil fuel for experience centres and theme parks. This was for heating (especially on New Zealand’s South Island
where coal is a commonly used fuel) and the demonstration of (historic) operations, such as coal fired ovens or steam trains. Industrial attractions, nature attractions and entertainment performances showed a very similar energy mix of electricity (circa 75%), gas (5%), and petrol/diesel (20%).

When looking at all attractions and entertainment, most petrol was used for road transport (70%), whereas diesel was rather used for other purposes, such as hot water or heating. Only 7% of diesel was used for road transport.

Electricity played a minor role for tourist activities, where fossil fuels were more prevalent. Petrol and diesel were the most important fuels, but were only partly used for road transport. On average, 68% and 56% of an activity operator’s petrol and diesel consumption, respectively, were for road transport. However, calculated for all activity operators, only 20% of the petrol and 18% of the diesel consumption were used for road vehicles. This implies that operators who consumed petrol or diesel in small quantities were more likely to use it for road transport and that large quantities of petroleum fuels were required for other purposes (e.g. diesel for boats).

It is no surprise that air activities accounted for the largest share of aviation fuel. However, all other activity sub-categories also relied on aviation fuel in the order of 5 to 20%. This is due to the use of aviation fuel for some jet boats and the occasional demand for flight services, such as helicopter transport. The relatively large proportion of gas (LPG) for motorised water activities is due to hot water heating for showers and hot drinks on board or after the trip (rafting, diving, swim with dolphins).

Energy use and visitor volume
The energy use per tourist is the quotient of the total annual energy use and the visitor numbers in this period. This parameter offers a useful comparison between different tourist attractions and activities. However, this standardisation results in the loss of valuable information on the attraction or activity, as different businesses could show a similar per tourist consumption. Further energy planning requires a presentation that includes both the visitor volumes and the energy use. By plotting these two primary variables for each attraction and activity type, a scatter plot was generated that allows for an assessment of each type’s relative position (Figure 4). This position also
determines the per tourist consumption by dividing the visitor value of the y-axis by the energy value of the x-axis.

The median-split of the two variables creates four groups (quadrants):
I: High total energy use - many visitors ⇒ moderate energy use per tourist
II: High energy use - few visitors ⇒ high energy use per tourist
III: Low energy use – few visitors ⇒ moderate energy use per tourist
IV: Low energy use – many visitors ⇒ low energy use per tourist

![Chart showing the relationship between visitor numbers and energy use]

Figure 19: Relationship between visitor numbers and energy use. Two median reference lines are displayed indicating above and below-average energy use and visitor numbers. The numbers in the chart provide sample size for operator types.

Attraction or activity types of the quadrant I with both large visitor numbers and energy use are, for example, museums (10 MJ/tourist), zoos (16 MJ/tourist), and experience centres (29 MJ/tourist). A similar energy use per tourist can be found in quadrant III, with for example rafting (36 MJ/tourist), other adventure activities (57
MJ/tourist), guided walks (110 MJ/tourist), and sailing (140 MJ/tourist). The constellation of large visitor volumes and a low overall energy use (quadrant IV) results in a minor energy use per tourist. For example, visitor centres and farm shows consume four and seven MJ per tourist, respectively. Conversely, a large energy consumption allocated to a small number of visitors results in an extraordinarily large energy use per tourist. This is typical for heliskiing (1300 MJ/tourist), diving (800 MJ/tourist), and scenic flights (340 MJ/tourist).

This matrix is a simple tool to swiftly assess the situation of a single operator or several operators forming a new type relative to others or to the average. Both extreme values for visitor numbers and energy use, and consequently energy use per tourist can be detected.

3.3.5 Discussion

Research on tourist attractions is often of a conceptual nature with the aim of defining and positioning them in the broader tourism framework (e.g. Leiper, 1990b). On the other hand, a considerable number of publications examine specific aspects of tourist attractions or activities, for example environmental impacts of tourists (e.g. Davies & Cahill, 1999). Often, these studies ignore the context of different attraction or activity types and, therefore, do not allow for a systematic comparison between these types. It appears that no adequate categorisation for the analysis of quantitative aspects, such as energy consumption, is available. This current study defined categories for this research purpose. In addition there is a lack of comprehensive studies on energy consumption and energy benchmarks for tourist attractions and activities as there is throughout the tourism sector. The overlapping of resource management and tourism seems to be a new research area. The nature of this interdisciplinary research is that the data accuracy depends strongly on those who supply the information.

The diverse character of tourist attractions and activities is a main feature, which makes it difficult to examine them systematically. One important factor is the management style and the relative importance of the business to the owner, which seems to be reflected in the accuracy in business records. Deloitte Ross Tohmatsu (1992) criticised the lack of systematic recording, as 35% of the visitor attractions they studied in New Zealand relied only on estimations of the customer numbers. In
contrast to these findings, some of the large tourist attractions and activity operators keep very detailed records and also try to minimise energy costs. All interviewees showed at least some interest and awareness of environmental aspects, but the connection between energy use and tourism was rarely recognised by them. There is clearly a need for more information on environmental issues of tourism businesses.

Businesses differ substantially in visitor volumes and business sizes. This was shown for the three categories: attraction, entertainment, and activity. Entertainment establishments attract 10 times the visitors of attractions (66,000) and 20 times those of activities (5,000). Note that tourist attractions in New Zealand are generally characterised by low visitation levels, compared with other countries. Notre Dame in Paris, for example, attracts 13 million visitors each year (Swarbrooke, 1995), which is more than 10 times the number of New Zealand’s largest attractions. Accordingly, the total energy use of such frequented attractions is likely to be elevated compared with New Zealand figures.

The analysis of the categories revealed different energy use patterns for tourist attractions, entertainment and activities. While entertainment attractions are major consumers in terms of total energy use, they consume much less energy per tourist than activities. Tourist attractions consume a similar amount of per capita energy as entertainment establishments. This results from the allocation of energy to large visitor volumes. Activities generally require more energy per tourist. This is partly due to the individual style and service orientation of activity packages, compared with (mass-tourism) attractions. Often, the product is complex and composite and requires energy at different stages.

Within the attraction and entertainment categories there is little difference between the sub-categories and operator types on a per visitor basis. The more interactive the establishment, the higher is the energy consumption. This applies, for example, for experience centres, which offer a diversity of electronic displays, show elements (e.g. light show, sound), replica of reality (e.g. steam train, snow cave, wave pool) as well as the more general energy services, such as heating, cooling, and hot water supply. However, all tourist attraction sub-categories consume less energy per tourist than the least energy intensive activity sub-category ‘adventure recreation’ (35 MJ/tourist).
Within the activity category air trips (442 MJ/tourist) and boat cruises (215 MJ/tourist), particularly trips on the open sea, consume most energy per tourist. Adventure and nature activities show similar energy use patterns, both in terms of energy use per tourist and energy mix. If purely viewed in the arena of energy use, these results confirm Buckley’s (2000) aggregation of nature-based tourism segments in a common sector called NEAT (nature, ecotourism, adventure tourism). However, it is important to keep in mind that other environmental impacts result from tourist activities, particularly from outdoor activities. In these terms, ecotourism with its high environmental standards, should generally not be confused with less benign forms of nature activities.

The analysis of the eleven sub-categories’ fuel mix revealed varying energy use patterns. Generally, electricity is the main energy source for attractions and entertainment. In terms of CO₂ emissions, this is principally considered as positive, as 62% of the electricity in New Zealand is generated from hydropower. However, increasing electricity demand in New Zealand is resulting in higher proportions of thermally produced electricity, which is characterised by larger CO₂ emissions (MED, 2000a). The significance of coal for the amusement sub-category is of concern, due to large emissions of CO₂ and other pollutants associated with coal. Petroleum fuels (petrol, diesel, aviation fuel) are another important energy source, mainly for activities. However, it appears, that although road transport is an important part of the service product, only a proportion of the fuels are used for it. This has important implications for energy efficiency measures, as the emphasis shifts from vehicles to other technical equipment, for example heating systems. Energy policies would probably achieve better results by tackling these components of the package. For example, the large diesel consumption of water transport vehicles could be reduced by replacing two-stroke motors with four-stroke motors that are more energy efficient and less noisy (Commonwealth Department of Tourism, 1995). The use of aircraft and helicopters increases an operator’s energy bill significantly. For all motorised activities, vehicle occupancy is a determining factor for the energy use per person.

The combination of visitor numbers and energy use was presented in four groups: high energy use with either large or small visitor volumes and low energy use combined with either few or many visitors (Figure 4). For example, an above-average
energy consumption for the sake of only a few tourists (e.g. heliskiing) is undesirable from the energy point of view. On the other hand, attractions with a generally low energy use and above-average visitation levels, could be promoted. There are a variety of activities with a moderate energy use per tourist both of the attraction and the activity category. From this perspective neither large energy consumers (e.g. theme parks) nor small ecotourism operators can be judged in terms of energy use without closer examination. The combined presentation of visitor volume and energy use reveals two options for decreasing an operator’s per capita energy use. While operators with very low visitation levels could aim to increase visitor numbers and occupancies, those with large energy demand could focus on increasing the energy efficiency of parts of their package (e.g. vehicles).

The energy use of attractions and activities goes far beyond the outlined components. Apart from the direct energy use investigated in this study, there is a large demand for indirect energy to provide the foundation elements for tourism. For example, the construction and maintenance of tracks in National Parks amounts to an additional energy use of three MJ per walker (calculation based on personal communication with Department of Conservation). Stettler (1997) argued that recreationists consume on average 50 MJ for infrastructure and equipment, and further 75 MJ for transportation per participation in a (sport) activity. This is particularly important for tourists, who organise their trips individually, and do not involve a tour operator. Further studies should include the indirect energy use to obtain a more complete picture. This could be in accordance with the New Zealand Tourism Satellite Account (Statistics New Zealand, 2001a), that estimates direct tourist expenditures of 4.2 billion dollars and indirect expenditures of further 4.2 billion dollars. While a direct link between energy use and tourism expenditures has not been shown yet, it is assumed that the ratio of direct and indirect energy use could be of a similar proportion to that of direct and indirect expenditures.

In summary, recreational activities are relevant in terms of energy use in the tourism sector. However, as reported below these are relatively minor compared with energy requirements for internal and international travel.
3.3.6 Conclusion

Energy use in the attraction and activity sub-sector within tourism is an important issue with regard to the sustainable management of resources. Clearly, the sub-sector is extremely heterogeneous with many options for tourists’ recreation. The variety of operators and establishments offer the potential to improve the sub-sector’s overall energy bill at diverse energy end-uses. Energy costs can either be reduced by restricting extremely energy intensive attractions and activities, and promoting alternatives, or by improving the energy efficiency of single products. Although each operator has the responsibility to contribute to energy savings, the greatest benefits for resource sustainability would result from decreasing the energy consumption of the big energy users. These are the entertainment and experience centres, sporting complexes, big museums and parks. This, however, is only partly a tourism issue, as it overlaps with recreation in the broader sense. In the context of offsetting greenhouse gas emissions by generating CO₂ sinks, parks may play an extra role as they could achieve a level of zero net emissions.

The ratio of energy use and visitor numbers indicates a per tourist consumption, and is a valid parameter to assess and compare energy intensities. To obtain a comprehensive examination of the energy saving potential of a single operator an individual energy audit should be conducted. Apart from visitation levels, determining factors are likely to be the management style, the service level (e.g. shuttle transport), the fuel mix and technical equipment, vehicle usage, and occupancies of vehicles.

Tourist activities are generally more energy intensive than attractions. This is of particular interest in the New Zealand context, as the marketing focuses increasingly on the activity part of the tourist experience. A main drawcard of New Zealand as tourist destination are activities that take place in the natural settings. Many of these activities are undertaken with a tour operator and require a considerable amount of energy. Even individually organised trips depend on a certain amount of energy, comprising at least transport and the supply of infrastructure. The figures presented in this study demonstrate that New Zealand’s focus on (nature) activities inevitably leads to an increased demand for energy. The results suggest that tourist destinations focusing on cultural attractions (e.g. European destinations) are less subject to
increasing energy use. From this point of view, visitation levels at (extreme) energy intensive activities should be minimised.

Finally, energy use is only one among other parameters to assess the environmental impact and there are many more effects that need to be considered. However, energy use is a valid parameter and has an advantage in that it is possible to assess it in a quantitative and objective way. This allows for a comparison with other components of the tourism sector or with other industries, both in New Zealand and elsewhere.
3.4 International air travel to New Zealand

3.4.1 Introduction

Since 1960 international air travel (revenue passenger kilometres) has grown steadily by about 9% per annum (OECD, 1997). This growth is expected to continue at around 5% per year (Airbus and Boeing, cited in Umweltbundesamt, 1999). International and long-haul air travel in particular are predicted to increase considerably (Schafer & Victor, 1999; Oppermann & Cooper, 1999), with regional traffic flows for flights within Asia, between Asia and Oceania or Europe, and flights between North America and Asia/Oceania becoming increasingly important (Penner et al., 1999). There is a trend towards longer trips, with an extension of average passenger trip length by 43% in the last two decades (OECD, 1997). Schafer and Victor (1999) argue that transport, as a result of this growing mobility demand and a fixed time budget, will ultimately be satisfied by aircraft and high-speed trains.

Tourism, in particular international tourism, plays a major role in the growth of air travel. Globally, international tourism is not only one of the fastest growing industries, but now also the third biggest industry behind petroleum and the automobile (Collier, 1999). The WTO (1998) reported average growth rates of 4% in the last decade. In 1996, the 597 million tourists (WTO, 1998) constituted almost 50% of the 1,390 million air passengers using the world’s airlines in the same year (ICAO23, 1998). The boost in tourism resulting from such factors as an increase in disposable income and leisure time, along with strong competition among airlines and a considerable drop in airfares, led to a mutually stimulating growth in both the air transport and the tourism sector.

However, despite being a major global industrial sector, the air travel component of international tourism has not gained much attention in tourism studies. Air travel of tourists has been analysed with regard to its economic importance for regional development, for example for Zimbabwe (Turton & Mutambirwa, 1996), Cairns in Australia (Prideaux, 2000), and Southeast Asia (Bowen, 2000). In the case of small

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23 The International Civil Aviation Organization (ICAO) is a United Nations agency with responsibility to develop standards and practices for international civil aviation.
island developing states, Abeyratne (1999) pointed out that promoting air travel to islands induces growing tourist flows that need to be carefully managed with regard to the three dimensions of sustainability, the economic, social, and environmental dimension. Environmental impacts of air travel itself have been discussed from a more general perspective (e.g. Price & Probert, 1995), without particular reference to tourism. While a comprehensive discussion of the externalities of aviation, such as air pollution, noise, accidents and congestion, is provided by Janić (1999), a systematic inclusion of environmental impacts of air travel, in particular energy use and greenhouse gases, in the discussion about sustainable tourism development is lacking, or "virtually excluded" (Gössling, 2000, p. 410).

Since the energy use involved with air travel to a particular destination has not been published so far, there is no basis on which to discuss and compare the dimensions of the resulting impact. To fill this gap, and to provide a first basis for further discussions in this field, this study quantifies the total energy use and CO₂ emissions associated with international passenger air travel to New Zealand. The procedure of estimating international visitor flows based on arrival cards filled out at New Zealand's Customs and Immigration is presented in detail to allow for further methodological improvements in this area. Finally, the results are discussed with regard to a tourist's 'energy bill', national and international climate policies, and the concept of sustainable tourism development.

3.4.2 Aviation, energy use and greenhouse gas emissions

Travelling by air requires considerable amounts of energy and releases greenhouse gases in the atmosphere. In a report on aviation and the atmosphere by the IPCC it was estimated that aviation accounts for 2-3% of the world's total use of fossil fuels, with more than 80% consumed by civil aviation (Penner et al., 1999). Olsthoorn (2001) estimated a three to six-fold increase in jet-fuel consumption and associated emissions until 2050, depending upon different scenarios (e.g. economic growth, energy taxes). Accordingly, aviation's annual contribution to global anthropogenic CO₂ emissions is forecast to grow to 3-7% by 2050 (Penner et al., 1999).

The effect of CO₂ is well understood, as it contributes directly to the warming of the atmosphere depending on its atmospheric concentration. Other greenhouse gases
(mainly NOx) influence the atmosphere indirectly by a complex interaction with other compounds, and it is difficult to quantify their contribution to global warming (Penner et al., 1999). Uncertainty also results from the increased effectiveness of emissions at an altitude of 9 to 12 kilometres, due to longer atmospheric residence times in these upper troposphere layers. It is assumed that the cumulative effect of all aircraft emissions is two to four times larger than CO2 emissions alone (Greenpeace, 1996; Olsthoorn, 2001). Apart from greenhouse gases, aircraft also emit soot mass, sulphate aerosols, and water vapour in the tropo-pause. Water vapour forms on particles and builds up to visible line clouds, so-called contrails. It is observed that aerosols indirectly affect cirrus cloud cover throughout the atmosphere and that contrails cause a positive radiative forcing, thus also contributing to the greenhouse effect. However, the overall impact of particles and contrails is not yet fully understood (Penner et al., 1999).

3.4.3 New Zealand as a (long-haul) destination

Situated in the South Pacific with its nearest neighbour, Australia, being at a flight distance of 2.5 hours, New Zealand is an isolated and geographically remote island group away from the main international airline routes. Airfares are an important factor in travel decisions (Crouch, 1994). In the past, fares to New Zealand were relatively high due to low passenger volumes and, hence, interest by international airlines to serve this country was low. The launch of a competitor to the international carrier Air New Zealand on the Trans-Tasman route to Australia in 1995 induced a price war with dramatic decreases in airfares. As will be described below, this process of price reduction has spread to other routes. Not only New Zealand residents increased their travelling overseas (Oppermann & Cooper, 1999), but international tourists also benefited from favourable airfares and direct flights from Asian hubs. Consequently, New Zealand has developed into a popular tourist destination, positioning itself in the international tourism market, where travel distance and price no longer constitute a major barrier for international tourists.

In recent years, tourism growth rates have reached up to 11.7% per annum (Collier, 1999). In 2000, New Zealand received more than 1.8 million international visitors.

24 Layer between the troposphere and stratosphere in an altitude of about 10 to 15 km.
Chapter 3 – International air travel to New Zealand

(Statistics New Zealand, 2001b), of which 90% match the WTO’s (1999) definition of a tourist. Of all visitors, 99% arrive by air (Statistics New Zealand, 2001b). Except for Australian visitors and Pacific Islanders this involves a long-distance flight of more than five hours. In 1993 visitors to New Zealand represented only 0.2% of the world’s total visitor arrivals (WTO, 1998). However, it was estimated that in the same year, New Zealand captured 2.1% of the world long-distance travel market (Collier, 1999).

To become more competitive on the international market, New Zealand liberalised its aviation policies, mainly by giving access to foreign carriers, and thus enhancing the network and national economic competitiveness. Part of this development was the joining of New Zealand’s flag carrier, Air New Zealand, to the world’s largest air alliance, Star Alliance, in 1999. Being in an alliance with other strong carriers, such as Air Canada, Lufthansa, SAS, Thai Airways, United and VARIG, attracts more traffic from around the world to the airline’s primary hub (Bowen, 2000). The main gateway of New Zealand is Auckland, which is currently scheduled by 31 international airlines with a total number of 76 international flights per day and 8 million passengers per year (Auckland International Airport, 2001)\textsuperscript{25}. In addition to Auckland, there are five other gateways with Christchurch (seven direct services to international destinations) and Wellington (three international services) being the largest. The liberalisation of international air services will continue to constitute an important issue of government policy with the aim of maximising the economic benefits of air travel and transport (MoT, 1998b). Simultaneously, however, the current government devoted itself to lead the world in climate-change policy by ratifying the Kyoto Protocol in August 2002 (New Zealand Climate Change Project, 2002).

3.4.4 Methodology

The following analysis uses data on visitor arrivals in 1999 recorded by Statistics New Zealand (2000b), and combines them with information on routings and mileage obtained by major airlines (Air New Zealand, Qantas, Thai Airways, United Airlines).

\textsuperscript{25} For comparison: In 1997 Kuala Lumpur airport reached a passenger volume of 17 million while Changi airport in Singapore plans for a projected volume of 64 million passengers in 2003 (Bowen, 2000).
Method for retracing visitor flows

Every passenger disembarking in New Zealand is obliged to fill out an arrival card and give information on their nationality and the port of last embarkation. Since the data are actual totals, the sampling error is assessed to be less than 1% for major origin markets (Travel & Tourism Intelligence, 1999). Generally, all passengers travelling for longer than 12 hours would report an airport other than their airport of first departure, as aircraft have a maximum range of 12 to 13 hours flying time.

Two different sets of data were generated based on the information provided by the arrival cards. First, the total number of visitor arrivals broken down by nationality at each of the three main international airports, Auckland, Christchurch, and Wellington was determined (other international airports are of minor significance, and visitor numbers were added to the geographically closest major gateway, e.g. Hamilton’s totals are added to Auckland). Based on this, the arrival number of each ‘nationality’ were converted into a share (in %) of the three airports of the nation’s total visitor flow. For example, 78.5% of all British visitors arrived in Auckland, while 16.9% arrived in Christchurch and the remaining 4.6% in Wellington.

Since visitors chose different routes to travel to New Zealand, information on the country of origin and the port of arrival was not sufficient to obtain a complete picture of international tourist flows. The port of last embarkation reported by each visitor gave an indication of the actual travel route. This information was provided in the second data set, where each nation’s total visitor numbers at different ports of last embarkation are compiled. These were often the large airport hubs in Southeast Asia: Singapore, Bangkok, Kuala Lumpur, or Hong Kong.

By linking the two data sets, it was possible to estimate likely passenger movements to New Zealand for the year 1999. All visitors were presumed to have ultimately arrived from their respective home countries via the biggest gateway (e.g. United Kingdom – London, Japan – Tokyo). This was also presumed in a study on Norwegian travel (Høyer, 2000). For most countries this should not affect the total travel distance to New Zealand considerably, especially if the distance between different potential gateways is small compared with the distance between the country
of origin and New Zealand. For example, there are different direct flights between various cities in Japan and New Zealand that differ less than 5% in their distance. However, larger countries with large tourist flows to New Zealand, such as Australia, the United States and Canada, were analysed in more detail to account for differing travel distance to New Zealand from different regions within each country. Since arrivals from these three countries are recorded at a state-level, visitor flows could be defined for different starting points (e.g. California – Los Angeles, New South Wales – Sydney). Nations with fewer than 100 arrivals in 1999 were not considered.

Countries of origin with more than 20,000 arrivals to New Zealand (major markets) in 1999 were split into two or three routes, depending on the degree of variation in arrival numbers at different ports of last embarkation. For European countries this procedure allowed for accounting for at least one route via Asia and one via the United States. Asian routes either continued directly to New Zealand or led there via Australia (Sydney).

Visitors from the United Kingdom, Germany, and Japan were divided into three geographic flows, whereas those from the United States, Korea, Canada, Hong Kong, China, Thailand were split into two flows. Despite having visitor arrivals fewer than 20,000 in 1999, Indian and South African flows were also split in two, as two equivalent travel choices were identified. Australia is unusual in that most Australians travel directly to New Zealand. To account for the complete travel distance, domestic flights that connect to an international flight (e.g. Perth to Sydney) were included. This procedure was also applied for the United States and Canada.

Passenger numbers of last ports of embarkation other than the ones identified as main flows were added to the geographically closest main tourist flow of the specific nation. For example, in the German case Singapore was identified as the most frequented hub and therefore represented other Asian routes, for example via Bangkok or Hong Kong. Adding up all visitor numbers at Asian airports of last embarkation revealed that 86% of German visitors flew via Asia, while 14% took the western route (e.g., via Chicago or Fiji), represented by Los Angeles. The German flow via Asia was further split into a direct flow to New Zealand, and one leading via Sydney. Each of the three German flows was finally disaggregated into three arrival
flows (if larger than 100) to the main international airports. Of each German flow, 76% were assumed to have arrived in Auckland, 20% in Christchurch, and 4% in Wellington. All other nations’ visitor flows were split in the same way according to the specific arrival share at the New Zealand main airports. In cases where no direct link between the last port of embarkation and the New Zealand gateway exists (e.g. Bangkok – Christchurch) a domestic flight from Auckland to the gateway was added. This approximates best to the total distance flown to the actual arrival airport.

For the purpose of this study, no distinction was made between multi- and single-destination travellers. It is known that 26% of visitors to New Zealand visit at least one other country on their way to or from New Zealand (TNZ, 2001a). This is relevant for the allocation of greenhouse gas emissions discussed later.

**Method for calculating travel distance and energy use**

Most airways release information on routings and the corresponding mileage, and thus the mileage for a given itinerary can be readily estimated. Considering all identified routes for each nation, the average travel distance from the country of origin to New Zealand was calculated. It is important to note, that the procedure of identifying main gateways and main routes is a conservative approach in that it does not include individual routings that may deviate considerably from the identified flows. For example, 525 British visitors (0.3%) arrived in New Zealand via Buenos Aires, which is a longer route than the identified ones via Los Angeles and Singapore. Consequently, the described methodologies underestimate slightly the average travel distance, and thus energy use.

The average distance for each nation was converted into energy use per passenger by multiplying it with the energy intensity (energy use per passenger kilometre that takes into account average load factors and an average freight to passenger ratio) of a long-distance flight. This is reported to be 1.75 MJ of secondary energy for modern aircraft (Lenzen, 1999). British Airways and Lufthansa report primary energy intensities of 2.03 and 1.86 MJ per passenger kilometre (Green Globe, 2000). The energy consumption given by Lenzen (1999) includes an average number of stops during long-distance flights, which is a relevant factor, as each landing and take-off cycle generally increase the energy consumption by about 1,000 MJ per passenger.
(Hofstetter, 1992). To convert energy consumption into CO₂ emissions, a factor of 69 g/MJ for kerosene was applied (Baines, 1993; MED, 2000a).

In addition to energy use associated with travel from countries of origin, travel flows on the last travel legs to New Zealand were analysed. This has implications for policies on the allocation of emissions, as will be discussed below. To most accurately estimate the energy use associated with the final network segment (e.g. Sydney to Auckland), the total visitor numbers regardless of nationality at different ports of last embarkation were analysed. Again, the distance for each flight sector was drawn from airlines’ mileage tables. In most cases this referred to a flight from an overseas airport to Auckland. However, Christchurch and Wellington are directly linked with seven and three, respectively, overseas airports. Since the data provided by Statistics New Zealand (2000b) are aggregated totals for arrivals in New Zealand and departures at last ports of embarkation, it is not possible to identify visitor number from a specific overseas port to a specific New Zealand arrival port. In these cases an average distance from the overseas airport to New Zealand was calculated. For example, the mileage between Singapore and New Zealand is calculated as the average of the Singapore to Auckland and the Singapore to Christchurch distance. For Australian airports (Sydney, Melbourne and Brisbane) this affects the distance only slightly (circa 5%). The final travel distance, visitor numbers at each airport of last embarkation and the energy intensity allowed for an estimate of energy use and CO₂ emissions for each last network segment.

3.4.5 Results

Energy use and country of origin

The procedure described in the methodology chapter splits the total of 1,591,650 (air) visitors in 346 visitor flow segments from 90 countries of origin. The minimum flying distance is from the Norfolk Islands (1,091 km one-way), and the furthest travel distance is from Ireland (21,434 km one-way via Asia). On average, visitors arriving in New Zealand in 1999 travelled for 12,915 kilometres. Table 13 compiles the total visitor numbers arriving by air in 1999 (Statistics New Zealand, 2000b), the average flying distance for countries of origin, the associated energy use and CO₂ emissions. Tourism involves return travel and the figures presented in Table 13 need to be doubled to obtain the full amount of energy use and emissions.
Table 13: Arrival numbers for main countries of origin, average flying distance, 
energy use and CO₂ emissions for 1999

<table>
<thead>
<tr>
<th>Country of origin</th>
<th>Total air arrivals</th>
<th>One way distance (km)</th>
<th>Energy use per visitor (MJ)</th>
<th>CO₂ per visitor (tonnes)</th>
<th>Energy use per country (PJ)</th>
<th>CO₂ per country (kilo tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>521,912</td>
<td>3,446</td>
<td>6,030</td>
<td>0.42</td>
<td>3.14</td>
<td>210</td>
</tr>
<tr>
<td>USA</td>
<td>173,182</td>
<td>11,146</td>
<td>19,500</td>
<td>1.4</td>
<td>3.37</td>
<td>230</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>167,202</td>
<td>19,955</td>
<td>34,900</td>
<td>2.4</td>
<td>5.83</td>
<td>400</td>
</tr>
<tr>
<td>Japan</td>
<td>146,953</td>
<td>9,931</td>
<td>17,400</td>
<td>1.2</td>
<td>2.55</td>
<td>180</td>
</tr>
<tr>
<td>Germany</td>
<td>45,603</td>
<td>20,701</td>
<td>36,200</td>
<td>2.5</td>
<td>1.65</td>
<td>110</td>
</tr>
<tr>
<td>Korea</td>
<td>43,386</td>
<td>10,684</td>
<td>18,700</td>
<td>1.3</td>
<td>0.811</td>
<td>56</td>
</tr>
<tr>
<td>Taiwan</td>
<td>40,186</td>
<td>9,579</td>
<td>16,800</td>
<td>1.2</td>
<td>0.675</td>
<td>46</td>
</tr>
<tr>
<td>Singapore</td>
<td>33,873</td>
<td>8,514</td>
<td>14,900</td>
<td>1.0</td>
<td>0.505</td>
<td>35</td>
</tr>
<tr>
<td>Canada</td>
<td>32,864</td>
<td>15,172</td>
<td>26,600</td>
<td>1.8</td>
<td>0.874</td>
<td>60</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>29,665</td>
<td>9,808</td>
<td>17,200</td>
<td>1.2</td>
<td>0.510</td>
<td>35</td>
</tr>
<tr>
<td>Thailand</td>
<td>23,233</td>
<td>10,257</td>
<td>18,000</td>
<td>1.2</td>
<td>0.418</td>
<td>29</td>
</tr>
<tr>
<td>China</td>
<td>22,978</td>
<td>13,874</td>
<td>24,300</td>
<td>1.7</td>
<td>0.558</td>
<td>39</td>
</tr>
<tr>
<td>Netherlands</td>
<td>19,394</td>
<td>19,077</td>
<td>33,400</td>
<td>2.3</td>
<td>0.648</td>
<td>45</td>
</tr>
<tr>
<td>Malaysia</td>
<td>17,161</td>
<td>8,755</td>
<td>15,300</td>
<td>1.1</td>
<td>0.263</td>
<td>18</td>
</tr>
<tr>
<td>South Africa</td>
<td>14,832</td>
<td>17,001</td>
<td>29,800</td>
<td>2.1</td>
<td>0.442</td>
<td>30</td>
</tr>
<tr>
<td>Fiji</td>
<td>14,151</td>
<td>2,218</td>
<td>3,880</td>
<td>0.27</td>
<td>0.055</td>
<td>3.5</td>
</tr>
<tr>
<td>Samoa</td>
<td>12,837</td>
<td>2,928</td>
<td>5,120</td>
<td>0.35</td>
<td>0.066</td>
<td>4.8</td>
</tr>
<tr>
<td>Switzerland</td>
<td>12,061</td>
<td>18,721</td>
<td>32,800</td>
<td>2.3</td>
<td>0.396</td>
<td>28</td>
</tr>
<tr>
<td>Other countries</td>
<td>220,177 (avg.)</td>
<td>13,208 (avg.)</td>
<td>23,100 (avg.)</td>
<td>1.6</td>
<td>5.01</td>
<td>350</td>
</tr>
<tr>
<td>Total</td>
<td>1,591,650</td>
<td></td>
<td></td>
<td></td>
<td>27.8</td>
<td>1,900</td>
</tr>
</tbody>
</table>

Due to the geographical distance, European tourists consume most energy by travelling to New Zealand. Interestingly, visitors from South Africa also consume a large amount of energy of 27,800 MJ (one way), which is explained by the indirect route via Hong Kong travelled by 40% of South African visitors. This leads to the emission of more than two tonnes (4 tonnes for the return trip) of CO₂, only exceeded by British, Germans, Dutch, and visitors from other European countries. With an average travel distance of 3,446 km Australians consume least of the major markets (except for the smaller markets of the Pacific Islands), and produce less than one tonne of CO₂ for the return trip to New Zealand.

It is also interesting to aggregate the total contribution of different countries of origin. For this purpose, each country of origin’s specific energy use for travelling to New Zealand was multiplied with the country’s total arrival number by air. When summed in this way, tourist volumes from four countries account for more than half of the total energy consumption of 27.8 PJ (and 1,900 kilo tonnes of CO₂), namely the United Kingdom, USA, Australia and Japan. Figure 20 displays each nation’s share in the
energy use associated with international air travel to New Zealand. Australia, while constituting 33% of all air visitor arrivals, contributes only 11% to the total energy use associated with international air arrivals. In contrast, the proportions of visitor numbers from the UK and Germany (11% and 2.9% respectively) are lower than the proportions of energy consumption from the two countries (22% and 6% respectively). The remaining 85 countries of origin not displayed in Figure 20 consume together 5.1 PJ (19%) for their trip to New Zealand (10 PJ for the return trip).

![Figure 20: Origin countries' share of total energy use associated with international flights to New Zealand.](image)

**Energy use and flight sector**

The analysis of the last port of embarkation reveals the most frequently used flight sectors to New Zealand (Figure 21), which is important information with regard to international regulations of air travel emissions. More than half of all visitors (52%) travelled from or via Australia (Sydney, Melbourne, Brisbane, Cairns). The second and third largest flows arrived from Los Angeles (9.0%) and Singapore (8.3%). The picture changes, however, for concomitant energy consumption. The visitor flow from Australia to New Zealand is equivalent to an energy use of 3.5 PJ or 22% of the total energy use of 15.9 PJ (arrival only) (Table 14). Flights from Los Angeles to Auckland contribute 17% to the total energy use, and flights from Singapore and Tokyo to New
Zealand make up 12.4% and 11.4%, respectively. Table 14 also presents CO₂ emissions associated with last network segments to New Zealand. The total amount of CO₂ emitted on the last flight sectors to New Zealand equals 1.1 million tonnes (one way). The last network segment contributes with 58% of the total CO₂ emissions of 1.8 million tonnes.

Table 14: Visitor arrivals, distances and resulting energy use and CO₂ emission for the last network segment to New Zealand

<table>
<thead>
<tr>
<th>Last port of embarkation</th>
<th>Visitor numbers</th>
<th>Distance (km)</th>
<th>Total energy use (PJ)</th>
<th>CO₂ emissions (kilo tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sydney</td>
<td>466,133</td>
<td>2,170</td>
<td>1.77</td>
<td>120</td>
</tr>
<tr>
<td>Melbourne</td>
<td>193,241</td>
<td>2,550</td>
<td>0.862</td>
<td>60</td>
</tr>
<tr>
<td>Brisbane</td>
<td>152,580</td>
<td>2,433</td>
<td>0.650</td>
<td>45</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>144,904</td>
<td>10,488</td>
<td>2.66</td>
<td>180</td>
</tr>
<tr>
<td>Singapore</td>
<td>134,120</td>
<td>8,410</td>
<td>1.98</td>
<td>140</td>
</tr>
<tr>
<td>Tokyo</td>
<td>113,089</td>
<td>9,150</td>
<td>1.81</td>
<td>130</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>60,051</td>
<td>9,233</td>
<td>0.970</td>
<td>67</td>
</tr>
<tr>
<td>Jakarta/Denpasar</td>
<td>56,170</td>
<td>7,506</td>
<td>0.738</td>
<td>51</td>
</tr>
<tr>
<td>Seoul</td>
<td>48,058</td>
<td>9,973</td>
<td>0.839</td>
<td>58</td>
</tr>
<tr>
<td>Fiji</td>
<td>44,103</td>
<td>2,158</td>
<td>0.167</td>
<td>11</td>
</tr>
<tr>
<td>Kuala Lumpur</td>
<td>30,844</td>
<td>8,825</td>
<td>0.476</td>
<td>33</td>
</tr>
<tr>
<td>Taipei</td>
<td>22,010</td>
<td>8,950</td>
<td>0.345</td>
<td>24</td>
</tr>
<tr>
<td>London</td>
<td>19,357</td>
<td>18,364</td>
<td>0.622</td>
<td>43</td>
</tr>
<tr>
<td>Honolulu</td>
<td>19,355</td>
<td>1,089</td>
<td>0.369</td>
<td>3</td>
</tr>
<tr>
<td>Other ports</td>
<td>87,635 (avg.)</td>
<td>12,780</td>
<td>1.96</td>
<td>140</td>
</tr>
<tr>
<td>Total</td>
<td>1,591,650</td>
<td>15.9</td>
<td>1,100</td>
<td>123</td>
</tr>
</tbody>
</table>

1) This figure is large due to the false reporting of ‘last ports of embarkation’ (e.g. Frankfurt or London)
Figure 21: Main international visitor flows to New Zealand (the width of the flow visualises its size) (Flows drawn on map from Kirkpatrick & Philipps, 1996).
3.4.6 Discussion

The implications of energy use and CO₂ emissions resulting from air travel to New Zealand are discussed below on an individual traveller basis, from a national and from a global perspective. More emphasis is put on energy use than on emissions, due to the uncertainty associated with the accumulated contribution of aviation to the greenhouse effect. In this discussion only CO₂ emissions will be considered, however, it is important to point out that this is a conservative approach and the impacts on the atmosphere are possibly considerably underestimated.

The tourist’s energy account

On a global average, the per capita emission of CO₂ as a result from all fossil fuel combustion (not just travel) amounts to 4.0 tonnes per year. In developed countries this figure rises to 10.3 tonnes, with a range between 5.5 to 20.2 tonnes (IPCC, 1995). New Zealand emits 8.0 tonnes of CO₂ per capita and year (MfE, 1997b). Biesiot and Noorman (1999) calculated that a continuous energy use of 1-1.5 kW per capita can be maintained sustainably, which translates into 31,500 to 47,300 MJ or 2.2 to 3.3 tonnes CO₂ per person and year. This estimate is based on the global capacity of renewable energy sources allocated equally to the earth’s projected population of 8 to 10 billion in 2050.

Visitors from Europe and South Africa consume their annual budget of 2.3 tonnes CO₂ only by their one-way trip to New Zealand. In a study on travel patterns in Sweden, Carlsson-Kanyama and Linden (1999) estimated a sustainable level of energy consumption for travel of 11,000 MJ (0.7 tonnes CO₂) per person per year. Considering the energy figures presented in Table 12, almost all visitors completely exhaust this budget by a single return flight to New Zealand.

In addition to the energy use associated with travelling to the destination, there is also considerable energy use within the country (Chapter 4). Hence, it is likely that even visitors from Fiji, who generally use the least amount of energy to travel to New Zealand, would exceed the sustainable limit of 11,000 MJ per annum. Based on such an energy profile, any visit to New Zealand must be considered as unsustainable, given current technology.
However, tourism is not only seen as being socially and economically beneficial for both travellers and hosts, but it also constitutes a form of land use that has the potential to safeguard and conserve the environments on which tourism draws. “Use it or loose it” became a common expression in tourism studies (Wolters, 1999) meaning that tourism may be a useful tool to safeguard nature, cultural and social provision. Therefore, a pragmatic approach is needed that allows for limited travel. Rather than measuring the total energy use associated with a trip, an indicator of energy intensity, such as energy use for the international flight per day, could be developed. Consequently, a longer stay would decrease the average daily energy use of the flight and increase the ratio of economic benefit for New Zealand (tourist spends) to the ‘invested energy’. For example, a visitor from Australia would need to stay in New Zealand for at least 92 days (ignoring energy use within New Zealand) to meet the criteria of sustainability (based on a sustainable energy use of roughly 130 MJ/day), whereas a Japanese visitor would have to stay for at least 134 days. This principal is in line with ecotourism ideals of longer, more intensive (in the sense of experience), but less frequent holidays (Wolters, 1999).

*National perspectives*

*Allocating emissions*

The neglecting of energy use associated with international tourism can partly be attributed to complex political reasons. At present, the United Nations Framework Convention of Climate Change does not cover international aviation in its policy guidelines. The *Guidelines for National Greenhouse Gas Inventories* released by the IPCC (1996) advise including international air transport in the so-called international bunker fuels, which are reported separately and excluded from national totals. Generally, energy use and aircraft emissions are only regulated for domestic flights and the landing and take-off phase up to an altitude of 900 metres (Green Globe, 2000; Olsthoorn, 2001). Internationally, there have been several suggestions to allocate air traffic emissions, ranging from ‘no national allocation at all’ to ‘allocation to the nationality of the airline’ or the ‘country of departure or arrival’ (ICAO, 2001). The New Zealand Ministry of Transport (1995) investigated the following allocation options:

- Emissions from fuel burned within New Zealand’s 200 km Economic Zone
- Emissions from fuel purchased within New Zealand
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- A half share of the fuel consumed between New Zealand and the first/last port of call overseas
- A half share of the fuel consumed between New Zealand and the origin or destination port.

The suggestion of fuel consumed in the economic zone of 200 km of New Zealand is not investigated any further, as the major proportions of international flights would remain uncontrolled. The three other options result in very different energy use and emission scenarios. The least energy use allocated to New Zealand results from sharing the consumption (of international visitors) with the last/next port of embarkation. Assuming the same routing for arrival and departure, a half share of energy use for 1999 would amount to 15.9 PJ or 1.1 million tonnes CO₂. The fuel purchased as international bunker fuels for aviation amounted to 25.6 PJ26 (1.8 million tonnes CO₂) in 1999 (MED, 2000b). The largest amount of energy (27.8 PJ) allocated and the emission of 1.9 million tonnes of CO₂ occurs when energy and emissions are shared between the country of origin and New Zealand.

Different countries are likely to favour different allocation scenarios. Main generating countries, such as Germany or Japan, will probably be opposed to the principle of allocating emissions to the country of origin (the nationality principle, as described in Knisch & Reichmuth, 1996). This option would lead to a considerable increase in national greenhouse gas emissions (to main countries of origin) without a direct economic benefit, since about half of tourists’ direct expenditure remains at the destination (Arbeitsgruppe Ökotourismus, 1995). For the same reason it is conceivable that top tourism destinations, for example small island states, would benefit from the ‘nationality principle’. The alternative of allocating emissions to countries of airline registration would result in considerable problems for airline hubs, especially for small countries, such as Singapore, with large hub based airlines. In the case of New Zealand where international arrivals and the departures of New Zealanders are within a similar range (1.6 million compared with 1.3 million), the option of fuel purchased within the country or the half share between New Zealand and the next port of embarkation seems acceptable. Again, several factors need to be

26 This includes all outbound travel (1.28 million short-term departures of New Zealanders in 1999 (Statistics New Zealand, 2000b) and returning overseas visitors).
considered, such as the possibly larger travel distance of visitors to New Zealand compared with outbound travel of New Zealanders (primarily to Australia).

Obviously, international agreements are difficult to achieve. As outlined in the Kyoto Protocol it is the role of the ICAO to implement appropriate mechanisms that allocate and limit international aviation’s greenhouse gas emissions (ICAO, 2001).

Future options for New Zealand
While contributing directly to New Zealand’s GDP at 4.9% (Statistics New Zealand, 2001a), tourism is also responsible for a considerable consumption of energy, especially if international air travel were to be included in national greenhouse gas inventories. Reductions in energy use from international travel could be achieved by promoting markets that are geographically close to New Zealand (Australia and the Pacific Islands) and by generally increasing the average length of stay. This, however, needs to be investigated in more detail, as different types of tourists are likely to have different travel styles with characteristic energy consumption patterns. Another option would be to discourage the increasing outbound travel of New Zealanders by promoting domestic holidays, and thus shifting the focus away from international visitors. Finally, New Zealand could investigate the potential of cruising tourism, which presently makes up only 1% of visitor arrivals (Statistics New Zealand, 2000b). However, there is little understanding of this market in the Pacific, and a closer examination of environmental impacts of cruising tourism is yet to be undertaken.

Further inventories of emissions resulting from international air travel to New Zealand will have to account for “trip chaining”, that is, tourists who travel from one country to another (Lue, Crompton & Fesenmaier, 1993). New Zealand is a popular stop-over for round-the-world travellers and is part of a “multi-destination area loop” defined by Oppermann (1995). According to Oppermann, 13% of all tourists to Australia visit New Zealand on the same trip. Depending on the allocation principle, this would reduce New Zealand’s share of total energy costs associated with air travel. Much research on carbon sequestration through the plantation of native trees was initiated in the last year. As a result of great uncertainties in this field the option of offsetting carbon emissions is not discussed any further in this context.
Measures to reduce emissions globally

Technical progress and increase in efficiency have been promoted as the most convenient means of reducing environmental impacts. In fact, since 1976, the aviation industry has doubled fuel efficiency (Green Globe, 2000), and it is believed that future improvements have the potential to decrease the fuel consumption by a further 8–10% (Penner et al., 1999). Whereas the chances of replacing jet fuels with renewable energy sources are slim, much increase in efficiency could be gained from improved operational management. This means, for example, increasing the average occupancy across the global fleet (currently at 66% (Green Globe, 2000), comparing favourably to other modes of transport). Other options in this field are better air traffic management to avoid congestion and to optimise routings or the operation of bigger planes. Better operational practices are estimated to reduce the energy consumption between 8 and 18% (Penner et al., 1999). For example, it has been shown in this paper that visitors from South Africa frequently used the route via Hong Kong (19,935 km compared with 13,166 km via Sydney), resulting in an elevated energy use. This is induced by cheaper airfares (that do not reflect real costs) via the Asian hubs, compared with the Australian route.

Clearly, there is a need for further economic regulation. Possible options are the regulation of aircraft emissions, removal of subsidies, market-based options, such as charges and taxes, emission trading, voluntary agreements, and substitution of aviation by other modes of transport (Penner et al., 1999). However, few of these instruments have been tested in aviation, and a macroeconomic analysis of effects is, therefore, required. Generally, the IPCC recognises that most of these options will increase airline costs, and, thus reduce demand for air travel. It is believed that an international framework could address mechanisms for internalising the environmental costs of aviation (Janić, 1999) through fiscal or regulatory policies. For this purpose, the OECD (1997) suggests a further harmonisation of international environmental standards under the auspices of the ICAO (as already indicated in the Kyoto Protocol) to avoid inequality between airlines and between airports. The first step in this direction is the monetary assessment of external costs associated with air travel. There are various estimates for the marginal costs of CO₂ emissions ranging from $5 to $125 per tonne of carbon (US$) (Department of the Environment,
Transport and the Regions, 2001; Frankhauser, 1994). These costs could be accounted for through fuel taxes. The introduction of such taxes, however, is one of the most controversially discussed measures. For example, Olsthoorn (2001) calculated that a carbon tax would only achieve minor reductions in emissions. In contrast, Abeyratne (1993) reported that fuel costs represent 10–25% of an airline’s variable costs and that any tax imposed on fuels would have considerable, detrimental effects on overall costs. This is confirmed by Crouch (1994), who found that long-haul tourism is more sensitive to transportation costs than tourism to closer destinations. According to this, countries that depend on long-haul travel will suffer most as a consequence of increased airfares.

**Sustainable tourism?**

Numerous studies have investigated the areas of sustainable tourism or sustainable tourism development (e.g. Hall & Lew, 1998). Key points in this context are ecological and social sustainability, and equity, both now and in the future (Høyer, 2000). The growing awareness of sustainability issues was accompanied with a boom in ecotourism as responsible tourism to natural areas that both conserves the environment and improves the well being of local people (The Ecotourism Society, 1997). According to this definition it is not surprising that most ecotourism guidelines and projects focus on local impacts rather than on global effects. Transport induces broader impacts on the environment that are often considered as being “beyond the scope” of ecotourism discussions (Buckley, 2001, p. 379).

While the conflict between sustainable development and tourist transport is generally poorly investigated (Hall, 1999; Høyer, 2000), the interface of air travel and the sustainability of tourism has been almost completely overlooked in previous research. Høyer (2000) points out, that tourism, if aimed at sustainability, needs to undergo a complete change by complying in the first instance with the criteria of sustainable mobility. These criteria include, according to the Centre for Sustainable Transportation in Canada (1997), aspects of equal access needs of individuals and societies, accordance with human and ecosystem health, affordability and efficiency, and a minimisation of resource use. Long-distance air travel fails with regard to the aspects of health and resource use. Moreover, the principle of a fair distribution of the used resources is not met by global air travel, as only a minority of the world’s
population can afford to fly. In fact, only 6.5% (313 million passengers) of the population participate in air travel (Greenpeace, 1996), generating some 206 million tonnes of CO₂ in 1995 (Olsthoorn, 2001).

To meet criteria of sustainability, Høyer (2000) suggested reducing “aeromobility” and to alter travel behaviour towards locally oriented and non-motorised travel styles. In the case of remote destinations, such as New Zealand, this shift would clearly result in decreased visitor volumes. This is often in conflict with economic expectations attached to tourism. To comply with sustainability criteria, while keeping or increasing visitor volumes, the only feasible option appears to be the creation of highly debated carbon sinks and offsetting emissions. These ideas are already considered by several environmental associations that offer web-based ‘carbon-calculators’ to determine emissions associated with travel and the number of trees to be planted (e.g. American Forest, 2001). Gössling (2000) calculated an area of almost 30,000 km² that would need to be afforested each year to offset global emissions resulting from tourist air travel. However, the creation of carbon sinks is conceived as a preliminary measure that cannot substitute for structural changes and more permanent options (see also Noble & Scholes, 2001 and Chapter 1). Future research on sustainable tourism is challenged by the obvious conflict between promoting sound tourism at the destination and minimising impacts associated with travel to and from the destination.

3.4.7 Conclusion

From an individual, a national and a global viewpoint international tourism and air travel are critical factors in achieving global sustainability. Apart from unsustainable energy use, the main detrimental effect of air travel is the emission of greenhouse gases. Clearly, remote countries that are focusing on tourism as a profitable and expanding industry, such as New Zealand, are in a delicate situation. The energy use of up to 27.8 PJ resulting from international air travel to and from New Zealand is comparable to the agricultural sector’s energy use. In the New Zealand Tourism Strategy 2010, New Zealand demonstrates its awareness of environmental impacts caused by tourism, including the use of resources and the impacts of greenhouse gas emissions. However, this awareness has so far not extended to the significant effects of international air transport. The country continues to increase visitor numbers and
maximise benefits. The promotion of long-haul tourism is questionable, particularly, because New Zealand markets itself as green destination with a recently launched global campaign of "100 % pure New Zealand" (TNZ, 2000). Clearly, air traffic will be prevalent and will continue playing an integral role in many countries' tourism development. However, countries that depend strongly on air transport, such as New Zealand, may gain advantage by analysing their situation in terms of emissions ahead of time and taking precautionary measures to reduce these emissions.

There are several options to improve the environmental record of international travel, and, thus reduce emissions. These include increasing the average length of tourist stay – potentially decreasing the frequency of long-haul journeys, promoting domestic tourism, and increasing promotion efforts in countries that are geographically close to the destination.

The relative importance of leisure air travel to the total emission of greenhouse gases both on a national and global scale emphasises the necessity to include emissions from aviation in national accounts. Globally, regulatory options such as emission controls and taxes will lead to an increase in airfares, and thus may reduce visitor volumes. Future research on sustainable tourism will need to broaden the perspective from local impacts to global ones by taking responsibility of the so far ignored impacts of air travel.
3.5 Summary – industry analysis

This chapter provided three analyses of tourism industries (sub-sectors) within New Zealand, namely the transport, accommodation and attraction/activity sub-sectors, and an additional analysis of international air travel to New Zealand.

The following general points can be made:

- In the New Zealand tourism industry there is a variety of small businesses, which makes it difficult to define benchmarks for energy use and also to develop generally applicable measures to decrease energy use.

- Energy use associated with transport depends largely on tourists rather than on operators, in that tourists chose specific transport modes and also decide how far they travel with these modes.

- A careful policy mix is required to change behaviour of tourists, business practices of operators and to advance technology to increase overall energy efficiency of transport.

- In the accommodation and attraction/activity sub-sectors, energy use depends on a large number of factors. Manager/operators’ attitudes towards the environment seem particularly important.

- Energy use varies considerably between different accommodation categories, with ‘service-oriented accommodation’ being more energy intensive than ‘purpose-oriented accommodation’.

- Tourist attractions consume less energy per tourist than tourist activities, where usually considerable energy is consumed to overcome physical barriers, either to gain access to the site or through the activity itself (e.g. boat cruise). Again, the variety of energy use between different attraction and activity categories is considerable.

- The goal to save costs by saving energy (through environmental audits) appears to be of minor importance among businesses.

- Technological improvements will be necessary to reduce energy use for travelling to New Zealand (international flights). Tourists who decide to travel to New

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27 It is important to note that results are based on survey data; and that conclusions made can only be as good as the data. Deficiencies in accuracy have been described for all analysed sub-sectors. Generally, data are subject to a sampling error.
Zealand should be encouraged to stay longer (and consequently travel less frequently).

- Energy use associated with travelling to New Zealand is far larger than energy use of any other destination-based travel components.
- Energy use is fossil fuel based for anything that involves a certain degree of mobility (transport and most tourist activities). Electricity is used for stationary tourism products, such as accommodation and tourist attractions.

It is important to distinguish between energy use occurring within New Zealand and that resulting from tourist activities outside New Zealand on their way to and from New Zealand. As a result of current greenhouse gas accounting regulations the primary focus of energy management is on destination-based energy use. It is, however, important to keep in mind that policies may change and emissions from international travel will be allocated to nations' accounts by one form or another. For this reason, in the long-term New Zealand will also have to be prepared to accept changes in the regulation of international air travel greenhouse gas emissions.

The analysis of the tourism industries within New Zealand showed that energy consumption in the tourism industry is a result of complex and multiple interactions between numerous factors. Management practices, technological standards and human behaviour seem to be equally important. However, these three components appear to determine the efficiency of an individual business to very varying degrees. It is therefore difficult to define generally applicable policies to decrease energy use. It appears more promising to develop a framework that allows tailoring individual solutions to different business situations. To this end, stakeholders will need to cooperate at business, industry (industry associations) and government levels.

There is disagreement as to the role government and industry should play. Miller (2001), for example, found in a delphi survey on sustainable tourism among tourism researchers that the National Government should take most responsibility for achieving sustainable tourism. Industry responsibility was considered slightly less important, and local government, tourists and local residents were rarely identified as key groups to undertake initial steps towards sustainability. Several experts stated that
theoretically industry should be most responsible and proactive, but will probably only act under pressure from government regulations.

In the case of New Zealand it is essential to take into consideration the large number of small and family-operated businesses. As outlined in the beginning of Chapter 3 there are numerous reasons why small operators should engage in green practices. There exist, however, numerous barriers to implementing green practices. Changing current practices, for example, often results in conflicts or coordination problems among personnel. Moreover, possible costs, lack of knowledge and advice, high staff turn-overs and a general absence of feeling responsible for environmental impacts impede the implementation of (energy) measures (Carlsen et al., 2001). Some of these barriers could be overcome by targeted education and information programmes and by (financial) support by industry associations and government institutions that "...ensure business success and sustainable tourism practices" (Carlsen et al., 2001, p. 295).

Energy use as an essential factor within the concept of sustainability seems not to be recognised as important by industry players (McCool, Moisey & Nickerson, 2001). Industry representatives in Montana (United States of America) ranked the indicator of ‘per capita energy consumption’ 25th in a list of 27 indicators of sustainability at state level. In the same study, representatives at the regional and community level ranked energy consumption least important among the 27 indicators. As already pointed out in Chapter 1, environmental indicators or impacts other than energy use are more important to both researchers and tourism suppliers. It can be concluded that energy efficiency needs to be promoted in specifically designed industry campaigns to first increase awareness and to then implement measures to decrease energy use.
4 CHAPTER 4 – TRAVEL CHOICES, ENERGY USE AND TOURIST TYPES

4.1 Methodology for analysing travel patterns

4.1.1 General approach

The previous chapter examined various sub-sectors of New Zealand tourism. It is the tourists, however, who demand energy, and who add a human and thus not directly measurable component to energy use in tourism. Humans often behave in an irrational and unpredictable way, particularly when looked at from an individual perspective (as opposed to statistical averages). To gain some understanding of tourist behaviour, and to base planning on ‘real world’ data, a systematic analysis of travel patterns is necessary. This chapter aims to provide such analysis.

The analysis presented in this chapter is based on three data sets: A pilot-study on international tourists, an analysis of domestic tourists and finally one of international tourists. These three sets were analysed using the same methodology and similar research methods. The methodology comprised four analytical steps as outlined below (see also Figure 22).

1. Data collection and preparation
   Tourist data were collected either directly from tourists or were generated from existing databases (secondary data) that required modification to be suitable for the specific research focus of energy use.

2. Travel choice analysis
   Travel behaviour was quantified in the form of travel choices. These travel choices were analysed with regard to energy use.

3. Data reduction
   Data on recreational activities were reduced to key dimensions.

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28 A ‘travel choice’ is an option a tourist can choose within each tourism sub-sector, such as a specific transport mode (e.g. car travel) or an accommodation category (e.g. hotel) (see Chapter 2). Several travel choices make up a travel pattern. A travel style comprises a concrete travel pattern (e.g. coach travel and hotel) as well as additional features, such as typical length of stay, degree of packaging, and so forth.
4. **Segmentation analysis**

Cluster analysis was used to segment the market based on tourists’ travel choice variables; and discriminant analysis was applied to validate the clusters.

![Diagram](image_url)

**Figure 22**: Step-wise procedure to analyse travel patterns of international and domestic tourists.

In the following sections, the four steps are briefly described insofar as they provide background information relevant for all data sets. Detailed information on the method of analysis that is specific to each data set, the results and discussion will be provided within the following three chapters. First of all, however, a brief discussion of two energy measures is given, namely total energy use of a tourist and energy use per day.

**4.1.2 Total energy use and energy use per day**

Two measures of energy use can be usefully distinguished. The first refers to the total energy consumed during a trip. This is important, since energy consumption by international tourists increases the national demand for energy and also generates carbon dioxide emissions that add to the national greenhouse gas account. Energy use of a domestic tourist does not constitute an additional energy use within New Zealand, since it is already accounted for in the traditional economic sectors (e.g. in the transport or commercial sector). Accounting for domestic tourists’ energy use, however, reveals the proportion of national energy demand that is specifically used for tourism purposes (which is an unknown number so far). If additional energy demand through domestic travel were of interest, another approach would be necessary. This would involve estimating a net energy use, by juxtaposing energy requirements for travel with energy use in every-day life. Croize (1978) suggested
that this balance could be even negative in the case of tourists fleeing colder areas for a summer holiday. For example, a domestic tourist travelling from the South Island to the Bay of Islands in winter (June to August) may compensate a certain amount of their transport energy by using less for heating at home. The same idea applies for international tourists where a ‘net energy use’ could be calculated, by taking into account energy not used at home during travelling. This energy-use-deficit approach (Baud, 1995) is a very useful, yet complex approach that requires energy data input not only for travel components but also for every-day activities. For this reason, this study is limited to energy use associated with the travel experience, and ignores net energy effects. It has to be noted that for international tourists the international travel to New Zealand requires considerable energy input, against which other (holiday) components appear to be minor, as shown for other countries (Müller, 1992; Gössling, 2000). However, as has been discussed in Chapter 3, international travel is not included in national greenhouse gas inventories (IPCC, 1996). Furthermore, this study is targeted at energy use within New Zealand. For this reason international travel is excluded from the analysis of energy use, and the total energy use of a tourist refers to energy used for internal transport, accommodation and attractions/activities.

The second measure is the energy intensity of travel (energy use per day). In contrast to total energy use, the energy intensity is normalised by the length of stay, and therefore suitable for comparing different travel styles. For example, a traveller who chose energy-efficient modes but stayed for a long period of time, may have used the same amount of energy as a short-term traveller with a high-energy travel choice profile\(^1\). Based on the concept of energy intensity it is possible to identify the most efficient travel styles and to estimate a potential for saving energy when these travel styles are promoted.

Given the above propositions, this study, therefore, focuses on the in-country holiday component (measured as total energy use and energy use per day), that is it focuses on a national perspective of energy use. In other words this study is about managing

\(^1\) Moreover (from a global perspective), a tourist who consumes a specific amount of energy within a short period of time will need additional energy (at home) for the remaining time, while the longer staying and more energy-efficient tourist is still travelling.
energy use within New Zealand and recommendations resulting from the analysis might differ when international travel is taken into account.

4.1.3 Data collection and preparation

Data sources

In New Zealand, international and domestic tourists are both important to the industry. In 1999, there were about 1.6 million international tourists (Statistics New Zealand, 2000b), and 16.6 million domestic tourist trips (Forsyte Research, 2000). Both market groups differ in their nature and thus in their needs, and benefits that can be gained as a result from their travel. It is assumed that travel patterns of international and domestic tourists are fundamentally different, which in turn manifests in different energy use patterns.

The data set first to be analysed stems from the West Coast pilot-study. These data were collected on the West Coast of New Zealand’s South Island. The purpose, research design, and outcome of this study are described in the section ‘West Coast pilot-study on international tourists’. Experience gained from analysing the pilot-study data set was incorporated in the data analysis of the other two data sets, the Domestic Travel Study (DTS) and the International Visitor Survey (IVS). The DTS was a large-scale study that updated information on the domestic market from 1989/90. The analysis and results of domestic travel patterns are presented in the ‘Domestic Tourists’ section. The IVS by Tourism New Zealand constitutes the basis for the in-depth analysis of international tourists (section ‘International tourists’).

All tourist surveys collected similar information and therefore are compatible. The information gathered from each individual tourist includes:

- demographic characteristics
- trip-related characteristics, such as trip length
- travel itinerary, including travel choices within the transport, accommodation, and attraction/activity sub-sectors.

Traditionally, socio-economic and demographic variables have been used to describe different tourists. However, the limitation of such variables, for example nationality,
has been recognised and debated widely in the tourism literature (e.g. Zins, 1999), and the use of other descriptors, for example the organisation of a trip as day trip, resort trip or round trip, has been advocated (Florenfeldt, 1999). The analysis of this study focused on the travel itinerary, i.e. travel choices as independent variables of the segmentation analysis, and employed the remaining demographic and trip-related variables as dependent variables to describe the market segments.

**Data preparation – translating tourist behaviour into energy use**

Chapter 3 provided information on energy use in the key sub-sectors. In particular, energy intensities for various transport modes (in MJ/vkm or MJ/pkm), six accommodation categories (MJ/visitor-night), and eleven attraction/activity categories (MJ/visit or MJ/participation) have been derived. Since it is difficult to collect information on energy use directly from tourists, it was necessary to convert easily reportable information (e.g. type of accommodation used) into new variables that can be translated into energy use by multiplying them with the respective energy intensities. These new variables are called travel choices, and the intensity of a travel choice is measured as kilometre, number of nights, or visits. Data preparation that was necessary to obtain travel choice variables is described within the respective sections. The procedure of combining travel choice variables with energy intensities is illustrated in Figure 23.

![Energy intensities from Chapter 3 – Industry analysis](image)

**Figure 23: Combining energy intensities and travel choice variables.**
Three different types of energy calculation are useful:

- travel choice-related energy use (energy use associated with a travel choice)
- sub-sector-related energy use (share of each travel choice within a sub-sector)
- tourist-related energy use (individual energy use by sub-sector or in total)

These calculations were undertaken in the travel choice analyses as described in the next section.

4.1.4 Travel choice analysis

The prepared tourist data were analysed to identify 'typical' behaviour and energy use associated with each travel choice. The results are structured based on the three sub-sectors, transport, accommodation and attractions/activities. The analysis included average travel distances and energy use associated with different transport types, average number of nights spent in each accommodation category and energy use associated with these categories, and the frequency of participation in different tourist attractions and activities, along with the average energy use. In addition, the contribution of each travel choice to a sub-sector's total energy use was estimated.

Energy use was also looked at from an individual tourist’s perspective in the section 'aggregated energy use'. Here, the total energy use of an average tourist was calculated for each of the three industry sectors and for the entire trip. Energy intensity (MJ/day) was obtained by dividing the total energy use by the length of stay. Finally, it was assumed that different travel choices influence the travel energy intensity to a varying degree. To identify what travel choices resulted in a larger or lower than average energy use per day, simple and multiple regression analysis were carried out. For domestic tourists an additional analysis of the role of transport is presented.

4.1.5 Data reduction with factor analysis

Leisure or tourist activities have traditionally been analysed with data reduction techniques (e.g. factor analysis or principal component analysis) to obtain an understanding of behaviour, while keeping the number of variables as low as possible. For example, Bishop (1970) analysed the participation in 25 recreational activities with factor analysis and obtained three dimensions to describe the participation patterns. Factor analysis has often been used in studies on travel motivations, as for
example in the case of Japanese tourists (Cha, McCleary & Uysal, 1995), where 30 push motivation items were reduced to six factors. Many studies apply a combined factor-cluster analysis that first reduces the set of variables, and then clusters on these reduced dimensions (e.g. Ryan & Glendon, 1998; Zins, 1999). For a further discussion of factor and principal components analysis (including tests for the data set, rotation, and the interpretation of factor loadings) refer to Hair, Anderson, Tatham & Black (1998), Kim and Mueller (1978a and 1978b) and Sharma (1996). Factor analysis was applied to the sample of international West Coast tourists to reduce the number of variables of recreational activities.

4.1.6 Segmentation analysis based on travel choice intensities

Literature review

Segmentation in tourism studies is grounded in marketing research and is achieved using a variety of methods that classify tourists into similar groups. There are two segmentation methods: a priori segmentation, where the analyst defines the number and identity of the segments, and a posteriori or post hoc segmentation, such as cluster analysis, which is an analytical procedure that produces groups of subjects with similar attributes, i.e. segments (Smith, 1995).

Both a priori and post hoc segmentation studies in tourism are abundant. For example, Taiwanese visitors to Guam have been a priori segmented based on their trip expenditures into light, medium, and heavy spenders (Mok & Iverson, 2000). Examples of cluster analyses include segmentations based on participation frequencies in different recreational activities (Tatham & Dornoff, 1971), the selection of theme attractions (Fodness & Milner, 1992), the participation in 36 activities of Hong Kong travellers during their recent trips (Hsieh, O’Leary & Morrison, 1992), leisure motivations in tourism (Ryan & Glendon, 1998), entertainment preferences in the hospitality sector (Jurowski & Reich, 2000), and National Park visitors in Australia (Ryan & Sterling, 2001). Fodness and Murray (1997) examined their cluster solution for travel information-seeking behaviour according to three criteria suggested by Clancy and Roberts (1984) (cited in Fodness & Murray, 1997). First, they assessed how segments differed in regard to descriptive variables. Secondly, the size of the segments and thirdly their usefulness for marketing applications were examined. This takes into consideration the availability
of a set of easily collectable and understandable variables allowing for a practical application of the segmentation. Along these lines, Smith (1995) summarised that the usefulness of a segment be judged on its “accessibility”, “size”, “measurability”, and its “appropriateness”. Fodness and Murray (1997) concluded that the applicability of a segmentation analysis is subject to the personal and subjective preferences of the researcher, and that “both the application and interpretation of cluster analysis is more art than science” (p. 511).

Applying cluster analysis

Cluster analysis has been subject to various criticisms. First, there is no extensive statistical framework behind cluster analysis, such as in factor analysis. Second, cluster analysis is used differently in various disciplines, and therefore is biased in terms of questions asked and data used for the classification. Third, the cluster solution depends on the clustering method, and different methods can result in very different classifications. Finally, while being a method to detect structure, cluster analysis is rather a structure imposing method (Ahlendorfer & Blashfield, 1984). Thus, the obtained classification reflects primarily the structure of the data and is not necessarily ‘real’. Despite a certain degree of subjectivity inherent within cluster analysis, this research of tourists employed cluster analysis and evaluated different cluster solutions in consideration of the assessment principles described above.

It is a common procedure to analyse and validate a cluster solution by carrying out a subsequent multiple discriminant analysis (Cardoso, Themido & Pires, 1999). This multivariate analysis clarifies the differences between clusters by identifying those variables that discriminate most between groups, and also allows visualisation (through discriminant scores) of the cluster solution. The method used in this study was a stepwise procedure with the Mahalanobis distance that adjusts for unequal variances and maximises the distance between the two closest groups at each step (Hair et al., 1998). The stepwise procedure eliminates redundant variables that may be interrelated with other variables (Klecka, 1980). Discriminant analysis could also be used to assign new tourists into existing clusters based on mathematical equations (discriminant functions) (ibid). This classification analysis can be tested on the original sample, a leave-one out sample (jackknife method), or a sub-sample (Norusis, 1994). The percentage of correctly classified cases (hit ratio) is an indicator for the
effectiveness of the model, however, it needs to be compared to the percentage based on a mere random assignment of cases (e.g. based on the proportional chance criterion) (Hair et al., 1998). A high percentage of correct classifications would indicate that the violation of assumptions (e.g. normal distribution) did not underlie the result (Klecka, 1980).

**Identifying tourist types**

Unique market segments are not only valuable for marketing, but also for identifying distinct target groups to manage tourism effectively. Knowledge about tourist types with similar travel patterns and concomitant energy use would facilitate the implementation of efficiency practices and the promotion of energy sound travel styles. Against this background, two questions can be formulated:

1) **Are there distinct groups of tourists who are similar with regard to their travel choice, and who are also alike with regard to other variables (e.g. demographics)?**

2) **Are these groups characterised by specific energy uses measured as total energy use and energy intensity?**

Question one was addressed by segmenting tourists to and in New Zealand based on their travel choices (travel pattern). The distinct tourist types were subsequently compared with regard to other variables. To address question two, the total energy use and the energy intensity (energy use per day) of their travel was compared between types. The results then showed what types or patterns lead to above-average energy use, and therefore are less compatible with national goals, and what tourist types have the potential to contribute to a more energy efficient tourism.

In the case of international tourists, the emphasis was on **tourist types** whereas for domestic tourists, who are likely to undertake several (possibly different in their travel choices) trips per year, the focus was on **trip types**.
4.2 West Coast pilot-study on international tourists

The West Coast of New Zealand’s South Island is popular with independent ‘off the beaten track’ travellers. In 2000, only 17.3% of New Zealand’s 1.64 million international tourists visited this region (TNZ, 2001a), and less than 2% of domestic tourists visited (Forsyte Research, 2000). Hence, tourists who include the West Coast region in their itinerary constitute a unique sub-sample of the national tourist flows, and therefore offer a useful starting point to develop a methodology to analyse tourist behaviours against their energy inputs.

4.2.1 Methodology

Data collection

A tourist survey on the West Coast of New Zealand’s South Island was carried out in summer 1999/2000. The tourists involved in this study are hereafter called ‘West Coast tourists’, although in most cases the West Coast region represents only a part of their itinerary. The West Coast region is a narrow corridor of land to the west of the Southern Alps that offers spectacular coastal view, glaciers, and incorporates four National Parks (Figure 24).

![Map of New Zealand showing the West Coast Region](http://www.west-coast.co.nz/index.html)

Figure 24: Location of the West Coast Region (Map taken from New Zealand West Coast: http://www.west-coast.co.nz/index.html).

The population density is low (32,500 population on an area of 23,336 km$^2$) and the resulting drive is best described as a ‘wilderness drive’. The 500 km long region is only accessible by three passes: Lewis Pass (Murchison/Reefton), Arthur’s Pass, and
the southern Haast Pass within the Te Waipounamu World Heritage Area. All three entry or exit points were chosen to encounter and randomly approach travellers. Tourists, who did not actually travel on the West Coast but stopped in one of these gateway locations, were also included in the survey.

The survey gathered information on tourist itineraries and specific modes of transport, accommodation types, and attractions visited or activities undertaken. Furthermore, information that was relevant to the calculation of per capita energy consumption rates, such as vehicle occupancy, was collected. The questionnaire, based on the 1992/93 and 1995/96 IVS (NZTB, 1993 and 1996), was distributed as a mail-back survey to both international and domestic tourists during their holiday. This design allowed the surveyors to briefly explain the purpose of the study and to emphasise the importance of studies on energy use in tourism for New Zealand.

Response

During both sampling periods in December 1999 and January 2000, 464 of the 1,212 distributed questionnaires were returned, resulting in a response rate of 38.3%. Five responses contained insufficient information and were excluded, as well as six international tourists staying longer than 180 days, because of their atypical, non-touristic travel patterns. The final sample was comprised of 273 international and 180 domestic tourists.

To examine possible biases between respondents and non-respondents, the returned questionnaires were compared with field distribution lists with regard to nationality and age group by using a Chi-square test. Since many questionnaires were distributed to couples or families, gender bias was not investigated. The Chi-square test for non-response was highly significant for both the country of origin and for age. Generally, visitors from Asia (73% non-respondents), Great Britain (68.5%), and New Zealanders (63.1%), as well as tourists aged under 34 (66.5%) were less likely to respond.

Additionally, the proportion of each nationality in the sample was compared to each nation’s total visitor arrivals at the West Coast throughout 1999 (TNZ, 2001a). Tourism on the West Coast is subject to seasonality, with a peak in the summer
season from October to April. The two samples were taken during the peak season, and were found to be generally representative, except for Germans and Swiss, who were over-sampled, and Australians, who were under-represented. As with other empirical surveys, the data are also subject to non-sampling errors. These comprise, for example, respondents misunderstanding questions and incomplete questionnaires.

It is important to note that the data represent a snapshot of a limited tourist flow (West Coast) in the peak season. The results of other sub-flows and other time periods may differ from the ones presented here, but it is assumed that the relationship between travel and energy use will not differ substantially. This chapter discusses international tourists; domestic tourists will be analysed in further detail based on the Domestic Travel Study undertaken by Forsyte Research (2000). Their travel patterns were not diverse enough to justify a segmentation analysis; in fact, most domestic tourists travelled from Christchurch to the Nelson region, using their private car and staying at campgrounds.

Sample profile

Demographic variables

The original questionnaire collected information on nationality, age, sex, occupation, and income (Table 15). The nationality was reduced to regions to enhance the sample sizes and allow for statistical tests (e.g. Chi-square).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Level (% of sample or mean)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nationality</td>
<td>Germany (25%), UK (19%), USA (11%), Australia (10%), Switzerland (8%), Netherlands (5%), Canada (5%), Singapore (4%), other (13%)</td>
</tr>
<tr>
<td>Region¹</td>
<td>Germany (25%), UK (19%), other Europe (16%), USA (11%), Australia (10%), Asia (7%), Canada (4%), Arabia (3%), Scandinavia (3%), Africa (1%)</td>
</tr>
<tr>
<td>Age</td>
<td>Mean: 42, Min: 16, Max: 76 years</td>
</tr>
<tr>
<td>Sex</td>
<td>Female (53.5%), male (46.5%)</td>
</tr>
<tr>
<td>Occupation</td>
<td>Professional/technical (33%), Retired (14%), Student (13%), Managerial worker (11%), Administration (9%), Trade/production/labour (6%), Service worker (4%), Salesperson (3%), Homemaker (2%), Agriculture/forestry/fishing (2%), Unemployed (2%), Army (0.4%)</td>
</tr>
</tbody>
</table>

¹) Aggregated from 31 nationalities

Trip characteristic variables

Trip characteristics included information specific to the trip, such as travel purpose and fellow travellers (Table 16). While 13 variables were collected directly, the
transport, accommodation, and activity travel choices are derived variables (see below). Also, length of stay was derived as the sum of all nights spent in New Zealand. This parameter is likely to directly affect energy use. The average length of stay (mean) of 34 days was considerably longer than the national average of 20 days (Statistics New Zealand, 2001b). Only 10% stayed for fewer than 11 days in New Zealand, while 10% of the respondents stayed longer than 65 days. This confirms earlier results of Pearce (1992), who showed that visitors to Westland National Park (West Coast) generally have longer holidays than other overseas visitors.

Some information on eating habits was collected, namely visits to restaurants and the amount of bottled drinks (high embodied energy) and fast food consumed per week. These data were collected with the purpose of estimating an ‘ecological rucksack’ that includes tourist activities other than the ones accounted for in the key sub-sectors. Due to insufficient information gained from tourists’ answers these variables are not analysed any further.

Table 16: Trip characteristics for international West Coast tourists (N= 273)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Level (% of sample or mean)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main purpose¹</td>
<td>Holiday (85%), Business (4%), VFR (10%)</td>
</tr>
<tr>
<td>Second purpose¹</td>
<td>Holiday (26%), Business (4%), VFR (18%), none (52%)</td>
</tr>
<tr>
<td>Length of trip</td>
<td>Mean: 81, Min: 5, Max: 1095 days</td>
</tr>
<tr>
<td>Length of stay (NZ)</td>
<td>Mean: 34, Min: 4, Max: 178 days</td>
</tr>
<tr>
<td>Travel party</td>
<td>Couple (45%), Family or Family and friends (18%), Friends (11%), Alone (25%), Business associates (1%)</td>
</tr>
<tr>
<td>Tour group</td>
<td>Yes (23%), No (77%)</td>
</tr>
<tr>
<td>Pre-booked</td>
<td>Yes (20%), No (80%)</td>
</tr>
<tr>
<td>Long haul travel²</td>
<td>Mean: 3.2, Min: 0, Max: 15 countries</td>
</tr>
<tr>
<td>Total expenditures</td>
<td>Mean: 6364, Min: 735, Max: NZ$37,500</td>
</tr>
<tr>
<td>Expenditures for shopping</td>
<td>Mean: 475, Min: 0, Max: New Zealand$250</td>
</tr>
<tr>
<td>National Parks visited</td>
<td>Mean: 5.6 Min: 0, Max: 15</td>
</tr>
<tr>
<td>Transport modes</td>
<td>Mean: 3.8 different modes</td>
</tr>
<tr>
<td>Accommodation categories</td>
<td>Mean: 3.1 different categories</td>
</tr>
<tr>
<td>Attractions/activities</td>
<td>Mean: 28.8 visits/participation</td>
</tr>
<tr>
<td>Hitchhiking</td>
<td>Yes (5%), No (95%)</td>
</tr>
<tr>
<td>Visits to restaurant</td>
<td>Mean: 0.4 visits per day</td>
</tr>
<tr>
<td>Bottled drinks</td>
<td>&lt; 2 l/week (18%); 2-6 l/week (48%), &gt;6 l/week (34%)</td>
</tr>
<tr>
<td>Fast food consumption</td>
<td>Never (67%), 3 meals/week (28%), 6 meals/week (5%)</td>
</tr>
</tbody>
</table>

¹ Aggregated from 10 travel purpose options
² Countries visited within the last 4 years, which involved more than 5 hrs flying time

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Data preparation and description

The travel pattern related information collected from tourists required some preparation and quantification to be usable for energy calculations. A tourist’s itinerary starts at the arrival airport and ends at the departure airport for international tourists. Additional information includes overnight locations, the number of nights spent at the overnight stop, the modes of transport used to get there and accommodation categories used. Furthermore, tourists reported their recreational activities (frequency and location of participation). Taken together these data require further preparation. In the following section, the transformation of the collected data into new variables for transport, accommodation and attractions/activities is described.

Transport variables

The generation of new transport variables required combining a tourist’s travel route with transport modes. To convert the itinerary into distances in km, 174 locations throughout New Zealand were coded and distances between these locations determined using road maps (AA, 1997). In addition to travel between overnight stops, side trips were considered where possible. These were reconstructed based on reported visits to National Parks and attractions and activities undertaken by the tourist. Travel between overnight locations, side trips, and legs with a transport mode different from the main mode were each coded as separate travel sectors. These were added up for each tourist to a total travel distance, and also to total travel distances broken down by transport modes. Hence, each tourist could be characterised by their distances (either in total or per day) travelled with different transport modes. A comparison between the estimated travel distance and the exact distance travelled of six tourists, who supplied this information voluntarily, indicated that this procedure was extremely accurate (80 to 97% of the travel distances were detected).

Originally, there were 22 transport variables offered in the questionnaire. These were reduced to 15 transport variables (Table 17). For example, the rental van (N= 4) was integrated into the rental car variable. Ferries other than the Cook Strait Ferries (e.g. Stewart Island Ferry) were excluded from further analysis, because they were not considered relevant both in terms of total energy use and in defining a tourist’s travel pattern. Of course, they were still included in the calculation of total transport energy.
Shuttle buses (both large and small ones) that were used as part of an activity package or visit to an attraction were excluded from the transport sector, since they are accounted for in the attraction/activity sub-sector.

All variables (measured as intensity, i.e. km/day) were characterised by a large standard deviation and ratio of standard deviation to the mean. Moreover, none of the variables were normally distributed, which was tested with the Kolmogorov-Smirnov test for normality and could also be seen from the skewness towards large values. This was not surprising since each tourist only used a limited range of transport vehicles (3.8 different modes) and thus scored zero on the unused modes. In addition to the large proportion of zero-scores within each distribution, outliers occurred towards extreme travel distances. The median is zero for all transport options, which shows that none of them was selected by a majority.

Table 17: Transport variables for international West Coast tourists (N= 273)

<table>
<thead>
<tr>
<th>Transport mode</th>
<th>Scale</th>
<th>Mean</th>
<th>SD</th>
<th>Skewness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rental car/ van</td>
<td>Km/day</td>
<td>49.5</td>
<td>73.2</td>
<td>1.5</td>
</tr>
<tr>
<td>Domestic air</td>
<td>Km/day</td>
<td>8.6</td>
<td>25.9</td>
<td>4.3</td>
</tr>
<tr>
<td>Coach</td>
<td>Km/day</td>
<td>32.5</td>
<td>76.3</td>
<td>2.2</td>
</tr>
<tr>
<td>Private car</td>
<td>Km/day</td>
<td>16.4</td>
<td>39.0</td>
<td>2.8</td>
</tr>
<tr>
<td>Camper van</td>
<td>Km/day</td>
<td>15.4</td>
<td>45.7</td>
<td>3.2</td>
</tr>
<tr>
<td>Cook Strait Ferry</td>
<td>Km/day</td>
<td>3.3</td>
<td>3.1</td>
<td>1.7</td>
</tr>
<tr>
<td>Backpacker bus</td>
<td>Km/day</td>
<td>9.2</td>
<td>31.8</td>
<td>3.7</td>
</tr>
<tr>
<td>Scheduled bus</td>
<td>Km/day</td>
<td>5.7</td>
<td>19.7</td>
<td>5.4</td>
</tr>
<tr>
<td>Shuttle</td>
<td>Km/day</td>
<td>3.5</td>
<td>10.6</td>
<td>5.6</td>
</tr>
<tr>
<td>Train</td>
<td>Km/day</td>
<td>3.7</td>
<td>11.4</td>
<td>4.1</td>
</tr>
<tr>
<td>Recreational boat</td>
<td>Km/day</td>
<td>0.03</td>
<td>0.4</td>
<td>11.6</td>
</tr>
<tr>
<td>Hitchhiking</td>
<td>Km/day</td>
<td>8.2</td>
<td>41.3</td>
<td>10.9</td>
</tr>
<tr>
<td>Motorcycle</td>
<td>Km/day</td>
<td>1.3</td>
<td>12.9</td>
<td>10.9</td>
</tr>
<tr>
<td>Cycle</td>
<td>Km/day</td>
<td>1.0</td>
<td>6.0</td>
<td>7.2</td>
</tr>
<tr>
<td>Tramping</td>
<td>Km/day</td>
<td>0.4</td>
<td>1.0</td>
<td>3.0</td>
</tr>
</tbody>
</table>

Accommodation variables

As with transport, quantitative variables were created to characterise each tourist by their accommodation choices. To this end, the total number of nights spent in a specific accommodation category was added up. Again, variables can be expressed as total nights spent in one category or as intensities, namely 'nights per day'.

---

30 'Nights per day' is calculated by dividing the total number of nights spent in a specific category by the length of stay. For example, a tourist staying 5 nights in a hotel during his 10-day visit spent 0.5 nights per day in a hotel (or 50% of his bed-nights).
The questionnaires provided a choice of 14 accommodation options among which tourists typically select. However, to match variables with categories analysed in the accommodation section (Chapter 3), it proved necessary to reduce the number of 14 variables to six categories (Table 18). The hotel category comprises the following original alternatives: top class hotel, mid-range hotel, luxury lodge, and motel with restaurant. Motels with restaurants were already demonstrated in the accommodation sub-sector analysis to more closely resemble hotels rather than motels, since they provide a broad range of services. The motel category, therefore, represents motels without a restaurant. Bed & Breakfast include hosted accommodation (e.g. farmstays and homestays), boats or yachts (e.g. Milford Wanderer), and budget hotels. Backpacker hostels comprise backpackers and youth hostels, and the camping category includes motorcamps, caravan parks, Department of Conservation huts in protected land (mostly National Parks), and free camping. Finally, homes include private and rented homes, and apartments. Again, the variables are not normally distributed and show large standard deviations.

| Table 18: Accommodation variables for international West Coast tourists (N= 273) |
| --- | --- | --- | --- | --- | --- |
| Category | Comprises | Scale | Mean | SD | Skewness |
| Hotel | Top-hotel, mid-range hotel, luxury lodge, motel with restaurant, | Nights/day | 0.21 | 0.34 | 1.5 |
| Motel | Motel without restaurant | Nights/day | 0.08 | 0.17 | 3.3 |
| B&B | B&B, home stay, farm stay, boat, budget hotel | Nights/day | 0.08 | 0.20 | 2.7 |
| Backpacker | Backpacker, youth hostel | Nights/day | 0.21 | 0.32 | 1.3 |
| Campground | Holiday park, hut, free camping | Nights/day | 0.23 | 0.33 | 1.3 |
| Home | Private home, rental home, apartment | Nights/day | 0.18 | 0.27 | 1.4 |

Attraction and activity variables

Tourists reported their participation in 42 different attractions or activities. These 42 tourist attractions and activities were reduced to the eleven categories introduced earlier in Chapter 3. The frequency of participation in each of these categories is the quantified variable to characterise tourists’ recreational behaviour (Table 19).
Table 19: Attraction/activity variables for international West Coast tourists (N= 273)

<table>
<thead>
<tr>
<th>Category</th>
<th>Comprises</th>
<th>Scale</th>
<th>Mean</th>
<th>SD</th>
<th>Skewness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buildings</td>
<td>Art gallery, historic building, museum, visitor centre</td>
<td>Visits/day</td>
<td>0.16</td>
<td>0.17</td>
<td>2.1</td>
</tr>
<tr>
<td>Parks</td>
<td>Aquarium, botanical garden, wildlife park, zoo</td>
<td>Visits/day</td>
<td>0.04</td>
<td>0.05</td>
<td>1.5</td>
</tr>
<tr>
<td>Amusement</td>
<td>Experience centre, gondola ride, sporting complex, theme park</td>
<td>Visits/day</td>
<td>0.03</td>
<td>0.06</td>
<td>3.3</td>
</tr>
<tr>
<td>Industry</td>
<td>Brewery, farm show, winery</td>
<td>Visits/day</td>
<td>0.05</td>
<td>0.11</td>
<td>9.2</td>
</tr>
<tr>
<td>Nature attract.</td>
<td>Geothermal, glow worm caves</td>
<td>Visits/day</td>
<td>0.05</td>
<td>0.06</td>
<td>1.9</td>
</tr>
<tr>
<td>Performance</td>
<td>Cinema, live theatre or concert, Maori cultural performance</td>
<td>Visits/day</td>
<td>0.04</td>
<td>0.04</td>
<td>1.8</td>
</tr>
<tr>
<td>Entertainment</td>
<td>Bar/night club, casino, shopping</td>
<td>Visits/day</td>
<td>0.18</td>
<td>0.19</td>
<td>1.7</td>
</tr>
<tr>
<td>Air activity</td>
<td>Scenic flight, air sports, whale watching by air, heliskiing</td>
<td>Visits/day</td>
<td>0.02</td>
<td>0.04</td>
<td>2.6</td>
</tr>
<tr>
<td>Mot. water activity</td>
<td>Diving, dolphins/ whale watching, jet boating, sailing, scenic boat cruise, sea/coastal fishing</td>
<td>Visits/day</td>
<td>0.07</td>
<td>0.08</td>
<td>2.9</td>
</tr>
<tr>
<td>Adventure</td>
<td>Adventure (e.g. bungy), kayaking, mountain biking, rock climbing/ caving, rafting, skiing, surfing</td>
<td>Visits/day</td>
<td>0.02</td>
<td>0.05</td>
<td>5.3</td>
</tr>
<tr>
<td>Nature activity</td>
<td>Cycling, golf, horseriding, fishing, tramping, wildlife, guided walks</td>
<td>Visits/day</td>
<td>0.34</td>
<td>0.30</td>
<td>1.7</td>
</tr>
</tbody>
</table>

Data analysis

Describing energy use

The prepared tourist data were combined with energy data generated in the industry (sub-sector) analyses (Chapter 3) by multiplying travel choice variables with energy intensities. Energy use associated with each of the 32 travel choices (15 in the transport sub-sector, 6 for accommodation and 11 recreational activities) was calculated along with typical travel choice intensities. The importance of a specific travel choice with regard to its contribution to the sub-sector’s total energy use was estimated. This depends on its popularity (share of tourists who use it at least once), the specific energy intensity, and the tourists’ travel choice intensity (e.g. travel distance in km). Finally, the total ‘energy bill’ of an averaged individual tourist was determined. To this end it is important to understand that a tourist’s holiday is an aggregation of all their travel choices, and that each of these choices contributes to the total energy use of their journey. The average total energy consumption for an individual tourist was calculated for each sub-sector and the total trip, as well as the average energy use per day.
Regression analysis

The possible relationship between the travel intensity of single travel choices and daily energy consumption for the entire trip was firstly analysed with simple linear regression analysis. Each single travel choice (km, nights, or activity participations per day) represents the independent variable and energy use per day the dependent variable. Only tourists who chose a specific travel choice at least once were included. The univariate approach provided a first insight into relationships between travel choice intensities and energy intensity. However, the multivariate nature of travel behaviour and tourist itineraries required a simultaneous consideration of more than one variable. For this reason, stepwise (restriction to relevant variables) multiple regression analysis was applied.

Factor analysis

The set of eleven variables in the attraction and activity sector already constitutes a condensed version of the original 42 variables in the questionnaire. However, it still appeared to be a relatively large set of interrelated variables with a possibly relative small importance for overall energy use compared with transport and accommodation variables. It is known that the usefulness of segments produced by cluster analysis depends strongly on the selected variables, and for this reason it is crucial to assess the utility of each variable at an early stage. Since the segmentation is undertaken against the background of energy consumption, it seemed that the full set of eleven variables may influence the cluster solution to an extent that does over-emphasise this sub-sector's contribution to a tourist's energy use of only 13%. For this reason, the suitability of the data set for factor analysis was tested (Kaiser-Meyer-Olkin Measure of Sampling Adequacy indicating the degree of common variance), a principal component analysis with a Varimax rotation was applied and factor scores were calculated. These factor scores, thereafter, represent tourists' travel choices within the attraction/activity sub-sector. Note, that energy use resulting from visiting tourist attraction/activities was still calculated from the number of visits to the original (11) categories.

Cluster analysis

It was decided that the basis for similarity between tourists should be daily travel behaviour (e.g. travel distance per day with a specific transport mode) rather than accumulative behaviour for the entire trip (e.g. total travel distance), which would be
strongly influenced by the length of stay. Therefore, the variables used for the cluster analysis were the travel choices measured as intensity (e.g. km/day).

The method used was agglomerative hierarchical cluster analysis with the average linkage method to combine cases or clusters based on a correlational similarity measure (Pearson correlation coefficient). This “shape measurement” (Klecka, 1980, p. 23) gives more weight to similar patterns than to the actual magnitude of the scores. Thus, tourists with similar travel choices that differ in their magnitude may still be recognised as being similar. This applies, for example, if one case is simply a linear projection of the other. This procedure seemed to best meet the understanding of similar travel patterns for international tourists. To determine the final number of clusters, both analytical results (e.g. agglomeration schedule) and utility considerations were combined to define a meaningful and relevant typology. The resulting tourist types were further analysed and validated with stepwise discriminant analysis to assess the cluster solution and to identify key discriminating variables. Energy use (and also other profiling variables) was compared for the clusters using ANOVA and Chi-square for non-metric variables.

4.2.2 Energy use associated with specific travel choices

Transport sector and energy use

Independent transport modes, such as rental cars (42%) and private cars (33%), were most popular with international West Coast tourists. Only 18% of West Coast tourists were part of an organised coach tour, compared with 24% for the national total (TNZ, 2001a). A high proportion (75%) of international tourists crossed the Cook Strait by ferry to travel between the North and South Island.

The average (mean) travel distances (per day and in total) and the average (mean) total energy use associated with each mode of transport are presented in Table 20. This refers to tourists who used a specific transport mode at least once during their trip. In the West Coast survey passenger numbers were collected for each tourist and vehicle (see Chapter 3 – Transport). Hence, the individual transport energy use was calculated by multiplying each individual tourist’s travel distance with the energy use per vehicle kilometre, divided by the number of people on board. An additional column presents the proportion of so-called ‘extra transport’, transport used to travel
somewhere different from the overnight destination. This includes side-trips (e.g. Cape Foulwind, Waitomo Caves) off the main route and loops, such as the ‘dead end’ road to Milford Sound (if no night was spent at this location). It is assumed that the actual travel distances are under-estimated due to incomplete reporting of tourists concerning their stops and activities that served to identify extra transport.

The coach is characterised by a large travel distance per day, as well as the camper van and the rental car. All of these modes were popular with ‘touring tourists’, who travelled about 3,000 km during their holiday. This leads to a large energy use of up to 8,000 MJ associated with camper vans. Public transport, such as scheduled buses, shuttle vans, and trains appeared to be less significant in terms of travel distance and concomitant energy use. Shuttle buses, for example, were often used as a means for a day trip or return trip to a specific (overnight) destination. This can be drawn from the large proportion of 60% that falls into the category of extra-transport. Coach tours are also characterised by a large proportion of extra transport (13%). In contrast, the scheduled bus, train, and bicycle are mainly used for main routes between overnight locations.

Table 20: Transport travel choices and energy use (mean) of international West Coast tourists who used a mode at least once

<table>
<thead>
<tr>
<th>Transport mode</th>
<th>Energy intensity (MJ/km)</th>
<th>Tourists N</th>
<th>Proportion (%)</th>
<th>Distance per day (km/day)</th>
<th>Total distance (km)</th>
<th>Extra transport (%)</th>
<th>Total energy use (MJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic air</td>
<td>2.75</td>
<td>56</td>
<td>20.5</td>
<td>41.7</td>
<td>774</td>
<td>0</td>
<td>2,128</td>
</tr>
<tr>
<td>Rental car</td>
<td>0.94</td>
<td>118</td>
<td>43.2</td>
<td>114.4</td>
<td>2,780</td>
<td>9.8</td>
<td>3,137</td>
</tr>
<tr>
<td>Coach tour</td>
<td>1.01</td>
<td>49</td>
<td>17.9</td>
<td>180.8</td>
<td>2,788</td>
<td>12.8</td>
<td>4,186</td>
</tr>
<tr>
<td>Private car</td>
<td>1.03</td>
<td>86</td>
<td>31.5</td>
<td>52.2</td>
<td>2,037</td>
<td>9.2</td>
<td>3,120</td>
</tr>
<tr>
<td>C. Strait Ferry</td>
<td>2.40</td>
<td>208</td>
<td>76.2</td>
<td>4.3</td>
<td>122</td>
<td>NA</td>
<td>292</td>
</tr>
<tr>
<td>Scheduled bus</td>
<td>0.75</td>
<td>87</td>
<td>31.9</td>
<td>17.9</td>
<td>641</td>
<td>5.3</td>
<td>481</td>
</tr>
<tr>
<td>Train</td>
<td>1.44</td>
<td>45</td>
<td>16.5</td>
<td>22.6</td>
<td>523</td>
<td>5.1</td>
<td>754</td>
</tr>
<tr>
<td>Camper van</td>
<td>2.06</td>
<td>33</td>
<td>12.1</td>
<td>127.8</td>
<td>3,848</td>
<td>7.2</td>
<td>8,303</td>
</tr>
<tr>
<td>Backpacker bus</td>
<td>0.58</td>
<td>29</td>
<td>10.6</td>
<td>86.8</td>
<td>2,447</td>
<td>6.4</td>
<td>1,428</td>
</tr>
<tr>
<td>Shuttle van</td>
<td>0.59</td>
<td>116</td>
<td>42.5</td>
<td>8.3</td>
<td>280</td>
<td>60.4</td>
<td>206</td>
</tr>
<tr>
<td>Hitchhiking</td>
<td>1.03</td>
<td>14</td>
<td>5.1</td>
<td>15.7</td>
<td>1,262</td>
<td>18.3</td>
<td>1,272</td>
</tr>
<tr>
<td>Rec. boat</td>
<td>1.75</td>
<td>2</td>
<td>0.7</td>
<td>4.7</td>
<td>84</td>
<td>35.7</td>
<td>561</td>
</tr>
<tr>
<td>Motorcycle</td>
<td>0.87</td>
<td>4</td>
<td>1.5</td>
<td>88.7</td>
<td>3,015</td>
<td>3.2</td>
<td>3,630</td>
</tr>
<tr>
<td>Cycle</td>
<td>0</td>
<td>9</td>
<td>3.3</td>
<td>28.7</td>
<td>1,218</td>
<td>1.7</td>
<td>0</td>
</tr>
<tr>
<td>Tramping</td>
<td>0</td>
<td>64</td>
<td>23.4</td>
<td>1.8</td>
<td>90</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

1) The order follows the popularity of transport modes among international tourists as reported by TNZ (2001a).
2) Extra transport in this column is expressed as proportion of total travel distance with a specific transport mode.
Chapter 4 – West Coast pilot-study on international tourists

The total travel distance of each tourist was calculated by adding up the travelled distances with different transport modes. On average an international tourist travelled for 3,737 km (median 3,659 km, standard deviation 1,418 km) during their trip in New Zealand. Furthermore, the calculation of each transport type’s share of the total transport energy use revealed that rental cars contributed 25%, private cars and camper vans 18% each, and organised coach tours 14%. Domestic air made up 8% of the total transport energy demand.

**Accommodation sector and energy use**

International West Coast tourists tended to stay at camping grounds with almost half of all visitors spending at least one night there, and 23% of all visitor-nights spent in this category. This differs clearly from the national total of only 6.1% of all visitor-nights spent in this category (TNZ, 2001a). While backpacker hostels accounted for 24% of West Coast international visitor accommodation nights, hotels contributed only 11%. These data clearly reflect the remote and rugged character of this region that attracts individually travelling tourists (FIT’s), as described earlier.

The proportion of nights that a tourist spent at a specific category was calculated as the nights spent at this category divided by the total number of nights. This is an indicator for a category’s significance as a main accommodation category. For example, B&Bs and motels were only visited every fourth or fifth night by those who chose this category at least once, while the other categories achieved a proportion of almost 50% (Table 21).

The average length of stay in each accommodation category was similar to national figures reported by TNZ (2001a). The energy use presented in Table 21 represents the average of all tourists, who visited an accommodation category at least once. As a result of either a large energy intensity (hotels) or an extended length of stay (homes), hotels and homes tended to be associated with larger per tourist energy use than other accommodation categories. International tourists consumed a considerable amount of energy in backpacker hostels, resulting from the long length of stay (17.6 nights) in this accommodation category.
Table 21: Accommodation travel choices and energy use (mean) of international West Coast tourists who visited a category at least once

<table>
<thead>
<tr>
<th>Category</th>
<th>Energy intensity (MJ/visitor-night)</th>
<th>Tourists N</th>
<th>Proportion (%)</th>
<th>Nights spent in category (%)</th>
<th>Number of nights</th>
<th>Energy use (MJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hotel</td>
<td>155</td>
<td>129</td>
<td>47.3</td>
<td>43.6</td>
<td>4.9</td>
<td>767</td>
</tr>
<tr>
<td>B&amp;B</td>
<td>110</td>
<td>110</td>
<td>40.3</td>
<td>20.1</td>
<td>4.3</td>
<td>468</td>
</tr>
<tr>
<td>Motel</td>
<td>32</td>
<td>83</td>
<td>30.4</td>
<td>29.5</td>
<td>8.4</td>
<td>268</td>
</tr>
<tr>
<td>Backpacker</td>
<td>39</td>
<td>125</td>
<td>45.8</td>
<td>46.5</td>
<td>17.6</td>
<td>688</td>
</tr>
<tr>
<td>Campground</td>
<td>25</td>
<td>131</td>
<td>49.5</td>
<td>45.6</td>
<td>14.7</td>
<td>367</td>
</tr>
<tr>
<td>Home</td>
<td>41</td>
<td>121</td>
<td>44.3</td>
<td>41.2</td>
<td>19.2</td>
<td>790</td>
</tr>
</tbody>
</table>

International West Coast tourists consumed most energy in hotels (30%) and in homes (20%). Backpacker hostels (18%), B&Bs (14%) and campgrounds (13%) also consumed considerable amounts of energy, while motels appeared to be less important with regard to energy use.

**Attraction and activity sector and energy use**

The energy use of various commercial tourist attractions and activities was analysed and aggregated into eleven distinct categories (*Chapter 3*). As many tourists’ activities or visits to attractions involve a commercial operator, these previous results can be directly applied to this study. However, non-commercial recreational activities are assumed to consume less energy than those reported previously (e.g. no office or marketing activities). Following the methodology in *Chapter 3*, the direct energy use of non-commercial, non-motorised activities would be zero. This applies mainly to nature activities, such as cycling or walking, that are often organised individually. The proportion of informal nature activities depends on the location within New Zealand, as some destinations are clearly linked with specific types of commercial activities (e.g. Westland National Park – glacier walking, Abel Tasman National Park – kayaking) (expert survey, Appendix B). Assuming a half share of these energy-use activities are within the nature activity category, the reported energy intensity of 53.1 MJ per person can be halved to 26.5 MJ (Table 22).

On average, international West Coast tourists participated in twelve attractions or activities. This is higher than the national average of nine activities for international visitors (NZTB, 1996). The most popular attractions or activities were shopping (entertainment category) (77%), half-day walks (nature activity) (69%), visiting museums or art galleries (building category) (68%), viewing wildlife (nature activity)
(64%), and taking scenic boat cruises (motorised water activity) (58%) (Table 22).

When compared with the national average for international tourists (e.g. 49% for shopping, 22% for scenic boat cruise, and 21% for beaches, TNZ, 2001a) the participation in all categories was high with a strong focus on nature activities.

Most attractions or activities were visited or undertaken only once. Buildings, entertainment, and nature activities, however, were more frequently visited or experienced. As these are all relatively energy efficient attractions or activities, the greater visitor frequency does not result in a large energy use. In contrast, air and motorised water activities are associated with a large energy consumption despite a generally lower participation frequency. The energy use associated with a specific attraction and activity category is calculated as the average of all tourists who participated at least once.

Table 22: Attractions/activity travel choices and energy use (mean) of international West Coast tourists who visited a category at least once

<table>
<thead>
<tr>
<th>Recreation category(^1)</th>
<th>Energy intensity (MJ/visit)</th>
<th>Tourists N</th>
<th>Proportion (%) of tourists</th>
<th>Total frequency (visits)</th>
<th>Total energy use (MJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buildings</td>
<td>3.5</td>
<td>226</td>
<td>82.8</td>
<td>3.4</td>
<td>14</td>
</tr>
<tr>
<td>Parks</td>
<td>8.4</td>
<td>165</td>
<td>60.4</td>
<td>1.5</td>
<td>12</td>
</tr>
<tr>
<td>Amusement</td>
<td>22.4</td>
<td>133</td>
<td>48.7</td>
<td>1.2</td>
<td>26</td>
</tr>
<tr>
<td>Industry</td>
<td>11.5</td>
<td>138</td>
<td>50.5</td>
<td>1.4</td>
<td>17</td>
</tr>
<tr>
<td>Nature attraction</td>
<td>8.5</td>
<td>191</td>
<td>70.0</td>
<td>1.4</td>
<td>13</td>
</tr>
<tr>
<td>Performance</td>
<td>12.0</td>
<td>167</td>
<td>61.2</td>
<td>1.4</td>
<td>17</td>
</tr>
<tr>
<td>Entertainment</td>
<td>6.9</td>
<td>235</td>
<td>86.1</td>
<td>4.3</td>
<td>30</td>
</tr>
<tr>
<td>Air activity</td>
<td>424.3</td>
<td>90</td>
<td>33.0</td>
<td>1.1</td>
<td>471</td>
</tr>
<tr>
<td>Mot. water activity</td>
<td>236.8</td>
<td>211</td>
<td>77.3</td>
<td>1.5</td>
<td>363</td>
</tr>
<tr>
<td>Adventure activity</td>
<td>35.1</td>
<td>82</td>
<td>30.0</td>
<td>1.4</td>
<td>50</td>
</tr>
<tr>
<td>Nature activity</td>
<td>26.5</td>
<td>255</td>
<td>93.4</td>
<td>3.3</td>
<td>95</td>
</tr>
</tbody>
</table>

\(^1\) Same order of categories as in Chapter 3 – Attractions/activities

It was found, that an attraction or activity’s energy intensity determines the aggregated energy use of a specific travel choice (category) to a stronger degree than in the transport and accommodation sectors. While tourist activities (air, sea, adventure, and nature) contributed 90% of the total energy consumption in the attraction and activity sector, tourist attractions and entertainment were less important with regard to energy use. Motorised water activities were dominant for international visitors (41%), making up about half of the energy use. Nature activities contributed another 33% of the total energy use for recreation of international tourists. It is important to note, that the energy use associated with nature activities might be
overestimated due to larger estimate for commercially organised activities that involve more energy than individually undertaken nature activities.

**Aggregated energy use**

There is a large variety in individual’s total energy use for each sector (Table 23). Generally, the variation reflects the diversity of travel choices, in particular transport modes, and the consequences for the total energy use both within a sub-sector and for the entire holiday. All sub-sectors and the aggregated energy use are characterised by a strongly skewed distribution, with more outliers towards large values.

Table 23: Individual energy use of international West Coast tourists for the three sub-sectors and the entire trip in New Zealand

<table>
<thead>
<tr>
<th></th>
<th>Transport (MJ)</th>
<th>Accommodation (MJ)</th>
<th>Attraction/activity (MJ)</th>
<th>Total energy use (MJ)</th>
<th>Energy use per day (MJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tourists</td>
<td>Mean</td>
<td>5,327</td>
<td>1,770</td>
<td>1,067</td>
<td>8,163</td>
</tr>
<tr>
<td>N= 273</td>
<td>Median</td>
<td>4,433</td>
<td>1,510</td>
<td>878</td>
<td>7,290</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>101</td>
<td>195</td>
<td>0</td>
<td>1,336</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>20,692</td>
<td>6,476</td>
<td>6,281</td>
<td>28,261</td>
</tr>
</tbody>
</table>

Clearly, transport was the dominant sub-sector in terms of energy use with an average contribution of 65% to the tourist’s ‘energy bill’. Accommodation and attractions/activities contributed 22% and 13%, respectively, to the total energy consumption (calculated from the averaged sub-sector totals in Table 23). The composition of the total energy use already indicated a correlation between energy used in the transport sector and total energy use. A linear regression analysis showed that 89.5% of the variability in a tourist’s ‘energy bill’ could be determined through transport energy use.

The question arises, whether a large overall energy bill is primarily a result of different holiday lengths. The relationship between total energy use and length of stay was analysed with regression analysis, assuming a linear relationship between the two variables. The R²-value specified that 29.2% of the variation in total energy use of tourists is explained by the variation in the length of stay. Hence, a considerable proportion of variation in the total energy use remains unexplained, and a normalisation of energy use by the length of stay provides additional information. The median energy use per day was 273 MJ per tourist, with a range of 1,140 MJ per day.
Do travel choices explain energy intensity of travel?

Clearly, energy use in tourism is strongly influenced by tourists and their respective travel behaviour, which manifests in their travel choices. It is conceivable that there is a linear relationship between the extent to which a specific travel choice (normalised by length of stay) is used (distance, number of nights, visits/participation) and the energy intensity of a travel style, i.e. the total amount of energy a tourist consumes per day. In the following analysis energy use per day is preferred to total energy use, since differences in energy use due to differing travel styles are blurred by varying lengths of stay. From here on three transport modes are excluded from the analysis: the Cook Strait ferry, because tourists either travel 96 km or 192 km return, hitchhiking, because it involves only 14 tourists, who used this mode only occasionally, and recreational boats, due to a sample size of only two. Motorcycles remain in the analysis despite a small sample size, because they were used as main transport modes and could contain important information on a small group of tourists.

Simple linear regression analysis indicated that most travel choices explained a significant amount of variance in energy use per day. Air travel, camper vans, hotels, and air activities stood out with between 74% and 30% in energy use per day being predictable based on these variables. Others, such as shuttle bus or camping did not contribute much to energy use and, thus, were weak predictors. Table 24 displays the regression results sorted by the proportion of variation in energy intensity explained.
Table 24: Energy use per day explained by travel choice intensities across the transport, accommodation, and attraction/activity sub-sector

<table>
<thead>
<tr>
<th>Travel choice</th>
<th>Variance explained (%)</th>
<th>F-value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transport modes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domestic air</td>
<td>74.0</td>
<td>153.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Camper van</td>
<td>59.1</td>
<td>44.7</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Backpacker bus</td>
<td>21.6</td>
<td>7.5</td>
<td>0.011</td>
</tr>
<tr>
<td>Coach</td>
<td>21.3</td>
<td>12.7</td>
<td>0.001</td>
</tr>
<tr>
<td>Rental car</td>
<td>16.9</td>
<td>23.7</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Train</td>
<td>13.6</td>
<td>6.8</td>
<td>0.013</td>
</tr>
<tr>
<td>Private car</td>
<td>11.4</td>
<td>10.8</td>
<td>0.001</td>
</tr>
<tr>
<td>Shuttle</td>
<td>7.7</td>
<td>9.6</td>
<td>0.002</td>
</tr>
<tr>
<td><strong>Accommodation categories</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hotel</td>
<td>30.0</td>
<td>54.5</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Home</td>
<td>14.3</td>
<td>19.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>B&amp;B</td>
<td>9.7</td>
<td>11.6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Camping</td>
<td>5.9</td>
<td>8.3</td>
<td>0.005</td>
</tr>
<tr>
<td><strong>Attraction/Activity categories</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air activity</td>
<td>41.7</td>
<td>63.1</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Water activity</td>
<td>23.8</td>
<td>65.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Nature attraction</td>
<td>20.6</td>
<td>49.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Parks</td>
<td>18.6</td>
<td>37.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Amusement</td>
<td>14.3</td>
<td>21.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Performance</td>
<td>12.2</td>
<td>22.9</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Adventure activity</td>
<td>10.4</td>
<td>9.3</td>
<td>0.003</td>
</tr>
<tr>
<td>Industry</td>
<td>5.2</td>
<td>7.4</td>
<td>0.007</td>
</tr>
<tr>
<td>Buildings</td>
<td>4.1</td>
<td>9.6</td>
<td>0.002</td>
</tr>
<tr>
<td>Entertainment</td>
<td>3.6</td>
<td>8.7</td>
<td>0.003</td>
</tr>
<tr>
<td>Nature activity</td>
<td>1.7</td>
<td>4.3</td>
<td>0.040</td>
</tr>
</tbody>
</table>

The multiple regression analysis was based on all 273 tourists (i.e. most tourists scored zero on several travel choices). The final model included eleven variables, explaining 74.5% of the variation in energy use per day. This high degree of explanation is not surprising, since energy use is calculated as the sum of energy use associated with all travel choices. Regression analysis, hence, identifies key variables, and also quantifies the amount of variance that is explained by those eighteen variables that were not included (25.5%). Multicollinearity did not appear to be a major problem (tolerance close to 1) (Table 25).
Table 25: Multiple regression model statistics for international West Coast tourists  
(Dependent variable: energy use per day)

<table>
<thead>
<tr>
<th></th>
<th>Unstd. Coefficients</th>
<th>Std. Coefficients</th>
<th>t-value</th>
<th>Significance</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>55.15</td>
<td></td>
<td>3.46</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Camper van</td>
<td>1.87</td>
<td>0.44</td>
<td>11.71</td>
<td>&lt;0.001</td>
<td>.683</td>
</tr>
<tr>
<td>Domestic air</td>
<td>2.14</td>
<td>0.29</td>
<td>8.39</td>
<td>&lt;0.001</td>
<td>.833</td>
</tr>
<tr>
<td>Coach</td>
<td>1.09</td>
<td>0.43</td>
<td>8.29</td>
<td>&lt;0.001</td>
<td>.361</td>
</tr>
<tr>
<td>Rental car</td>
<td>0.79</td>
<td>0.30</td>
<td>7.22</td>
<td>&lt;0.001</td>
<td>.571</td>
</tr>
<tr>
<td>Private car</td>
<td>1.23</td>
<td>0.26</td>
<td>6.91</td>
<td>&lt;0.001</td>
<td>.757</td>
</tr>
<tr>
<td>Hotel</td>
<td>184.05</td>
<td>0.33</td>
<td>6.59</td>
<td>&lt;0.001</td>
<td>.396</td>
</tr>
<tr>
<td>Air activity</td>
<td>843.32</td>
<td>0.16</td>
<td>4.50</td>
<td>&lt;0.001</td>
<td>.764</td>
</tr>
<tr>
<td>B&amp;B</td>
<td>228.20</td>
<td>0.21</td>
<td>5.76</td>
<td>&lt;0.001</td>
<td>.766</td>
</tr>
<tr>
<td>Backpacker</td>
<td>84.73</td>
<td>0.14</td>
<td>3.75</td>
<td>&lt;0.001</td>
<td>.681</td>
</tr>
<tr>
<td>Water activity</td>
<td>196.09</td>
<td>0.08</td>
<td>2.42</td>
<td>0.016</td>
<td>.813</td>
</tr>
<tr>
<td>Building</td>
<td>78.82</td>
<td>0.07</td>
<td>2.19</td>
<td>0.029</td>
<td>.955</td>
</tr>
</tbody>
</table>

The unstandardised coefficients are the coefficients of the regression model and account for the different scales of the variables. To compare the relative influence of each variable, the standardised coefficients and the t-values are appropriate. These show that transport variables are important in explaining energy intensity, especially the camper van, domestic air, coach, and the rental and private car. The stay at homes, although being highly significant in the simple regression, did not explain enough unique variation to enter the model. The same applies for most attraction/activity variables.

4.2.3 Factor analysis of recreational tourist activities

The data set was appropriate for factor analysis with the Sampling Adequacy being 0.614. Five factors (eigenvalue >1) were extracted, explaining 64.1% of the variance. The highest loading for each variable, if larger than 0.35, was used to assign this variable to a factor (Table 26).

The first factor ‘Scenic gazing & theme attractions’ included typical New Zealand tourist activities, such as scenic flights and boat cruises, and amusement attractions (e.g. Shantytown on the West Coast or the International Antarctic Centre in Christchurch). A ‘Nature & interpretation’ factor includes nature activities and buildings. Visited buildings were in many cases DoC Visitor Centres that are close to National Parks where many nature activities take place. Tourist attractions within a man-made environment, for example wine trails, botanical gardens or managed
wildlife parks, loaded highly on an 'Urban attraction' factor, while a 'Fun & action' dimension included adventure activities (often jet boating or bungee jumping) and entertainment attractions (bar, casino, shopping). Finally, the 'Natural and cultural heritage' factor contained cultural performances (Maori), and nature attractions (e.g. Waitomo glow-worm caves, geothermal attractions in Rotorua). The factor scores were calculated for each tourist and serve as new 'variables' to describe recreational travel choices. This reduced the total number of variables from 29 to 23: twelve transport and six accommodation variables, and the five attraction/activity factors.

Table 26: Factors extracted from eleven attraction/activity categories
(international West Coast tourists)

<table>
<thead>
<tr>
<th>Factor</th>
<th>Loading</th>
<th>Eigenvalue</th>
<th>% of variance expl.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor 1: Scenic gazing &amp; theme attr.</td>
<td>0.760</td>
<td>2.29</td>
<td>20.8</td>
</tr>
<tr>
<td>Air activity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motorised water activity</td>
<td>0.754</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amusement</td>
<td>0.551</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factor 2: Nature &amp; interpretation</td>
<td></td>
<td>1.52</td>
<td>13.8</td>
</tr>
<tr>
<td>Nature activities</td>
<td>0.818</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buildings</td>
<td>0.766</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factor 3: Urban attractions</td>
<td></td>
<td>1.19</td>
<td>10.8</td>
</tr>
<tr>
<td>Industry</td>
<td>0.736</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parks</td>
<td>0.640</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factor 4: Fun &amp; action</td>
<td></td>
<td>1.06</td>
<td>9.7</td>
</tr>
<tr>
<td>Adventure activity</td>
<td>0.771</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other entertainment</td>
<td>0.668</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factor 5: Natural/cultural heritage</td>
<td></td>
<td>1.00</td>
<td>9.1</td>
</tr>
<tr>
<td>Performance</td>
<td>0.802</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nature attractions</td>
<td>0.693</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1.2.4 Segmentation: Tourist types and energy types

Clustering process

A critical presupposition of cluster analysis is to have a representative sample and to remove extreme values, because both variables with a high measurement error and outliers may distort the structure (Hair et al., 1998). Having examined the outliers, it was decided not to exclude them from the analysis, since they may represent an under-sampled group containing important features of a segment. It is generally argued that the deletion of outliers may result in a tautology confirming 'standard solutions' (Klecka, 1980). The data were also analysed with regard to multicollinearity, and the option of performing a factor analysis before clustering was considered. A loss of information occurs with factor analysis, as only a proportion of
the original variance is expressed in the factor solution (Hair et al., 1998), and with a comparatively small number of variables (23) this option was not exercised.

In this analysis, the clustering process indicated major discontinuities for both a four and a nine-cluster solution. Therefore, each solution (ranging from four to nine) was computed for comparison. The four-cluster solution contained a large cluster of tourists using hotels and motels that split into two almost equal parts in the five-cluster solution. These two new clusters separated tourists travelling with rental cars and by coach tours. The six-cluster solution, then, split the ‘coach tour’ type into a budget coach tourist staying in B&Bs, and one tending to stay in hotels. The seven-cluster solution produced a new cluster with tramping (hiking) tourists emerging from a previous ‘camping’ cluster. The cluster solution of eight and nine clusters, respectively, separated motorcyclists and cyclists from the ‘camping’ cluster. Since both groups represent only marginal proportions of the total international tourist flow (0.3% and 0.4%, respectively, TNZ, 2001a), it was reasoned, that a seven cluster solution best reflects tourist types travelling on New Zealand’s West Coast.

To explore how different sets of variables would affect the cluster solution, additional cluster analyses based on transport variables only, accommodation variables only, and on transport, accommodation and the original set of eleven recreational variables were undertaken. Interestingly, four distinct types of tourists emerged in every analysis. These were ‘camping’ and ‘coach’, ‘visiting friends/relatives (VFR)’ type, and ‘backpacker’. The main difference between the cluster analyses was the assignment of cases with high scores on obviously less distinct variables, such as the train, domestic air, the motel, B&B, and attraction and activity variables into existing clusters or the appearance of new clusters containing these cases (e.g. the ‘soft comfort traveller’ described below). The relative certainty about cases with extreme or clear scores compared to those with complex patterns was also found in a cluster analysis on hosts’ reactions toward tourism events (Fredline & Faulkner, 2000).
Profile of clusters

The key distinguishing features of each cluster are outlined in Table 27. For example, 61% of the ‘camper’ travelled by camper van with an average travel distance of 132 kilometres per day. Similarly, ‘coach tourists’ travelled mainly by coach (87%) and stayed at hotels (95%). Also, they scored highly on the ‘Scenic gazing & Theme attractions’ and the ‘Natural and cultural heritage’ factors, which indicates coach tourists’ preference for tourist icons. In addition to typical travel choices, tourist types were also characterised by socio-economic and trip-characteristic variables. Not surprisingly, it was found that the ‘backpacker’ and the ‘trampler’ were generally younger, stayed longer and were more likely to be students. Not much emphasis was given to the nationality, due to the bias towards German speaking tourists.

Statistically significant differences at the 5%-level between the clusters (tourist types) were found for all metric variables, except the ‘long distance travel experience’, ‘total expenditures’, and ‘expenditure for shopping’. Chi-square analysis of non-metric variables revealed that all differed significantly for the clusters, except for ‘gender’ and the ‘consumption of bottled drinks’.
Table 13: Tourist types resulting from a cluster analysis on 23 travel choices (international West Coast tourists) and key characteristics

<table>
<thead>
<tr>
<th>Tourist type</th>
<th>N; % of sample</th>
<th>Travel choice variables used in cluster analysis. Proportion of tourists and means</th>
<th>Other key variables for each type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camper</td>
<td>51; 18.7%</td>
<td>61% camper van (132km/day) 16% cycle 96% camping ground Nature &amp; Interpretation score: 0.23</td>
<td>Mean length of stay: 37 days 69% couple 41% professional 45% Germany</td>
</tr>
<tr>
<td>Backpacker</td>
<td>50; 18.3%</td>
<td>60% shuttle (17 km/day) 48% backpacker bus (100 km/day) 36% domestic air (23 km/day) 96% hostel Fun &amp; Action score: 0.33; Natural and cultural heritage score: 0.30</td>
<td>Mean length of stay: 32 days 36% travelled alone 42% couple Mean age: 31 70% younger than 35 22% Student</td>
</tr>
<tr>
<td>Visit friends and relatives (VFR)</td>
<td>49; 17.9%</td>
<td>84% private car (77 km/day) 100% home</td>
<td>Mean length of stay: 48 days 41% main purpose VRF 29% second purpose VFR 27% UK</td>
</tr>
<tr>
<td>Auto tourist</td>
<td>45; 16.5%</td>
<td>98% rental car (163 km/day) 80% hotel; 76% motel Urban attractions score: 0.65 Scenic gazing &amp; Theme attractions scores: 0.40; Nature &amp; Interpretation score: 0.37</td>
<td>Mean length of stay: 23 days 49% couple 38% family group 55.5% aged 25 to 44 0.6 restaurant visits / day 40% professional 18% managerial 22% USA</td>
</tr>
<tr>
<td>Coach tourist</td>
<td>39; 14.3%</td>
<td>87% coach (203 km/day) 26% domestic air (91.6 km/day) 95% hotel Scenic gazing &amp; Theme attractions Themes score: 0.74; Natural and cultural heritage score: 0.44</td>
<td>Mean length of stay: 16 days 0.83 restaurant visits / day 87% tour group 85% pre-booked Mean age: 51 26% retired</td>
</tr>
<tr>
<td>Tramper</td>
<td>22; 8.1%</td>
<td>100% tramping (3.3 km/day) 91% shuttle (10.0 km/day) 55% private car (56.5 km/day) 100% campground; 82% hostel</td>
<td>Mean length of stay: 58 days 55% travelled alone; 8 National Parks 32% student; 50% aged 25 to 34 14% Israel</td>
</tr>
<tr>
<td>Soft comfort traveller</td>
<td>17; 6.2%</td>
<td>53% coach (183 km/day) 35% tramping (1.5 km/day) 100% B&amp;Bs or budget hotels 65% hotel Fun &amp; Action score: 0.41; Natural and cultural heritage score: 0.37</td>
<td>Mean length of stay: 32 days 47% travelled alone 41% tour group 70.6% male</td>
</tr>
</tbody>
</table>

Validation of tourist types

The discriminant analysis of the seven tourist types produced six significant discriminant functions, with the amount of variance explained ranging from 28.8% for function one to 8.1% for function six. Fifteen out of the 23 variables entered the model. Each function was named according to the travel choice, which had the highest loading. For example, the first discriminant function, the ‘camping dimension’, was
strongly positively correlated with campgrounds (loading: 0.617) and the camper van (0.318). Similarly, there were a ‘backpacker’, ‘tramp & home’, ‘coach’, ‘rental car’, ‘B&B’ dimension (Table 28). The described dimensions are reflected in the group centroids. According to this, the ‘Camping tourist’ scores highly on the ‘camping dimension’, and so forth.

Table 28: Structure matrix with variables’ loadings on six discriminant functions (international West Coast tourists)

<table>
<thead>
<tr>
<th>Function</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camping</td>
<td>0.617</td>
<td>-0.364</td>
<td>0.064</td>
<td>0.115</td>
<td>0.011</td>
<td>-0.119</td>
</tr>
<tr>
<td>Hotel</td>
<td>-0.437</td>
<td>-0.225</td>
<td>-0.159</td>
<td>0.294</td>
<td>0.289</td>
<td>-0.227</td>
</tr>
<tr>
<td>Camper van</td>
<td>0.318</td>
<td>-0.259</td>
<td>-0.103</td>
<td>-0.005</td>
<td>0.132</td>
<td>0.063</td>
</tr>
<tr>
<td>Urban attractions</td>
<td>-0.148</td>
<td>0.068</td>
<td>-0.055</td>
<td>0.103</td>
<td>0.089</td>
<td>-0.018</td>
</tr>
<tr>
<td>Nature &amp; interpretation</td>
<td>0.119</td>
<td>-0.007</td>
<td>-0.109</td>
<td>0.017</td>
<td>-0.069</td>
<td>-0.004</td>
</tr>
<tr>
<td>Cycle</td>
<td>0.113</td>
<td>-0.092</td>
<td>-0.034</td>
<td>0.000</td>
<td>0.045</td>
<td>0.019</td>
</tr>
<tr>
<td>Motorcycle</td>
<td>0.070</td>
<td>-0.056</td>
<td>-0.026</td>
<td>-0.003</td>
<td>0.032</td>
<td>0.018</td>
</tr>
<tr>
<td>Backpacker hostel</td>
<td>0.212</td>
<td>0.710</td>
<td>-0.160</td>
<td>0.165</td>
<td>0.199</td>
<td>-0.039</td>
</tr>
<tr>
<td>Backpacker bus</td>
<td>0.059</td>
<td>0.306</td>
<td>-0.129</td>
<td>0.065</td>
<td>0.135</td>
<td>0.049</td>
</tr>
<tr>
<td>Shuttle bus</td>
<td>0.051</td>
<td>0.160</td>
<td>-0.003</td>
<td>0.096</td>
<td>0.021</td>
<td>-0.067</td>
</tr>
<tr>
<td>Natural /cultural heritage</td>
<td>-0.044</td>
<td>-0.149</td>
<td>-0.007</td>
<td>-0.040</td>
<td>0.087</td>
<td>0.008</td>
</tr>
<tr>
<td>Private car</td>
<td>-0.036</td>
<td>0.049</td>
<td>0.341</td>
<td>-0.277</td>
<td>0.074</td>
<td>-0.001</td>
</tr>
<tr>
<td>Scenic gazing &amp; themes</td>
<td>-0.111</td>
<td>-0.090</td>
<td>-0.150</td>
<td>0.098</td>
<td>0.058</td>
<td>-0.077</td>
</tr>
<tr>
<td>Home</td>
<td>-0.118</td>
<td>0.050</td>
<td>0.475</td>
<td>-0.631</td>
<td>0.122</td>
<td>0.148</td>
</tr>
<tr>
<td>Coach</td>
<td>-0.404</td>
<td>-0.241</td>
<td>0.027</td>
<td>0.563</td>
<td>0.397</td>
<td>0.235</td>
</tr>
<tr>
<td>Scheduled coach</td>
<td>0.062</td>
<td>-0.001</td>
<td>0.130</td>
<td>0.142</td>
<td>0.068</td>
<td>0.017</td>
</tr>
<tr>
<td>Rental car</td>
<td>-0.103</td>
<td>0.021</td>
<td>-0.308</td>
<td>-0.198</td>
<td>-0.480</td>
<td>-0.212</td>
</tr>
<tr>
<td>Motel</td>
<td>-0.113</td>
<td>-0.067</td>
<td>-0.161</td>
<td>-0.180</td>
<td>-0.330</td>
<td>-0.199</td>
</tr>
<tr>
<td>Fun &amp; action</td>
<td>-0.052</td>
<td>0.066</td>
<td>-0.048</td>
<td>0.005</td>
<td>0.141</td>
<td>0.077</td>
</tr>
<tr>
<td>Train</td>
<td>-0.067</td>
<td>0.030</td>
<td>-0.045</td>
<td>-0.006</td>
<td>-0.104</td>
<td>-0.023</td>
</tr>
<tr>
<td>Domestic air</td>
<td>-0.052</td>
<td>-0.028</td>
<td>-0.023</td>
<td>0.006</td>
<td>-0.054</td>
<td>-0.019</td>
</tr>
<tr>
<td>B&amp;B</td>
<td>-0.074</td>
<td>-0.072</td>
<td>0.024</td>
<td>0.210</td>
<td>-0.531</td>
<td>0.700</td>
</tr>
<tr>
<td>Tramping</td>
<td>0.151</td>
<td>0.113</td>
<td>0.515</td>
<td>0.433</td>
<td>-0.408</td>
<td>-0.534</td>
</tr>
</tbody>
</table>

By comparing partial F-values (F to remove) and potency indices (Hair et al., 1998), the ‘campground’ travel choice and the ‘backpacker accommodation’ were identified as the most important discriminators between the tourist types. ‘Tramping’, ‘homes’, and ‘coach travel’ were further key variables to distinguish tourist types. The clear separation of tourist types based on the ‘camping’ and ‘backpacking’ discriminant function (explaining 28.8% and 23.1% of the variance) can be seen in Figure 25, where the ‘camper’, the ‘coach tourist’ and the ‘backpacker’ are most apart, defining a triangle in which the remaining four groups fit.

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The value of the cluster solution was further confirmed by ‘classification analysis’ that achieved a successful classification of 92.7% for the original sample (leave-one out sample: 91.2%). For comparison, a mere random assignment would result in a proportion of 15.9% correctly classified cases (proportional chance criterion, Hair et al., 1998). An attempt to classify tourists into seven clusters based on their demographics age, sex, nationality, and the length and purpose of trip failed. This discriminant analysis achieved a successful classification rate of only 48.0% (leave-one out sample: 42.6%). This confirms the usefulness of clustering tourists based on their travel choices.
Are tourist types energy types?

As stated above the energy intensity is the appropriate measure to compare different travel styles. For this reason, energy use per day is analysed first, followed by a comparison of total energy use among the seven tourist types.

Energy use per day differed for the seven tourist types (Figure 26) with ANOVA being highly significant ($F = 20.3$, df = 6, 266, $p < 0.001$). The ‘coach tourist’ had the most energy intensive travel pattern with 536 MJ per day, which differed significantly from even the second most energy intensive travel pattern, the ‘soft comfort traveller’ (431 MJ/day). The ‘auto tourist’ and the ‘camper’ did not differ significantly in energy use per day (321 MJ/day and 310 MJ/day, respectively). The ‘camper’ and the ‘backpacker’ were not statistically different with regard to energy intensity, neither were the ‘backpacker’, the ‘VFR’ type, and the ‘tramper’. These, sometimes referred to ‘budget travellers’, were most energy efficient with an energy use per day ranging from 205 MJ (VFR) to 250 MJ (Backpacker).

![Figure 26: Energy use per day for the seven international West Coast tourist types. The continuous horizontal line shows the mean energy use per day of 314 MJ.](image-url)
A very different picture emerged when total energy use of the seven tourist types was compared (Figure 3). Again, ANOVA showed that the groups differed significantly ($F=8.9, df=6, 266, p<0.001$). The ‘coach tourist’ consumed 8,056 MJ, which was somewhat below the average of 8,163 MJ. In contrast, the ‘tramper’ used most energy of all types (10,351 MJ), which results from their length of stay of about 58 days. The ‘soft comfort traveller’ consumed energy above the average due to their elevated energy intensity combined with an above-average length of stay (32 days).

![Figure 27: Total energy use for the seven international West Coast tourist types. The horizontal line shows the mean total energy use of 8,163 MJ.](image)

Not only energy intensity and total energy use differed for the tourist types, but also their energy profile. While the camper van tourist spent the largest proportion of energy on transport (75%) and somewhat understandably consumed least energy for accommodation (13%), the ‘auto tourist’ consumed least for transport (57%), and consequently more on accommodation (27%) and attractions/activities (16%). At 18% of their total energy use, the ‘backpacker’ spent relatively most energy on attractions and activities (Figure 28).
1.2.5 Discussion

General comments on travel itineraries

New Zealand tourists travelling in remote regions, such as the West Coast of the South Island, are not representative of the national average; they constitute a unique sub-sample of national tourist flows. It was found that West Coast tourists stay longer, which confirms earlier results of Pearce (1992), who showed that visitors to Westland National Park (West Coast) generally have longer holidays compared with other overseas visitors. Trip length (total time away from home) may differ considerably from the length of stay in New Zealand, which indicates multi-country travel. In the case of New Zealand West Coast tourists, an average tourist’s trip length is more than double their length of stay in New Zealand, supporting Oppermann’s (1995) findings that New Zealand is a popular destination for round-the-world travellers.

Also, individual travel options (as opposed to ‘packaged’) dominate on the West Coast, manifesting in the high use of cars and camper vans, and in the popularity of backpacker hostels and campgrounds as accommodation choices. West Coast tourists
have a strong nature focus when choosing attractions and activities. Overall, international West Coast tourists’ travel patterns, particularly the high proportion of those visiting both the North and the South Island indicate that patterns are characterised by ‘trip chaining’, that is tourists travelling from one place to another without a main single destination (Lue, Crompton & Fesenmaier, 1993). This feature of multi-destination trips, prevalent among New Zealand tourists in general (Oppermann, 1995), appears to be particularly frequent for West Coast tourists.

**Travel choices and tourists’ energy use**

Multi-destination trips are more diverse and, thus more complex than single-destination trips. The diversity of travel choices associated with multi-destination trips partly explains the large variation in individual energy use of West Coast tourists. The analysis of energy use was based on 30 travel options, among which West Coast tourists chose to compose their ‘holiday package’: fourteen in the transport sector, five in the accommodation sector, and eleven categories in the attraction and activity sector. Each of these options is characterised by a specific travel behaviour and energy intensity. For example, an international (West Coast) coach tourist travels on average 2,788 km consuming 4,186 MJ. For the accommodation sector, hotels are most important in terms of energy use. Several options to increase the efficiency of hotels have been discussed in *Chapter 3 – Accommodation*. Holiday and private homes are another popular accommodation choice. Private homes are traditionally part of the residential sector and already constitute a target for energy planning in New Zealand through EECA (2000).

With twelve attractions/activities visited on average, tourist attractions and activities are important to international West Coast tourists. For this sub-sector, the main components contributing to energy use are motorised activities. Among these, water-borne activities, such as scenic boat cruises, jet boat rides, sea fishing and sailing, as well as air-borne activities, for example scenic flights or heli-skiing, are particularly important. Tourist attractions like buildings and theme attractions, however, contribute little to the overall energy demand. Generally, urban attractions are easier to manage and energy savings can be achieved with less effort, than in the case of mobile sources of energy demand with fewer visitors.
The many travel options result in an extremely diverse set of total individual ‘energy bills’. To explain differences in each individual’s total energy use by different lengths of stay, regression analysis was undertaken. However, it was shown that trip length is only one factor determining the ‘energy bill’ and that daily energy use is comprised of a variety of sources. Energy use per day is subject to a large fluctuation: for example the maximum daily energy use of an international tourist (1,179 MJ) is 30 times the minimum energy use (39 MJ). This indicates potential for energy reductions, particularly in transport. The transport choices domestic air, coach, or camper van show a large overall energy use and energy intensity. Similarly, tourists who stay at hotels are likely to generally use an above-average amount of energy. Energy use of a tourist, both as a total and as energy intensity, is clearly dominated by the transport component with a contribution of 65%. This proportion even exceeds Lange’s (1995) (cited in Høyer, 2000) estimate of 40-60% of tourists’ overall environmental impacts resulting from transport, and another 20-30% being related each to catering (hospitality) and leisure activities.

Tourists types

The analysis has shown that market segmentation based on travel choices is a valid and relevant concept for understanding energy demand. The resulting tourist types are based on a set of tourists who included the West Coast in their New Zealand itinerary and therefore may differ from the larger national set.

A prior factor analysis revealed typical patterns of recreational activities. For example, tourists who engage in adventure activities are also likely to visit entertainment attractions. The factor analysis showed that certain ‘bunches of attractions/activities’ could be promoted together, especially in combination with knowledge on what tourist types prefer what packages. Tourist types for the sub-set of West Coast travellers have been identified through cluster analysis on travel choices. In accordance with the unique attraction of the West Coast as a rugged and remote ‘off-the beaten track’ region, a ‘camper’, including cyclists and motorcyclists, and a ‘backpacker’ are the most prevalent tourist types. Both types are generally described as ‘independent travellers’ (for example in the marketing research by TNZ, 2001b). The ‘trapper’ is another type of independent traveller, undertaking overnight tramps during a long stay in New Zealand. Other types are a ‘visiting friends/relatives (VFR)’
type travelling by private car and staying at private or rented homes, an ‘auto tourist’ using rental cars and staying at hotels or motels, and a short staying ‘coach tourist’ travelling as part of a pre-booked package coach tour. The coach tourist matches the marketing target group of a tourist “…seeking a structured and secure holiday in an organised group” (TNZ, 2001b). Finally the ‘soft comfort traveller’ is a modification of the ‘auto tourist’ and the ‘coach tourist’, who prefers to stay at budget hotels and B&Bs. The seven types have been tested and validated and emerged as a solid and useful basis for planning and marketing in general, especially for the purpose of addressing energy issues.

The analysis of the tourist types’ energy use revealed the ‘coach tourist’ by far as the largest consumer of energy per day (536 MJ). This surprises, since coach travel is generally considered more energy efficient than other transport modes. However, this result can be explained by the ‘tight’ travel schedules requiring large travel distances per day, the use of energy-intensive hotels and the participation in generally energy-intensive tourist activities, such as scenic flights and boat cruises. In a marketing study, TNZ (2001b) recognised that “Coach tour visitors find the tight, demanding schedules stressful…” and that “…it is difficult for them to experience the people and culture in New Zealand”. In response to this finding, TNZ suggested developing new products that convey a sense of the New Zealand way of life. The option of reducing travel distances by focusing on one island or staying longer in one region have not yet been explored, but would offer a promising way to reduce energy use of coach tourists. This becomes even more important considering that coach tourism, especially for visitors from Asia, plays a much bigger role in the national context compared with the West Coast.

In contrast to the ‘coach tourist’, the ‘budget travellers’, namely the ‘VFR’, ‘backpacker’ and ‘tramper’ travel relatively energy efficiently. This is mainly a result of longer stays in New Zealand, and thus shorter travel distances per day. Also, the stay at budget accommodation (backpacker hostels, camping grounds, private homes) and sharing of facilities contributes to their low energy intensities. Tourists who travel independently but use a personal (rental) vehicle are characterised by an intermediate use of energy per day. These are typically the camping and rental car (auto) tourists.
Energy use per day is only one measure to assess energy consumption of different tourist types. Total energy use has the advantage of taking different lengths of stay in the country. It has been shown that tourists who travel comparatively efficiently are not always the ones who consume least energy in total. In contrast, it is often the ‘budget travellers’ who stay longer, and as a result, require considerable energy input during their stay. Coach travel has been identified as an (energy)-intensive form of travel, however, the overall (energy) impact of these tourists (coach tourists) is smaller compared with long-term travellers.

The energy profile of each tourist types provides additional information on what holiday components are most important to the energy bill of the different tourist types. This is particularly important for considerations of greenhouse gas emissions. Emissions per unit of energy are larger for transport (combustion of fossil fuels) compared with accommodation, where three quarters of energy use are electricity-based (see Chapter 3 – Accommodation).

This analysis offers first insight into different tourist types and their respective travel and energy consumption patterns. These have been specified for the seven tourist types of New Zealand’s West Coast. It is important to note that these types reflect a regional picture only and that this may differ for other regions.
4.3 Domestic tourists

4.3.1 Methodology

Data source: the Domestic Travel Study

The Domestic Travel Study (DTS) was funded by the Foundation for Research, Science and Technology (FRST) and carried out by Forsyte Research in 1999\textsuperscript{31}. The objectives were to "...provide estimates of the size of the domestic travel market (...) to a regional level..." and to "...provide estimates of the direct expenditure impact of domestic travel in New Zealand" (Forsyte Research, 2000, p. 5). When referring to the DTS hereafter, Forsyte Research will not be cited each single time. The DTS was undertaken within the period from 18 January 1999 to 17 January 2000 with 17,037 completed telephone interviews. The sampling procedure and questionnaire design are described in Forsyte Research (2000). Of all interviewees, 5,765 made at least one overnight trip (outside their usual environment for at least one night but less than 12 months) in the previous four weeks. By weighting the sample Forsyte Research estimated a total number of 16.594 million overnight trips in 1999. Day-trippers, while also sampled by Forsyte Research, were not included as tourists in this study. All overnight trips from which the respondent had returned in the four weeks before the interview were recorded. If several trips were recalled, one was randomly selected for more specific information, including attractions visited and activities undertaken. Apart from general information on their trip and demographics, tourists reported their travel itinerary, transport modes and accommodation types. For this purpose 'travel sectors' were introduced, that is travel between two overnight stops, whereas their residential home is the starting point for the first travel sector, and the finish place for the last sector.

Sample profile

The final sample of domestic tourists included 5,455 tourists and 7,737 overnight trips. Of the reduced sample (see below), each tourist undertook on average 1.4 trips with a trip length of 3.2 nights. One third made a one-night trip (32.4%), another 28.8% stayed two nights, 14.1% stayed three nights away from home, and the

\textsuperscript{31} The data were provided through the Spatial Analysis Facility at the University of Auckland (see also Chapter 4 - International tourists).
remaining 24.7% stayed for more than three nights. Males (49.3%) and females (50.7%) were equally represented in the sample. The largest proportion of respondents was in the age group of 25 to 44 years (44.2%). Other age groups were 15 to 24 years (22.3%), 45-69 years (28.7%) and 70 years or older (4.8%). Most trips were for visiting friends or relatives; holiday ranked second and business ranked third. Table 29 shows the frequency of various travel purposes aggregated to generic categories.

<table>
<thead>
<tr>
<th>Category</th>
<th>Comprises</th>
<th>Frequency</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VFR</td>
<td>Visit friends, visit relatives, baby sit, reunion, club meeting, Xmas/Easter</td>
<td>2,793</td>
<td>36.1</td>
</tr>
<tr>
<td>Holiday</td>
<td>Holiday, sports, concert/event, drive, visitors, school trip, sightseeing, dine out, hot pools, zoo, casino, vineyard, honeymoon, prize, fishing, tramping, camping, picnic, hunting, skiing, movies, sailing/surfing, America’s cup</td>
<td>2,570</td>
<td>33.2</td>
</tr>
<tr>
<td>Business</td>
<td>Business, conference, work experience, interview, other business</td>
<td>1,496</td>
<td>19.3</td>
</tr>
<tr>
<td>Other</td>
<td>Health, graduation, pick up/drop off someone, house hunting, airport, shifting, church, holiday home maintenance, don’t know, refused</td>
<td>878</td>
<td>11.3</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>7,737</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Most tourists travelled together with one other person, often with their partner (20.6%) or a family member (20.3%). One fourth of tourists travelled alone (Table 30, Table 31).

<table>
<thead>
<tr>
<th>Group size</th>
<th>Frequency</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1973</td>
<td>25.5</td>
</tr>
<tr>
<td>2</td>
<td>2676</td>
<td>34.6</td>
</tr>
<tr>
<td>3</td>
<td>984</td>
<td>12.7</td>
</tr>
<tr>
<td>4</td>
<td>998</td>
<td>12.9</td>
</tr>
<tr>
<td>5</td>
<td>407</td>
<td>5.3</td>
</tr>
<tr>
<td>6+</td>
<td>699</td>
<td>9.0</td>
</tr>
<tr>
<td>Missing</td>
<td>7</td>
<td>0.1</td>
</tr>
<tr>
<td>Total</td>
<td>7,737</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Travel party</th>
<th>Frequency</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Friends/ mixed company</td>
<td>1620</td>
<td>20.9</td>
</tr>
<tr>
<td>Partner</td>
<td>1595</td>
<td>20.6</td>
</tr>
<tr>
<td>Family</td>
<td>1574</td>
<td>20.3</td>
</tr>
<tr>
<td>Business associates</td>
<td>401</td>
<td>5.2</td>
</tr>
<tr>
<td>Friend</td>
<td>250</td>
<td>3.2</td>
</tr>
<tr>
<td>Special interest group</td>
<td>209</td>
<td>2.7</td>
</tr>
<tr>
<td>School group</td>
<td>31</td>
<td>0.4</td>
</tr>
<tr>
<td>Bus passengers</td>
<td>19</td>
<td>0.2</td>
</tr>
<tr>
<td>Don’t know or other</td>
<td>9</td>
<td>0.2</td>
</tr>
<tr>
<td>Missing</td>
<td>1910</td>
<td>24.7</td>
</tr>
<tr>
<td>Total</td>
<td>7,737</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Maori represented 8.6% of the sample; Asian and Chinese were the largest minorities with 0.8% and 0.6%, respectively. New Zealand Pakeha/Europeans made up 86.7%, which is larger than their proportion in New Zealand’s population of 79.6% in 1999 (Statistics New Zealand, 2001). This means that Pakeha were either over-sampled (at the expense of mainly Maori who constitute 14.5% of New Zealand’s population), or they are more likely to undertake an overnight trip than other ethnic groups. More than half (54.3%) of the respondents were married or lived in a de facto relationship; 31.1% were never married. Forty percent had a household income of less than $50,000, while 11.5% earned more than $100,000 per year. The average expenditure was $345 per trip (median of $175), whereby business travellers spent on average $433 for a two-day trip, holiday travellers spent $405 (for 3 days median), and visiting friends/relatives tourists spent least on average with $248 per two-day trip.

Data preparation and description

The information provided in the original database required some modifications to allow for calculating tourists’ energy use. First, the number of overnight trips had to be reduced as a result of missing information on transport modes and travel locations (295 cases deleted). This information would be fundamental in the context of energy use calculations. Furthermore, three interviewees who travelled on an army truck were excluded from the analysis. Twelve cases were deleted due to unrealistic itineraries, such as Nelson to Northland return by camper van for one night or Auckland to Invercargill return by car for one night. For the multivariate analysis (see below) the transport modes ‘private plane’ and ‘helicopter’ (although treated separately for the calculation of transport energy use) were combined into ‘air travel’.

Reconstructing itineraries

The main step in the data processing was the expansion of tourist itineraries. This was necessary, when tourists used two or more transport modes during a single travel day. This mainly involved tourists, who crossed Cook Strait or used any other ferry. Because tourists did not usually start their travel at the departure harbour (e.g. Picton) and finish the sector at the arrival harbour (e.g. Wellington), this leg was usually not reported separately. Also, itineraries of tourists travelling by plane and using another transport mode to or from the airport required expansion. After expanding multiple transport itineraries, the reported transport modes were assigned to the new travel sectors. For example, a tourist who travelled from Lower Hutt to Christchurch by car
and plane was assigned two travel sectors, one from Lower Hutt to Wellington by car, and one from Wellington to Christchurch by plane.

**Travel distances**

The reconstruction and completion of itineraries served as a basis of the calculation of travel distances, which in turn are required to calculate energy use. For this purpose the original 9,860 different locations throughout New Zealand were condensed to 142 new ‘representative locations' (Figure 29). The key locations were identified as follows: in the original database the locations had been coded by the district they belong to. Each of the 79 coded districts was now assigned a key location (city), based on size (and thus significance in terms of travel origin or destination) and geographical position, ideally in the centre of the district. The aim was to identify a city that is representative for a district and, thus, minimises the error in distances associated with locations within a district other than the denominated key location. For example, Hawera represents the South Taranaki district, Picton the Marlborough district, and Twizel the Mackenzie District. In addition, a list of the 150 most frequented locations (including many of the above described district key locations) within the sample revealed popular places that needed to be coded separately. These include, for example, Russell and Pahia in the Bay of Islands, Whitianga on Coromandel Peninsula, and Blenheim and Methven in the South Island. Additionally, remote tourist locations not accounted for in the top 150 were coded. Milford Sound, Stewart Island, and Mt. Cook are examples of such locations. All together 63 locations were coded in addition to the already identified key locations.

Once the representative locations were defined, travel distances were calculated based on distances provided in auto maps (AA, 1997). No distinction was made between distances for road and rail travel. However, air travel was treated separately, using a mileage table from Air New Zealand. This proved to be useful, since distances are significantly shorter for some routings travelled by air compared with land-based travel (on average by about 20%). Auckland to Wellington, for example, is 660 km by car and only 480 km by air. Tourists, who reported air travel from one location to another, where no direct flights exist (e.g. Whangarei to Christchurch), were assigned the most likely routing of existing connections (e.g. Whangarei to Auckland and further on to Christchurch). All together, there were 3,303 different travel sectors (note: Auckland – Wellington and Wellington – Auckland count as two sectors) that
were assigned a travel distance either on land or by air or both. These travel distances were then linked with each tourist’s itinerary and total travel distances broken down by transport mode could be calculated.

Figure 29: Coded representative locations (142) to describe domestic travel (Map: Kelly & Marshall, 1996).
Transport variables

The diverse transport choices reported by domestic tourists were integrated in transport modes already analysed in terms of energy intensity (Chapter 3 – Transport). The recoding into 12 transport modes is displayed in Table 32, along with key statistics. The statistics are calculated for the whole sample of 7,737 tourists, and, hence, also include those who did not use a specific transport mode and scored zero for it. It can be seen that none of the variables is normally distributed, and that all of them are characterised by extremes towards the larger end of travel distances. A large mean travel distance either results from many tourists using the specific mode (and few scoring zero) or from few tourists using it extensively. The private car had the largest mean (189 km), and was also the only transport mode that was chosen by more than half of all tourists (median of 140 km). Forsythe Research did not collect ‘tramping’ as transport variable, but as a recreational activity. For this reason it was included in the attraction/activity sub-sector.

Table 32: Transport variables for domestic tourists (N= 7,737)

<table>
<thead>
<tr>
<th>Mode</th>
<th>Comprises</th>
<th>Scale</th>
<th>Mean</th>
<th>SD</th>
<th>Skewness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private car</td>
<td>Private car</td>
<td>Km/day</td>
<td>189.1</td>
<td>219.3</td>
<td>2.9</td>
</tr>
<tr>
<td>Domestic air</td>
<td>Domestic air, helicopter, plane</td>
<td>Km/day</td>
<td>68.2</td>
<td>227.9</td>
<td>4.4</td>
</tr>
<tr>
<td>Company car</td>
<td>Company car</td>
<td>Km/day</td>
<td>14.7</td>
<td>83.9</td>
<td>7.9</td>
</tr>
<tr>
<td>Rental car</td>
<td>Rental car, taxi, limousine</td>
<td>Km/day</td>
<td>4.8</td>
<td>46.7</td>
<td>14.8</td>
</tr>
<tr>
<td>Scheduled bus</td>
<td>Inter-city service, shuttle bus</td>
<td>Km/day</td>
<td>4.5</td>
<td>40.6</td>
<td>13.7</td>
</tr>
<tr>
<td>C. S. Ferry</td>
<td>Cook Strait Ferry</td>
<td>Km/day</td>
<td>1.0</td>
<td>10.5</td>
<td>13.8</td>
</tr>
<tr>
<td>Camper van</td>
<td>Rental and private camper van, private bus, truck</td>
<td>Km/day</td>
<td>1.0</td>
<td>15.8</td>
<td>20.5</td>
</tr>
</tbody>
</table>

Ferry

<table>
<thead>
<tr>
<th>Mode</th>
<th>Comprises</th>
<th>Scale</th>
<th>Mean</th>
<th>SD</th>
<th>Skewness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Train</td>
<td>Commercial ferry, cruise ship</td>
<td>Km/day</td>
<td>0.3</td>
<td>4.2</td>
<td>22.4</td>
</tr>
<tr>
<td>Coach</td>
<td>Train</td>
<td>Km/day</td>
<td>1.7</td>
<td>23.3</td>
<td>17.3</td>
</tr>
<tr>
<td>Yacht</td>
<td>Coach, backpacker bus&lt;sup&gt;2&lt;/sup&gt;</td>
<td>Km/day</td>
<td>2.3</td>
<td>28.3</td>
<td>15.2</td>
</tr>
<tr>
<td>Motorcycle</td>
<td>Yacht</td>
<td>Km/day</td>
<td>0.9</td>
<td>19.2</td>
<td>34.0</td>
</tr>
</tbody>
</table>

<sup>2</sup> Incorporated into coach due to small sample size of backpacker bus users (N= 2)

Accommodation variables

The accommodation categories visited by tourists were transformed into ‘accommodation travel choices’, i.e. new variables that describe how many nights in total a tourist spent at a specific category, for example in a hotel. Where more than one category of accommodation was used at one location, the number of nights was equally split between the reported accommodation categories. To this end, the original 27 accommodation variables of the DTS were condensed to the six accommodation categories discussed earlier (Table 33).
Homes were the most frequented place to spend the night during the trip; most tourists spent one night (median of 1) at homes. Hotels and motels were relatively often visited, however the standard deviations were large with a relative deviation from the mean of more than 200%. B&Bs and Backpackers were less frequented; both with an extremely positively skewed distribution. This indicates the existence of a large number of tourists who did not visit, and only few that spent many nights at these categories of accommodation.

<table>
<thead>
<tr>
<th>Category</th>
<th>Comprises</th>
<th>Scale</th>
<th>Mean</th>
<th>SD</th>
<th>Skewness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hotel</td>
<td>Luxury lodge, conference centre, licensed motel, mid-range hotel, top-class hotel</td>
<td>Nights/day</td>
<td>0.15</td>
<td>0.35</td>
<td>2.4</td>
</tr>
<tr>
<td>B&amp;B</td>
<td>Boat, pub, home stay, cruise-ship</td>
<td>Nights/day</td>
<td>0.02</td>
<td>0.12</td>
<td>7.72</td>
</tr>
<tr>
<td>Motel</td>
<td>Motel without restaurant</td>
<td>Nights/day</td>
<td>0.11</td>
<td>0.30</td>
<td>2.47</td>
</tr>
<tr>
<td>Backpacker</td>
<td>Hostel, school, recreational hall</td>
<td>Nights/day</td>
<td>0.02</td>
<td>0.12</td>
<td>7.62</td>
</tr>
<tr>
<td>Campground</td>
<td>Caravan /camp site, hut, car, camper van, outdoors</td>
<td>Nights/day</td>
<td>0.09</td>
<td>0.28</td>
<td>2.86</td>
</tr>
<tr>
<td>Home</td>
<td>Private or rented home, university, student home, bach, marae, club, convent, apartment, army</td>
<td>Nights/day</td>
<td>0.61</td>
<td>0.48</td>
<td>-0.45</td>
</tr>
</tbody>
</table>

Attractions and activities

The original list of 112 activities was condensed into the 11 energy classes described earlier. Additionally, the activities 'dined at café/restaurant', 'visit friends', and 'tramping' were extracted as separate variables. Finally, each tourist's frequency of participation in each of the original eleven plus the three new categories was defined as a new variable. It is important to note that tourists reported their recreational activities only for the one trip that was randomly selected out of all recalled trips. This means that the sample size for the analysis of attractions/activities equals the number of interviewed tourists.

Visiting entertainment establishments was most popular with domestic tourists (Table 34). This variable also displayed the smallest deviation from the normal distribution, which indicates that there were neither an unusually large number of tourists who scored zero, nor were there tourists with extremely frequent visits to such attractions. The median of all variables was zero, which means that none of the attractions/activities were visited by a majority. Of all tourists, 17.4% dined at least once in a café or restaurant. For consistency with the West Coast sample, this variable is not
included in any further analysis of attractions and activities. The reported activities of a scenic drive, non-specific walk, day trip, picnic, refreshment, business, family event (e.g. funeral), house hunting, conference, job interview, off road driving/motor biking, ice skating, motor cross, and rodeo were not included in the analysis because of little knowledge about energy use. It is assumed that some of these activities could be comparatively energy intensive, and it would be useful to include them in further energy use studies.

Table 34: Attraction/activity variables for domestic tourists (N= 7,737)

<table>
<thead>
<tr>
<th>Category</th>
<th>Comprises (not all listed)</th>
<th>Scale</th>
<th>Mean</th>
<th>SD</th>
<th>Skewness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buildings</td>
<td>Interpretation, sight seeing, museum, historic site, Parliament</td>
<td>Visits/day</td>
<td>0.07</td>
<td>0.22</td>
<td>3.80</td>
</tr>
<tr>
<td>Parks</td>
<td>Botanical garden, zoo, playground</td>
<td>Visits/day</td>
<td>0.01</td>
<td>0.08</td>
<td>11.36</td>
</tr>
<tr>
<td>Amusement</td>
<td>Experience centre, gondola, sky tower, cable car/ tram, exhibitions</td>
<td>Visits/day</td>
<td>0.02</td>
<td>0.13</td>
<td>11.33</td>
</tr>
<tr>
<td>Industry</td>
<td>Farm show, vineyard</td>
<td>Visits/day</td>
<td>0.01</td>
<td>0.08</td>
<td>10.67</td>
</tr>
<tr>
<td>Nature attractions</td>
<td>Hot pools, geothermal attraction, glow worm caves</td>
<td>Visits/day</td>
<td>0.02</td>
<td>0.11</td>
<td>8.14</td>
</tr>
<tr>
<td>Performance</td>
<td>Concert/theatre, cinema, Maori, sports event</td>
<td>Visits/day</td>
<td>0.02</td>
<td>0.13</td>
<td>6.76</td>
</tr>
<tr>
<td>Entertainment</td>
<td>Bar, shopping, casino, ball/dance</td>
<td>Visits/day</td>
<td>0.29</td>
<td>0.46</td>
<td>2.17</td>
</tr>
<tr>
<td>Air activity</td>
<td>Scenic flight, heli-skiing, air sports</td>
<td>Visits/day</td>
<td>0</td>
<td>0.02</td>
<td>32.63</td>
</tr>
<tr>
<td>Mot. water activity</td>
<td>Scenic boat cruise, whale watching, jet boating, sailing, other</td>
<td>Visits/day</td>
<td>0.02</td>
<td>0.12</td>
<td>7.79</td>
</tr>
<tr>
<td>Adventure</td>
<td>Mountain biking, bungee, climbing, skiing, rafting, kayaking</td>
<td>Visits/day</td>
<td>0.02</td>
<td>0.11</td>
<td>10.69</td>
</tr>
<tr>
<td>Nature activity</td>
<td>Bush walk, swimming, dolphins, beach, wildlife, golf, cycling, fishing, horse riding, hunting</td>
<td>Visits/day</td>
<td>0.13</td>
<td>0.30</td>
<td>3.66</td>
</tr>
<tr>
<td>Visit</td>
<td>Visit friends/relatives</td>
<td>Visits/day</td>
<td>0.17</td>
<td>0.31</td>
<td>18.20</td>
</tr>
<tr>
<td>Tramping</td>
<td>Tramping</td>
<td>Tramp/day</td>
<td>0.01</td>
<td>0.06</td>
<td>13.87</td>
</tr>
</tbody>
</table>

1) Maximum of 1, since tramping is defined to be for at least one day and one night

Data analysis

Describing and analysing energy use

In the same way as for international West Coast tourists, travel choices (energy related variables) were linked with their respective energy intensities to calculate energy use. Descriptive statistics were applied to analyse energy use associated with these travel choices as well as the total 'energy bill' of an average domestic tourist. The relative contribution of each travel choice to the sub-sectors total energy use was calculated (based on the unweighted sample).
Regression analysis was used to analyse a possible relationship between total energy use of a tourist and length of stay, and also between energy intensity and travel choices (in particular transport modes). It is, however, important to be aware that for large samples, even weak relationships could achieve significance in the statistical (not practical) sense (Moore & McCabe, 1993).

Cluster analysis
For the analysis of domestic tourist data, a non-hierarchical cluster method (K-means) was undertaken. This method (as opposed to the hierarchical analysis with a correlational measure used for international West Coast tourists) gives more weight to the actual magnitude of travel choice intensities (e.g. travel distance) and less weight to the combinations (and their relative intensities) of travel choices. This was considered more appropriate for domestic tourists, who were expected to be less diverse in their travel choices but more distinct in their intensities.

The K-means cluster analysis (SPSS) is particularly used to deal with large sample sizes (Hair et al., 1998), because it evaluates only one solution instead of the complete covariance matrix. Cluster seeds are selected randomly and cases are assigned to the closest cluster at each iteration (based on the Euclidian distance), after which the cluster centres are re-specified. This cluster method required a specification of the cluster number by the researcher beforehand. Since a ‘real’ number of cluster was unknown, several cluster solutions were computed and compared based on homogeneity, cluster sizes and meaningfulness. Tourist types were statistically tested with ANOVA for metric variables and Chi-square for other variables, and the cluster solution was furthermore validated with multiple discriminant analysis. Differences in energy use of the tourist types were tested with ANOVA.

4.3.2 Energy use associated with specific travel choices
The analysis of specific travel choices and energy use only involved tourists who selected the respective mode or category at least once.

Transport sector and energy use
The private car was by far the most commonly used transport mode (76.6%), with domestic air ranking second (13.3%), and all other modes being used by each less than five per cent (Table 35). Air travel is characterised by the longest average (mean) travel distance per day (514 km) and in total (1,052 km), which consequently resulted
in the largest energy use of 2,894 MJ. The second largest energy use was associated with camper van travel, despite a comparatively low travel distance of 170 km per day. The energy intensity associated with company cars was assumed to be the same as for rental cars. However, this is based on an average occupancy of 2.5 passengers as sampled at the West Coast, which could overestimate the actual occupancy of company cars. In the DTS, 41% of company car users reported to have travelled alone, and another 32% travelled with one other person, indicating a load factor of close to one. The actual occupancy could not be estimated from the sample, because respondents reported the size of the travel group and not the passenger number per vehicle (e.g. one company car-based trip comprised a group of 30). Camper vans, while consuming a considerable amount of energy, were only used by 1% of domestic tourists. Domestic tourists mostly relied on one transport mode: only 5.7% travelled with more than one mode.

Table 35: Transport travel choices (mean) and energy use (mean) of domestic tourists who used a mode at least once

<table>
<thead>
<tr>
<th>Mode</th>
<th>Energy intensity (MJ/km)</th>
<th>Tourists N</th>
<th>Proportion of tourists (%)</th>
<th>Distance per day (km)</th>
<th>Total distance (km)</th>
<th>Total energy use (MJ/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private car</td>
<td>1.03</td>
<td>5,924</td>
<td>76.6</td>
<td>242</td>
<td>530</td>
<td>546</td>
</tr>
<tr>
<td>Domestic air</td>
<td>2.75</td>
<td>1,027</td>
<td>13.3</td>
<td>514</td>
<td>1,052</td>
<td>2,894</td>
</tr>
<tr>
<td>Company car</td>
<td>0.94</td>
<td>354</td>
<td>4.6</td>
<td>322</td>
<td>555</td>
<td>522</td>
</tr>
<tr>
<td>Rental car</td>
<td>0.94</td>
<td>157</td>
<td>2.0</td>
<td>235</td>
<td>593</td>
<td>557</td>
</tr>
<tr>
<td>Scheduled bus</td>
<td>0.75</td>
<td>180</td>
<td>2.3</td>
<td>195</td>
<td>497</td>
<td>373</td>
</tr>
<tr>
<td>Cook Strait Ferry</td>
<td>2.40</td>
<td>143</td>
<td>1.8</td>
<td>57</td>
<td>185</td>
<td>444</td>
</tr>
<tr>
<td>Camper van</td>
<td>2.06</td>
<td>79</td>
<td>1.0</td>
<td>170</td>
<td>718</td>
<td>1,480</td>
</tr>
<tr>
<td>Ferry</td>
<td>3.53</td>
<td>83</td>
<td>1.1</td>
<td>30</td>
<td>66</td>
<td>232</td>
</tr>
<tr>
<td>Train</td>
<td>1.44</td>
<td>71</td>
<td>0.9</td>
<td>191</td>
<td>633</td>
<td>912</td>
</tr>
<tr>
<td>Coach</td>
<td>1.01</td>
<td>67</td>
<td>0.9</td>
<td>260</td>
<td>677</td>
<td>683</td>
</tr>
<tr>
<td>Yacht</td>
<td>1.75</td>
<td>51</td>
<td>0.7</td>
<td>129</td>
<td>305</td>
<td>538</td>
</tr>
<tr>
<td>Motorcycle</td>
<td>0.87</td>
<td>37</td>
<td>0.5</td>
<td>320</td>
<td>715</td>
<td>622</td>
</tr>
</tbody>
</table>

The total travel distance per tourist was calculated by adding up distances travelled with different transport modes. The average total distance was 623 km per trip, whereby short trips (1 or 2 nights) involved 496 km of travel compared with longer trips of 825 km. The reason for splitting trips based on trip length will be discussed later.

The private car contributed most to energy use within the transport sector (Figure 30), although, its share of energy use decreased to 46%, compared with 77% of tourists,
who used this mode. In contrast, domestic air, while only used by 13% of domestic tourists, contributed 43% to the total energy use. This is a result of both long travel distances and the large energy intensity of 2.75 MJ/pkm.

![Pie chart showing transport modes](image)

**Figure 30: Contribution to total energy use by different transport modes (other = Cook Strait Ferry, other ferries, camper van, train, coach, yacht, motorcycle).**

**Accommodation sector and energy use**

As can be seen from Table 36 most tourists spent at least one night in the ‘home category’ (63.6%). Tourists who stayed at homes did so almost exclusively, which can be seen from the large proportion (95% of all nights) of nights spent in this accommodation category. Domestic tourists spent on average 3.1 nights at the home category during their trip, which was associated with an average energy use of 129 MJ. Hotels were the most important commercial accommodation category, with 17% of all tourists staying there at least once. As a result of the large energy intensity of hotels, the total energy use associated with this category is largest (318 MJ), despite a relatively short stay of only 2.1 nights on average. Campgrounds were generally visited for longer stays, and are also a category, which is visited almost exclusively (95.7% of all nights). This means that a domestic camping tourist rarely stays at other accommodation categories. In contrast, B&B guests were most likely to also stay at other categories (77.2% of all nights spent in this category). Only few tourists used B&Bs (2.1%) or backpackers (2.1%).
Table 36: Accommodation travel choices and energy use (mean) of domestic tourists who visited a category at least once

<table>
<thead>
<tr>
<th>Category</th>
<th>Energy intensity</th>
<th>Tourists</th>
<th>Proportion</th>
<th>Nights spent in category (%)</th>
<th>Number of nights</th>
<th>Total energy use (MJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hotel</td>
<td>155</td>
<td>1,315</td>
<td>17.0</td>
<td>89.1</td>
<td>2.1</td>
<td>318</td>
</tr>
<tr>
<td>Motel</td>
<td>32</td>
<td>1,024</td>
<td>13.2</td>
<td>84.6</td>
<td>2.4</td>
<td>78</td>
</tr>
<tr>
<td>B&amp;B</td>
<td>110</td>
<td>162</td>
<td>2.1</td>
<td>77.2</td>
<td>2.7</td>
<td>301</td>
</tr>
<tr>
<td>Backpacker</td>
<td>39</td>
<td>162</td>
<td>2.1</td>
<td>79.2</td>
<td>2.7</td>
<td>106</td>
</tr>
<tr>
<td>Campground</td>
<td>25</td>
<td>780</td>
<td>10.1</td>
<td>89.3</td>
<td>3.5</td>
<td>88</td>
</tr>
<tr>
<td>Home</td>
<td>41</td>
<td>4,922</td>
<td>63.6</td>
<td>95.7</td>
<td>3.1</td>
<td>129</td>
</tr>
</tbody>
</table>

1) Number of nights spent in one category divided by the total number of nights stayed away from home.

The large energy use associated with hotels results in a considerable contribution of hotels (33%) to the total energy use associated with accommodating domestic tourists. Private homes or holiday homes were the largest contributor with 51% of energy use in the accommodation sub-sector. Motels (6%), campgrounds (5%), B&Bs (4%), and backpacker hostels (1%) contributed less.

**Attraction/activity sector and energy use**

Almost one third (31.1%) of all domestic tourists visited an entertainment establishment at least once, for example, a bar, a shopping mall, or a casino (Table 37). Other popular activities included visiting someone (23.0%), undertaking a nature activity (17.0%), and visiting buildings (11.2%). Most attraction visits or activities were undertaken once; buildings, entertainment establishments, and nature activities were the most likely to be visited or undertaken more often. Air and water activities were generally associated with a large energy use. A small proportion of tourists did not visit an attraction or undertake an activity (10.6%).
Table 37: Attraction/activity travel choices and energy use (mean) of domestic tourists who visited a category at least once

<table>
<thead>
<tr>
<th>Category</th>
<th>Energy intensity (MJ/visit)</th>
<th>N</th>
<th>Proportion of tourists (%)</th>
<th>Total frequency (visits per trip)</th>
<th>Total energy use (MJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buildings</td>
<td>3.5</td>
<td>868</td>
<td>11.2</td>
<td>1.4</td>
<td>6</td>
</tr>
<tr>
<td>Parks</td>
<td>8.4</td>
<td>146</td>
<td>1.9</td>
<td>1.1</td>
<td>9</td>
</tr>
<tr>
<td>Amusement</td>
<td>22.4</td>
<td>260</td>
<td>3.4</td>
<td>1.2</td>
<td>26</td>
</tr>
<tr>
<td>Industry</td>
<td>11.5</td>
<td>137</td>
<td>1.8</td>
<td>1.1</td>
<td>13</td>
</tr>
<tr>
<td>Nature attraction</td>
<td>8.5</td>
<td>214</td>
<td>2.8</td>
<td>1.2</td>
<td>10</td>
</tr>
<tr>
<td>Performance</td>
<td>12.0</td>
<td>268</td>
<td>3.5</td>
<td>1.1</td>
<td>13</td>
</tr>
<tr>
<td>Entertainment</td>
<td>6.9</td>
<td>2408</td>
<td>31.1</td>
<td>1.5</td>
<td>10</td>
</tr>
<tr>
<td>Air activity</td>
<td>424.3</td>
<td>22</td>
<td>0.3</td>
<td>1.0</td>
<td>442</td>
</tr>
<tr>
<td>Motorised water activity</td>
<td>236.8</td>
<td>308</td>
<td>4.0</td>
<td>1.2</td>
<td>272</td>
</tr>
<tr>
<td>Adventure activity</td>
<td>35.1</td>
<td>208</td>
<td>2.7</td>
<td>1.2</td>
<td>21</td>
</tr>
<tr>
<td>Nature activity</td>
<td>26.5</td>
<td>1313</td>
<td>17.0</td>
<td>1.5</td>
<td>43</td>
</tr>
<tr>
<td>Visit</td>
<td>0</td>
<td>1781</td>
<td>23.0</td>
<td>1.1</td>
<td>0</td>
</tr>
<tr>
<td>Tramping</td>
<td>0</td>
<td>60</td>
<td>0.8</td>
<td>1.2</td>
<td>0</td>
</tr>
</tbody>
</table>

Aggregated energy use

The sample sizes, means, medians and ranges for the sub-sectors and total energy use are displayed in Table 38. The apparent difference between the mean and the median indicated that the variables were not normally distributed, but strongly positively skewed. Clearly, transport was the main contributor to an individual tourist’s energy use (85.1%) (based on the medians presented in Table 38). Accommodation contributed 13.7%, while the visit of attractions/activities made up only 1.2%.

Table 38: Energy use of domestic tourists for the three sub-sectors and the entire trip

<table>
<thead>
<tr>
<th></th>
<th>Transport (MJ)</th>
<th>Accommodation (MJ)</th>
<th>Attraction/activity (MJ)</th>
<th>Total energy use (MJ)</th>
<th>Energy use per day (MJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>7,737</td>
<td>7,737</td>
<td>5,456</td>
<td>5,456</td>
<td>5,456</td>
</tr>
<tr>
<td>Mean</td>
<td>896</td>
<td>164</td>
<td>31</td>
<td>1,108</td>
<td>457</td>
</tr>
<tr>
<td>Median</td>
<td>508</td>
<td>82</td>
<td>7</td>
<td>700</td>
<td>292</td>
</tr>
<tr>
<td>Min</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>25</td>
<td>18</td>
</tr>
<tr>
<td>Max</td>
<td>10,830</td>
<td>3,300</td>
<td>1,021</td>
<td>11,913</td>
<td>7,060</td>
</tr>
</tbody>
</table>

The large range of total energy use can only partly be explained by different trip lengths. Simple linear regression for energy use and trip length resulted in an $R^2$-value of 0.153 (F= 981.9, df= 1, 5454, p<0.001), which indicates some but no strong relationship. Also, the range of energy use was similarly large for all trip lengths, with, for example, a range of 7,035 MJ and 7,091 for one-night and two-night trips, respectively, and 7,499 MJ for 10-night trips. Obviously, trip length has no major
influence on energy use, which in turn means, that shorter trips do not necessarily consume less energy than longer trips.

A normalisation of energy use by trip length is useful to compare the energy intensities of different trips. Concluding from the results above, it can be assumed that energy intensity decreases with increasing lengths of stay, simply as a result of dividing a similar total energy use by a larger number of nights. A scatterplot confirmed this trend, and regression analysis showed that 4.2% (F= 242.0, df= 1, 5,454, p<0.01) of the decreasing energy intensity for longer trips is explained by trip length. This (surprisingly) small proportion is a result of the large range of energy intensity for short trips. The energy intensity of one-night trips, for example, varied by 7,035 MJ, compared with 3,546 MJ for two-night trips, 1,095 MJ for seven-night trips, and 732 MJ for 10-night trips. The decrease in energy use per day can mainly be explained by a similar transport energy being ‘spread’ over several days; i.e. tourists travel similar distances regardless of their length of stay.

The role of transport

The previous analysis showed that transport is the main driver of energy use; and within transport the private car and air travel account for the largest share of travel distance and energy use. This dominance was confirmed by results from a simple linear regression analysis for energy use per day and different travel choices (measured as intensity, i.e. per day). Here, it was found, that most transport variables explained a considerable amount of energy intensity (calculated for tourists who used the transport mode at least once) (Table 39). Air travel explained 99% of the variance in a tourist’s energy use per day. This means, that energy use associated with travel choices other than air travel can be neglected for those who travel by domestic air. Transport modes that were used as main modes, such as the yacht, train, motorcycle, camper van, and coach, were also good predictors for energy use per day, whereas ‘secondary modes’ accounted for less, yet still significant variation. The rental car was the only transport mode that did not explain a significant amount of variance of energy use per day. The large proportion of rental car tourists who travelled by plane on the same trip (30%), or who stayed at least once in the energy-intensive hotel category (40%) partly explains this.
Table 39: Energy use per day explained by travel choice intensities (km/day) across the transport sub-sector through simple linear regression (domestic tourists)

<table>
<thead>
<tr>
<th>Transport choice</th>
<th>Variance explained (%)</th>
<th>F-value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic air</td>
<td>99.0</td>
<td>66652.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Yacht</td>
<td>93.7</td>
<td>536.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Train</td>
<td>90.8</td>
<td>580.6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Motorcycle</td>
<td>88.8</td>
<td>135.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Camper van</td>
<td>88.5</td>
<td>261.5</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Coach</td>
<td>86.7</td>
<td>300.9</td>
<td>0.001</td>
</tr>
<tr>
<td>Private car</td>
<td>51.8</td>
<td>4550.6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Cook Strait Ferry</td>
<td>48.0</td>
<td>101.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Company car</td>
<td>20.8</td>
<td>53.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Ferry</td>
<td>17.0</td>
<td>12.9</td>
<td>0.001</td>
</tr>
<tr>
<td>Scheduled bus</td>
<td>5.0</td>
<td>7.1</td>
<td>0.009</td>
</tr>
</tbody>
</table>

Only significant predictors.

Among the remaining travel choices within the accommodation or attraction/activity sub-sector, only hotels ($F = 62.3, df = 1, 891, R^2$-value $= 0.065$) accounted for a reasonable amount of variance (more than 1%) among all travel choices. This again reflects the dominant role of transport for domestic tourists’ energy use. In a multiple regression model (stepwise analysis), air travel explained 83.5% of energy use per day, and air travel together with the private car explained 94.5% of variance in energy intensity. Multiple regression with all travel choices as input variables is not presented in further detail, since not much more information was gained compared with the simple regression analyses.

The relationship between transport in general and energy use was investigated further. Clearly, total energy use strongly depends on energy use for transportation ($F = 133838.0, df = 1, 5454, R^2$-value $= 0.96$). This strong relationship may be influenced by trip length. For example, a shift from energy use for transport to other sub-sectors may occur for longer stays at one destination. This possibility was analysed by eleven separate regression analyses (1 to 10 nights and >10 nights away from home) for transport energy and total energy use for different trip lengths. Linear relationships for all trip lengths were found with regression coefficients ranging from 0.960 for 10 nights to 0.995 for one night. Longer trips (>10 nights) had a slightly weaker relationship ($R^2$-value $= 0.798$), indicating the increasing contribution of other activities to the energy bill.
4.3.3 *Factor analysis of recreational tourist activities*

In contrast to the sample of international West Coast tourists, the factor analysis on recreational travel choices did not provide useful results. First, the statistical tests to determine the appropriateness of the data indicated a lack of correlation between the original travel choice variables. And second, the six-factor solution with eigenvalues greater than one explained only 52.2% of the variation. It appeared that there exist no consistent patterns of typical ‘sets of activities’ undertaken by domestic tourists during their trip. For these reasons, this option was not followed up any further.

4.3.4 *Segmentation: Tourist types and energy types*

Data sets that may contain distinct groups based on a variable that will not be used for the segmentation should be separated before performing a cluster analysis (Hair et al., 1998). It is believed that trip length is such an interacting variable, and that there are two logical groups of trips that may differ in other variables as a result of trip length. These are short trips of one or two nights, and longer trips of more than two nights. Differences between the groups may either manifest in the occurrence of certain travel patterns, i.e. tourist types, or in different estimates of quantitative variables for patterns that occur within both groups. To account for the possible effect of different trip lengths, an *a priori* segmentation into short trips (N= 3,114) and longer trip tourists (N= 2,341) was undertaken. This is not only useful with regard to the following cluster analysis, but also for future management of different tourist trips. Note that only trips containing the full information on travel choices (transport, accommodation, and attractions/activities) were used for the segmentation analysis, i.e. one trip per tourist entered the cluster analysis.

*Clustering process*

A two-stage cluster analysis of hierarchical clustering followed by a quick cluster analysis, as suggested by Arimond and Elfessi (2001), did not prove useful for the domestic tourist data. The large sample size of 5,455 impeded a hierarchical cluster analysis of the complete sample. For this technical reason a hierarchical cluster analysis was applied to a smaller sub-sample to 1,000 tourists, however, it did not reveal whether small clusters were a result of unusual extremes or constituted a valuable market segment. The K-means analysis, however, could be applied to the
complete sample, and thus allowed for a better assessment of small clusters. It also seemed to fit the purpose of segmenting domestic tourists as described earlier.

The described method was applied to the sample of short trips and longer trips with initially 31 energy related variables (travel choices). Both analyses provided best results for an eight-cluster solution. However, ANOVA showed that not all variables were significant, and hence did not contribute to the cluster solution. For short trips, the insignificant variables were the camper van, yacht, motorcycle, B&Bs, backpackers, buildings, parks, amusement, industry attractions, performance, air activities, water activities, adventure activities, tramping. Regarding longer trips, the yacht, motorcycle, ferry, B&Bs, parks, nature attractions, air activities, water activities, adventure activities, and tramping were not significant. Thus, 16 variables determined the cluster analysis of short trips; and 21 the analysis of longer trips.

The cluster analysis of short trip tourists involved 22 iterations to achieve convergence of clusters (cluster centres do not change any more), while tourists with longer trips were clustered with 15 iterations.

Profile of clusters

Short trip types

The cluster analysis of short trips revealed three generic trip patterns among the eight clusters (Table 26), namely private car based trips, business travel by air or company car, and trips by other transport modes for various reasons other than business. Three private car trip types could be distinguished based on different travel distances. The ‘extreme car’ trip involved a travel distance of almost 1,000 km per day often crossing Cook Strait, whereas ‘medium car’ and ‘soft car’ trips were only for 396 and 129 km, respectively. Most of the car tourists stayed at homes, with the ‘soft car traveller’ having been most likely to stay at campgrounds, mostly for holiday reasons. Car trips were frequently undertaken by families to visit friends or family, mostly in a group of two (median). These three different trip types that are based on the private

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5 The judgemental labels were purposely chosen to emphasise the main characteristic of each type in a non-academic language.

6 Note that the average distance per day is calculated by summing up the travel distance and dividing by the number of nights (i.e. travel distance/night).
car accounted for 86% of all trips, with the ‘soft car travel’ having been the most frequent type.

Two different types of air-based trips were identified, namely ‘Long air business’ trips and ‘short air’ trips. Both of these trip types are frequently undertaken by business travellers. ‘Short air’ trips were also made for mixed other reasons (e.g. 15% for visiting friends/relatives). A large proportion of both types of air travellers stayed at hotels. Air travellers (mostly male) belonged to high-income groups, and travelled most often alone. The ‘long air business’ travellers had the highest expenditures of all tourists with more than $500 for a one or two day trip. Another business-related trip type is the ‘company-business’ trip, which involved travel by the company car, mostly undertaken by two persons. Some company car based trips were undertaken to visit friends or relatives (11%).

The rental car and the scheduled bus were sufficiently often used to constitute the basis of separate clusters. ‘Rental car’ trips resembled ‘auto tourist’ as described for international West Coast tourists, mainly because of their stay at motels and their recreational activities. Rental car tourists often travelled in groups of three (median). The ‘flexible trip’ involves scheduled coaches and the stay at homes. Young, unmarried tourists of lower income groups undertook this trip type. Tourists on a flexible trip were most active, with 1.2 attractions/activities in total.  

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33 For consistency with the West Coast pilot-study this includes only visits to the eleven recreation categories, excluding ‘visit’, ‘tramping’, or ‘restaurant’.
Table 40: Short trip types resulting from a cluster analysis of 16 travel choices (domestic tourists)

<table>
<thead>
<tr>
<th>Trip type</th>
<th>N: % of sample</th>
<th>Typical travel choices</th>
<th>Other key variables for each type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme car</td>
<td>171 5.5%</td>
<td>100% private car (969 km/day)</td>
<td>Purpose: 19% other</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6% Cook Strait Ferry</td>
<td>Travel party: 27% family</td>
</tr>
<tr>
<td></td>
<td></td>
<td>54% home</td>
<td>Mean length of stay: 1.1 days</td>
</tr>
<tr>
<td>Medium car travel</td>
<td>1,001 32.1%</td>
<td>100% private car (396 km/day)</td>
<td>Purpose: 44% visit friends/relatives</td>
</tr>
<tr>
<td></td>
<td></td>
<td>62% home</td>
<td>Travel party: 28% family</td>
</tr>
<tr>
<td></td>
<td></td>
<td>35% visit</td>
<td></td>
</tr>
<tr>
<td>Soft car travel</td>
<td>1,501 48.2%</td>
<td>85% private car (151 km/day)</td>
<td>Purpose: 35% holiday</td>
</tr>
<tr>
<td></td>
<td></td>
<td>64% home</td>
<td>Travel party: 26% family</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11.3% campground</td>
<td>Mean length of stay: 1.6 days</td>
</tr>
<tr>
<td></td>
<td></td>
<td>22% nature activity; 31% visit</td>
<td></td>
</tr>
<tr>
<td>Long air-bus.</td>
<td>43 1.4%</td>
<td>100% domestic air (1467 km/day)</td>
<td>Purpose: 81% business</td>
</tr>
<tr>
<td></td>
<td></td>
<td>67% hotel</td>
<td>67% male</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Group size (median): 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mean length of stay: 1.1 days</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mean expenditure: $591</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Household income: 37% &gt;$100,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Restaurant: 0.2 visits/day</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Visit to attraction/activity: 0.4 in total</td>
</tr>
<tr>
<td>Short air travel</td>
<td>225 7.2%</td>
<td>100% domestic air (701 km/day)</td>
<td>Purpose: 64% business</td>
</tr>
<tr>
<td></td>
<td></td>
<td>55% hotel</td>
<td>62% male</td>
</tr>
<tr>
<td></td>
<td></td>
<td>55% entertainment</td>
<td>Group size (median): 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mean expenditure: $523</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Household income: 33% &gt;$100,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Restaurant: 0.3 visits/day</td>
</tr>
<tr>
<td>Company business</td>
<td>113 3.6%</td>
<td>100% company car (433 km/day)</td>
<td>Purpose: 80% business</td>
</tr>
<tr>
<td></td>
<td></td>
<td>36% hotel</td>
<td>Age: 33% aged 45 to 69</td>
</tr>
<tr>
<td></td>
<td></td>
<td>33% home</td>
<td>69% male; 68% married/de facto</td>
</tr>
<tr>
<td>Rental car</td>
<td>27 0.9%</td>
<td>100% rental car (441 km/day)</td>
<td>Group size (median): 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>41% motel</td>
<td>Age: 70% aged 25 to 44</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15% buildings</td>
<td>11.1% Maori</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Restaurant: 0.2 visits/day</td>
</tr>
<tr>
<td>Flexible trip</td>
<td>33 1.1%</td>
<td>100% Scheduled bus (391 km/day)</td>
<td>Purpose: 52% visit friends/relatives</td>
</tr>
<tr>
<td></td>
<td></td>
<td>58% home</td>
<td>Group size (median): 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>55% entertainment</td>
<td>Age: 55% aged 15 to 24; 9% &gt;70</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30% visit</td>
<td>Household income: 30% &lt;$20,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>64% never married</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Visit to attraction/activity: 1.2 in total</td>
</tr>
</tbody>
</table>

To verify whether variables other than travel choices were significantly different for the eight clusters, ANOVA and Chi-square tests were carried out. Only one variable, namely the number of trips longer than two days within the last year, did not differ significantly at the 5%-level for the eight trip types.

The average distance of cases from the cluster centre gives an indication of the tightness of a cluster. According to this, the trip types ‘extreme car travel’ and ‘long air business’ are relatively loose clusters, with cases deviating from the average pattern as described above. In contrast, the ‘medium car travel’ and ‘soft car travel’ are compact clusters with tourists behaving fairly alike.
Longer trip types

Similar travel patterns as for short trips occurred for longer ones (Table 41). The private car was again a key travel choice for two clusters ('soft car travel' and 'medium car travel') that comprised 85% of all tourists. While 'soft car' travel involved a travel distance of 88 km per day, 'medium car' trips were for 266 km. The longer stay of ‘soft car’ travellers (7.2 days) compared with ‘medium car’ travellers (4.3 days) may explain this. Both trips were often undertaken with family members, and the main accommodation type was ‘home’.

‘Air travel’ was the basis for the third most popular trip type (8.6% of all longer trips), often undertaken by business travellers and 'visiting friends or relatives' tourists. One third of tourists in this cluster spent at least one night in a hotel, presumably those, who reported ‘business’ as main travel purpose. Entertainment establishments (bars, casinos, shopping) were frequented, as well as restaurants. Air travellers were middle-aged and wealthier than tourists in any other group. Another type of business travel involved the company car, often undertaken by male tourists. The ethnic group of Maori was least represented in this cluster.

Four other trip types appeared relevant, although undertaken only by a minority of tourists. ‘Rental car’ trips were often associated with the stay at hotels or motels, and the participation in water or adventure activities. As for shorter rental-car based trips, tourists often travelled in a larger group (median of 4), which may also be reflected in the highest average travel expenditures. Almost every fifth tourist travelling by rental car did so for business purpose. The ‘flexible trip’ is similar to the one described for short trips. The ‘camper van’ trip involved staying at campgrounds, and visiting attractions and activities. This trip was mostly for holiday reasons, and tourists travelling in a camper van also appeared to be the most frequent travellers. Finally, tourists who used a train and stayed at homes constituted a separate group ('visit by train'). Apart from the train, other less frequently used transport modes, such as the organised coach, were clustered into this group. A large proportion of elderly women undertook this type of trip.
<table>
<thead>
<tr>
<th>Trip type</th>
<th>N; % of sample</th>
<th>Typical travel choices</th>
<th>Other key variables for each type</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Medium car travel</strong></td>
<td>607; 25.9%</td>
<td>100% private car (266 km/day)</td>
<td>Travel party: 33% partner, 27% family</td>
</tr>
<tr>
<td></td>
<td></td>
<td>69% home</td>
<td>Mean length of stay: 4.3 days</td>
</tr>
<tr>
<td></td>
<td></td>
<td>42% visit</td>
<td>9.7% Maori</td>
</tr>
<tr>
<td><strong>Soft car travel</strong></td>
<td>1375; 58.7%</td>
<td>83% private car (88 km/day)</td>
<td>Purpose: 54% holiday</td>
</tr>
<tr>
<td></td>
<td></td>
<td>71% home</td>
<td>Travel party: 33% family</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17% campground</td>
<td>Mean length of stay: 7.2 days</td>
</tr>
<tr>
<td></td>
<td></td>
<td>42% nature activity</td>
<td>Household income: 36% &lt;$40,000</td>
</tr>
<tr>
<td><strong>Air travel</strong></td>
<td>201; 8.6%</td>
<td>100% air travel (345 km/day)</td>
<td>Purpose: 31% business, 31% visit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>32% hotel</td>
<td>Household income: 18% &gt; $100,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>64% entertainment</td>
<td>Age: 50% 25 to 44</td>
</tr>
<tr>
<td></td>
<td></td>
<td>41% visit</td>
<td>Restaurant: 0.13 visits/day</td>
</tr>
<tr>
<td><strong>Company business</strong></td>
<td>44; 1.9%</td>
<td>100% company car (199 km/day)</td>
<td>Purpose: 66% business</td>
</tr>
<tr>
<td></td>
<td></td>
<td>46% hotel</td>
<td>Household income: 49% $50,000 to $100,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Age: 96% 25 to 69; 45% Maori</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>71% male, 73% married/de facto</td>
</tr>
<tr>
<td><strong>Rental car</strong></td>
<td>33; 1.4%</td>
<td>100% rental car (285 km/day)</td>
<td>Travel party: 31% friends/mixed company</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15% Cook Strait Ferry</td>
<td>Expenditures: $1,010 in total</td>
</tr>
<tr>
<td></td>
<td></td>
<td>49% hotel, 46% motel, 12% hostel</td>
<td>Group size (median): 4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15% water activity, 12% adventure</td>
<td>Expenditures: $275 in total</td>
</tr>
<tr>
<td><strong>Flexible trip</strong></td>
<td>50; 2.1%</td>
<td>100% scheduled coach (174 km/day)</td>
<td>Household income: 30% &lt;$20,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>74% home</td>
<td>Group size (median): 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>52% visit</td>
<td>Expenditures: $275 in total</td>
</tr>
<tr>
<td><strong>Camper van</strong></td>
<td>17; 0.7%</td>
<td>100% camper van (216 km/day), 77% campground, 59% buildings, 12% industry, 18% nature attractions, 47% nature activity</td>
<td>Purpose: 65% holiday</td>
</tr>
<tr>
<td></td>
<td></td>
<td>77% camp ground</td>
<td>Trips: 2 days (last year): 4.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>59% buildings, 12% industry, 18% nature attractions</td>
<td>Age: 41% 45 to 69, 35% 15 to 24</td>
</tr>
<tr>
<td><strong>Visit by train</strong></td>
<td>14; 0.6%</td>
<td>100% train (254 km/day)</td>
<td>Purpose: 57% holiday</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7% ferry, 7% coach</td>
<td>Expenditures: $932 in total</td>
</tr>
<tr>
<td></td>
<td></td>
<td>71% home</td>
<td>Age: 36% &gt; 70</td>
</tr>
<tr>
<td></td>
<td></td>
<td>29% amusement, 43% visit</td>
<td>14% widowed; 43% never married</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>64% female</td>
</tr>
</tbody>
</table>

All variables (travel choices and other variables) differed significantly for the eight clusters. The analysis of cluster tightness revealed that 'soft car travel' was a homogenous cluster, as well as 'camper van travel', and 'medium car travel'. 'Visit by train' and 'air travel' appeared to be the least homogenous pattern.

**Validation of tourist types**

Discriminant analysis was applied separately to short and longer trip types to identify key variables and to verify the reliability of the cluster solution. The stepwise discriminant analysis produced each seven significant discriminant functions, including nine (short trips) and ten (longer trips) variables, respectively. While the first five functions explained the variance of short trips almost completely (99.9%), this was more evenly distributed across the seven functions for longer trips.
The seven discriminant functions clearly reflected travel choices within the transport sub-sector. Function one was dominated by air travel (loading: 0.979), while function two was positively correlated with the private car (0.809) and negatively correlated with the company car (-0.556). This indicates that these modes are almost mutually exclusive. Domestic air and the private car had the largest partial F-values (F to remove) in the final model, which indicates their significance in discriminating trips. Functions three to six were strongly influenced by the travel intensity on the company car (0.774), the scheduled bus (0.860), rental car (0.862), and the Cook Strait ferry (0.750), respectively. The last function reflected the stay at homes (0.326), while being negatively correlated with hotels (-0.786). Figure 31 shows the separation of trips based on the first two functions that explain together 68.6% of the variation.

Figure 31: Plot of individuals’ scores on the first two discriminant functions (domestic tourists) for short trips.
The importance of transport variables was even more evident for the discrimination between longer trips. However, the relative importance of the modes changed, with the company car and the train being important discriminators (loading: 0.970 and 0.930 on function 1 and 2, respectively, and large partial F-values in the final model). The scheduled bus and domestic air were key variables for function three (domestic air, loading: 0.836) and four (scheduled bus, loading: 0.933), respectively. Finally, the rental car, camper van and private car correlated positively with functions five to seven (0.917, 0.943, 0.787, respectively). A clear separation of clusters was obtained by plotting the domestic air versus the private car function (Figure 32).

![Figure 32: Plot of individuals' scores on the first two discriminant functions (domestic tourists) for longer trips.](image)

The large proportion of correctly classified cases in the classification analysis (96.0\% for short trips; 94.8\% for longer trips) confirms the cluster solutions.
Energy use of different trip types

The above segmentation analysis of the domestic tourism market showed that there are distinct types of trips composed of specific travel choices. The cluster analyses resulted in eight distinguishable clusters for both short and long trips. It is now of interest whether energy use differ for the trip types. This is first discussed for the energy intensity (energy use per day) and second for total energy use.

ANOVA for the energy use per day for different types was highly significant for short (F = 2,612.2, df = 7, 3,106, p<0.001) and longer (F = 644.0, df = 7, 2,333, p<0.001) trips. Additionally, multiple comparisons (LSD test) revealed pair-wise differences between groups. According to this, short trip types were broken down into five energy intensity ranges (Figure 33). ‘Long air business’ travel (mean energy use of 4,187 MJ/day) was clearly the most energy intensive type of travel, and was also significantly different from short air travel, which consumed on average 2,055 MJ per day. Both trip types were also characterised by the largest total energy use (4,504 MJ and 2,884 MJ, respectively). The ‘extreme car travel’ of tourists, who travelled extremely far by car for one or two nights, was also characterised by a significantly different energy per day (1,087 MJ) compared with the other types. The energy intensity of company-car based trips, rental car and medium private car travel, and flexible trips did not differ significantly from each other. Hence, these trips were similar with an energy intensity of 426 MJ per day (‘flexible trips’) to 536 MJ per day (‘rental car trips’). Finally, the ‘soft car travel’ was the most energy efficient trip with 262 MJ per day and 422 MJ in total. The continuous reference line in Figure 33 displays the mean energy intensity of 574 MJ for all short trips. The pattern of total energy use (as opposed to energy use per day) across the eight short trip types parallels the one presented for daily energy use, due to the short trip length of one or two nights.
The average energy intensity of longer trips of 301 MJ per day was roughly half that of short trips (see reference line in Figure 34). Again, air-borne trips were clearly the most energy intensive form of travel (1,045 MJ/day and 4,410 MJ in total), although the energy intensity was considerably lower compared with short air travel for short trips. This is a result of the longer average stay of 4.6 days. Significantly less energy use per day was associated with ‘medium car travel’, camper vans (438 MJ/day), rental cars (386 MJ/day), and ‘visit by train’ trips (451 MJ/day). The lowest energy use per day occurred for company-car related travel (275 MJ/day), ‘flexible trips’ (213 MJ/day), and ‘soft car travel’ (171 MJ/day).
Figure 34: Energy use per day for eight longer trip types. The continuous horizontal line displays the mean energy use of 301 MJ. The vertical lines separate the generic groups as described in the text (domestic tourists).

The relative difference in total energy use among the eight trip types was similar to the pattern of energy use per day. Although, length of stay differed significantly between the types (ANOVA: F= 25.7, df= 7, 2,333, p<0.001), the difference did not affect the overall pattern. In fact, the mean length of stay ranged between four days ('medium car travel') to seven days ('soft car' and 'camper van travel'). The lowest total energy use was associated with 'flexible trips' (916 MJ in total).
4.3.5 Discussion

General comments on travel itineraries

Domestic tourism of New Zealanders often involves a one or two-nights trip. Few tourists undertake longer trips, with only 9.9% of all trips lasting longer than a week. Accordingly, domestic trips are rarely multi-destinalional, but rather focus on one single destination. A closer look at the travel sectors revealed that only 15% of all domestic tourists travelled for three travel sectors making two different overnight stops, 8% for four sectors, and 11% for more than five sectors, with the remaining 66% visiting a single location. Generally, domestic tourists travel relatively far for a short stay at the destination. This results in a large travel distance per day. The most frequented travel sector was Auckland to Wellington (and return). Auckland to Hamilton, to Rotorua and to Tauranga ranked second to fourth, and Wellington to Picton was the fifth most common travel sector. The sixth and seventh most frequent sector was Auckland to Christchurch and Wellington to Christchurch.

Travel choices and tourists' energy use

Domestic tourists' energy use was analysed with regard to 31 variables (12 transport, 6 accommodation and 13 attraction/activity variables). The private car clearly dominates transport: more than three quarters of all domestic tourists use the car, with an average travel distance of 530 km and an energy consumption of 546 MJ per trip. Apart from the car, domestic tourists travel frequently by plane, especially to cover long distances within a short time. In fact, the travel sector from Auckland to Wellington by plane is the most popular sector when broken down by transport modes. Of all tourists travelling from Auckland to Wellington, 81% travel by air. Air travel is associated with a considerable demand for energy: while only 13% of all tourists chose this mode, it is responsible for almost half (43%) of the total transport energy use. This is both a result of a large energy intensity (2.75 MJ/pkm) and large travel distances (1,052 km on average). Transport modes other than the car and domestic air each account only for a small proportion of transport energy use.

The most popular 'accommodation category' is 'homes', which in most cases is the private home of friends or relatives, but which could also be a holiday home, apartment or other non-commercial facilities (e.g. student accommodation). In total,
40.3% of all domestic tourists spend at least one night in one of these three categories, with the hotel being the most popular one (17.0%). The large energy intensity of hotels and their relative popularity result in hotels’ significant contribution to total energy use within the accommodation sub-sector (33%).

Domestic tourists generally visit few attractions and undertake few activities. Most often their activities do not require direct energy input, for example visiting friends and going swimming or walking. Furthermore, domestic tourists prefer urban attractions that are mostly characterised by low energy demand. It can be concluded that attractions and activities play a minor role in domestic tourists’ energy use.

On average (median), domestic tourists consume 700 MJ for their trip, with an intensity of almost 300 MJ per day. Energy use (total and per day) of domestic tourists, however, shows extreme variations. The large range reflects the broad range of travel distances, while different trip lengths play only a minor role. Transport was found to be the key determinant of total energy use (85.1% of a tourist’s energy bill) while the other two components accommodation (13.7%) and attractions/activities (1.2%) were of minor importance.

The analysis of single travel choices, the aggregated energy use and particularly the examination of transport through regression analysis have clearly shown that the biggest potential to reduce energy demand lies with the transport sub-sector. Measures directed towards other parts of the industries (particularly hotels) should be part of the strategy to ascertain each business’ contribution, however, they will have marginal effects on the overall energy consumption. Since private homes are part of the residential sector and are not tourism businesses in the commercial sense, measurements to increase energy efficiency need to be embedded in a broader strategy targeted at households.

**Trip types**

The factor analysis of recreational activities did not reveal any clear patterns, as there are no ‘typical sets’ of activities for domestic tourists. It has already been mentioned above that attractions/activities do not match the important role they hold for international tourists.
The segmentation analysis, however, provided a useful typology of domestic tourists. Domestic trips were *a priori* segmented in short trips of one or two nights, and longer trips, before cluster analyses for each set of trips were undertaken. Both analyses provided an eight-cluster solution with generally similar trip types. Transport travel choices and, in particular, the private car and domestic air were essential variables to define trip types. This result may be influenced by the clustering method (K-means), which gives more weight to variables with a large scale (transport km) compared with small-scaled variables (attraction visits). This approach, however, seems to reflect the dominant role of transport already identified through the travel choice analysis.

The private car is mostly associated with holiday travel and visiting friends or relatives trips (stay at homes) undertaken by families. The car formed the basis for three different trip types for short trips and two different types for long trips. The difference between these trips mainly lies in the travel distance. These trip types account for most (85% for each short and longer trips) of domestic tourists' trips.

Air travel is second most important in terms of frequency. The analysis of short trips identified a 'long air business' and a 'short air travel' cluster. This association with business travel explains the above-average use of hotels. The 'long air business' trip is characterised by an extremely long flying distance of almost 1,500 km per day. 'Air travel' is also a segment for longer trips, accounting for about 9% of all trips. With airfares becoming cheaper (Oppermann & Cooper, 1999) it is likely that the number of tourists undertaking this trip type increases, particularly the share of non-business travellers (now about 20%) might increase.

Trip types based on transport modes other than the car and plane were identified for both short ('company business', 'rental car trip' and 'flexible trip') and longer trips ('company business', 'rental car', 'flexible trip', 'camper van', and 'visit by train'). However, only a minority of trips account for these types. The relative number of company-car based trips is smaller for longer trips (1.9%) than for short trips (3.6%), while 'flexible trips' are more often undertaken by New Zealanders who stay for more than two nights. Multiple discriminant analysis confirmed the cluster solution of eight trip types each for short and longer trips.
Clearly, air-borne trips are the big energy consumers: ‘Long air business’ trips consuming almost 4,200 MJ per day and ‘short air travel’ consuming 2,100 MJ per day. Similarly for longer trips, air-related trips are most energy-intensive with more than 1,000 MJ consumed per day. These energy-intensive air-trips are undertaken by a small number of tourists, as well as the energy intensive land-based types, such as the ‘extreme car travel’ (short trips) and the ‘camper van trip’ (longer trips). In contrast, the most frequent trip type, the ‘soft car travel’, is comparatively energy efficient. Tourists who travel on a scheduled bus and who stay at homes consume the smallest amount of energy per day. Again this group is very small and energy saving measures for this trip type would be less effective than those for air-borne trips.

Generally, it was found that short trips are more energy intensive than longer trips (574 MJ/day compared with 301 MJ/day), because tourists do not adapt travel distance to length of stay. In this sense the trend towards more frequent shorter trips, as reported by Forsyte Research (2000), is alarming and will result in increasing energy demand. Vuletich and Fairgray (2000b) forecast an increase of domestic trips by 3.1% per annum and an above-average increase in short trips, which would result in an average trip length of 2.9 days in 2006.

New Zealanders hold strong views about their private vehicle usage. The increase in travel distance and frequency is accompanied by a trend towards bigger cars with larger engine sizes. As a result of this, transport is the fastest growing sector in terms of energy use and carbon dioxide emissions. EECA (2001, p. 21) stated “Energy use is generally a secondary consideration in transport decision-making, with energy efficiency being ignored or traded off against other objectives”. Clearly, tourism is only a small part of this general picture with domestic tourists’ travel attitudes being founded in their every-day travel behaviour. Consequently, an awareness to reduce travel, to increase passenger loads, to use efficient vehicles, to use public transport options, to travel less but stay longer, and so forth can only be created as integral part of a broader transport behaviour strategy.
4.4 International tourists

4.4.1 Methodology

Data source: International Visitor Survey

The IVS is the key data source for international visitors’ travel behaviour in New Zealand and has formed the basis for over a decade of reports on regional patterns of visitor behaviour and expenditure, as well as background on their preferences and attitudes. Information collected includes data on transport modes, accommodation used and attractions/activities visited by tourists, the details of which have changed marginally over time. It is also possible to create itineraries from the sequences of responses detailing the places visited, although this was not done to any degree in the early years and is only now being studied in more depth (Forer & Simmons, 2002).

The IVS is a continuous survey that has run in a fairly stable form since 1990/91 undertaken in the form of an exit survey at New Zealand’s main international airports, Auckland, Christchurch and Wellington (which constitute the exit point for 98% of all international visitors). The sample comprises visitors over 15 years who are surveyed face-to-face by multilingual surveyors now using a computer-based survey tool (CAPI = computer assisted personal interviewing). During survey sessions every 18th visitor passing the airport security checkpoint is asked to participate and only a 10.8% refusal rate is reported (TNZ, 2001a). Approximately 5,500 visitors are now interviewed each year. The Spatial Analysis Facility at the University of Auckland has been working for some time on modelling and mapping flow data based on itineraries extracted from the IVS (Forer & Simmons, 1998, 2002). In order to restructure the data into itineraries the data needs to be extracted from the existing survey analysis package, reformatted into a commonly readable form, validated against known tables and then transformed into a structure suitable for allowing the query and mapping of flows. Work has been progressing to convert the IVS from 1996 to 2001 into an itinerary database, and the transformed itinerary data for 2000 have been provided by the University of Auckland Spatial Analysis Facility for this study. Their analysis at present only contains information on transport (based on the itinerary) and accommodation, and attractions/activities have not yet been included and therefore cannot be included in the following analysis.
Sample description

A summary of the results from the IVS 2000 can be found at TNZ's homepage (www.tourisminfo.govt.nz). Only key characteristics of the sample are presented here. Note that TNZ weights the sample to estimate total numbers whereas statistics presented here refer to the (modified, see below) final sample of 5,422 tourists.

For the analysis of international tourists it was necessary to split the sample and exclude specific groups of tourists from some of the analyses (Figure 35). First of all, cases with insufficient information (see below) had to be deleted. Then, as for the West Coast sample, tourists who stayed longer than 180 days were separated from the sample. It is assumed that these long-term tourists differ from other tourists. Long-term tourists were only included in the description of demographic and trip-related variables. Too little information was available for their whole stay in New Zealand to include them in any travel pattern specific analysis.

It was found that there were a considerable number (N = 1,160 or 21%) of tourists who did not leave their city of arrival (Auckland, Wellington or Christchurch). These are called ‘gateway-only tourists’ hereafter. They differ from ‘touring tourists’ in that no transport mode has been recorded for their stay in New Zealand (although it is assumed they used transport while being at the gateway city). This results from the way the questionnaire is phrased. The IVS asks for a tourist’s overnights stops and based on this transport modes used to get there are reported. For gateway-only tourists the first overnight stop (and the second, third and so forth) is the city of arrival, and, hence no transport usage is reported. Gateway-only tourists are included in the descriptive analysis of demographic and trip-related variables as well in the analysis of accommodation variables and associated energy use. They are excluded from the segmentation analysis, but remain an interesting group for further analysis. Finally, cruise ship tourists (N = 8) were excluded from the segmentation analysis, but they as well remain as separate group.
Demographic and trip-characteristic variables

Demographic and trip-characteristic variables are described separately for long-term staying tourists, gateway-only tourists, and touring tourists. The purpose of travelling to New Zealand clearly differed for the three groups. While touring tourists mainly travelled for holiday reasons, gateway-only tourists were often travelling for business, conferences and also to visit friends or relatives. Long-term tourists were most likely to be in New Zealand for educational reasons. Gateway-only tourists often came from Australia, while long-term students were most likely from the United Kingdom or Japan. The nationality mix of touring tourists most reflected the typical mix for New Zealand visitors with Australians being most important, followed by visitors from the UK, Japan, the United States and Germany. Other selected characterising variables are presented in Table 42. Interestingly, Auckland seemed to be less

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34 Australians appear to be under-represented in the IVS when compared with visitor arrival statistics (Statistics New Zealand, 2000b). The sampling frame (no children are interviewed, and airports such as Hamilton and Queenstown with direct flights to Australia are not considered) may serve as one explanation.
important as departure airport for touring tourists than for the other two groups, and Wellington (the Capital City) clearly attracted a significant proportion of gateway-only tourists. A cross-tabulation showed that gateway-only tourists who travelled for business reasons were most likely to visit Wellington, while conference visitor travelled comparatively often to Christchurch.

Table 42: Key demographic and trip-characteristic variables for international tourists

<table>
<thead>
<tr>
<th>Variable</th>
<th>Long-term tourists (N= 61 or 1%)</th>
<th>Gateway-only tourists (N= 1,160 or 21%)</th>
<th>Touring tourists (N= 4,201 or 77%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Purpose:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Holiday</td>
<td>29.5%</td>
<td>26.3%</td>
<td>67.5%</td>
</tr>
<tr>
<td>Visit friends/relatives</td>
<td>18.0%</td>
<td>21.0%</td>
<td>13.6%</td>
</tr>
<tr>
<td>Business</td>
<td>11.5%</td>
<td>34.0%</td>
<td>6.9%</td>
</tr>
<tr>
<td>Conference</td>
<td>4.9%</td>
<td>4.7%</td>
<td>1.5%</td>
</tr>
<tr>
<td>Education</td>
<td>11.5%</td>
<td>3.8%</td>
<td>3.2%</td>
</tr>
<tr>
<td>Skiing</td>
<td>1.6%</td>
<td>0%</td>
<td>1.0%</td>
</tr>
<tr>
<td><strong>Nationality:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td>11.5%</td>
<td>36.6%</td>
<td>19.3%</td>
</tr>
<tr>
<td>UK</td>
<td>23.0%</td>
<td>8.7%</td>
<td>14.8%</td>
</tr>
<tr>
<td>USA</td>
<td>8.2%</td>
<td>7.5%</td>
<td>11.9%</td>
</tr>
<tr>
<td>Japan</td>
<td>23.0%</td>
<td>8.6%</td>
<td>17.1%</td>
</tr>
<tr>
<td>South Korea</td>
<td>1.6%</td>
<td>1.2%</td>
<td>2.2%</td>
</tr>
<tr>
<td>Germany</td>
<td>3.3%</td>
<td>1.9%</td>
<td>4.3%</td>
</tr>
<tr>
<td>Taiwan</td>
<td>3.3%</td>
<td>3.3%</td>
<td>3.3%</td>
</tr>
<tr>
<td>China</td>
<td>6.6%</td>
<td>2.6%</td>
<td>1.8%</td>
</tr>
<tr>
<td>Canada</td>
<td>3.3%</td>
<td>2.0%</td>
<td>3.1%</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-29</td>
<td>43%</td>
<td>21%</td>
<td>28%</td>
</tr>
<tr>
<td>30-49</td>
<td>28%</td>
<td>49%</td>
<td>35%</td>
</tr>
<tr>
<td>50 or older</td>
<td>30%</td>
<td>29%</td>
<td>37%</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td>54% male</td>
<td>66% male</td>
<td>54% male</td>
</tr>
<tr>
<td><strong>Travel party</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alone</td>
<td>53%</td>
<td>54%</td>
<td>24%</td>
</tr>
<tr>
<td>Couple</td>
<td>26%</td>
<td>18%</td>
<td>34%</td>
</tr>
<tr>
<td>Family</td>
<td>8%</td>
<td>10%</td>
<td>12%</td>
</tr>
<tr>
<td>Tour group</td>
<td>5%</td>
<td>6%</td>
<td>14%</td>
</tr>
<tr>
<td>Business associates</td>
<td>2%</td>
<td>8%</td>
<td>3%</td>
</tr>
<tr>
<td>Stay (mean/ median)</td>
<td>258/264 days</td>
<td>11/4 days</td>
<td>17/11 days</td>
</tr>
<tr>
<td>First visit to New Zealand</td>
<td>59%</td>
<td>39%</td>
<td>70%</td>
</tr>
<tr>
<td>Total expenditure (mean)</td>
<td>$NZ11,796</td>
<td>$NZ 6,764</td>
<td>$NZ 8,170</td>
</tr>
<tr>
<td>Expenditure per day (mean)</td>
<td>$NZ47</td>
<td>$NZ 1,733</td>
<td>$NZ 891</td>
</tr>
<tr>
<td>Departure (interview place)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auckland</td>
<td>86.9%</td>
<td>84.5%</td>
<td>68.9%</td>
</tr>
<tr>
<td>Wellington</td>
<td>3.3%</td>
<td>7.8%</td>
<td>3.6%</td>
</tr>
<tr>
<td>Christchurch</td>
<td>9.8%</td>
<td>7.8%</td>
<td>27.5%</td>
</tr>
</tbody>
</table>

1) Only key variables are presented.
Data preparation and description

Reconstructing itineraries

The original database contained 5,480 tourists with almost 40,000 travel sectors. An examination of the itineraries (by scanning the data table) revealed several sources of systematic error in terms of identifying travel distances. Measures taken to correct for these are described in the following section.

- Tourists staying the first night(s) at the international gateway (i.e. Auckland, Wellington and Christchurch) were not asked to report the transport mode they used to get to their accommodation.
- Similarly, tourists leaving New Zealand without staying the last night at the gateway did not report the transport mode used for their last travel sector to the airport. If the last overnight stop was far from the gateway (e.g. Rotorua to Auckland), this results in a considerable underestimation of travel distance.
- Long-term tourists (>180 days) often reported no itinerary except for travel to and from their main location of stay, often Auckland. Hence, no insight into travel behaviour can be gained from these tourists.
- Tourists who used two transport modes on one travel sector often only reported their main transport mode. This applied particularly for tourists crossing the Cook Strait by ferry or plane, and for other ferry trips (e.g. Stewart Island) or domestic flights (see also Chapter 4.3 about domestic tourists).
- Apparently, some tourists had problems in remembering the sequence of their overnight stops correctly or confused similarly sounding locations, such as Palmerston (South Island) and Palmerston North (North Island).
- Transport modes were possibly subject to tourists’ perceptions. For example, it appeared that the ‘coach tour’, ‘backpacker bus’ and ‘scheduled coach’ were not always understood in the same sense. Also, tourists reported to have crossed the Cook Strait on yachts or cruise ships when it was likely that they actually used the ‘commercial (Cook Strait) ferries’, as most tourists do.
- Some tourists could not remember the location of their overnight stops or how they got there (coded with ‘don’t know’). Also, the database contained the reply ‘other specify’ without any further specification.
Some of these data problems and inconsistencies could not be overcome and it was necessary to delete 43 cases from the database. This was mainly due to absent information on transport modes or overnight locations or obviously unrealistic itineraries. A further 14 cases were deleted due to the complete lack of itineraries; one visitor was on transit and was removed from the database. Hence, 5,422 cases remained in the database; of these the 61 long-term tourists were separated and not analysed any further.

First of all, it was estimated that travel from (or to) the airport to (or from) the accommodation at the gateway city was for about 30 km each, if not reported. If no assumption could be made about the transport mode, the most energy-efficient option, the scheduled bus (which is also similar to the airport shuttle bus in terms of energy use), was chosen. For gateway-only tourists this (60 km by public bus) is the only information transport available for further analysis. While allowing a minimum transport energy use for these tourists, this procedure also results in a bias towards the use of scheduled buses and associated average travel distances. For this reason these tourists are excluded from the transport-related analyses.

An important modification was the expansion of the itineraries as already described for domestic tourists. New travel sectors had to be inserted where tourists used more than one transport mode per travel sector. For example, tourists travelling by rental car from Wanganui to Kaikoura were assumed to have travelled by car to Wellington, then by ferry to Picton and finally by car to Kaikoura. Replies of ‘other’, ‘don’t know’ or missing values (e.g. travel from/to the airport) were replaced by the most realistic options, for example the transport mode most often used by the respective tourist (in the case of missing transport information) or a location on the route to the next known overnight stop (in the case of an unknown overnight stop).

In some cases the order of overnight stops seemed to be wrong (e.g. travel from the North Island to the South Island to the North Island and so forth), and needed to be modified to generate a realistic itinerary. It is acknowledged that this procedure could falsify the (actually correct) itinerary and therefore underestimate the travel distance. Generally, efforts to remedy data errors were made in favour of energy efficient options to avoid overestimating energy use.
A further source of potential error lies in the often falsely reported length of stay. Length of stay can either be obtained by using arrival and departure dates (which should be free of error in most cases) or by adding up the total number of nights spent in different locations within New Zealand. Obviously, the latter is subject to tourists’ correct reporting. Several tourists (especially those who stayed comparatively long) seemed to have forgotten how many nights they spent at a specific location or could not recall a location at all, which generally led to reporting fewer nights than were actually spent in New Zealand.

Despite the larger error associated with the number of nights calculated from tourists’ itineraries this approach is taken in this study, simply because only for reported nights accommodation categories are available. Missing nights (which could be calculated for each tourist) constitute a mere number with no further information on travel behaviour.

**Cruise ship tourists**

Cruise ship tourists clearly constitute a very distinct type of tourist, defined by their main transport mode, the cruise ship. New Zealand is a destination offered by cruising companies often in combination with other destinations in the South Pacific and in the form of ‘fly and cruise packages’. Little is known about this type of tourist, in particular about cruise ship tourists’ travel routes and energy use. There are several reasons why it is more difficult to analyse energy use of cruise ship tourists compared with other tourists:

- Cruising companies are often large international companies that are difficult to approach, in particular for information that is not market-related.
- The fuel consumption varies considerably for different types of cruising ships and it is difficult to obtain information on a per passenger km basis.
- Diesel consumed by the ship is for transport and on-board electricity generation necessary to meet catering and hospitality functions, i.e. the accommodation and entertainment components of the trip. The share of each ‘sub-sector’ is unknown.

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35 The analysis of cruise ship tourists in this Chapter relies on only eight cases. However, since there is a general lack of information on cruise ship tourists in New Zealand and elsewhere, it was decided to keep them in the analysis and discuss them alongside land-based ‘touring tourists’.
• Cruise ship tourists consume (possible large amounts) energy on their land-trips in addition to on-board energy use.
• Cruising ships accommodate a large number of staff, consuming probably more energy than staff in regular tourism businesses where no accommodation and food is provided.
• Travel distances difficult to determine, because routings for cruising ships are not readily available.

Some indication on energy use of a cruise ship can be obtained from the web, where some information on fuel consumption is provided. In combination with (maximum) passenger numbers the energy use per passenger can be estimated. For the four web sources (footnote) energy use ranges between 1,500 and 4,000 MJ per passenger-day.

Energy use associated with cruising requires a thorough investigation. Since very little is known about (New Zealand) cruise ship tourists a cautious estimate is undertaken in this study. The assumptions was made that energy use of cruise ships is assumed to be the same as for ‘other ferries’ (3.6 MJ/pkm). It is acknowledged that actual energy use may be larger when considering that ferries usually have the sole purpose of transporting passengers, which most likely results in higher load factors than cruise ships.

It is furthermore assumed that cruise ships as accommodation are most likely to be similar to hotels, due to their service orientation and the obvious level of luxury.
Finally, a scan of New Zealand cruise ship tourists’ itineraries (e.g. Milford Sound to Dunedin, Christchurch, Wellington to the Bay of Islands) showed similar routings of those for land-based travel. To obtain an estimate for travel distances, the (possibly shorter) land-based travel distances are applied to cruise ship itineraries.

These assumptions are believed to lead to an under-estimate of energy use. To account for the high uncertainty of energy use, cruise ship tourists are separated from other touring tourists for the ‘aggregated energy use’ calculation.

Travel distances
The database as provided by the University of Auckland contained 169 different coded locations. Several were identified to be doubled or geographically so close that they could be combined (e.g. Westland and Westland National Park). Also, some locations were renamed to match them with the distance table for domestic tourists (e.g. Abel Tasman National Park was changed into Motueka, the gateway of the Park). Five locations were added to the distance table of domestic tourists. These were: Nelson Lakes National Park, Marlborough Sounds (previously represented by Picton), Mt Aspiring National Park, Hokiaŋga/Opononi in Northland, (Lake) Manapouri in Southland and Fox Glacier on the West Coast. The location table for international tourists contains 114 coded locations, 58 of which were on the North Island and 55 on the South Island.

Transport variables
International tourists reported 18 different transport modes. Shuttle buses were not reported separately (as for international West Coast tourists) and it is assumed that they form part of scheduled buses. The key statistics of the 18 transport variables are presented in Table 43. All tourists (except for long-term tourists) were included in this analysis. Tourists who did not use a specific mode (distance is 0 km) were considered as well as those who used it at least once. As a consequence all variables are strongly positively skewed, especially those that were selected by few tourists. It is assumed that ‘secondary transport modes’, such as the taxi or a helicopter, are under-estimated, due to preferred reporting of main transport modes by tourists. This is likely to apply for tramping as well, since many tourists use some transport to get to a walk or track before they actually walk to the hut or campsite, i.e. their overnight location.
Table 43: Transport variables for international tourists (N = 5,361)

<table>
<thead>
<tr>
<th>Mode</th>
<th>Scale</th>
<th>Mean</th>
<th>SD</th>
<th>Skewness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic air</td>
<td>Km/day</td>
<td>50.7</td>
<td>96.9</td>
<td>3.1</td>
</tr>
<tr>
<td>Coach</td>
<td>Km/day</td>
<td>35.8</td>
<td>74.0</td>
<td>2.5</td>
</tr>
<tr>
<td>Rental car</td>
<td>Km/day</td>
<td>27.3</td>
<td>59.4</td>
<td>2.4</td>
</tr>
<tr>
<td>Scheduled bus</td>
<td>Km/day</td>
<td>9.3</td>
<td>28.5</td>
<td>8.9</td>
</tr>
<tr>
<td>Private car</td>
<td>Km/day</td>
<td>7.7</td>
<td>27.3</td>
<td>5.4</td>
</tr>
<tr>
<td>Camper van</td>
<td>Km/day</td>
<td>5.7</td>
<td>30.8</td>
<td>5.8</td>
</tr>
<tr>
<td>Cook Strait Ferry</td>
<td>Km/day</td>
<td>3.1</td>
<td>1.1</td>
<td>5.4</td>
</tr>
<tr>
<td>Backpacker bus</td>
<td>Km/day</td>
<td>2.1</td>
<td>14.7</td>
<td>8.4</td>
</tr>
<tr>
<td>Train</td>
<td>Km/day</td>
<td>1.9</td>
<td>10.9</td>
<td>10.4</td>
</tr>
<tr>
<td>Cruise ship</td>
<td>Km/day</td>
<td>0.3</td>
<td>9.2</td>
<td>29.3</td>
</tr>
<tr>
<td>Hitchhiking</td>
<td>Km/day</td>
<td>0.3</td>
<td>4.4</td>
<td>24.9</td>
</tr>
<tr>
<td>Motorcycle</td>
<td>Km/day</td>
<td>0.2</td>
<td>6.8</td>
<td>34.8</td>
</tr>
<tr>
<td>Cycle</td>
<td>Km/day</td>
<td>0.2</td>
<td>3.7</td>
<td>27.3</td>
</tr>
<tr>
<td>Taxi</td>
<td>Km/day</td>
<td>0.2</td>
<td>5.7</td>
<td>46.3</td>
</tr>
<tr>
<td>Yacht/boat</td>
<td>Km/day</td>
<td>0.1</td>
<td>2.7</td>
<td>62.3</td>
</tr>
<tr>
<td>Other ferries</td>
<td>Km/day</td>
<td>0.1</td>
<td>0.9</td>
<td>28.8</td>
</tr>
<tr>
<td>Helicopter</td>
<td>Km/day</td>
<td>0.03</td>
<td>1.1</td>
<td>39.7</td>
</tr>
<tr>
<td>Tramping</td>
<td>Km/day</td>
<td>0.02</td>
<td>0.6</td>
<td>56.9</td>
</tr>
</tbody>
</table>

Accommodation variables

Accommodation types reported by international tourists had to be integrated into the accommodation categories described earlier. In the original data there was no explicit distinction between motels with and without restaurant (often motor inns), and every reported ‘motel’ night was allocated to the motel category. Possibly, energy use is slightly underestimated as a result of this allocation to the energy-efficient motel category. Nevertheless, hotels were the most popular accommodation category with 0.45 nights per tourist being spent at this category. ‘Homes’ and motels were other popular accommodation categories (Table 44). The standard deviation and skewness were smallest for hotels, indicating reasonable spread and normal distribution, whereas the distribution for campgrounds is strongly positively skewed. This means that a small number of tourists spend comparatively many nights at campgrounds.
Table 44: Accommodation variables for international tourists (N= 5,361)

<table>
<thead>
<tr>
<th>Category</th>
<th>Comprises</th>
<th>Scale</th>
<th>Mean</th>
<th>SD</th>
<th>Skewness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hotel</td>
<td>Lodge, hotel, cruise ship</td>
<td>Nights/day</td>
<td>0.45</td>
<td>0.47</td>
<td>0.23</td>
</tr>
<tr>
<td>B&amp;B</td>
<td>Farmstay, homestay, boat</td>
<td>Nights/day</td>
<td>0.03</td>
<td>0.15</td>
<td>5.26</td>
</tr>
<tr>
<td>Motel</td>
<td>Motel/motor inn</td>
<td>Nights/day</td>
<td>0.11</td>
<td>0.27</td>
<td>2.48</td>
</tr>
<tr>
<td>Backpacker</td>
<td>Youth hostel</td>
<td>Nights/day</td>
<td>0.09</td>
<td>0.26</td>
<td>2.94</td>
</tr>
<tr>
<td>Campground</td>
<td>Caravan /camp site, cabin, hut, free camping</td>
<td>Nights/day</td>
<td>0.06</td>
<td>0.21</td>
<td>3.70</td>
</tr>
<tr>
<td>Home</td>
<td>Private or rented home, time share, student home</td>
<td>Nights/day</td>
<td>0.27</td>
<td>0.40</td>
<td>1.08</td>
</tr>
</tbody>
</table>

Data analysis

Describing and analysing energy use

Typical travel behaviour and energy use associated with the 24 (18 in the transport sub-sector and 6 accommodation travel choices) different travel choices was analysed as described for international West Coast tourists and domestic tourists. By adding up all energy use that was associated with a specific travel choice, the relative contribution of each travel choice to a sub-sector's total was determined. Only the relative share is presented since no projection of total energy use from the sample to the whole New Zealand tourism sector was made at this stage (see Chapter 5). It is assumed that the (relative) proportions remain similar when inferences are made from the sample to the population.

The 'energy bill' of an individual tourist was calculated based on the transport and accommodation component. Finally, the relationship between travel choices and energy intensity of travel (MJ/day) was analysed with linear regression and stepwise multiple regression analysis.
Cluster analysis

Since attraction/activity variables have not been available, factor analysis was not applied to this sample (as had been done for international West Coast tourists). Only transport and accommodation travel choices were considered for the segmentation analysis.

First of all, an *a priori* segmentation of gateway-only tourists (N= 1,160), cruise ship tourists (N= 8) and other touring tourists (N= 4,193) was undertaken. Only touring tourists were included in the cluster analysis. The basis for the cluster analysis was tourists’ travel behaviour measured through their travel choice intensities (i.e. km/day and nights/day). A hierarchical cluster analysis with a correlational measure seemed appropriate to segment tourists into similar groups (informed by the pilot-study on international West Coast tourists). This method, however, is not suitable for large sample sizes (Hair et al, 1998)[37]. For this reason the sample of touring tourists had to be randomly split into four sub-samples with about 1,050 cases each. The tourist types resulting from each of the four sub-sample segmentations were then compared and recombined to one final tourist type solution. The tourist types were profiled, tested (ANOVA and Chi-square), validated (multiple discriminant analysis) and analysed in terms of their energy uses.

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[37] In fact, it was impossible to cluster analyse data sets larger than 1,200 cases using the hierarchical method.
4.4.1 Energy use associated with specific travel choices

Transport sector and energy use

This analysis refers to touring tourists who used a specific transport mode at least once. Domestic air was the most popular transport mode with touring tourists, with almost every second tourist having travelled by plane at least once within New Zealand. Coach tours and rental cars were each used by about a third of all touring tourists, whereas camper vans, backpacker buses and the train were used by relatively few tourists (about 5% each) (Table 45).

On average, international touring tourists travelled for about 1,950 km within New Zealand. The largest distance on average was travelled by camper vans, both in trip total and per day. This distance was only paralleled by cruise ship tourists (2,590 km per trip).

Table 45: Transport travel choices and energy use of international touring tourists who used a mode at least once (N= 4,201)

<table>
<thead>
<tr>
<th>Mode</th>
<th>Energy intensity (MJ/pkm)</th>
<th>Tourists (N)</th>
<th>Proportion (%)</th>
<th>Distance per day (km/day)</th>
<th>Total travel distance (km)</th>
<th>Avg. total energy use (MJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic air</td>
<td>2.75</td>
<td>2,002</td>
<td>47.7</td>
<td>135.8</td>
<td>1,039</td>
<td>2,857</td>
</tr>
<tr>
<td>Coach</td>
<td>1.01</td>
<td>1,391</td>
<td>33.1</td>
<td>137.9</td>
<td>1,131</td>
<td>1,143</td>
</tr>
<tr>
<td>Rental car</td>
<td>0.94</td>
<td>1,285</td>
<td>30.6</td>
<td>113.9</td>
<td>1,646</td>
<td>1,548</td>
</tr>
<tr>
<td>C. Strait Ferry</td>
<td>2.40</td>
<td>965</td>
<td>23.0</td>
<td>6.11</td>
<td>115</td>
<td>277</td>
</tr>
<tr>
<td>Scheduled bus</td>
<td>0.75</td>
<td>783</td>
<td>18.6</td>
<td>36.6</td>
<td>523</td>
<td>392</td>
</tr>
<tr>
<td>Private car</td>
<td>1.03</td>
<td>749</td>
<td>17.8</td>
<td>54.2</td>
<td>1,053</td>
<td>1,985</td>
</tr>
<tr>
<td>Train</td>
<td>1.44</td>
<td>280</td>
<td>6.7</td>
<td>35.8</td>
<td>530</td>
<td>764</td>
</tr>
<tr>
<td>Camper van</td>
<td>2.06</td>
<td>218</td>
<td>5.2</td>
<td>141.1</td>
<td>2,525</td>
<td>5,202</td>
</tr>
<tr>
<td>Backpacker bus</td>
<td>0.58</td>
<td>190</td>
<td>4.5</td>
<td>59.9</td>
<td>1,504</td>
<td>873</td>
</tr>
<tr>
<td>Other ferries</td>
<td>3.53</td>
<td>56</td>
<td>1.3</td>
<td>4.93</td>
<td>94</td>
<td>332</td>
</tr>
<tr>
<td>Hitchhiking</td>
<td>1.03</td>
<td>49</td>
<td>1.2</td>
<td>29.7</td>
<td>908</td>
<td>936</td>
</tr>
<tr>
<td>Taxi</td>
<td>0.94</td>
<td>20</td>
<td>0.5</td>
<td>4.1</td>
<td>301</td>
<td>283</td>
</tr>
<tr>
<td>Yacht/boat</td>
<td>1.75</td>
<td>15</td>
<td>0.4</td>
<td>22.8</td>
<td>431</td>
<td>754</td>
</tr>
<tr>
<td>Motorcycle</td>
<td>0.87</td>
<td>10</td>
<td>0.2</td>
<td>124.8</td>
<td>2,104</td>
<td>1,830</td>
</tr>
<tr>
<td>Cruise ship</td>
<td>3.53</td>
<td>8</td>
<td>0.2</td>
<td>226.9</td>
<td>2,590</td>
<td>9,142</td>
</tr>
<tr>
<td>Cycle</td>
<td>0</td>
<td>14</td>
<td>0.3</td>
<td>61.4</td>
<td>1,993</td>
<td>0</td>
</tr>
<tr>
<td>Tramping</td>
<td>0</td>
<td>11</td>
<td>0.3</td>
<td>7.84</td>
<td>126</td>
<td>0</td>
</tr>
<tr>
<td>Helicopter</td>
<td>4.68</td>
<td>5</td>
<td>0.1</td>
<td>34.0</td>
<td>307</td>
<td>1,438</td>
</tr>
</tbody>
</table>
As a result of large travel distances and the associated large energy intensity, domestic air travel generates the largest energy use per person of all transport modes. Air travel is also dominant in terms of its contribution to total energy consumption of international tourists for transport. Rental cars, coaches, camper vans and private cars are also important contributors, while the remaining transport modes only contribute marginally (Figure 36).

![Pie chart showing transport modes and their energy contribution]

Figure 36: Contribution of different transport modes to total energy use associated with international tourists’ transport. Other: Cook Strait Ferry, train, backpacker bus, hitchhiking, motorcycle, yacht/boat, other ferries, helicopter, taxi.

**Accommodation sector and energy use**

Hotels were popular with more than every second tourists (57.7%) having spent at least one night there (Table 46), however, hotels also seemed to be visited by tourists who stayed comparatively short periods (6.3 nights on average). A tourist staying at a hotel did so in 75.0% of their total nights, hence hotel visitors spent 25% of their nights at other accommodation categories. B&Bs were mainly used as a supplementary accommodation category (only 37.4% of a tourist’s nights were spent in this category, when used at least once) with relatively short stays (7.3 days on average). Energy use associated with B&Bs was large, because of their energy intensity of 110 MJ per visitor-night. Motels were only visited by 26.5% of all tourists; and only for about half of their nights. In contrast, homes and backpacker hostels were characterised by tourists staying often (about two thirds of their total nights in New Zealand) and long (19 days). Campgrounds, while being used at moderate levels in terms of visitor numbers, nights spent there, and total number of nights, were characterised by a low energy use per person. This can be explained by the low energy intensity of only 25 MJ per visitor-night. ‘Homes’ were visited by one
third of all international tourists. Tourists stayed comparatively long at homes (19 days).

Table 46: Accommodation travel choices and energy use of international touring tourists who visited a category at least once (N = 4,201)

<table>
<thead>
<tr>
<th>Category</th>
<th>Energy intensity (MJ/visitor-night)</th>
<th>Tourists (N)</th>
<th>Proportion (%)</th>
<th>Nights spent in category (%)</th>
<th>Number of nights</th>
<th>Avg. total energy use (MJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hotel</td>
<td>155</td>
<td>2,426</td>
<td>57.7</td>
<td>75.0</td>
<td>6.3</td>
<td>976</td>
</tr>
<tr>
<td>B&amp;B</td>
<td>110</td>
<td>396</td>
<td>9.4</td>
<td>37.4</td>
<td>7.3</td>
<td>803</td>
</tr>
<tr>
<td>Motel</td>
<td>32</td>
<td>1,115</td>
<td>26.5</td>
<td>49.0</td>
<td>18.8</td>
<td>231</td>
</tr>
<tr>
<td>Backpacker</td>
<td>39</td>
<td>686</td>
<td>16.3</td>
<td>62.4</td>
<td>18.8</td>
<td>734</td>
</tr>
<tr>
<td>Campground</td>
<td>25</td>
<td>577</td>
<td>13.7</td>
<td>54.8</td>
<td>13.0</td>
<td>324</td>
</tr>
<tr>
<td>Home</td>
<td>41</td>
<td>1,382</td>
<td>32.9</td>
<td>68.2</td>
<td>19.3</td>
<td>790</td>
</tr>
</tbody>
</table>

The popularity of a specific accommodation category and the energy intensity determine its contribution to total energy use in the sub-sector. Hotels accounted for half of the energy consumed by international tourists in the accommodation sub-sector (Figure 37). Homes were second most important, while the remaining categories only contributed with between 3% (Campgrounds) and 9% (backpackers).

Figure 37: Contribution of different accommodation categories to total energy use associated with international tourists’ accommodation.
Aggregated energy use

Energy use has been aggregated for gateway-only tourists, touring tourists and cruise ship tourists. While transport energy use of gateway-only tourists constitutes a minimum estimate (as a result of the missing transport information), energy use of touring tourists contains the full information on transport and accommodation. It is important to remember, however, that no ‘extra-transport’ that is transport in addition to that from one overnight location to the next has been reported as for international West Coast tourists. The figures given in Table 47 constitute minimum estimates.

Gateway-only tourists are characterised by a comparatively low energy use both in total (766 MJ) and per day (114 MJ/day), which is a result of low transport energy use and also a shorter length of stay (in terms of total energy use) when compared with touring tourists. Touring tourists consumed about 4,055 MJ per trip or 387 MJ per day. Transport makes up 69.4% of total energy use (calculated based on the medians given in Table 47). Adding the attraction/activity component would reduce transport’s contribution slightly.

There is a large range between the minimum and maximum energy use both for transport and accommodation. The maximum energy use of almost 20,000 MJ for accommodation is related to a tourist who stayed 125 nights in a hotel. This is considered unusual, as well as the large energy use for transport of over 14 GJ which resulted from a 11,000 km trip by rental car and domestic air.

Table 47: Energy use of international tourists for the two sub-sectors and the entire trip in New Zealand

<table>
<thead>
<tr>
<th></th>
<th>Transport (MJ)</th>
<th>Accommodation (MJ)</th>
<th>Total energy use (MJ)</th>
<th>Energy use per day (MJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gateway-only tourists</td>
<td>Mean 46</td>
<td>720</td>
<td>766</td>
<td>114</td>
</tr>
<tr>
<td></td>
<td>Median 45</td>
<td>410</td>
<td>467</td>
<td>156</td>
</tr>
<tr>
<td></td>
<td>Min  0</td>
<td>32</td>
<td>77</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>Max 144</td>
<td>20,150</td>
<td>20,195</td>
<td>299</td>
</tr>
<tr>
<td>N = 1,160</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Touring</td>
<td>Mean 2,932</td>
<td>1,123</td>
<td>4,055</td>
<td>387</td>
</tr>
<tr>
<td>tourists</td>
<td>Median 2,721</td>
<td>930</td>
<td>3,920</td>
<td>288</td>
</tr>
<tr>
<td></td>
<td>Min  45</td>
<td>41</td>
<td>164</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>Max 14,351</td>
<td>19,549</td>
<td>25,596</td>
<td>4,202</td>
</tr>
<tr>
<td>N = 4,193</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cruise ship</td>
<td>Mean 10,797</td>
<td>1,861</td>
<td>12,658</td>
<td>1,090</td>
</tr>
<tr>
<td>tourists</td>
<td>Median 10,553</td>
<td>1,628</td>
<td>12,160</td>
<td>1,144</td>
</tr>
<tr>
<td></td>
<td>Min  8,080</td>
<td>1,395</td>
<td>10,556</td>
<td>540</td>
</tr>
<tr>
<td></td>
<td>Max 14,522</td>
<td>3,255</td>
<td>16,546</td>
<td>1,326</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Do travel choices explain energy intensity of travel?

Simple linear regression was used to explain total energy use by length of stay. There was a significant relationship ($F= 1685.0$, $df= 1, 5359$, $p< 0.001$) with 23.9% of variation in total energy use being explained by tourists staying for different periods of time. However, more than 75% of variation remains unexplained which means that other factors also influence total energy use. Linear regression was applied to analyse how specific travel choices explained energy use per day (dependent variable).

Only touring tourists (gateway-only tourists were excluded due to lacking transport information) who made a specific travel choice at least once were included in the linear regression analysis. Hence, regression tested the influence of, for example, coach travel on the total energy use per day of a ‘coach tourist’. Since the individual ‘energy bill’ consists only of transport and accommodation choices it is not surprising that most of the travel choices were significant. Only hitchhiking, motorcycle, helicopter, the taxi, the motel and the backpacker hostel did not explain variation in energy use per day on the 5%-level. Domestic air travel was the strongest explanatory travel choice with about 90% ($F= 18225.1$, $df= 1, 2,000$, $p< 0.001$) of a tourist’s energy intensity being explained, if the tourist used it at least once.

The results of the linear regression analysis were considered to provide trivial information only. For this reason, multiple regression analysis on all travel choices (km/day and nights/day) was undertaken to explain energy use per day. All touring tourists were included (also those scoring zero for a travel choice).

Again, domestic air was the strongest explanatory variable explaining 85.6% of all variance (model 1 with one variable). The model was improved by including further variables, and it was decided that a model with five variables (domestic air, coach, camper van, home accommodation and rental car) explaining 96.9% of variance was a good compromise between prediction accuracy and number of variables\(^{38}\) (Table 48). ANOVA for this model was highly significant ($F= 26220.0$, $df= 5, 4195$, $p< 0.001$).

The multiple regression analysis identified variables that contributed most to a tourist’s energy use as well as variables that were not important in this context. It is

---

\(^{38}\) The more variables included in the model the larger is the proportion of variance explained.
worth noting that 19 variables not entered in the model accounted for only about 3% of variation in energy intensity of travel.

Table 48: Multiple regression model to explain energy use per day.

<table>
<thead>
<tr>
<th>Travel choice (km or nights/day)</th>
<th>Unstd. Coefficients</th>
<th>Std. Coefficients</th>
<th>t-value</th>
<th>Significance</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>90.74</td>
<td></td>
<td>61.34</td>
<td>&lt;0.001</td>
<td>0.735</td>
</tr>
<tr>
<td>Domestic air</td>
<td>2.64</td>
<td>0.87</td>
<td>273.80</td>
<td>&lt;0.001</td>
<td>0.626</td>
</tr>
<tr>
<td>Coach</td>
<td>0.83</td>
<td>0.21</td>
<td>60.79</td>
<td>&lt;0.001</td>
<td>0.942</td>
</tr>
<tr>
<td>Camper van</td>
<td>1.77</td>
<td>0.19</td>
<td>68.35</td>
<td>&lt;0.001</td>
<td>0.851</td>
</tr>
<tr>
<td>Rental car</td>
<td>0.72</td>
<td>0.15</td>
<td>49.54</td>
<td>&lt;0.001</td>
<td>0.535</td>
</tr>
<tr>
<td>Hotel</td>
<td>118.52</td>
<td>0.17</td>
<td>45.70</td>
<td>&lt;0.001</td>
<td></td>
</tr>
</tbody>
</table>

The five travel choice variables across the transport and accommodation sub-sectors explain 96.9% of the variation in energy use per day.

4.4.2 Segmentation: Tourist types and energy types

Clustering process

Cluster analysis was applied to land-based touring tourists. As a result of small sample size the following travel choices were not included in the analysis: yacht, tramping, taxi and helicopter. Hence, 19 travel choices entered the cluster analysis. As mentioned above, four separate sub-samples were cluster analysed. The sub-samples generated very similar results in terms of the clustering process (meaningful number of clusters), relative cluster sizes and cluster characteristics both in terms of travel choices and profiling variables.

The clustering process is briefly described (in reverse order) for the four sub-samples. The first cluster that emerged comprised about one third of all cases and was characterised by coach and air travel and the stay at hotels. This cluster remained stable in the following steps. The remaining tourists were split into a ‘rental car plus motel’ cluster (later ‘auto tourist’) and one that contained a broader range of independently travelling tourists. These were further separated into ‘visiting friend/relatives’ tourists and other independent travellers, who in the next step split into ‘camping tourists’ (‘camper’) and ‘backpackers’. The sixth cluster to emerge originated either from the ‘coach tourist’ cluster or the ‘auto tourist’ cluster and comprised tourists with a comfort-oriented travel style organised in a more independent way compared with coach travellers. This cluster – called ‘soft comfort traveller’ – also comprised special interest tourists such as cyclists and motorcyclists. A seven-cluster solution further split the ‘auto tourist’, but was considered not to
provide sufficient extra information. Hence, a six-cluster solution was adopted and the sub-samples were merged to one final cluster solution for which key travel choices and other characteristics were calculated (Table 48). A comparative table of the four sub-samples and key travel choices can be found in Appendix C.

ANOVA showed that all travel choice variables differed on the 1%-level, except ‘yacht’, ‘tramping’ and ‘motorcycle’. Length of stay, total costs in NZ$ and costs per day also differed significantly. Country of origin, travel party, travel purpose, previous visits to New Zealand, age, sex were all significantly different among the tourist types (Chi-square).
Table 49: Tourist types resulting from a cluster analysis on 19 travel choices
(international land-based touring tourists) and key characteristics

<table>
<thead>
<tr>
<th>Tourist type</th>
<th>N, % of sample</th>
<th>Travel choice variables used in cluster analysis</th>
<th>Key other variables for each tourist type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coach tourist</td>
<td>1481 / 27.6%</td>
<td>73% domestic air (185 km/day) 73% coach (156 km/day) 100% hotel</td>
<td>35% Japanese, 6% Taiwanese 35% tour group 77% holiday, 10% business 41% older than 54 yrs Total expenditure: NZ$9,729 Expenditure per day: NZ$1,563 Stay: 7.7 days</td>
</tr>
<tr>
<td>VFR</td>
<td>1026 / 19.1%</td>
<td>57% private car (60 km/day) 39% domestic air (70 km/day) 95% home 32% motel</td>
<td>28% Australian, 22% British 45% travelled alone 43% visit is travel purpose, 7% education 60% visited NZ before Total expenditure: NZ$6,167 Expenditure per day: NZ$387 Stay: 27.6 days</td>
</tr>
<tr>
<td>Auto tourist</td>
<td>832 / 15.5%</td>
<td>81% rental car (140 km/day) 69% motel 58% hotel</td>
<td>28% Australian, 60% male 47% couple, 16% family Total expenditure: NZ$8,813 Expenditure per day: NZ$787 Stay: 13.5 days</td>
</tr>
<tr>
<td>Backpacker</td>
<td>444 / 8.3%</td>
<td>55% Cook Strait Ferry 54% scheduled bus (46 km/day); 28% backpacker bus (84 km/day) 19% private car (42 km/day) 8% hitchhiking (49 km/day) 93% backpacker hostel</td>
<td>29% British 48% travelled alone 83% younger than 35 yrs Total expenditure: NZ$6,073 Expenditure per day: NZ$331 Stay: 30.3 days</td>
</tr>
<tr>
<td>Camper</td>
<td>232 / 4.3%</td>
<td>62% camper van (148 km/day) 55% Cook Strait Ferry 38% rental car (104 km/day) 99% campground</td>
<td>25% Australian, 22% British, 13% German 57% couple, 60% male Total expenditure: NZ$8,400 Expenditure per day: NZ$468 Stay: 21.3 days</td>
</tr>
<tr>
<td>Soft comfort traveller</td>
<td>178 / 3.3%</td>
<td>47% Cook Strait Ferry 40% rental car (103 km/day) 31% camper van (162 km/day) 25% train (50 km/day) 4% cycle (56 km/day) 56% camping 42% hotel; 33% B&amp;B</td>
<td>17% British, 16% American, 16% Australian Total expenditure: NZ$8,420 Expenditure per day: NZ$598 Stay: 21.2 days</td>
</tr>
</tbody>
</table>
Validation of tourist types

Multiple discriminant analysis was used to validate tourist types, identify key variables in the discrimination among types and to show the relative separation between types. Five discriminant functions (all of them significant) were produced. The first function basically separated tourists who stayed at a hotel from those who stayed at homes (Table 28) and accounted for 41.3% of the variance among types. The last function on which the train and B&B loaded highly accounted for only 0.4% of the variance.

Table 50: Structure matrix with variables’ loadings on five discriminant functions

<table>
<thead>
<tr>
<th>Function</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hotel</td>
<td>-0.637</td>
<td>-0.186</td>
<td>0.312</td>
<td>0.327</td>
<td>0.046</td>
</tr>
<tr>
<td>Home</td>
<td>0.629</td>
<td>-0.469</td>
<td>0.159</td>
<td>0.152</td>
<td>-0.070</td>
</tr>
<tr>
<td>Coach</td>
<td>-0.261</td>
<td>-0.057</td>
<td>0.158</td>
<td>0.241</td>
<td>0.100</td>
</tr>
<tr>
<td>Domestic air</td>
<td>-0.184</td>
<td>-0.068</td>
<td>0.121</td>
<td>0.159</td>
<td>0.057</td>
</tr>
<tr>
<td>Private car</td>
<td>0.179</td>
<td>-0.107</td>
<td>0.056</td>
<td>0.049</td>
<td>-0.068</td>
</tr>
<tr>
<td>Ferry</td>
<td>0.031</td>
<td>-0.011</td>
<td>0.111</td>
<td>0.006</td>
<td>0.007</td>
</tr>
<tr>
<td>Backpacker hostel</td>
<td>0.236</td>
<td>0.846</td>
<td>0.335</td>
<td>-0.021</td>
<td>0.014</td>
</tr>
<tr>
<td>Backpacker bus</td>
<td>0.051</td>
<td>0.213</td>
<td>0.095</td>
<td>-0.001</td>
<td>0.060</td>
</tr>
<tr>
<td>Campground</td>
<td>0.066</td>
<td>0.203</td>
<td>-0.805</td>
<td>0.452</td>
<td>0.258</td>
</tr>
<tr>
<td>Camper van</td>
<td>0.020</td>
<td>0.101</td>
<td>-0.438</td>
<td>0.245</td>
<td>0.106</td>
</tr>
<tr>
<td>C. Strait Ferry</td>
<td>0.007</td>
<td>0.091</td>
<td>-0.096</td>
<td>-0.091</td>
<td>0.000</td>
</tr>
<tr>
<td>Motel</td>
<td>-0.017</td>
<td>-0.059</td>
<td>-0.135</td>
<td>-0.573</td>
<td>0.258</td>
</tr>
<tr>
<td>Rental car</td>
<td>0.000</td>
<td>0.064</td>
<td>-0.178</td>
<td>-0.527</td>
<td>0.147</td>
</tr>
<tr>
<td>Train</td>
<td>-0.025</td>
<td>0.020</td>
<td>-0.011</td>
<td>0.051</td>
<td>-0.665</td>
</tr>
<tr>
<td>B&amp;B</td>
<td>-0.018</td>
<td>0.010</td>
<td>-0.103</td>
<td>-0.208</td>
<td>-0.640</td>
</tr>
<tr>
<td>Hitchhiking</td>
<td>0.018</td>
<td>0.075</td>
<td>0.015</td>
<td>0.004</td>
<td>-0.204</td>
</tr>
<tr>
<td>Cycle</td>
<td>0.003</td>
<td>0.019</td>
<td>-0.070</td>
<td>0.037</td>
<td>-0.185</td>
</tr>
<tr>
<td>Scheduled bus</td>
<td>-0.002</td>
<td>0.101</td>
<td>0.058</td>
<td>0.037</td>
<td>-0.127</td>
</tr>
<tr>
<td>Motorcycle</td>
<td>0.011</td>
<td>-0.010</td>
<td>-0.005</td>
<td>-0.011</td>
<td>-0.061</td>
</tr>
</tbody>
</table>

The F-values (F to remove) showed that all accommodation travel choices except the motel and B&Bs were important contributors to the discrimination as well as were the private and the rental car. The classification analysis resulted in 88.2% or successfully classified cases for the original cases and 88.0% for the leave-one out sample.

The scatter-plot (Figure 38) of all groups for the first two discriminant functions clearly shows that ‘coach tourists’, ‘backpackers’ and ‘visiting friends/relatives tourists’ are most apart. The ‘soft comfort traveller’ dispenses between the ‘coach tourist’ and the ‘backpacker’ and is also relatively close to the ‘auto tourist’ who is in the centre of the triangle.
Figure 38: Plot of individuals’ scores on the first two discriminant functions (international land-based touring tourists).

Are tourist types energy types?

Energy use per day clearly differed for the six tourist types (ANOVA: F= 573.1, df= 5, 4,187, p<0.01) (Figure 39). The ‘coach tourist’ had the largest energy intensity of travel with 654 MJ per day. This was almost twice the average energy use of 387MJ per day (reference line). The ‘soft comfort traveller’ (329 MJ/day), the ‘camper’ (318 MJ/day)), and the ‘auto tourist’ (298 MJ/day) travelled with similar energy intensities, as did the ‘backpacker’ and the ‘VFR’ (195 and 183 MJ/day, respectively). A post hoc test confirmed that these three groups of tourist types namely the ‘coach’, ‘soft comfort’, the ‘camper’, ‘auto’, ‘backpacker’ and the ‘VFR’ differed significantly on the basis of their energy intensity. It has to be noted that the ‘VRF’ is characterised by a large number of outliers and extreme values.
Figure 39: Energy use per day for the six international tourist types. The continuous horizontal line shows the mean energy use per day of 387MJ. Not all outliers and extremes are captured by the y-axis.

As a result of different travel lengths total energy use did not parallel energy intensity profiles for the six tourist types as discussed above. Notwithstanding, total energy use differed significantly (ANOVA: F= 73.3; df= 5, 4187, p<0.001) for the six tourist types. While the ‘coach tourist’ (4,422 MJ) consumed energy slightly above the average of 4,055 MJ, it was the ‘camper’ (5,787 MJ) and the ‘soft comfort traveller’ (5,364 MJ) who consumed the most energy overall. This results from the above-average length of stay of 21 days for each the ‘camper’ and the ‘soft comfort traveler’. The ‘backpacker’ consumed 4,287 MJ for their trip, while the ‘auto tourist’ and the ‘VFR’ consumed least with 3,426 MJ and 3,316 MJ, respectively. As is demonstrated in Figure 40, the ‘coach tourist’ differed significantly from the other types, except the ‘backpacker’. The ‘camper’ did not differ from the ‘soft comfort traveller’, neither did the ‘auto tourist’ and the ‘VFR’.
Figure 40: Total energy use for the six international tourist types. The horizontal line shows the mean total energy use of 4,055 MJ. Not all outliers and extremes are captured by the y-axis.

1.4.3 Discussion

General comments on travel itineraries

There are three important groups of international tourists, namely long-term tourists (1%), who stay longer than six months, gateway-only tourists (21%), who stay at the city of arrival and touring tourists (77%). Since touring tourists are usually considered as ‘typical tourists’ most of the analysis presented in this chapter focuses on this group. While less information is available for the other groups, they still constitute important markets for the New Zealand tourism industry. In particular, long-term tourists who stay on average about nine months deserve more research, despite their comparatively small size. These tourists who often come for business, education or conference purposes and are frequently from Japan may have considerable flow-on effects to the economy. Specific positive and negative effects may result both from their long stay (and hence multiple interactions and impacts) and also from induced travel through friends or relatives who visit the long-term tourist and the word-of-mouth marketing generated by these ‘quasi residents’.
About every fifth tourist belongs to the group of 'gateway-only' tourists. Most of these tourists visit Auckland. Business is an important reason for gateway-only travel, undertaken especially by male visitors from Australia. Christchurch, in particular, attracts a considerable number of conference travellers from various countries. Holiday and visiting friends or relatives are also important reasons to visit for gateway-only travellers. In these cases it is assumed that international tourists resemble domestic tourists in their travel behaviour. It is also likely that these gateway-only tourists undertake day trips from their urban basis. This 'extra transport' could be even more significant than transport undertaken by touring tourists, since daytrips require return travel back to the starting point.

Touring tourists stay at least one night at a location other than their city of arrival. A small yet significant group of touring tourists is similar to gateway-only tourists. These tourists are single-destination tourists within New Zealand, either because they visit a friend or relative or because they are on a short stop-over, possibly in combination with a trip to Australia. A popular destination in this category is Rotorua; about one per cent of all international tourists (or 4% of touring tourists) travel from Auckland to Rotorua (overnight stop) and back to Auckland from where they leave the country. Most touring tourists, however, travel further within New Zealand, although interestingly only about half of all touring tourists travel for more than seven travel sectors, i.e. stay at more than six different locations. The number of travel sectors of multi-destination trips allows neither conclusion about length of stay or travel distances. In particular, air travel allows travelling large distances, while only visiting few locations, e.g. golden triangle (Forer & Simmons, 1998). About half of all tourists travel both the North and the South Island. Of these, 39% cross the Cook Strait, 30% fly between Christchurch and Auckland and 15% between Auckland and Queenstown.

Cruise ship tourists constitute a distinct segment within the group of touring tourists. Obviously, the locations they visit are shore-connected destinations, often harbour cities, which are limited in number. Furthermore, travel between the destinations on board of a 'accommodation and entertainment complex' is part of the experience. Consequently, travel distances per day (or night) are generally further than for land-based travel. Interestingly, cruise ship tourists often do not travel on a cruising ship
for their whole trip, but they use international air to enter or/and leave the country (otherwise they would not have been interviewed for the IVS, which does not interview at seaports).

**Travel choices and tourists’ energy use**

International tourists use on average two different transport modes (mean 1.7) and between one and two accommodation categories (mean 1.5). Of all transport travel choices, domestic air is most popular; almost every second tourist uses it at least once. Air travel is associated with large per capita travel distances (1,040 km on average) and accordingly energy use. In combination with the large energy intensity these trends lead to domestic air’s dominant contribution (45%) to total transport energy use by international tourists. Rental cars and coach tours are also popular, with rental cars being used slightly less often than coach travel (in terms of visitor numbers), but being more important in terms of energy use per tourist. This results from larger distances travelled by rental car (1,650 km per tourist) compared with coach travel (1,131 km per tourist).

Camper vans require special attention due to their contribution to total energy use, despite a relatively small visitor volume. While only 5% use a camper van at least once, the camper van contributes about 9% to total transport energy use. Domestic air, coach, camper van and rental car were also found to be most important for explaining daily energy use of an individual tourist (regression analysis).

It is noteworthy that a comparatively large number of tourists use public transport at least once (scheduled bus and train). However, relatively smaller travel distances (523 km per tourist) indicate that these transport modes are often used as an additional mode. Cycling, the only zero-emission transport mode is undertaken by less than one per cent of all international tourists. Visitor trends in previous IVS show that there is a declining trend in cycle tourism. As already discussed in *Chapter 3 – Transport*, there is further potential for cycle tourism in New Zealand.

In the accommodation sub-sector, homes and hotels are the most important accommodation categories. While homes are targeted by EECA for example through the HEEP programme, hotels are not part of a specific energy saving programme.
They are part of the commercial sector and hence, general guidelines for building and business operation apply. Given the large contribution of hotels to energy use by international tourists, a more specifically targeted programme could improve or accelerate energy efficiency gains within this industry. Backpacker hostels also contribute substantially to total energy use, because they are a frequently visited accommodation category. Campgrounds turn out to be relatively efficient; 14% of all international tourists use them and stay 13 nights on average. However, campgrounds only contribute at 3% to total accommodation energy use by international tourists. In terms of energy consumption one night in a hotel is equivalent to six nights on a campground.

The total ‘energy bill’ of gateway-only tourists is low because of the absence of any data on the transport component, but also because of a relatively short stay. It is assumed that gateway-only tourists use some transport during their stay. An attractive public transport system, especially in Auckland, could contribute to keep energy use of these tourists low.

Touring tourists consume 4,055 MJ on average for their trip within New Zealand, which is equivalent to energy derived from 120 litres of petrol. On a daily basis international tourists consume 387 MJ (mean) or the equivalent of eleven litres of petrol. In fact, most of this energy use supplies transport (about 70%). This transport energy use estimate is conservative since ‘extra-transport’ (travel in addition to that between two overnights stops) has not been included. It is also worth remembering that the attraction/activity component is missing from this energy total. Attractions/activities added on average (mean) 1,067 MJ (or 13%) to the total energy bill of international West Coast tourists. The large range of total energy use and energy intensity indicates a potential to reduce overall energy use, in particular when managing extreme energy use as displayed in Table 47.

Finally, cruise ship tourists – despite conservative assumptions that result in an underestimate – appear to be very energy-costly in total and per day. Their energy use per day is about three times that of other touring tourists. The range of energy use for cruise ship tourists is smaller than for other tourists, which indicates a relatively
homogenous travel itinerary for cruising trips around New Zealand, despite the small sample size.

**Tourists types**

Most tourists travelling New Zealand fall in the category of touring tourists. A segmentation analysis on touring tourists (N= 4,193) revealed that there exist similar types of tourists with characteristic combinations of travel choices. The segmentation into six groups of tourists was found to best represent the diversity of travel styles. The following section briefly describes the six types.

The most prevalent type (28% of all tourists) is the ‘coach tourist’. This type comprises coach-borne travel mostly combined with domestic air and hotel based accommodation. Coach travel is dominantly undertaken by Asian tour groups, who are the largest spenders, despite their short length of stay (total trip and per day expenditure). In contrast, the ‘VFR’ tourists stay long and spend little, which can be explained by their travelling by private car and staying with their friends/relatives at private homes. Many ‘VFRs’ are Australians or from the UK and are not first time visitors. The third largest type with about 15% of all touring tourists are the ‘auto tourists’, who travel by rental car and stay at motels. They are often couples and families, who stay for about two weeks. ‘Backpackers’ are young travellers (often from Europe) who show the most various mix of travel choices. They frequently use scheduled or backpacker buses and stay at backpacker hostels. ‘Backpackers’ have the lowest expenditure per day. Tourists who stay at campgrounds – the ‘campers’ – either travel by camper van or by rental car. They are mostly couples from Australia or Europe, who stay for three weeks on average. Finally, ‘soft comfort travellers’ comprise a mix of travellers with slightly uncommon yet often comfortable travel choices, such as train travel and the stay at B&Bs. They are medium spenders, who often travel alone for an average of about three weeks. The ‘soft comfort traveller’ closest resembles the ‘coach tourist’ and the ‘auto tourist’ in terms of their travel choices.

Energy use differs significantly among the six tourist types. The ‘coach tourist’ consumes most energy per day, in fact almost twice the average of all touring tourists of 387 MJ per day. This is explained by the intensive use of domestic air and coach
travel, as well as the prominence of hotel stays. The ‘soft comfort traveller’, the ‘camper’ and the ‘auto tourist’ are characterised by a moderate level of energy use per day. Most of their energy use is invested in their individual transport mode, since these types generally stay at relatively energy efficient accommodation categories. The ‘budget tourists’ are the tourist types who consume least energy per day, almost half of the average of all touring tourists. Except for occasional air travel, these tourists mostly opt for energy-efficient travel choices, such as buses, backpacker hotels and private homes.

Total energy use is largest for ‘campers’, followed by ‘soft comfort travellers’ and ‘coach tourists’. It is revealing that ‘coach tourists’ consume more energy during their eight-day stay than ‘auto tourists’, ‘backpackers’ and ‘VFRs’, who all stay considerably longer. This results from the large energy intensity associated with coach tours, which means that a ‘backpacker’ tourist can travel for three days with the energy budget of a ‘coach tourist’.

The segmentation analysis based on four sub-samples (Appendix C), the similar hierarchical structure of these samples, and the multiple discriminant analysis validate the cluster analysis result. It is believed that the tourist types described above are a useful and valid segmentation of New Zealand’s touring market. It is now important to use these results in a context of tourism planning and energy efficiency programmes. Furthermore, other parameters need to be included in the analysis and specified for the different tourist types to allow optimising the market mix from more other, non-energy viewpoints.
4.5 Summary – tourist analysis

Comparisons between domestic (internal) and international tourists are fraught. In the following, however, a summary and a comparative description of travel patterns and associated energy use are presented for domestic tourists and international tourists. This highlights the differences between these tourists, which has implications for managing energy use. It is important to note that the analysis of tourist travel patterns provided through the DTS and IVS has some limitations. First, through the coding of overnight locations, the spatial resolution is considerably reduced. Second, overnight stops provide punctiform information and do not reveal actual travel corridors, i.e. routings of tourists. Third, the lack of information on side-trips results in an underestimate of travel distances (Forer & Simmons, 2002). Despite these limitations it is still believed, that tourist flow analysis provides a sound basis for analysing travel patterns and concomitant energy use.

An important feature of domestic tourism is the popularity of short trips. In fact, more than half of all overnight trips by domestic tourists (57% of all trips) are for one or two nights only. Single-destination trips are also typical for domestic tourists (66% of all trips). Domestic tourists mainly travel by private car and domestic air, with an average travel distance per trip of 623 km. ‘Private homes’ are by far the most important accommodation category. Hotels and motels are the most important commercial categories, with hotels being particularly important in terms of energy use. Domestic tourists prefer urban attractions and nature activities that involve only little energy use.

International tourists’ travel patterns are more diverse, as most international tourists are in fact multi-destination travellers (77% of all international tourists). The touring aspect of tourism in New Zealand is particularly important for international tourists visiting the West Coast, which is reflected in the average travel distance of 3,737 km compared with 1,950 km for all international tourists. The high activity potential of international West Coast tourists also manifests in the above-average participation in

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39 Energy use only includes direct energy use within the three analysed sub-sectors. Overall energy use of a tourist may be considerably larger when considering all sectors.
attraction/activities. Domestic air, the coach and individual transport modes such as
the rental car, the private car and the camper van are most popular with international
tourists, however, it is domestic air, which is most significant in terms of total energy
use. Hotels, homes and backpacker hostels are most popular, and overall the most
energy consuming accommodation categories. Backpacker hostels are an increasingly
important accommodation choice (Statistics New Zealand, 2002). Within the
attraction/activity sector analysed for international West Coast tourists, motorised
water activities and nature activities (often involving transport) were most important
in terms of their contribution to total energy use.

The difference in travel patterns has implications on energy use by domestic and
international tourists. Domestic tourists consume less energy per holiday (1,108 MJ
mean) than international tourists for their internal travel (4,055 MJ). International
West Coast tourists consume even more than all international tourists (8,163 MJ) due
to generally large travel distances and a length of stay of 34 days compared with 20
days for all international tourists. Interestingly, the energy intensity, i.e. energy use
per day is larger for domestic tourists (457 MJ/day) than for international tourists (387
MJ/day or 314 MJ/day for international West Coast tourists). This means that
domestic tourists travel more energy intensively than international tourists do. This is
mainly a result of large travel distances within New Zealand for short-term trips.

It is important to note that international tourists constitute a considerable additional
source of national energy demand, while domestic tourists’ energy use ultimately has
to be accounted for in the light of the concept of ‘net energy use’. When comparing
energy use of domestic tourists with that of international tourists, it also important to
take into account that an average New Zealander undertakes 4.4 (internal) overnight
trips per year (Forsyte Research, 2000), and therefore consumes a total (annual)
amount of energy of 2,940 MJ for holidaying in New Zealand.

All three tourist analyses clearly showed that transport is the main driver of energy
demand: 85% of domestic tourists’ energy use, 69% of all international tourists’
(attractions/activities excluded) and 65% of international West Coast tourists’ energy
use is due to transport. Hence, there is a large potential to reduce overall energy use
by changing transport behaviour. It was found in previous studies that behaviour
might be changed when people are made aware of their environmental impacts and when realistic and individually tailored alternatives are offered (Rose & Ampt, 2001). Improving the public transport system, particularly the frequency of connections between main tourist destinations, could be an important step in this direction.

Segmenting tourists based on their travel pattern is a strategic way to identify groups of tourists that often already exist in heuristic forms in marketing tourism destinations. The combination of specific transport, accommodation, and attraction/activity choices is not only valid in its own right, but it also provides a sound basis for analysing energy use and implementing efficiency strategies.

Tourist types or trip types differ considerably for domestic tourists and international tourists. Domestic tourists are differentiated mainly by travel distance, in particular the private car and for domestic air. There is only a small group of domestic tourists who have a broader mix of travel choices and who are therefore comparable to international tourists. Business travellers are a distinct group of domestic tourists, as well as those who use their private vehicle heavily (‘extreme car traveller’).

International tourist types are more diverse reflecting very different combinations of travel choices. Interestingly, international West Coast tourists and overall international tourist types were very similar. Both cluster analyses resulted in a ‘coach tourist’, ‘VRF’, ‘auto tourist’, ‘camper’, backpacker’ and ‘soft comfort traveller’, although relative sizes of groups differ for the national and the regional analysis. Furthermore, the analysis of international West Coast tourists produced a ‘tramper’ tourist type who matches the general image of natural ruggedness and outdoor appeal associated with the West Coast. This type was absent from the analysis of all international tourists.

Tourist types identified for both domestic and international tourists differed with regard to their energy use, both on the basis of total energy use and energy intensity. Generally, it was found that tourists who frequently travel by domestic air (‘long air-business’, ‘short air travel’, ‘air travel’ for domestic tourists and ‘coach tourists’ for international tourists) are characterised by large energy intensities. These are mostly the same tourist types who prefer to stay at hotels. In contrast, tourists who visit
friends or relatives often use little energy per day. Free independent travellers (FITs) who often use rental cars or camper vans and stay at motels, campgrounds or B&Bs are characterised by an intermediate level of energy use per day. These types (as well as the otherwise efficient backpacker) are among the large energy user in terms of total energy use as a result of their above-average length of stay.

The travel pattern (bundle of travel choices) of each type in combination with the tourist profile (e.g. demographic variables) provide a typology that helps addressing the market segment effectively. This is relevant especially for tourism management in New Zealand when comparing tourist types on the basis of their energy costs, and also when aiming at a ‘desirable’ mix of tourist types. Considerations of desirability become complex when including dimensions other than energy use. It is likely that tourist types not only differ in their energy consumption patterns, but also in their economic, social, and other environmental impacts. The exploration of the relationship between energy use, expenditures and economic yield is crucial in this context. In particular the question needs to be raised if there is a relationship between expenditures and energy demand. This would imply that high-energy tourists are also high-yield tourists, as is the case with coach tourists. If this were to prove true, it would become significantly more difficult to achieve a balance between environmental, economic and social sustainability. It is also important to take into account that there are tourist types, whose expenditures contribute more directly to regional development than those of other tourist types, and who also consume products other than those promoted as core products.

It can be concluded that to manage energy use it is crucial to understand the sources of energy demand, namely tourist types and their energy profiles, and also the implications of addressing different tourist types. Measures to moderate travel patterns require careful considerations of more factors than energy use.

It can be concluded that to effectively manage and reduce energy use it is crucial to understand the sources of energy demand (e.g. tourist type and energy profile) and also the implications of addressing different tourist types. Measures to moderate travel patterns require careful consideration of several factors to achieve a balance of energy use (and other environmental factors), social impacts and economic benefits.
5  CHAPTER 5 – TOTAL ENERGY USE IN NEW ZEALAND

5.1  Projection of energy use and carbon dioxide emissions

5.1.1  Introduction

The previous chapters presented energy use within different tourism sub-sectors, and more specifically energy use of different travel choices. The energy consumption of individual domestic and international tourists per trip and per day has also been quantified. Moreover, a differentiation of different types of trips or tourists has been made. These tourist-centred data are important for understanding and managing tourists. However, they do not reveal the magnitude of energy use in the New Zealand tourism sector and therefore do not allow assessment of the total energy use in the sector. This chapter quantifies energy use by the New Zealand tourism sector. Opportunities to reduce energy use are explored using scenario analysis. The total CO₂ emissions resulting from this energy use are also quantified. Finally, the potential for decreasing energy use through a market shift, i.e. changing the mix of tourist types and possibly the mix of different countries of origin, is briefly outlined.

5.1.2  Methodology

Logical steps

Energy use of tourism depends primarily on two factors:

i.  Energy intensities of the travel choices (MJ/pkm for transport, MJ/visitor-night for accommodation, MJ/visit for attractions/activities);

ii.  Mix and intensity of these travel choices as chosen by tourists (e.g. km per transport mode per tourist).

In addition, tourists can be grouped into distinct types that correspond on the basis of travel choices but that differ in energy demand (Chapter 4). Such grouping reduces the total number of tourists to a manageable number. Hence, total energy use in New Zealand also depends on the mix of tourist types (relative size of each market segment).

To determine total energy use in the New Zealand tourism sector, the energy intensities derived in Chapter 3 – Industry analysis were used to compute energy use
tourist numbers in each market segment were then estimated separately for domestic and international tourists. On the basis of the estimated tourist numbers for each tourist or trip type, total energy use of domestic tourism and international tourism was estimated using the following approach:

i. Quantification of single travel choices (e.g. km or number of nights) averaged by tourist type;

ii. Multiplication of the average travel choice quantity with the respective energy intensity (e.g. MJ/pkm);

iii. Summation of energy use associated with all travel choices for each tourist or trip type. This provides the typical total energy use of each type;

iv. Multiplication of the typical total energy use of each type with the total number of tourists or trips of this type;

v. Summation of total energy use of all types.

Risk analysis

Most variables used in the stepwise procedure described above are uncertain, because they constitute a single-point estimate of a sample distribution. This applies to all travel choice variables, and also to the energy intensities of the accommodation and attraction/activity sub-sectors. It can be argued that transport energy intensities are also uncertain (they constitute average consumptions across many different vehicle types), however, since they are mostly taken from secondary sources the degree of uncertainty cannot be quantified. In contrast, variables that stem from primary data can be characterised by a sample distribution that allows the likelihood of occurrence of specific values to be calculated.

The above considerations identify the need to use a method called ‘Uncertainty Analysis’ that allows the uncertainty associated with a specific decision situation to be quantified. The software package @risk (Palisade Corporation) allows defining the uncertainty of input variables in an existing Microsoft Excel spreadsheet model by replacing single cell values with probability distributions. The spreadsheet model can
then be analysed through simulation\textsuperscript{40} to generate a probability distribution of the outcome, in this case total energy use. The output distribution can be assessed in a much more sophisticated and accurate way than a single estimate. For example, the most likely value can be identified as well as a range of values and their likelihood of occurrence (Palisade Corporation, 1994). The sampling method used in this study is \textit{Latin Hypercube}. In this method, the input probability distribution is stratified into equal intervals on the cumulative probability scale and samples are randomly selected from each interval. This method is more efficient than \textit{Monte Carlo} sampling, which randomly samples the entire distribution (see for more detail the Palisade Corporation, 1994). In this study each simulation involved 1,000 iterations.

Uncertainty in the energy use model was determined by replacing average values in step i) and ii) (see above) with most suitable distributions. Histograms of each variable were examined to choose the appropriate distribution. In this study only normal, logarithmic normal and discrete distributions were employed. All travel choices were substituted with their respective distributions as well as energy intensities of accommodation categories. The sample sizes for attractions/activities were too small to define useful distributions for energy intensities, and single point estimates (Chapter 3 – Attractions/Activities) were applied (Figure 41). Correlations between variables (to reduce the risk of highly unlikely combinations) were not considered in this analysis.

\textsuperscript{40} A simulation involves recalculating the spreadsheet model a defined number of times (iterations). At each iteration the input distributions are sampled, the sampled values are taken to calculate the output value(s) and finally the distribution of the output function is generated based on all iterations.
Figure 41: Excel spreadsheet model (selection of three international tourist types coach tourist, VFR and Camper; and long term tourists in the bottom) analysed with the add-on software @risk (see toolbar left corner).

**Estimating carbon dioxide emissions**

It had been stated in the introduction that energy use in this thesis is mainly seen in the context of greenhouse gas emissions and climate change. For this reason, emissions of CO₂ resulting from energy use in the tourism sector were estimated. Other greenhouse gases were not included, because CO₂ is the main greenhouse gas resulting from energy use, and because emission factors for other gases are not as straightforward and readily available as those for CO₂. To calculate CO₂ emissions, energy intensities provided in Chapter 3 were converted into emissions using emission factors and typical fuel mixes. Table 51, Table 52 and Table 53 show the derived emission factors for transport, accommodation, and attractions (more information: Appendix D).

The coefficients given in the tables above allow calculation of typical CO₂ emissions associated with each tourist type. This, multiplied by the total number of tourists (trips) of the total number of tourists or the respective type, provides total
CO₂ emissions per tourist type. Summing over tourist types gives total CO₂ emissions of the tourism sector.

Table 51: CO₂ emission coefficients per passenger kilometre for transport modes

<table>
<thead>
<tr>
<th>Mode</th>
<th>Energy intensity (MJ/pkm)</th>
<th>CO₂ per MJ¹ (g)</th>
<th>CO₂ per passenger kilometre (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Helicopter</td>
<td>4.68</td>
<td>68.7</td>
<td>321.5</td>
</tr>
<tr>
<td>Ferry (other)/cruise ship</td>
<td>3.53</td>
<td>68.8</td>
<td>242.9</td>
</tr>
<tr>
<td>Domestic air</td>
<td>2.75</td>
<td>68.7</td>
<td>188.9</td>
</tr>
<tr>
<td>Cook Strait Ferry</td>
<td>2.40</td>
<td>68.8</td>
<td>165.1</td>
</tr>
<tr>
<td>Camper van</td>
<td>2.06</td>
<td>68.4</td>
<td>140.9</td>
</tr>
<tr>
<td>Yacht</td>
<td>1.75</td>
<td>66.6</td>
<td>116.6</td>
</tr>
<tr>
<td>Train (diesel)</td>
<td>1.44</td>
<td>68.7</td>
<td>98.9</td>
</tr>
<tr>
<td>Private car</td>
<td>1.03</td>
<td>66.7</td>
<td>68.7</td>
</tr>
<tr>
<td>Coach</td>
<td>1.01</td>
<td>68.5</td>
<td>69.2</td>
</tr>
<tr>
<td>Rental car/company car/taxi</td>
<td>0.94</td>
<td>66.7</td>
<td>62.7</td>
</tr>
<tr>
<td>Motorcycle</td>
<td>0.87</td>
<td>66.6</td>
<td>57.9</td>
</tr>
<tr>
<td>Scheduled bus</td>
<td>0.75</td>
<td>68.5</td>
<td>51.4</td>
</tr>
<tr>
<td>Backpacker bus</td>
<td>0.58</td>
<td>68.5</td>
<td>39.7</td>
</tr>
<tr>
<td>Hitchhiking</td>
<td>1.03</td>
<td>66.7</td>
<td>68.7</td>
</tr>
<tr>
<td>Cycle</td>
<td>0.00</td>
<td>0.00</td>
<td>0.0</td>
</tr>
</tbody>
</table>

¹) Emission calculated based on Baines' conversion factors and petrol to diesel ratios as discussed in Chapter 3 - Transport.

Table 52: CO₂ emission coefficients per visitor-night for accommodation categories

<table>
<thead>
<tr>
<th>Category</th>
<th>CO₂ per visitor-night (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hotel</td>
<td>7.895</td>
</tr>
<tr>
<td>B&amp;B</td>
<td>4.142</td>
</tr>
<tr>
<td>Motel</td>
<td>1.378</td>
</tr>
<tr>
<td>Backpacker</td>
<td>1.619</td>
</tr>
<tr>
<td>Campground</td>
<td>1.364</td>
</tr>
<tr>
<td>Home¹</td>
<td>1.579</td>
</tr>
</tbody>
</table>

¹) Based on EECA, 2000

Table 53: CO₂ emission coefficients per visit for attraction/activity categories

<table>
<thead>
<tr>
<th>Category</th>
<th>CO₂ per visit (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building</td>
<td>172</td>
</tr>
<tr>
<td>Park</td>
<td>526</td>
</tr>
<tr>
<td>Amusement</td>
<td>1,507</td>
</tr>
<tr>
<td>Industry</td>
<td>576</td>
</tr>
<tr>
<td>Nature attraction</td>
<td>417</td>
</tr>
<tr>
<td>Performance</td>
<td>589</td>
</tr>
<tr>
<td>Other entertainment</td>
<td>338</td>
</tr>
<tr>
<td>Air activity</td>
<td>27,697</td>
</tr>
<tr>
<td>Sea activity</td>
<td>15,312</td>
</tr>
<tr>
<td>Adventure recreation</td>
<td>2,241</td>
</tr>
<tr>
<td>Nature recreation</td>
<td>1,674</td>
</tr>
</tbody>
</table>
5.1.3 Domestic trips

Estimating trip numbers

Estimating total domestic trips for 1999 involved estimating total tourist numbers and the total number of trips undertaken by these tourists.

To arrive at total tourist numbers, Forsyte Research (2000) weighted their sample of domestic tourists to account for a bias due to periods of high tourist activity (e.g. school holidays) and to correct data by income, household size, age and by sex to meet regional demographic profiles. These weights were provided in the original database and therefore could be used to estimate total tourist numbers. It is important to note that only tourists aged over 15 were considered. Furthermore, the projection in this study was based on 5,457 overnight trippers; 308 cases less (deleted cases, see Chapter 4 – Domestic tourists) than the 5,765 tourists considered by Forsyte Research (2000). Taking into account the weight of each tourist, the database used in this study underestimates the total number of tourists by 39,184 tourists (4.52%). This underestimate was corrected in later calculations of tourist trip numbers.

Total trip numbers were estimated on the basis of a respondent’s weighting and the number of reported trips within the last weeks prior to the survey. Total trip numbers were multiplied by a factor of 52/4 to calculate annual trip numbers. This procedure is appropriate since the effect of different four-week periods has been accounted for by respondents’ weights. The following example summarises the process: a tourist with a weighting of 200 represents 200 trips in four weeks of the year. These 200 trips represent 2,600 trips for the period of one year (multiplied by 52/4). Assuming the interviewed tourist with the weighting of 200 undertook two trips within the four-week reporting period, each of the two trips would represent 200 trips. The total number of trips taken by domestic tourists in 1999 was estimated to be 15.772 million, which is 4.96% less than Forsyte Research’s estimate of 16.594 million trips in 1999.

Accordingly, the total number of short and longer trips, and the total number of each trip type (eight within each short and longer trips) was estimated. The missing 4.96% of trips were added proportionally to each trip types’ total. The estimated trip numbers
Chapter 5 – Projection of energy use and carbon dioxide emissions

are presented in Table 54. The relative size of each trip type does not differ largely from the cluster sizes presented in Chapter 4 – Domestic tourists, which means that the weighting process and the projection to the whole year (1999) only slightly modified the relative proportions.

Table 54: Number of domestic tourists’ trips in each cluster for short and longer trips

<table>
<thead>
<tr>
<th>Trip type</th>
<th>Number of trips</th>
<th>Proportion (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short trips</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extreme car</td>
<td>476,028</td>
<td>4.7</td>
</tr>
<tr>
<td>Long air- business</td>
<td>109,713</td>
<td>1.1</td>
</tr>
<tr>
<td>Rental car</td>
<td>103,088</td>
<td>1.0</td>
</tr>
<tr>
<td>Flexible trip</td>
<td>127,578</td>
<td>1.3</td>
</tr>
<tr>
<td>Company business</td>
<td>357,892</td>
<td>3.6</td>
</tr>
<tr>
<td>Medium car travel</td>
<td>3,171,428</td>
<td>31.5</td>
</tr>
<tr>
<td>Soft car travel</td>
<td>5,043,981</td>
<td>50.1</td>
</tr>
<tr>
<td>Short air travel</td>
<td>673,936</td>
<td>6.7</td>
</tr>
<tr>
<td>TOTAL short trips</td>
<td>10,063,644</td>
<td>100</td>
</tr>
<tr>
<td>Longer trips</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soft car travel</td>
<td>3,857,153</td>
<td>59.4</td>
</tr>
<tr>
<td>Air travel</td>
<td>503,817</td>
<td>7.8</td>
</tr>
<tr>
<td>Company business</td>
<td>117,674</td>
<td>1.8</td>
</tr>
<tr>
<td>Camper van</td>
<td>48,925</td>
<td>0.8</td>
</tr>
<tr>
<td>Rental car</td>
<td>76,352</td>
<td>1.2</td>
</tr>
<tr>
<td>Medium car travel</td>
<td>1,714,056</td>
<td>26.4</td>
</tr>
<tr>
<td>Visit by train</td>
<td>42,033</td>
<td>0.7</td>
</tr>
<tr>
<td>Flexible trip</td>
<td>130,352</td>
<td>2.0</td>
</tr>
<tr>
<td>TOTAL longer trips</td>
<td>6,490,362</td>
<td>100</td>
</tr>
</tbody>
</table>

Calculating energy use and carbon dioxide emissions

Total energy use of domestic tourists (for transport, accommodation and attractions/activities) was 17.76 PJ in 1999. In total, shorter trips consumed more than longer trips. Energy use of domestic tourists was equivalent to the emission of 1,115 kilo- tonnes of CO₂. The mean and the confidence intervals for short trips, longer trips and all domestic trips are presented in Table 55.

Table 55: Energy use and CO₂ emissions of domestic tourism

<table>
<thead>
<tr>
<th>Trip type (domestic)</th>
<th>Energy use (PJ)</th>
<th>90% conf. interval lower and upper limit (PJ)</th>
<th>CO₂ emissions (kilo- tonnes)</th>
<th>90% conf. interval lower and upper limit (kilo- tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shorter trips</td>
<td>10.04</td>
<td>9.36 – 11.33</td>
<td>621</td>
<td>585 - 704</td>
</tr>
<tr>
<td>Longer trips</td>
<td>7.72</td>
<td>6.85 – 9.37</td>
<td>494</td>
<td>454 - 568</td>
</tr>
<tr>
<td>All trips</td>
<td>17.76</td>
<td>16.51 - 19.91</td>
<td>1,115</td>
<td>1,053 – 1,218</td>
</tr>
</tbody>
</table>
5.1.4 International tourists

Estimating tourist numbers

In contrast to the DTS the IVS database did not provide information on respondents' weightings. The IVS, however, is considered sufficiently representative at a national level due to the random sampling all year round. The relative sizes of tourist types in the sample (5,422 tourists) were extrapolated to the total number of tourists of 1,648,988 (Statistics New Zealand\textsuperscript{41} 2001a) for the year ended December 2000. As already pointed out in Chapter 2 it is not considered problematic that the reference year for international (2000) and domestic (1999) tourists differs.

It is acknowledged that Australian tourists may be under-sampled by the IVS (see Chapter 4 – International tourists) and that a weighting by nationality could possibly increase the representativeness of the IVS. This would then change slightly the proportion of tourist types in favour of those types where Australians are strongly represented. However, several problems arise when attempting to weight the IVS sample for the purpose of estimating energy use. First, demographic variables (in particular nationality) are only vague indicators for travel patterns. Second, the visitor arrival statistics differ in their scope from the IVS (all visitors to New Zealand are recorded, not only tourists older than 15) and it is unknown to what degree this affects the size of the Australian market (where for example an above average number of families with children is represented). Hence, it is believed that, while some inconsistencies in scope and representativeness exist, using the IVS data in their existing form provides a sufficiently accurate estimate of tourist types and energy use.

\textsuperscript{41} The TSA includes all overseas visitors to NZ (all ages) and excludes those undertaking study or seeking medical attention, hence, the scope differs slightly from that of the IVS.
Table 56: Tourist numbers of each international tourist type

<table>
<thead>
<tr>
<th>Tourist type</th>
<th>Tourists numbers of IVS sample, Chapter 4</th>
<th>Relative size (%)</th>
<th>Projected total number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coach tourist</td>
<td>1,481</td>
<td>27.3</td>
<td>450,415</td>
</tr>
<tr>
<td>Visit friends/relatives</td>
<td>1,026</td>
<td>18.9</td>
<td>312,036</td>
</tr>
<tr>
<td>Auto tourist</td>
<td>832</td>
<td>15.3</td>
<td>253,035</td>
</tr>
<tr>
<td>Camper</td>
<td>444</td>
<td>8.2</td>
<td>135,033</td>
</tr>
<tr>
<td>Backpacker</td>
<td>232</td>
<td>4.3</td>
<td>70,558</td>
</tr>
<tr>
<td>Soft comfort traveller</td>
<td>178</td>
<td>3.3</td>
<td>54,135</td>
</tr>
<tr>
<td>Cruising tourists</td>
<td>8</td>
<td>0.2</td>
<td>2,433</td>
</tr>
<tr>
<td>Gateway-only</td>
<td>1,160</td>
<td>21.4</td>
<td>352,790</td>
</tr>
<tr>
<td>Long-term</td>
<td>61</td>
<td>1.1</td>
<td>18,552</td>
</tr>
<tr>
<td>TOTAL</td>
<td>5,422</td>
<td>100</td>
<td>1,648,988</td>
</tr>
</tbody>
</table>

1) The proportions differ from Table 49, because they refer to all international tourists not only touring tourists used in the cluster analysis.

Calculating energy use and carbon dioxide emissions

Energy use for transport and accommodation associated with each tourist type was calculated following the procedure (steps i to v) described above. The missing attraction/activity sub-sector (Chapter 4 – International tourists) was estimated based on results from the West Coast pilot-study, where the average energy use for attractions/activities was 41 MJ per day\(^{42}\). This was multiplied by each tourist’s length of stay in the IVS database. As a result, the distribution (reflecting length of stay) of energy use for attractions/activities was determined and added as a ‘uncertain variable’ (log-normal, because length of stay across all tourists is logarithmic normally distributed) to each tourist type’s energy use (see row 25 in Figure 41). For the CO\(_2\) emission calculation for attractions/activities an average of 49g CO\(_2\) per day was calculated based on the West Coast sample. This results from the average fuel mix across different attraction/activity categories. The factor is low compared with those presented in Table 51, due to the use of electricity at many tourist attractions. The CO\(_2\) factor was applied to the IVS sample as described above for energy use.

Furthermore, it was necessary to estimate an energy use for long-term tourists. To avoid overestimating total energy use it was decided to assign the lowest energy use

\(^{42}\) It is acknowledged that West Coast tourists may differ in their recreational behaviour from all international tourists to New Zealand. Also, a linear relationship between energy use for attractions/activities and length of stay may not exist. However, this procedure is nevertheless believed to best estimate the lacking energy data on recreational activities.
of all other international tourist types to long-term tourists. Gateway-only tourists consume least energy per day (155 MJ); hence this energy intensity was multiplied with length of stay of each long-term tourist. The resulting distribution was normally distributed (mean: 40.043, SD: 8.063) and could be added to the spreadsheet model. Again a factor of 49 g CO₂ per day was applied to calculate CO₂ emissions.

Total energy use in New Zealand by international tourists was 7.58 PJ in 2000 resulting in the emission of 434 kilo-tonnes of CO₂. Long-term tourists make up about 10% of international tourists’ energy use (Table 57), although they only constitute 1.1% of all international tourists (Table 56).

Table 57: Energy use and CO₂ emissions of international tourism

<table>
<thead>
<tr>
<th></th>
<th>Energy use (PJ)</th>
<th>90% conf. interval lower and upper limit (PJ)</th>
<th>CO₂ emissions (kilo-tonnes)</th>
<th>90% conf. interval lower and upper limit (kilo-tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>International (exc. long term)</td>
<td>6.83</td>
<td>4.57 – 9.82</td>
<td>396</td>
<td>267 - 585</td>
</tr>
<tr>
<td>All international tourists</td>
<td>7.59</td>
<td>5.29 – 10.61</td>
<td>434</td>
<td>302 - 626</td>
</tr>
</tbody>
</table>

Most of the total energy use (30%) can be attributed to coach tourists, both as a result of their tourist numbers (27% of all tourists) and the large energy use per tourist. Visiting friends/relatives tourists, auto tourists and campers also contribute considerably, while cruising tourists, despite a large per capita energy use, are less important overall because of relatively low numbers (Figure 42).

![Figure 42: Contribution of each tourist type to total energy use of 7.59 PJ by international tourists.](image-url)
5.1.5 Total energy use

Total energy use of tourism within New Zealand was 25.35 PJ in 2000, constituting 5.6% of the national energy demand in 2000 of 453.3 PJ (MED, 2001). Note that this assumes constant energy use of domestic tourism in 1999 and 2000. The upper limit of the 90% confidence interval implies a contribution of 6.4%, while the lower limit implies that tourism contributes 5.0% (Figure 43). Domestic tourism accounts for 3.9% of national energy use, while international tourism accounts for 1.7%.

![Distribution for total energy use of New Zealand tourism](image)

Figure 43: Distribution of total energy use by domestic and international tourists in New Zealand.

Total CO₂ emissions were 1,549 kilo-tonnes (90% confidence interval from 1,403 – 1,767 kilo-tonnes). Tourism contributed 5.1% to the total CO₂ emissions in New Zealand in 2000 (30,589 kilo-tonnes, MED, 2001).

The above figures for energy use and emissions in the New Zealand tourism sector constitute minimum estimates. Most importantly, it has been shown in the West Coast pilot-study that ‘extra transport’ in addition to transport between overnight stops adds significantly to the total travel distance (particularly for coach transport) (Chapter 3 – West Coast pilot-study). Based on the results of the West Coast study, it is estimated that transport energy use would increase by about 10% when taking into account extra transport. Furthermore, it is likely that transport is underestimated as a result of false reporting by tourists (e.g. forgotten trips) or detours not accounted for in the distance.
table (which assumes shortest distances between two locations). It was seen in the West Coast pilot-study that this could add another 5% to the transport component. Finally, it is important to emphasise that this study only analysed the three key sub-sectors of tourism (transport, accommodation and attractions/activities). Clearly, tourists consume energy at various other places or sub-sectors, most important among them probably gastronomy and retail. The contribution of 5.6% to total national energy consumption in New Zealand by tourism therefore could increase substantially when accounting for the total spectrum of tourism industries.
5.2 Sensitivity analysis

5.2.1 Development of scenarios

A scenario explores possible outcomes for a conceivable development of specified parameters. Scenario analysis does not claim to provide a most likely or realistic picture, but seeks to serve as supporting tool for complex decisions. By changing trends or fixed values, so-called ‘what-if’ situations can be described.

Scenarios developed in this study explore the effects of industry-related and behavioural changes (mostly targeted at improvements of efficiency) with regard to total energy use. The chosen scenarios reflect ‘snapshots’ and do not represent a systematic structure of more complex developments (this would require a refinement of the model). Energy use was also analysed against the background of growing visitor numbers and increasing domestic tourism. This scenario assumed ‘business as usual’ (BAU) conditions for the industry and tourist type behaviour, and a targeted number of 2.53 million international visitors (Vuletich & Fairgray, 2000a) and 20.6 million domestic tourists (Vuletich & Fairgray, 2000b) in 2006. This ‘visitor growth’ scenario was calculated both for energy use and CO₂ emissions.

Table 58: Scenarios for total energy use of New Zealand tourism

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Energy domestic (PJ)</th>
<th>Change (%)</th>
<th>Energy intern. (PJ)</th>
<th>Change (%)</th>
<th>Total (PJ)</th>
<th>Change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10% increase in efficiency of air travel</td>
<td>17.19</td>
<td>-3.21</td>
<td>7.43</td>
<td>-2.11</td>
<td>24.62</td>
<td>-2.88</td>
</tr>
<tr>
<td>10% increase in efficiency of private/rental cars</td>
<td>17.02</td>
<td>-4.17</td>
<td>7.52</td>
<td>-0.92</td>
<td>24.54</td>
<td>-3.20</td>
</tr>
<tr>
<td>10% increase in efficiency for all transport modes</td>
<td>16.32</td>
<td>-8.11</td>
<td>7.21</td>
<td>-5.01</td>
<td>23.52</td>
<td>-7.22</td>
</tr>
<tr>
<td>10% increase in efficiency for all accommodation categories</td>
<td>17.45</td>
<td>-1.75</td>
<td>7.29</td>
<td>-3.95</td>
<td>24.74</td>
<td>-2.41</td>
</tr>
<tr>
<td>10% increase in efficiency of hotels</td>
<td>17.64</td>
<td>-0.68</td>
<td>7.47</td>
<td>-1.58</td>
<td>25.11</td>
<td>-0.95</td>
</tr>
<tr>
<td>Target main energy users: reduce air travel distance for three domestic air types and air and coach travel for int. 'coach tourist' by 10%</td>
<td>17.31</td>
<td>-2.53</td>
<td>7.44</td>
<td>-1.98</td>
<td>24.75</td>
<td>-2.37</td>
</tr>
<tr>
<td>Reduce travel distance by 10% (main transport mode per type)</td>
<td>16.54</td>
<td>-6.87</td>
<td>7.43</td>
<td>-2.11</td>
<td>23.96</td>
<td>-5.48</td>
</tr>
<tr>
<td>Gateway-only travel 300 km instead of 60 km by bus</td>
<td>17.74</td>
<td>-0.11</td>
<td>7.66</td>
<td>+0.92</td>
<td>25.4</td>
<td>+0.20</td>
</tr>
<tr>
<td>Long term tourists consume 10% less energy</td>
<td>17.75</td>
<td>-0.06</td>
<td>7.55</td>
<td>-0.53</td>
<td>25.3</td>
<td>-0.20</td>
</tr>
<tr>
<td>Transport is 15% larger than minimum estimate</td>
<td>19.70</td>
<td>+10.92</td>
<td>7.80</td>
<td>+2.77</td>
<td>27.50</td>
<td>+8.48</td>
</tr>
</tbody>
</table>
5.2.2 Scenario findings

The scenario analysis shows the following:

- An increase in efficiency of domestic air travel by 10%, i.e. decreasing fuel consumption by 10%, would achieve an overall reduction of energy use by about 2.9%, mainly due to reductions in domestic tourists’ energy use.
- An increase in efficiency by 10% for private and rental cars would achieve even greater reductions, namely 3.2%. This decrease is also largely attributed to domestic tourism, because of its high dependence on car travel.
- If all transport modes decrease their energy use by 10% the overall effect would be a decrease of 7.2% of total energy use. This is the largest improvement of all scenarios.
- The same increase of efficiency across all accommodation categories would reduce total energy use by 2.4%, particularly as a result of international tourists’ reduced energy use.
- Targeting hotels only (increase of efficiency by 10%) would still result in an overall energy reduction of 1%.
- Significant reductions can be made when targeting the main energy consumers, namely ‘long-air business’, ‘short air travel’, ‘air travel’ tourist types for domestic tourists and ‘coach tourists’ for international tourists. When reducing energy use associated with air travel and additionally coach travel for the ‘coach tourist’ by 10% this would have an overall effect of 2.4% energy savings. This measure affects only 15.6% of all domestic tourists and 27.3% of international tourists.
- Even more effective is a decrease in travel distance for all tourist/trip types by 10% with their main transport mode (one per tourist type). This behavioural change would reduce overall energy use by 5.5%, and that of domestic tourists by 6.9%.
- The transport component of gateway-only tourists was estimated with the minimum travel of 30 km from and 30 km to the airport. If total transport was 300 km (arbitrary estimate) by bus in total (instead of 60 km), total energy use of international tourists would increase by about 1% and total energy use by 0.2%.
- If long-term tourists consumed 10% less than what had been estimated (155 MJ/day), total energy use would decrease by 0.2%.
• If, in fact, each tourist travels 15% further with their main transport mode (only one per tourist type), then total energy use would be 27.5 PJ and contribute with 6.1% to national energy use (as noted previously, it is assumed by the author that this is closer to reality than the 'minimum estimate' of 25.34 PJ provided above).

• Given the visitor growth for the New Zealand tourism sector as described above, total energy use will increase by 31.5% to the year 2006 (Table 59). This is largely due to the strong growth of international tourism. In 2006, international tourism will make up 33.8% of total energy use in tourism, compared with 29.9% in 2000.

Table 59: Energy use and CO₂ emissions in 2000 and 2006

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2006</th>
<th>Change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy use domestic tourists (PJ)</td>
<td>17.76</td>
<td>22.08</td>
<td>+24.32</td>
</tr>
<tr>
<td>Energy use international tourists (PJ)</td>
<td>7.59</td>
<td>11.26</td>
<td>+48.35</td>
</tr>
<tr>
<td>Total energy use (PJ)</td>
<td>25.35</td>
<td>33.34</td>
<td>+31.52</td>
</tr>
<tr>
<td>CO₂ domestic tourists (kt)</td>
<td>1,115</td>
<td>1,387</td>
<td>+24.39</td>
</tr>
<tr>
<td>CO₂ international tourists (kt)</td>
<td>434</td>
<td>647</td>
<td>+49.08</td>
</tr>
<tr>
<td>Total CO₂ emissions (kt)</td>
<td>1,549</td>
<td>2,034</td>
<td>+31.31</td>
</tr>
</tbody>
</table>

1) 90% confidence interval: 29.56 – 38.24 PJ

5.2.3 Options to reduce energy use

The scenarios show that considerable effort is required to reduce energy use and CO₂ emissions, given the forecast visitor growth in particular. This implies that energy use has to be reduced by more than 5% each year just to keep total energy use constant at the 2000 level. Additional reductions will be necessary to decrease energy use to 1990 levels, the benchmark for the Kyoto Protocol. Clearly, transport plays the critical role in achieving substantial reductions, in particular air travel. However, the analyses have shown that it will not be sufficient to target transport only, and other sub-sectors, such as hotels need to be considered as well. Furthermore, technological improvements have to be complemented with behavioural changes, such as decreasing travel distance.

Changing tourist behaviour is critical to achieve significant energy savings. The model of tourist types and knowledge on travel choice combinations along with tourist type profiles for both domestic and international tourists is useful in this context. The typologies allow approaching tourist types in a more targeted way. The
typology also gives information on those travel choices that are most important for each type and where reductions would be most effective.

It is acknowledged that changing travel behaviour is very difficult, requiring inputs from various disciplines such as sociology and psychology. It is not attempted in this study to explore possibly campaigns in further detail. However, it is considered useful to summarise key target areas both for technological improvements and behavioural shifts for each tourist type (Table 60). Regulatory measures would have to consider other aspects, such as employment, business viability, visitor satisfaction and so forth.

<table>
<thead>
<tr>
<th>Tourist/trip type</th>
<th>Technological: increase efficiency of ....</th>
<th>Behavioural shift</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Domestic short trip</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extreme car</td>
<td>Private car, home</td>
<td>Trip suppression; reducing travel distance, increasing length of stay</td>
</tr>
<tr>
<td>Medium car travel</td>
<td>Private car, home</td>
<td>Reducing travel distance, increasing length of stay</td>
</tr>
<tr>
<td>Soft car travel</td>
<td>Private car, home</td>
<td>No suggestion</td>
</tr>
<tr>
<td>Long air- business</td>
<td>Domestic air, hotels</td>
<td>Trip suppression, telecommunication, increasing length of stay</td>
</tr>
<tr>
<td>Short air travel</td>
<td>Domestic air, hotels</td>
<td>Modal shift to bus transport</td>
</tr>
<tr>
<td>Company business</td>
<td>Company car, hotels</td>
<td>Tele-working, ridesharing, trip chaining, opting for efficient company car</td>
</tr>
<tr>
<td>Rental car</td>
<td>Rental car, motels, hotels</td>
<td>Reducing travel distance</td>
</tr>
<tr>
<td>Flexible trip</td>
<td>Public bus</td>
<td>No suggestion</td>
</tr>
<tr>
<td><strong>Domestic long trip</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium car travel</td>
<td>Private car, home</td>
<td>Reducing travel distance, increasing length of stay</td>
</tr>
<tr>
<td>Soft car travel</td>
<td>Private car, home</td>
<td>No suggestion</td>
</tr>
<tr>
<td>Air travel</td>
<td>Domestic air, hotels</td>
<td>Trip suppression, modal shift, telecommunication</td>
</tr>
<tr>
<td>Company business</td>
<td>Company car, hotels</td>
<td>Tele-working, ridesharing, trip chaining, opting for efficient company car</td>
</tr>
<tr>
<td>Rental car</td>
<td>Rental car, motels, hotels</td>
<td>Reducing travel distance</td>
</tr>
<tr>
<td>Flexible trip</td>
<td>Public bus</td>
<td>No suggestion</td>
</tr>
<tr>
<td>Camper van</td>
<td>Camper van</td>
<td>Reducing travel distance</td>
</tr>
<tr>
<td>Visit by train</td>
<td>Train</td>
<td>No suggestion</td>
</tr>
<tr>
<td><strong>International</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coach tourist</td>
<td>Coach, domestic air, hotel</td>
<td>Choosing tours with short travel distances per day and little air travel</td>
</tr>
<tr>
<td>VFR</td>
<td>Private car, homes</td>
<td>Travelling less by air</td>
</tr>
<tr>
<td>Auto tourist</td>
<td>Private car, homes, Rental car, motel</td>
<td>Reducing travel distance, shifting from hotel to motel</td>
</tr>
<tr>
<td>Backpacker</td>
<td>Backpacker hostel, rental car, buses</td>
<td>Shifting towards public transport, reducing energy use for attractions/activities</td>
</tr>
<tr>
<td>Camper</td>
<td>Camper van</td>
<td>Reducing travel distance, choosing efficient camper van (appropriate size)</td>
</tr>
<tr>
<td>Soft comfort traveller</td>
<td>Hotel, camper van, domestic air</td>
<td>Opting for efficient options within broad mix of type-specific travel choices</td>
</tr>
<tr>
<td>Cruising tourist</td>
<td>Cruising company</td>
<td>Choosing environmentally aware company, short travel distance per day</td>
</tr>
<tr>
<td>Long-term tourists</td>
<td>Too little is known about the travel behaviour of this tourist type to identify key areas for reducing energy use.</td>
<td></td>
</tr>
<tr>
<td>Gateway-only tourist</td>
<td>Hotel, home</td>
<td>Using public transport at gateway-city</td>
</tr>
</tbody>
</table>
1.3 Changing the mix of international tourist types?

A country like New Zealand, where visitor numbers are growing continuously, may seek advantage in shaping international tourism and the composition of tourist flows into a direction that meets national goals as for example outlined in the New Zealand Tourism Strategy. Energy use of different tourists is one aspect to consider and the concept of tourist types is a good starting point to induce change.

It is possible that travel (choice) behaviour could be influenced once tourists have arrived in New Zealand. The decision for a specific style of travel, i.e. tourist type, however, is likely to be made before arriving in New Zealand. Hence, overseas marketing and campaigns play a central role in influencing this stage of decision-making. Overseas marketing by Tourism New Zealand is country-specific, that is, main countries of origin are approached through different campaigns and themes (for example the ‘8 Kaido’ theme for the Japanese market developed by Tourism New Zealand Japan, 2002). For this reason, it is helpful to look in more detail at the connection between nationality and tourist type. This is undertaken for the main markets, Australia, UK, USA, Japan, South Korea and Germany (Figure 44).

It has been argued that nationality is not a key variable that determines travel behaviour (and hence energy consumption). However, it is conceivable that the cultural background of a visitor (i.e. nationality) has at least some influence on their preference for a range of travel styles. This is the case for Asian visitors who often travel on coach tours and, hence, are more likely to be ‘coach tourists’ than other visitors. Australians, in contrast, often travel to visit friends or relatives or for business, hence they often belong to the ‘VFR type’ and the ‘gateway-only’ traveller. The UK, USA and German market are mixed with all types being represented.

It has been indicated in Chapter 4 that some tourist types are possibly more ‘desirable’ than others in terms of energy use, and it was also pointed out that, for example, the ‘coach tourist’ is at the upper end of the energy use spectrum (when measured as energy use per day). Clearly, it is important to take into account many factors, other than energy use, to derive a comprehensive picture of a ‘desirable mix of tourist types’. However, it appears that once an ‘optimised mix’ is agreed upon, a
marketing strategy for more efficient travel styles could be adopted by Tourism New Zealand's overseas agencies.

![Tourist types charts](Image)

**Figure 44: Tourist type composition for main countries of origin.**

When considering influencing the market mix and tourists’ decision making, caution needs to be exercised not to scare away tourists. The risk of tourists boycotting a destination was pointed out in a study on European alpine resorts. In these resorts the less welcome day-trippers (by car) were discouraged to visit through the prohibition of driving in the city, and free buses were offered to induce a modal shift (Frey Marti & Laesser, 1996).
1.4 Extending the perspective to include international air travel

Energy use analysed above included tourism components within New Zealand. International air travel has been excluded for reasons discussed in Chapter 3 – International air travel (mainly because international air travel is not included in the Kyoto Protocol). If the international component were to be included in national accounts this would change the picture dramatically, not only in terms of overall energy use but also with regard to the ‘desirability’ of tourist types. Tourist types within New Zealand would still be the same (it still is reasonable to segment tourists based on their voluntary travel patterns), thus energy use associated with bringing a specific tourist to New Zealand would have to be an additional variable in the profile of a tourist type. The procedure of balancing benefits and costs associated with tourist types would then become more complex.

The energy mix for an individual tourist for the key international markets analysed before plus China and Canada, the next important markets, is presented in Figure 45. The average destination-based energy use reflects the country-specific mix of tourist types, while energy use associated with the international flight to New Zealand is a constant for each country of origin. International travel comprises only one-way energy use (as discussed, a half share between country of origin and destination New Zealand is assumed; for a full inventory, figures for the flight need to be doubled).

![Energy use chart](image)

Figure 45: Country profiles for total energy use.
It can be seen that visitors from Germany and the UK are most energy-costly, while Australians require the least amount of energy overall. German visitors are furthermore characterised by a large share of destination-based energy use, mainly a result of their length of stay, in particular due to the high share of (long staying) ‘auto’ and ‘camping’ tourists. The generally short length of stay of South Korean and Chinese visitors leads to a strikingly high share of the international flight of total energy use (about 95% compared with, for example, 21% for Australian visitors).
1.5 Conclusion

This chapter integrated results from the industry analysis and the tourist analysis to estimate total energy use and CO₂ emissions of the New Zealand tourism sector. The model used in this analysis was built on tourist types and their respective travel behaviours, and visitor volumes. Sensitivity analysis, which builds on sample distributions as opposed to single point estimates, was applied to obtain a more accurate result, and also to determine the uncertainty associated with the estimate of total energy use and emissions.

Total energy use of tourism in New Zealand in 2000 was 25.3 PJ. Seventy percent of this can be attributed to domestic tourism. Total CO₂ emissions amounted to 1,549 kilo-tonnes, constituting 5.1% of all CO₂ emissions in New Zealand in 2000. In the case of domestic tourists, short trips consumed more energy than longer trips, because they were more important in terms of tourist volumes (61% of all domestic tourists are undertaking a short trip of one or two nights). Among international tourists, the coach tourists accounted for the largest share of energy use (30%). Gateway-only visitors seemed most energy-efficient; they constituted 21% of all tourists, but contributed only 6% to energy use. This needs to be treated with caution due to the likely underestimate of transport energy use of this tourist type. Camping tourists contributed significantly to total energy use, because of their large travel distances, often with comparatively energy-intensive camper vans.

Several scenarios have been calculated for various technological and behavioural changes. Decreasing energy use associated with air travel, either through increasing technological energy efficiency, or through decreasing average travel distance per tourist, is the most effective single option, with overall reductions of energy use between 2 and 3%. The largest reduction of about 7% (among the explored scenarios) could be achieved through an increase in (engine) efficiency of 10% for all transport modes. Similarly, energy use could be reduced by over 5% when tourists travel 10% less far with their main transport mode. The visitor growth scenario for the year 2006 is particularly important, because it highlights the rapid increase in energy use and emissions (more than 30%) when no measures are taken. This projected growth makes it particularly difficult to reduce total energy use.
The mix of tourist types determines energy use and emissions. An increase of (international) coach tourists, for example, would result in an above-average increase in energy use, whereas, a growing market of city tourism (gateway-only) has the potential to be less energy costly. To a certain degree the mix of international tourist types is related to nationality, in particular in the case of Asian coach tourists. This relationship between tourist type and nationality can be used to inform overseas marketing campaigns. Countries such as Germany are characterised by a diverse mix of tourist types, and more complex campaigns would be necessary to influence travel behaviour. The effectiveness of overseas marketing and educational campaigns to promote energy-efficient travel, as well as the effectiveness of different distribution channels require further investigations. This applies in a similar way to initiatives targeted at domestic tourists. For domestic tourists it needs to be emphasised that many factors influence travel behaviour and decision-making. Domestic tourists’ travel patterns are assumed to be more set (traditional) and constrained, for example through family and business requirements or the preference for holiday homes. Potential to influence the mix of trip types through management intervention is therefore possibly limited.

If international air travel is included in the model, total energy use increases considerably. Energy use associated with tourists travelling to New Zealand (one way) was calculated to be 27.8 PJ (1,900 kt CO₂), which is slightly larger than the energy use consumed within New Zealand by the whole tourism sector. The importance of international air travel increases when outbound travel of New Zealanders is included. It can be estimated that the 1.28 million New Zealanders travelling overseas per year consume slightly less energy than international tourists visiting New Zealand, because of both lower volumes and the popularity of Australian and other Pacific destinations.

Apart from a dramatic increase in energy use and CO₂ emissions as a result of including international travel, the broader perspective has important implications for the energy use of different source countries. Visitors from Europe, in particular, carry a considerable carbon burden, regardless of their travel behaviour within New Zealand. In contrast, visitors from Australia are per se advantaged in terms of their
overall energy account. These considerations are relevant, given a possible inclusion of international travel in emission accounts in the near future.

The model developed in this thesis proved useful to estimate energy use and CO₂ emissions resulting from tourism. It also provided a basis for exploring ‘what-if’ scenarios, and for outlining opportunities to manage energy use. The model, however, could be improved by increasing the accuracy of several elements on which the model relies. Improvements of this kind would decrease the uncertainty of the estimates (i.e., reducing the spread of the distribution as shown in Figure 43). The following improvements or amendments could be made:

i. Increasing the accuracy of energy intensities of travel choices, in particular occupancy factors for private vehicles, and energy intensities for the different accommodation and attractions/activities. A further disaggregation of categories (e.g., that considers business sizes or urban/rural differences) would be an option to decrease the great variability of energy use.

ii. Applying the tourist type analysis to other years (e.g., to the 2001 IVS) and investigating possible trends. In the present model the types were assumed to be static, whereas in reality they are likely to be dynamic, both in terms of travel behaviour and volumes.

iii. Increasing the representativeness of both the DTS and the IVS (i.e., increase sample size) and overcoming problems associated with the nature of collecting punctiform travel data based on overnight locations. In particular, more regional data would be required to analyse local travel behaviour, such as day trips, and visits to attractions and activities.

iv. Improving understanding of long-term tourists’ travel behaviour, in particular disaggregated into a possible ‘touring component’ and a ‘residing component’ (e.g., in the case of educational visitors).

v. Increasing the knowledge on gateway-only tourists, in particular their transport and recreational behaviour.

vi. Including a dynamic component of the relative mix of tourist types. Changes, such as a relative increase of camper tourists or backpacker tourists, could have substantial impacts on energy use in New Zealand and would also be important for tourism planning and management in general.
6 CHAPTER 6 – POLICY IMPLICATIONS AND FUTURE RESEARCH

6.1 Findings and policy implications

This study analysed the energy use of tourism in New Zealand from both an industry and a consumer perspective and combined findings of the two analyses to estimate total energy use in the sector. The two-sided approach allows consideration of what sub-sectors are particularly important in terms of energy use and what tourists need to be approached to reduce energy use. The industry perspective is discussed first.

Transport is the dominant contributor to energy use in the New Zealand tourism sector. Aeroplanes and cars are the most widely used transport modes, both of which require considerable input of energy. Air travel\(^1\), the infrequently used sea transport, camper vans and cars are the most energy-intensive forms of transport. Energy use on a per-passenger kilometre basis for domestic air travel is about the same as for car travel with the driver only. Nonetheless, air travel is probably the most concerning transport mode from an environmental perspective, because of usually large travel distances and the emission of greenhouse gases in higher layers of the atmosphere, where the impact on the climate is about 2-4 times higher compared with the lower troposphere. Moreover, the efficiency of car travel can easily be improved by increasing passenger numbers.

Public transport systems offer energy-efficient transportation, but as for car travel, the energy efficiency depends strongly on passenger load factors. A 50-seater bus consumes about seven times as much energy as an average car; this means that at least eight passengers have to travel on the bus to make it more efficient than car travel with the driver only. Cycling and walking have been described as environmentally friendly, zero-emission transport options, which could be better promoted in New Zealand, not only in the context of tourism.

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\(^{1}\) Domestic air in New Zealand, however, is relatively efficient (2.75 MJ/pkm) compared with other countries, as a result of a modern fleet and high load factors (occupancy) of about 67% (Air New Zealand, 2000).
Several options to decrease transport energy use have been discussed. These were, for example, targeting transport providers such as rental vehicle companies, who could change their renting schemes or modernise their fleet to include vehicles with alternative fuel sources. Regional and local government play a role in that they could encourage public transport systems, provide shuttle buses to key tourist attractions, develop programmes to increase tourists' length of stay and establish cycle networks. Tourists themselves have a large range of options to change their transport behaviour, for example in choosing more energy-efficient modes. The implementation of many of these measures could be supported by Government initiatives, either in the form of ‘carrots’ or ‘sticks’. In New Zealand, the ‘sticks’ are currently being discussed by the Government in the form of an emission tax at $25 per tonne of CO₂ equivalent (New Zealand Climate Change Project, 2002). Revenue generated from this carbon tax could be used to provide ‘carrots’ to tourism providers to become more energy-efficient.

In New Zealand, there is a large range of accommodation providers, both commercial and private. The diversity of this sub-sector results in a range of energy consumption patterns within and between different accommodation categories. Hotels are the largest accommodation businesses and consequently consume most energy in total. Since hotels provide many different services for their customers they also require large energy inputs on a per visitor-night basis (155 MJ/visitor-night). It is believed, however, that (large) hotels also have the greatest potential to become energy-efficient for several reasons. They are often part of a hotel chain, have more capital than smaller providers, employ more specialised personal, and provide a wide range of functions to which energy-saving measures could be applied (e.g. swimming pools, air conditioning systems). The assumption of a relationship between size and potential energy efficiency is supported by the fact that the generally small Bed & Breakfast businesses operate comparatively inefficiently (110 MJ/visitor-night). B&Bs are often family businesses where occupancy rates are low and where profit maximisation is not the overriding goal.

Hotels and B&Bs have been described in this research as ‘service-oriented’ accommodation categories. In contrast, motels, campgrounds and backpackers were named ‘purpose-oriented’ accommodation, because they mainly seek to provide the
basic service of a place to spend the night. In the case of these purpose-oriented and more energy-efficient categories, it is important to note that some energy use may be transferred to other businesses, for example restaurants, bars and other entertainment providers. The relationship between service level and energy use needs to be explored more carefully. Additional (materialistic) service is often associated with an increase in energy use, for example a fresh towel every day or a private spa pool. This kind of service has been described as the “...technically competent performance of a task...” (Smith, 1994, p. 587). Service, however, can be augmented by hospitality as “…the attitude or style in which the task is performed” (ibid). It is argued that improving hospitality as opposed to service may add value to a product without increasing energy consumption. As a consequence it may be possible to decouple an increasing service/hospitality level with energy use.

The main feature of energy use in accommodation businesses is the dominant use of electricity. In motels, for example, 94% of energy use is electricity-based. Electricity use is ambiguous in carbon terms, because of the increasing contribution of thermal power generation in New Zealand. Electricity generation based on fossil fuels is associated with substantial CO₂ emissions. Given the growth in tourism, especially since 1990, the base year for the Kyoto Protocol, much energy use of tourism could be considered ‘marginal’, which means that high emission factors have to be applied to electricity use (pers. comm. H. Aulakh [EECA], May, 2000). In this context it is worth remembering that three units of gas input are required to generate one unit of electricity in a thermal plant. Alternatively, there exist many opportunities to generate electricity from renewable sources, for example using solar panels, photovoltaic systems and wind turbines. This may be particularly useful in remote regions, where traditional electricity supply is expensive (Lowe & Lloyd, 2001).

Homes are the most important ‘accommodation category’ in terms of visitor-nights. While in terms of energy use per visitor-night (41 MJ) they are similar to backpacker hostels, they contribute much more to total energy use, because of their visitor

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2 New Zealanders’ hospitality is already recognised as one of New Zealand’s strengths (TNZ, 2001b) in terms of international tourism.
volumes. Making homes more energy-efficient and healthy is a prime concern of New Zealand energy programmes (EECA, 2001), regardless of tourism issues.

Tourist attractions and the provision of (commercial) tourist activities constitute an important part of the holiday experience. Overall, this sub-sector contributes less to energy use of the New Zealand tourism sector than the two sub-sectors already discussed. Nevertheless, each sub-sector should be encouraged to engage in energy-saving initiatives to the best of their ability. Generally, tourist attractions and entertainment attractions consume less energy per visitor (about 6 MJ per visit) than tourist activities (96 MJ). Most energy use in attractions is associated with building functions, which makes it easy to introduce energy measures, such as improving insulation, modernising the heating system and replacing light bulbs with more efficient forms. Despite the relative efficiency of most built attractions, they are most important in terms of overall energy use, because of their visitation levels. Visitor numbers to some attractions can reach up to several hundred thousand visitors per year. These visitor volumes are rarely achieved by tourist activities, except the large New Zealand ski fields (which could be considered attractions as well). Activity packages are often energy intensive, because they offer an individual style and service orientation that requires energy at different stages, compared with (mass-tourism) attractions. Furthermore, activities often rely on the use of motorised vehicles, either to get to the location where the activity takes place or for the activity itself (e.g. jet boat rides). In the case of New Zealand, boat cruises and other water transport are most important in this context. Generally, the input of petroleum fuels is a characteristic of ‘activities’, while ‘attractions’ rely on electricity for their buildings. These findings are important, given New Zealand’s strong marketing focus on tourist activities.

The relatively new ‘ecotourism’ product, promoted as a responsible, nature-based form of tourism that seeks to contribute to nature conservation, has rarely been discussed in the light of energy use. While not having been particularly targeted at ecotourism operators, this research indicated that ‘ecotours’ often build around taking visitors to natural assets by various types of motorised vehicles, for example four-wheel drive vehicles or boats. The environmental impact resulting from the energy use embodied in these tours has often been neglected, with researchers to date
focusing on local environmental impacts. Clearly, against this background there is a strong contradiction within the concept of ecotourism. Ecotourism standards, as currently being developed by the TIANZ within the wider framework of Green Globe 21, may consider energy use as a priority parameter.

A tourist’s trip comprises different travel choices across the three sub-sectors discussed above. The diversity of travel patterns, i.e. different bundles of travel choices, constitutes the basis of the model of tourist types developed in this thesis. This typology, derived from a cluster analysis, proved useful for analysing tourist-type characteristic travel patterns, associated demographic and trip-related characteristics and energy use per tourist. These analyses were undertaken both for domestic and international tourists.

Domestic tourists differ considerably from international tourists in that they take many short trips, mainly by their private car, but also to a considerable degree by air. Many domestic trips are family or business related. The diversity of domestic trips is small and manifests mainly in different travel distances, as, for example, in the case of ‘long air business’ and ‘short air’ travellers. In contrast, international tourists make many different travel choices to compose their trips and accordingly, tourist types reflect diverse transport-accommodation travel choice combinations. ‘Coach tourists’, for example, travel by coach and domestic air, and tend to stay at hotels. The West Coast pilot-study indicated that coach tourists are also attracted by tourist icons and other built attractions (e.g. farm shows). Three different tourist types belong to the category of FITs, namely the ‘camper’, the ‘auto tourist’ and the ‘backpacker’, all of which are characterised by a typical set of transport-accommodation travel choices. ‘Visiting friends and relatives’ tourists constitute another international tourist type, who stay at private homes and travel by private car or bus. A large proportion of international tourists are ‘touring tourists’, which means that they visit more than one place, whereas domestic tourists tend to travel to a single destination. Multi-destinational travel is often associated with a large total energy use, due to significant transport energy requirements and also because of longer trip durations.

Different travel styles, both between domestic and international tourists, and within these two categories, require different energy inputs. Domestic tourists consume about
1,108 MJ per trip and 457 MJ per day across all tourist types. This compares to 4,055 MJ in total and 387 MJ per day for international tourists (attractions/activities not included). It is evident that domestic tourists travel less efficiently, which may be explained by larger travel distances per day. In fact, transport makes up 85% of a domestic tourist’s total energy use, compared with international tourists, who spend 69% of their energy on transport.

In the case of domestic tourists, the most energy intensive trip types are air-based trips and ‘extreme car travel’ trips. ‘Long air business’ travellers, for example, consume five times the energy (1,087 MJ per day) of public-transport-based ‘flexible trip’ tourists. Similarly, the highly air travel dependent (international) ‘coach tourists’ consume most energy per day (654 MJ) compared with the other international tourist types (183–329 MJ). As a result of an average length of stay of only eight days, the total energy use of a ‘coach tourist’ is in the medium range of the energy spectrum. ‘Camping tourists’ consume most energy in total (almost 6,000 MJ per trip), because of their average stay of three weeks. ‘Visiting friends and relatives’ tourists consume little energy, both in total and per day.

The energy profiles of different trip or tourist types have been compared and several questions have arisen. First, how can we reduce energy use associated with each type without compromising the holiday experience? Second, what tourist types require most urgent action; i.e. who are the biggest energy consumers? Third, are there tourist types that are more ‘desirable’ than other types? Finally, what indicators other than energy use should an assessment of ‘desirability’ include? These questions have been raised in this study; and each compels a need for further research. Future research would need to address both energy use associated with different travel styles and other environmental, economic, and social indicators in relation to these travel styles. The Office of Tourism and Sport (1999, p. 7) compared economic benefits of different export products saying, for example, “One international visitor is worth the equivalent of the fleece of 150 sheep, 1,000 kilos of beef, 1.5 ha of plantation forest and 880 kilos of butter”. It is only one step further to say ‘One backpacker tourist costs … amount of energy, and is worth …. dollars revenue’.
This study has analysed tourism businesses and individual tourists’ travel patterns, which provided understanding at the micro level, and also offered some information for developing measures to save energy at this level. These results were used to project national energy use (bottom-up analysis). While the main goal was to assess the full extent of energy use in the New Zealand tourism sector, key drivers of this energy consumption were also explored.

Total energy use of tourism in New Zealand in 2000 was 25.35 PJ, which means that tourism contributed 5.6% to national energy demand. These figures only include the transport, accommodation and attraction/activity sub-sectors, which means that the above figures are conservative estimates. CO₂ emissions resulting from tourism amounted to 1,549 kilo-tonnes, a contribution of 5.1% of all CO₂ emissions in New Zealand. Domestic tourists are the larger energy consumers (70% of total energy use), as a result of their tourist volumes compared with those of international tourists. Given the projected average annual growth rates of 6.7% for international visitors between 2000 and 2006 (Vuletich & Fairgray, 2000a) and 1.5% for domestic tourist between 1999 and 2006 (Vuletich & Fairgray, 2000b) it is obvious that the relative significance of international tourism will increase. While international tourists tend to stay longer in New Zealand than they did previously³, domestic tourism will be characterised by more frequent but shorter trips (in 2006 the projected average trip will be 2.9 days long). It is difficult to assess the implications of domestic tourists’ travel pattern changes on CO₂ emissions. Energy use per trip may decrease slightly if tourists travel less distance for shorter-duration trips. The analysis of domestic tourists in this study, however, indicates that domestic tourists do not adapt travel distances to their length of stay.

Several options to reduce energy use through technological improvements and behavioural shifts have been explored. The scenarios where transport energy is reduced either through increasing vehicle efficiency or through reducing travel distances appeared most promising. The option of modal shifts, for example from air to train travel for business travellers as discussed for other countries (e.g. Høyer &

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³ The average length of stay in the year ended April 2002 was 22.0 days, compared with 20.2 in January 2001 and 19.6 in January 1998 (Statistics New Zealand, International Visitor Arrivals, various years).
Naess, 2002), is only partly practical in the New Zealand context. While it is desirable and feasible to substitute private car travel with public bus travel, the alternatives of rail travel are limited, because New Zealand does not possess an extended rail network as found in many European countries. Furthermore, New Zealand’s geography makes air travel a competitive transport mode in many regards. This is particularly true for inter-island travel, for example from Christchurch to Auckland, but also for travel over long distances within each Island. The trip from Auckland to Wellington, for example, takes seven hours by land compared with about one hour by plane (flying time). In the case of New Zealand, air travel is often competitive even in terms of energy use, because travel distances are much shorter than road travel distances, and domestic flights by Air New Zealand usually have high occupancy rates. The alternative ferry transport for inter-island travel is as energy intensive as flying on a per passenger kilometre basis. In other words, shifting passengers from air travel to public land transport is in many cases neither promising nor beneficial. It is possible that a segment of international tourists who have loose time constraints could be shifted from air travel to land-based travel. The more effective way for reducing energy use from domestic air travel, however, seems to be diminishing the need to travel, i.e. trip suppression. This applies particularly for energy-intensive domestic (business) tourists. Trip suppression is discussed further in the research implications.

Energy reduction measures in the transport sub-sector need to be complemented by initiatives in other sub-sectors to achieve substantial reductions overall, for example decreasing energy use by hotels. Clearly, the mix of tourist types and, accordingly, to some degree the mix of nationalities in the case of international tourists has further implications on energy use. A growth of visitors from the Asian markets, for example, leads to an increasing proportion of coach tourists and therefore energy use. In contrast, growing visitor numbers from Australia (either for business or visiting friends or relatives) are likely to be associated with a relative decrease in energy use. An absolute reduction in energy use can be achieved when energy-efficient tourist types increase in numbers at the expense of energy-intensive ones, for example through a shift in marketing. Considerations of this kind are very complex and may raise ethical questions, in particular when preferences are linked with nationalities. Further research is needed to be confident enough to target an optimised mix of tourist types.
The most important component of energy use associated with tourism has been neglected so far in the discussion. International air travel, necessary to transport tourists to and from New Zealand (or allow New Zealanders to travel abroad), has been identified as the overriding contributor to energy use. Depending on country of origin, the international flight makes up between 81% (Australia), 91% (UK) and 95% (China) of an individual tourist’s total energy use (including the international flight and energy use within New Zealand). This is a highly critical issue for New Zealand, given its ‘green and clean’ image at present. Energy use associated with international travel is important in three ways. First of all, New Zealand is potentially affected by the inclusion of international travel into the Kyoto Protocol with various consequences, for example price increases of airfares. On the competitive market, in particular against the background of New Zealand competing against countries that are not part of the Kyoto Protocol, such as Chile and many Asian countries, this disadvantages New Zealand when tourists chose cheaper destinations. Secondly, the fact that tourists have to undertake a long-distance flight to travel to New Zealand might constitute a barrier for environmentally aware tourists, who seek to keep their greenhouse gas emissions low. Thirdly, considerations of which tourist type mix (and which country of origin) is best for New Zealand in terms of a balance between energy use and profit become even more complex.
6.2 Limitations

There are some limitations to the results of this study. First of all, there is an unknown degree of error associated with energy intensities derived from industry surveys. This results from small sample sizes, from high levels of aggregation, and the number of estimates necessary to process information provided by business operators. Both the comparison of energy profiles for the different tourist types and the projection of national energy use of tourism depend on these inputs. A review and improvement in accuracy of the measurement of energy intensities is, however, possible without changing the tourist type model.

This study focused on the three key sub-sectors, transport, accommodation, and attractions/activities. Tourists further consume products of other sub-sectors, in particular ‘food and beverage’ and ‘retail’. Energy use associated with these may be small compared with the sub-sectors analysed, but may still contribute to some extent.

Furthermore, indirect energy use may be a significant factor that needs to be considered when assessing the full consequences of tourism. To this end, the concept of an ‘ecological rucksack’ that includes the embodied (indirect) energy consumption of an individual tourist would be useful. In the case of bottom-up calculations, the embodied energy for a wide range of characteristic tourism products and services needs to be considered, such as the energy use of 12 GJ required to produce a car (Maibach et al., 1995). An alternative approach is a top-down analysis that uses multipliers to assess economy-wide flow on effects of a specific activity, in this case tourism (Patterson & McDonald, 2002).

Finally, it has already been noted that the scope and type of questions asked in the DTS and IVS surveys lead to several problems. Due to small sample sizes, small visitor groups in particular are subject to a considerable sampling error. Furthermore, it has been argued that the DTS and IVS are not representative at a regional level and that they provide limited information on actual travel routes (Forer & Simmons, 2002). Increasing the sample size for the IVS and increasing the frequency of surveying for the DTS would overcome some problems, as would complementing these national surveys with more detailed regional studies.
6.3 Research implications

The discussion of previous research on energy use and tourism showed that most studies focused on the effects climate change has on tourism, while little research has been undertaken on the energy consumption of tourism and resulting impacts on the global climate. The few existing studies on energy use mostly focused on single businesses, or on immediate environmental impacts, such as air pollution. The somewhat more abstract impact of climate change seems to play a minor role in such research. Only recently, tourism and climate change featured as a topic of discussion at international institutions, such as the UNEP and the WTO, and national bodies, such as the Tourism Industry Association New Zealand (Turney et al., 2002). It is hoped that this study contributes in attracting attention to the topic of tourism’s role in climate change, and also provides initial information on how to decrease energy use.

While there are some international initiatives to make tourism more sustainable, such as the Tour Operators’ Initiative for Sustainable Tourism Development by the UNEP, UNESCO and WTO, it is generally believed that the industry’s awareness of energy consumption and its impacts is low. In the New Zealand case, Kearsley et al. (1999) found that one third of tourism business operators know little or nothing about sustainable tourism, another 35% had moderate knowledge and the remainder reported that they knew ‘quite a bit’. Despite this limited knowledge, operators felt that tourism needs to be managed carefully to avoid detrimental effects on the environment. To realise any energy savings in tourism it seems crucial to increase the industry’s awareness and knowledge in this regard. The Green Globe 21 initiative by TIANZ potentially plays a role in this process.

In the case of tourists, the degree to which they commit to environmental action remains unclear. Current trends in travel behaviour of ‘shorter, but more frequent and further’ holidays indicate little interest in energy-related impacts. The increasing popularity of ‘no frill’ airlines offering extremely cheap flights (e.g. Ryanair in Europe) supports this assumption. On the other hand, it is often argued that tourists care for the environment, and include it as a factor in their travel decisions (Müller, Landes & Scheurer, 2001). It is debatable whether awareness and knowledge about environmental effects are sufficient to change behaviour. On the contrary, there often
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seems to be a gap between environmental attitudes and actual behaviour, as, for example, shown in an Australian study on environmentalism and transport choices (Knight, 1992), and a Swedish study on environmental concerns and travel behaviour (Nilsson & Küller, 2000).

In their psychological study on denial procedures with regard to mitigation strategies for climate change, Stoll-Kleemann, O’Riordan & Jaeger (2001) noted that a gap between attitude and behaviour results in some dissonance, which is denied using various strategies (Stoll-Kleemann et al., 2001, p. 112). These are, for example:

- Metaphor of displaced commitment – I protect the environment in other ways
- Denial of responsibility – I am not the main cause of this problem
- Powerlessness – I am only an infinitesimal being in the order of things
- Comfort – It is too difficult for me to change my behaviour.

The authors described a general unwillingness to give up comforts and change lifestyle, despite the recognition of climate change as a serious and realistic threat. They further discussed the phenomenon of the ‘tragedy-of-the-commons’, which indicates that individuals behave in such a way that the outcomes are positive for themselves; however, when undertaken by a large number of individuals or societies the consequences are devastating⁴. Finally, the authors concluded that there is a “…level of sophistication and cohesion in socio-psychological reactions that will prove difficult to alter, unless very wide-ranging policy responses are integrated over a prolonged period of time” (Stoll-Kleemann et al., 2001, p. 115). A preferred way of avoiding the dissonance described above is to contribute financially (and therefore internalise externalities to some degree), while keeping the privilege of continuing current practices. It has been shown that tourists are willing to pay an environmental tax, rather than restricting environmentally harmful behaviour and renouncing comfort during their holiday time (Weiss et al., 1998, cited in Hudson & Ritchie, 2001; Müller et al., 2001). Thus, the conclusion is emerging that changing travel behaviour is extremely difficult.

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⁴ This contradiction is largely a result of ‘free use’ of some resources (e.g. air), i.e. the external costs of air pollution are not (economically) accounted for in market price structures.
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It is often argued that ecotourists are generally more aware of, and committed to the environment than other tourists. A study on ecotourists in New Zealand found that visitors to ecotourism operations are concerned about the environment, mainly about pollution (15.2% of all respondents), global warming (8.6%), deforestation (7.9%) and ozone depletion (6.8%). The depletion of natural resources (3.0%) and car use/fossil fuels (2.7%) were also listed (Higham, Carr & Gale, 2001). Research on ecotourism experiences as a catalyst for changing behaviour is contradictory, with some studies indicating that some form of environmental advocacy exists (e.g. Orams, 1997), and others showing that nature experiences lead to, at most, small changes in attitude or behaviour (Beaumont, 2001). Tourists with the least environmental knowledge seemed to be influenced most by nature experiences, resulting in some shift in attitude and behaviour, at least in the short term. In contrast, in the case of already environmentally aware tourists, ecotourism experiences simply served as a reinforcement of existing attitudes (‘preaching to the converted’) (ibid). Ecotourists already put environmental awareness into practice more often than other tourists. Highham et al. (2001) reported that a large majority of New Zealand ecotourists (mainly from Europe) engage in recycling and energy-saving practices at home. It has to be critically noted that the perception of being environmentally friendly is biased toward an overemphasis on everyday activities (e.g. turning the lights off) compared with the extreme (one-off) impact of a long-haul flight from Europe to New Zealand. Hence, the gap between attitudes and behaviour is maybe particularly apparent for ecotourists. In the case of ecotourists the above-mentioned ‘metaphor of displaced commitment’ may frequently serve as a denial strategy.

Keeping in mind the difficulties of actually changing tourist behaviour, reducing energy use from tourism could be achieved in two ways, namely reducing the need to travel and making travel more energy-efficient. The perceived ‘need’ for leisure travel is in fact most often a ‘want’, which is nourished by modern societies’ attitudes, lifestyles, economic prosperity and available leisure time. An entire shift in societies’ paradigms would be necessary to reduce this ‘want’. The dilemma faced by business and conference travel, in contrast, is that there is, at least some perceived, need to travel, which has to be balanced with time, money and energy spent on this travel (Høyer & Naess, 2001). In the case of business travel there exist ways to reduce the need to travel, for example web-based conferences or other telecommunication.
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Given the popularity of travelling and the difficulty of reversing the above structures supporting travel demand, the solution of making travel more efficient remains. From the tourist type model produced for New Zealand it is suggested that changing tourist itineraries would have the largest effect on reducing energy use. The tourist itinerary determines the distance travelled by the tourist, and influences to some extent travel choices made in the transport sub-sector (what mode is used), accommodation and attractions/activities sub-sectors. In this sense, the itinerary constitutes a framework for other travel decisions, which make an important contribution to decreasing energy (e.g. through choosing environmentally sound accommodation) in addition to energy saved through sound route planning. Itineraries could be modified in such a way that overall travel distance is reduced. This could be achieved through regional promotion, which means that tourists stay longer at one location and hence have less need to travel. This is not only beneficial in terms of reducing transport energy use, but it also provides economic potential. When staying within a region, tourists may distribute their expenditure within the community, and thereby provide impetus for new and innovative products and attractions. Business opportunities could arise in the first instance from tourists staying at one place and having more time (because they do not travel), but also from tourists seeking energy-efficient travel services to regional attractions. Educational bus tours, shuttle services, the organisation of ride-shares, and providing bicycles are some options among many. A regionalised approach to tourism management has potential for the development of innovative businesses and for the new conceptualisation of destinations.

Clearly, tourists only adopt new travel styles when they recognise personal advantages. Benefits for international tourists resulting from changed travel patterns and itineraries are: (i) a richer experience of local attractions, nature, and New Zealand people; (ii) more time at one destination and therefore less stress (in particular less driving stress); (iii) cost savings resulting from less money spent on petrol and flexible transport systems (e.g. public bus and bike); (iv) active contribution to environmental protection. The last point may only sound attractive to some tourist types, for example campervan tourists, who showed the largest interest in nature (activities). These benefits could be communicated through marketing to international tourists to give them the opportunity to decide on relaxed, in-depth holidays while at the same time generating a lower energy profile.
Visitor decision-making is a hierarchical process of visitors deciding where to go, when to go, and how to travel. More knowledge on the different stages of decision-making is needed to shape those decisions that contain some potential for more environmentally friendly travelling. Some knowledge about how tourists build their itineraries in New Zealand already exists. A study on tourists in the New Zealand’s West Coast Region, for example, showed that 59% of all visitors had planned their itinerary at home, while 21% planned it during their travel (Moore, Simmons & Fairweather, 2000). Travel planning differed for nationalities, with domestic tourists, as well as visitors from Asia and the USA, being more likely to have planned the trip at home. Germans planned less further ahead compared with the other markets.

Advice from ‘friends and relatives’ was the most important source of information, in particular for tourists in rental vehicles. Travel brochures were also important for rental car and camper van tourists, as well as for first-time visitors. The experience gained in previous visits is an essential factor for itinerary planning (ibid). There is some potential to reduce energy use, in that repeat visitors (44% of all visitors [TNZ, 2001a]) may be more inclined than first-time visitors to focus on regions instead of ‘surveying’ the whole country. It is suggested that environmental attitudes, visitor motivations and expectations, and travel decision-making should be analysed in future research for developing strategies to change itineraries and travel patterns. Future research will have to take into account the different cultural origins of tourists.

The analysis of energy use in tourism in this study, although being New Zealand specific, has value for other countries. Results presented here allow some general conclusions about the importance of tourism as a consumer of energy within national economies, as well as the relative significance of sub-sectors and different tourist activities, and tourist types. It is believed that the key findings and the implications of this research also apply more directly to countries that offer similar nature-oriented tourism products, marketed in the form of multi-destination tours to a range of natural and cultural tourist icons. Similar countries are, for example, Australia, Canada, Chile and Argentina. It would be interesting to analyse how the size of countries, in particular Australia and Canada, affects tourist itineraries and also transport mode choices. In large countries, tourists may focus on one region (e.g. British Columbia in Canada, or Queensland in Australia, both of which are still larger than New Zealand), or tourists may increase air travel to visit several regions during one trip. The research
presented in this study is probably less relevant for countries offering forms of tourism very different to the one in New Zealand. Cruise ship destinations (e.g. the Caribbean), resort-based holiday locations (e.g. Spain), or trekking destinations (e.g. Nepal) may be visited by completely different tourist types, which results in different energy requirements by tourism industries. A comparison of visitor types and energy consumption patterns between different destinations would be a very valuable addition.

In conclusion, this research marks a starting point for research on energy use and tourism, while at the same time identifying key areas and needs for future research. If climate change and other impacts resulting from the excessive consumption of fossil fuels are to be taken seriously, tourism will have to develop some concrete strategies to render tourism more energy-efficient. To date, this has been largely ignored in discussions on the sustainability of tourism. In this light, international air travel, in particular long-distance travel, deserves particular attention and urgent action. Despite some further improvements in aircraft efficiency, it appears to be critical to reduce the currently increasing volume of air-based travel. Otherwise, following current projections, market growth continuously outweighs gains in fuel economy, with the result of increasing CO₂ emissions from air travel. Fundamental to this is increasing the awareness of (potential) tourists with regard to climate change issues and even more importantly their willingness to actually change behaviour. Along with such change it is hoped that tourists also consider travelling in more energy-efficient ways by, for example, decreasing total travel distance and staying longer within one (geographically small) destination. The anticipated ratification of the Kyoto Protocol in 2002 will exert pressure on global tourism to make a significant contribution to mitigating climate change.
REFERENCE LIST


Reference list


Appendix A: Questionnaires

Questionnaire West Coast pilot-study

(This questionnaire was also distributed in a German translation)
Energy Use and Tourism

Why do we want to know more about it?

New Zealand is a country of outstanding natural beauty and we are proud to promote it as a preferred holiday destination. To preserve our natural assets like they are and to guarantee their survival for future generations we aim to prevent or mitigate any negative effects on the environment. To do so in an efficient way, we first have to know exactly where impacts occur and how serious they are. One of the biggest threats to our environment is the use of resources, especially energy. In this study we want to find out how much energy is required by tourism and whether it could be decreased by a change in current practices. By knowing exactly what happens we can plan in a responsible way and fulfil our obligations in international conventions, like the protocol of Kyoto (Japan) to prevent global warming.

How can you help?

With your assistance in answering the following questions you will help us gain valuable information on the energy used in tourism activities. Please keep this questionnaire in a safe place and complete it when you have finished your holiday in New Zealand. Please use the prepaid envelope provided and mail it back. The more thoroughly you answer the questions, the more valuable it will be for our research.

The survey

This survey is divided into four sections:

- General information on your trip
- Where did you go in New Zealand?
- Activities and Attractions
- Personal questions

The survey asks for every important detail to enable us to estimate the energy use of each person. To ensure that we have a good cross section of people in our survey we also ask for some personal questions.

What do you do with this questionnaire?

Complete it on your own

You may complete some of the questions immediately, if you wish. The remaining questions refer to your complete holiday. You may either answer them every day or finish them all at once at the end of your trip.

It is very important that the answers refer to one person, only. Please don’t answer the questions as a family, a couple or any other group of people. If you have difficulties with the language you may of course ask someone to help you filling in your answers. An example is provided wherever it might be difficult to understand a question.

For long-term travellers: If you spend several months in New Zealand, we ask you to fill out the questionnaire for at least 4 weeks. Please leave a note on your actual length of stay.
Mail it back

Please return the completed survey in the prepaid envelope. International visitors will probably post it at the airport. Please note, that the prepaid postage only applies within New Zealand. Domestic tourists are requested to post it as soon as possible after their arrival at home.

Extra information

If you would like to provide any extra information or comments, please feel free to attach additional notes. Any feedback is most welcome.

Your chance to win

Your information remains confidential, we do not record your name or address with the survey. Completed surveys will go in the draw for valuable prices like camping gear, travel books or New Zealand picture books, which will be sent to the address you provide on the entry form attached to this survey. You are not required to provide these details if you do not wish to enter the draw.

If you have any questions, please contact one of the following persons.

Susanne Beeken  
PhD Student  
Department of Human Science  
PO Box 84  
Lincoln University  
Lincoln 8152  

Phone: 03-337 9165  
Email: beckens@lincoln.ac.nz

Or:  
Prof. David Simmons  
TREC  
PO Box 84  
Lincoln University  
Lincoln 8152  

Phone: 03-325 3820

(This questionnaire is based on the International Visitor Survey of the New Zealand Tourism Board (NZTB), 1993/93 and 1995/96)
General information on your trip to/in New Zealand

Q 0 Are you living in New Zealand? In what town is your normal home located?

Q 1 On what date did you arrive in New Zealand (for International Visitors only)?

Q 2 At which airport did you arrive (for International Visitors only)?
(Please tick one box only)
1 Auckland 3 Christchurch
2 Wellington 4 Other (please specify)

Q 3 Which people, if any, have you travelled with in New Zealand?
Please, exclude anyone you met while in New Zealand. We require your “personal travel party” only—that is, the group who planned, booked and travelled together.
(Please tick one box only)
1 Travelled alone 5 Business associates
2 Couple 6 Family and friends
3 Family Group 7 Two or more couples
4 Friends 8 Other

Q 4a Did you travel on a group tour for more than half of your time in New Zealand?
(Please tick one box only)
1 Yes 2 No (If no, go to Q5)

Q 4b How many persons were travelling together with you in this group?
(Please record number) ____________________________ persons

Q 4c Where did you book the group tour?
1 In your home country
2 In New Zealand
3 Other (specify) ________________________________

Q 5 Which of these describe your reasons for travelling to/in New Zealand?
(Please tick all boxes that apply and underline the main reason)
1 General holiday 10 Other business
2 Skiing holiday 11 To watch or play sport
3 Golf holiday 12 Formal education
4 Fishing holiday 13 Educational/study tour
5 Honeymoon 14 Working holiday
6 Publicised Special Event (please specify) 15 Stopover
7 Incentive trip (reward for good work) 16 Millennium
8 To visit friends or relatives 17 America’s Cup
9 Participation in conference or seminar 18 Other (please specify)

Q 6 What is the total length of this trip, that is, the total number of nights you will spend away from home? (Please include the time you spent in other countries, as well as the time in New Zealand)

__________ days __________ months __________ years

How long is your holiday in New Zealand? ________________________________
Appendix A

Where did you go in New Zealand

In this section we want to find out about your itinerary and all types of transport, accommodation and restaurants you used within New Zealand. For the following questions Q7a to Q7d, please use the list on the next page. Use the three boxes below (Transport used, Accommodation used, Map of New Zealand) to answer the questions. You can use the codes for each type of transport and accommodation, if you want.

Q 7a Please have a look on the map of New Zealand. Where was the first place you stayed at least one night, and the next? (Please fill in column A to record all places where you have spent a night)
Q 7b What main transport type did you use to get there? (Please fill in column B for each transport type used to get to each location)
Q 7c What type of accommodation did you use there? (Please fill in column C for each accommodation used at each location)
Q 7d How many nights did you stay there? (Please record number of nights for each location in column D)

Transport used
1 Rental Car/Van
2 Private Car
3 Campervan
4 Organised Coach tour
travelling as a group
5 Flexible/modular coach tour
6 Backpacker Bus (eg Kiwi experience)
7 Domestic Air
8 Train
9 Cook Strait Ferry
10 Shuttle Bus/Van
11 Hitchhiking
12 Motorcycle
13 Cycle
14 Tramping
15 International Air
16 Other (specify)

Accommodation used
1 Private home – with friends or relatives/Batch
2 Rented home/apartment/time share
3 Paid farm stay/paid home stay/historic home
4 Bed and Breakfast
5 Backpacker/Hostel
6 Campervan/camp/camping ground
7 Department of Conservation park huts
8 Budget hotel/private hotel
9 Motel – no restaurant
10 Motel – with restaurant
11 Mid range hotel/motor inn
12 Luxury lodge
13 Yacht/boat
14 Top class NZ hotel (see list below)
15 Other (please specify)

Top Class NZ Hotels
AUCKLAND
The Regent Auckland
Hyatt Auckland
Sheraton Auckland Hotel & Towers
Centre Auckland Hotel
Novotel Auckland
Pan Pacific Hotel
Hotel Du Vin
ROTORUA/TAUPO
Sheraton Rotura
Quality Resort Lake Rotorua
Wairakei Resort Hotel
WELLINGTON
James Cook Centre
Wellington Parkroyal
City Apartments
Plaza International
Quality Inn Pihimmer Towers
CHRISTCHURCH
Noahs (Rydges)–Christchurch
Parkroyal Christchurch
MT COOK
Glencoe – Mt. Cook
Hermitage Mt. Cook
QUEENSTOWN
Holiday Inn Queenstown
Parkroyal Queenstown
THC Queenstown
Milbrook Golf Resort

Source: Department of Survey and Land Information. In NZTB: IVS, 199293

You can mark your route on the map, if you want

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Q 9 Did you usually have your breakfast in your accommodation?

(please tick one box only)
1 Yes 2 No (please specify)

Q 10 Except for breakfast, where did you usually have your meals during your holiday in New Zealand? (Please tick one box only)
1 Restaurant associated with the accommodation
2 Restaurant somewhere else
3 Meals provided in private accommodation
4 Take-aways (includes everything that is not consumed at the place you buy it)
5 Self-contained (Camping, Backpcker, self-contained motel or hostestays and so on)
6 Other (specify)

Q 11 How often did you eat in a Restaurant during your holiday in New Zealand?

(Please tick only one)
1 never 5 more than 13 times
2 1-4 times 6 Other (please specify)
3 5-8 times
4 9-12 times

Q 11 How often did you prepare convenience food (that means heat-and-eat food, for example Pizza and pre-cooked dishes)?

1 never 2 about 3 meals per week 3 about 6 meals per week

Q 12 How many litres of bottled beverages (Soft Drinks, Beer, Wine etc.) did you drink per week during your holiday in New Zealand?

1 less than 2 litres 2 2 to 6 litres 3 more than 6 litres

Activities and Attractions

The next questions are about what you did while in New Zealand, the activities you took part in and the attractions you visited.

Q 13 Did you visit any National Parks, Forest Parks or Maritime Parks in New Zealand?

(please tick one box only)
1 Yes 2 No 3 Don’t know (Got to Q15)

Q 14 If yes, which parks did you visit?

(please tick all boxes that apply)
1 Abel Tasman NP
2 Arthur's Pass NP
3 Egmont NP (Mt. Taranaki)
4 Fiordland NP (Milford Track, Kepler Track)
5 Kahurangi NP (Ward Track, Cob Chasm Track)
6 Mount Aspiring NP (Rob Roy Track, Routeburn Track)
7 Mount Cook NP
8 Nelson Lakes NP (Lake Rotoiti/Wanaka, Travers/Caples Track)
9 Paparoa NP (Pancake Rocks, Pororari)
10 Tongariro NP (Whakarewarewa, Mt Ruapehu)
11 Whanganui NP (Whanganui River, Picoiki)
12 Westland NP (Franz Josef Glacier)
13 Urewera NP (Lake Waikaremoana)
14 Bay of Islands Maritime Park
15 Hauraki Golf Maritime Park
16 Marlborough Sounds Maritime Park
17 Other Forest Parks

Q 8 If you travelled by private car, rental car, motorhome/campervan or a motorcycle, how many people were travelling with you in the same vehicle?

(If the occupancy of the vehicle changed very often, try to estimate an average)

Total number of people in vehicle

<table>
<thead>
<tr>
<th></th>
<th>Private car</th>
<th>Rental car</th>
<th>Motorhome/Campervan</th>
<th>Motorbike</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Transport to attractions/activities

This part deals with transport used to take you to attractions or activities that is not recorded in your itinerary, yet (Q 7). For the next questions Q18a to Q18d, please use the list below. Fill in column A to record all attraction/activities where additional transport was necessary. Repeat questions Q18b and Q18d for each attraction/activity.

**Q 18a** Which of the visited attractions and activities involved additional transport, which is not recorded in the itinerary asked in questions Q7?

(Record relevant activities in the column A)

**Q 18b** What main type of transport did you use to get to the attraction or activity?

(Record transport type used to get to each location in column B)

**Q 18c** How many kilometres did you use this type of transport to get there?

(Record estimated kilometres in column C)

**Q 18d** How many persons were travelling in the same vehicle?

(Record number of persons in column D)

---

<table>
<thead>
<tr>
<th>A</th>
<th>Attraction/Activity</th>
<th>B</th>
<th>Type of transport</th>
<th>C</th>
<th>Kilometres</th>
<th>D</th>
<th>Number of persons per vehicle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

(You can use the codes for the attraction/activities and the type of transport from Q7, if you want.)

---

**Q 16** Which of the following activities did you take part in while you were in New Zealand and how many times or days did this involve? Where was it?

(Record all boxes that apply and write in the number of visits and the location, eg. Auckland.)

<table>
<thead>
<tr>
<th>No.</th>
<th>Activity Description</th>
<th>Days</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>Shopping (not supermarket)</td>
<td>Days</td>
<td>A:</td>
</tr>
<tr>
<td>21</td>
<td>Lake/river fishing</td>
<td>Days</td>
<td>A:</td>
</tr>
<tr>
<td>22</td>
<td>Coastal fishing</td>
<td>Days</td>
<td>A:</td>
</tr>
<tr>
<td>23</td>
<td>Bungee jumping</td>
<td>Days</td>
<td>A:</td>
</tr>
<tr>
<td>24</td>
<td>Jet boating</td>
<td>Days</td>
<td>A:</td>
</tr>
<tr>
<td>25</td>
<td>Sailing</td>
<td>Days</td>
<td>A:</td>
</tr>
<tr>
<td>26</td>
<td>Other water based sports (eg. diving, kayaking, water-skiing, surfing)</td>
<td>Days</td>
<td>A:</td>
</tr>
<tr>
<td>27</td>
<td>Mountain rock climbing</td>
<td>Days</td>
<td>A:</td>
</tr>
<tr>
<td>28</td>
<td>Off road mountain biking</td>
<td>Days</td>
<td>A:</td>
</tr>
<tr>
<td>29</td>
<td>Golf</td>
<td>Days</td>
<td>A:</td>
</tr>
<tr>
<td>30</td>
<td>Cycling</td>
<td>Days</td>
<td>A:</td>
</tr>
<tr>
<td>31</td>
<td>Wine trail/visit vineyard</td>
<td>Days</td>
<td>A:</td>
</tr>
<tr>
<td>32</td>
<td>Snow skiing</td>
<td>Days</td>
<td>A:</td>
</tr>
<tr>
<td>33</td>
<td>Heli skiing</td>
<td>Days</td>
<td>A:</td>
</tr>
<tr>
<td>34</td>
<td>Bungy jumping</td>
<td>Days</td>
<td>A:</td>
</tr>
<tr>
<td>35</td>
<td>Scenic flight (excluding seaplane flights, excluding whale watching)</td>
<td>Days</td>
<td>A:</td>
</tr>
<tr>
<td>36</td>
<td>Air sports (skydiving, ballooning, parasailing, glider flight)</td>
<td>Days</td>
<td>A:</td>
</tr>
<tr>
<td>37</td>
<td>Scenic boat cruise</td>
<td>Days</td>
<td>A:</td>
</tr>
<tr>
<td>38</td>
<td>Jet skiing</td>
<td>Days</td>
<td>A:</td>
</tr>
<tr>
<td>39</td>
<td>Helicopter</td>
<td>Days</td>
<td>A:</td>
</tr>
<tr>
<td>40</td>
<td>Walk in bush or countryside (less than 1 hour)</td>
<td>Days</td>
<td>A:</td>
</tr>
<tr>
<td>41</td>
<td>Walk in bush or countryside (1 hour to less than 1 day)</td>
<td>Days</td>
<td>A:</td>
</tr>
<tr>
<td>42</td>
<td>Walk in bush or countryside (1 day to 1 week)</td>
<td>Days</td>
<td>A:</td>
</tr>
<tr>
<td>43</td>
<td>Trekking/tramping (at least one night in hut or camping)</td>
<td>Days</td>
<td>A:</td>
</tr>
<tr>
<td>44</td>
<td>Other (please specify)</td>
<td>Days</td>
<td>A:</td>
</tr>
</tbody>
</table>
Personal Questions

Next, we would like to ask you some personal questions about your travel costs, travel experience and some demographic details.

Q 19 Thinking about all the money you spent on this trip to New Zealand, please estimate the amount of this total which was spent on each of the items listed below. It is important to include all costs, even if you did not pay for them yourself (e.g. someone else paid for dinner). (Please include all expenditure while in New Zealand and all prepaid expenditure. Please exclude money spent on other persons (e.g. your family) and on trips to other countries, for example stop-over in Australia or Asia.) (You may use either NZ$, US$ or any other currency.)

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
<th>Currency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 International airfares</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Accommodation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Transport in New Zealand (exclude international airfares)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Food/Meals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Sightseeing and attractions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Other entertainment (e.g. bars)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 Personal Items</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 Gifts and souvenirs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 Other shopping</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The TOTAL should be an estimate of the total costs of your visit to New Zealand. Please check again if this is right.

Q 20 Which of the following countries have you visited on holiday in the last five years which involved travelling on a plane for more than four hours to get to your destination? (Please tick all boxes which apply)

| Country | 1 None | 2 Australia | 3 Fiji | 4 French Polynesia (e.g. Tahiti, New Caledonia) | 5 Other Pacific | 6 Singapore | 7 Hong Kong | 8 Thailand | 9 Indonesia | 10 Malaysia | 11 Japan | 12 China | 13 Taiwan | 14 Other Asia | 15 Hawaii | 16 Other USA | 17 Canada | 18 Mexico | 19 Other Americas | 20 India | 21 United Kingdom | 22 France | 23 Other Europe | 24 Africa | 25 New Zealand | 26 Other |

Q 21 In which country did you last live for 12 months or more? (Please tick one box only)

| Country  | 1 Australia | 2 USA | 3 Canada | 4 United Kingdom | 5 Germany | 6 Switzerland | 7 Netherlands | 8 Japan | 9 Taiwan | 10 Korea | 11 Singapøré | 12 Thailand | 13 Malaysia | 14 Indonesia | 15 Hong Kong | 16 New Zealand | 17 Schweden | 18 Danmark | 19 Ireland | 20 Other (specify) |

Q 22 Please record the year you were born.

_________________________________________year

Q 23 Are you? 1 female 2 male
Appendix A

Q 24 Which of the following ranges does your total household income fit into in?

New Zealand
(NZ$ per annum before tax)
1. less than 18,499
2. 18,500 – 27,799
3. 27,800 – 43,399
4. 43,400 – 68,199
5. 68,200 – 87,999
6. more than 88,000

Australia
(Australian $ per annum before tax)
1. less than 10,000
2. 10,000 – 17,999
3. 18,000 – 27,999
4. 28,000 – 43,999
5. 44,000 – 68,000
6. Over 68,000

USA
(US $ per annum before tax)
1. less than 10,000
2. 10,000 – 19,999
3. 20,000 – 29,999
4. 30,000 – 39,999
5. 40,000 – 65,000
6. Over 65,000

Japan (Yen per month before tax)
1. less than 250,000
2. 250,000 – 449,999
3. 500,000 – 599,999
4. 600,000 – 699,999
5. 700,000 – 850,000
6. Over 850,000

UK
(Pounds sterling per annum before tax)
1. less than 4,000
2. 4,000 – 7,999
3. 8,000 – 13,999
4. 14,000 – 21,999
5. 22,000 – 43,000
6. Over 43,000

Germany
(Deutsche Mark per month after tax)
1. less than 1,600
2. 1,600 – 2,299
3. 2,300 – 2,999
4. 3,000 – 3,999
5. 4,000 – 5,000
6. Over 5,000

Taiwan
(New Taiwan $ per annum before tax)
1. less than 400,000
2. 400,000 – 649,000
3. 650,000 – 849,000
4. 850,000 – 1,099,000
5. 1,100,000 – 1,900,000
6. over 1,900,000

Korea
(Won per month before tax)
1. less than 500,000
2. 500,000 – 749,999
3. 750,000 – 999,999
4. 1,000,000 – 1,499,999

Singapore
(Singapore $ per month before tax)
1. less than 1,000
2. 1,000 – 1,999
3. 2,000 – 2,999
4. 3,000 – 4,999
5. 5,000 – 6,000
6. more than 6000

Hong Kong
(Hong Kong $ per month before tax)
1. less than 75,000
2. 75,000 – 149,999
3. 150,000 – 224,999
4. 225,000 – 349,999
5. 350,000 – 500,000
6. over 500,000

Thailand
(Baht per month before tax)
1. less than 5,000
2. 5,000 – 8,999
3. 9,000 – 13,999
4. 14,000 – 19,999
5. 20,000 – 30,000
6. over 30,000

Other:__________________

Q25 Which occupation group are you in?
(Please tick the box below which best describes your current occupation or employment status)

1. Retired
2. Unemployed
3. Student
4. Homemaker
5. Agriculture, Forestry and Fishing workers
6. Tradespeople, Production and Transport workers, Labourers (e.g. taxi driver, fabric workers)
7. Service workers (e.g. restaurant)
8. Sales workers
9. Administration and Clerical workers (e.g. accountant, secretary)
10. Managerial workers
11. Professional and Technical workers (e.g. teacher, lawyer, doctor)

Thank you very much for taking the time to answer these questions. Please put the questionnaire in the prepaid envelope provided and return it when you have finished your trip. If you leave New Zealand, post the envelope at the airport. Don't forget, if you would like to enter our draw, to fill in your details on the entry form and post it together with this survey.
Questionnaires

Accommodation and Attraction/Activity operator survey
Dear Sir or Madam:

Thank you for agreeing to participate in the energy survey undertaken by Lincoln University and Landcare Research.

Resource use is an important issue in New Zealand’s movement towards sustainable business practices. In this part of the project our focus is on energy use in the tourism sector.

Tourism in New Zealand is predicted to continue to increase and to play a major part in our economy. We need to gain some knowledge of current energy use patterns to inform the industry and decision-makers about where we are at, and what potential there is for better energy management in the future. This knowledge is vital for New Zealand to comply with its international obligations resulting from the Kyoto Protocol on climate protection.

To build a reliable model of the tourism sector we need to calculate how much energy is used by different types of tourists in their transport, accommodation, activities and attractions choices. Our goal is to estimate energy use per visitor. For that purpose we need information on your visitor numbers and their energy consumption.

In anticipation of you being able to help with our research, I have enclosed a survey sheet and an envelope, and I would be very grateful if you would complete it for your business and return it to Lincoln University. We appreciate that this survey is time consuming. Your time and information will be going towards improvements in the industry, our energy resources, the environment and New Zealand’s image as a “clean and green” place to visit.

We are aware of commercial sensitivities in the competitive market place. Please be assured that individual data will only be accessible to the research team; and that only sub-sector (e.g. rafting, scenic boat cruises) analysis will be brought forward into the final model. In this way no individual business will be able to be identified. As is our common practice raw data will be kept under secure file at Lincoln University.

If you have any queries or problems regarding the survey, please contact either of the undersigned.
Yours Sincerely,

Susanne Becken
Researcher (PhD student)
Lincoln University
Phone: 03-325 3820
Fax: 03-325 3857
Email: beckens@lincoln.ac.nz

David Simmons (PhD)
Professor of Tourism
Department of Human Science
PO Box 84, Lincoln University
dsimmons@lincoln.ac.nz
INFORMATION ON THE BUSINESS
Ideally, the following information should cover the last financial year. However, if this is not convenient, please supply as much information as you can, stating the dates that the bills relate to.

Operating Time and Total number of visitor-nights

Q: Did the business operate for the whole financial year?
   Yes   No   if no: what was your operating period?

Q: What is the total capacity of the business?
Number of beds/sites (a double bed counts as two beds):
_________________ Number of bedrooms: ____________________

Q: What was the total number of visitor-nights from 01 April 99 – 31 March 00?
(Note: one visitor-night = one guest for one night. If you had two guests staying for three nights, you would have (2 x 3) = 6 visitor-nights). Please write the total below, and any necessary comments:
TOTAL NUMBER OF VISITOR-NIGHTS =

Total business area and amenities of your property

Q: What is the total business area (floor space) of your property?
Please include all buildings used for accommodation, restaurants and maintenance etc. If there are two or more floors please include the total floor space for each level. Please write the total in square metres:
Total business floor area of buildings =

Q: Please tick the box for the following amenities that belong to the business:

<table>
<thead>
<tr>
<th>Restaurant</th>
<th>Bar</th>
<th>Lounge</th>
<th>Swimming Pool</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spa</td>
<td>Sauna</td>
<td>Laundry</td>
<td>Other (specify)</td>
</tr>
</tbody>
</table>

Energy Used by the Business

Commercial use means use for business excluding private consumption.

Electricity

Please refer to the electricity bills for the period 01 April 99 – 31 March 2000 for actual units consumed in kilowatt hours (kWh).

Q: Total commercial units used in 99/2000: ____________________ kWh
(You could use this table to help calculate the total yearly consumption for electricity. You could also just copy the power bills and attach them to the survey)

<table>
<thead>
<tr>
<th>Month</th>
<th>kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apr</td>
<td></td>
</tr>
<tr>
<td>May</td>
<td></td>
</tr>
<tr>
<td>June</td>
<td></td>
</tr>
<tr>
<td>July</td>
<td></td>
</tr>
<tr>
<td>Aug</td>
<td></td>
</tr>
<tr>
<td>Sep</td>
<td></td>
</tr>
<tr>
<td>Oct</td>
<td></td>
</tr>
<tr>
<td>Nov</td>
<td></td>
</tr>
<tr>
<td>Dec</td>
<td></td>
</tr>
<tr>
<td>Jan</td>
<td></td>
</tr>
<tr>
<td>Feb</td>
<td></td>
</tr>
<tr>
<td>Mar</td>
<td></td>
</tr>
</tbody>
</table>
Appendix A

Gas

Q. Does the business use Natural Gas LPG any other (please specify)

Q. Total commercial units used in 99/00: ____________________________ kg

Wood

Q. Units of measurement (please specify m³, 3m³, cords or other):

Q. Total commercial units used in 99/00: ____________________________ (m³, 3m³, cords etc)

Fuel for generators and other machinery used in the business

This includes fuel for generators and other machinery used directly for running the business. Please refer to business records, for the period 01 April 99 – 31 March 2000 for actual units consumed, measured in litres (l).

Q. Diesel: Total commercial units used in 99/00: ____________________________ l

Q. Other fuel..............: Total commercial units used in 99/00: ____________________________ l

Coal

Please refer to business records, for the period 01 April 99 – 31 March 2000 for actual units consumed, usually measured in kilograms (kg).

Q. Total commercial units used in 99/00: ____________________________ kg

Other fuels and sources of energy

Q. Does the business use other fuels and sources of energy not covered by this survey?

If so, please record this with an estimate of how much the business used in the operating period.

Business vehicles

Q. How many vehicles does the business operate for business purposes other than guests recreational activities and how many kilometres did these vehicles travel in the operating period for the business?

THESE INCLUDE VEHICLES FOR TRANSPORTING GUESTS TO AND FROM THE ACCOMMODATION, AND OTHER BUSINESS RELATED ACTIVITIES SUCH AS SHOPPING FOR SUPPLIES ETC.

<table>
<thead>
<tr>
<th>Vehicle type</th>
<th>Fuel (Regular gasoline, diesel etc.)</th>
<th>Number of business kilometres in 99/2000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This is the end of the survey. Thank you very much for the time you have taken to complete this, we realize that it is a considerable task.

Many thanks!
Appendix A

Survey on energy consumption in the tourism sector

Which of the following best describes your tourist activity?

| O Air Sports, O Bungy jumping, O Caving, O Cycling, O Fishing, O Heli skiing, O Horse riding, |
| O Guided Tramp, O Jet boating, O Mountain/Rock climbing, O Nature Tours, O Rafting, O Sailing, O Scenic Boat Trips, O Scenic Flights, O Water Sports, O Whale watching, O other |

Ideally, the following information should cover the last financial year. However, if this is not convenient, please supply as much information as you can, stating the dates that the bills relate to.

1. How many different types of attraction or trips did you offer in 1999/2000 and what were they? (please describe briefly and/or attach a brochure)

2. How many clients did you have in 1999/2000? How many took part in each different trip?
   TOTAL: 
   Trips 
   (%):

3. Do you have electricity bills associated with the running of your business (e.g. heating, running the office, appliances)? If so, could you please calculate the amount of electricity used in 99/2000, measured in units of kWh?

4. Besides electricity, do you use any gas, wood or coal for running your business (for example for heating or hot water)? If so, how much was it in 1999/2000?
   O LPG (in kg) 
   O Natural Gas (m³) 
   O Other Gas 
   O Wood: measured in O m³ O cordes O kg 
   O Coal (kg) 

5. Do you use any for running your business or activities? If so, please tick the appropriate circle and indicate in litres how much you used in 99/2000.
   O Petrol 
   O Diesel 
   O Aviation Fuel 
   O Kerosene 
   O Any other (please specify) 

6. Is any of this fuel used to transport tourists to the activity as part of a package (e.g. shuttle bus to jetty or airport)? If so, how much fuel is used for this kind of extra transport?

7. Notes for extra information.

Thank you very much!
Survey on energy consumption in the tourism sector

Which of the following best describes your tourist attraction:

| O Bar, O Botanical Gardens, O Casino, O Cinema, O Experience Centre, O Golf, O Geothermal Attraction, O Historic Site, O Museum or Art Gallery, O Theatre or Concert, O Maori Cultural Performance, O Shopping O Winery, O Zoo, O other |

Ideally, the following information should cover the last financial year. However, if this is not convenient, please supply as much information as you can, stating the dates that the bills relate to.

1. How many guests/clients did you have in the last year 1999/2000? If you have no records, please estimate a daily, monthly or annual average.

2. What sources of energy do you use for running the attraction? What is the energy used for?

3. Do you have electricity bills associated with the running of your business (e.g. heating, running the office, appliances)? If so, could you please calculate the amount of electricity used in 99/2000, measured in units of kWh?

4. Besides electricity, do you use any gas, wood or coal for running your business (for example for heating or hot water)? If so, how much was it in 1999/2000?

   O LPG (in kg) ____________________________________________
   O Natural Gas (m³) ________________________________________
   O Other Gas _____________________________________________
   O Wood: in m³ O cordes O kg _______________________________
   O Coal (kg) ____________________________________________

5. Is there any petroleum fuel used for the running of your business? If so, what kinds of fuel are these and how much (in litres) was it in the last financial year?

6. Are there any other issues that could be of interest for us with regard to your consumption of energy?

Thank you very much!
APPENDIX B:

Additional information on the calculations of energy intensities in Chapter 3
Transport

Private cars:
Total energy use/vkm = (34.5 MJ/L * 0.093 L/km * 0.937) + (38.1 MJ/L * 0.066 L/km * 0.062) + (50.0 MJ/kg * 0.077 kg/km * 0.0)
Total energy use/vkm = 3.16 MJ/vkm

Rental cars:
Total energy use/vkm = (34.5 MJ/L * 0.067 L/km * 0.886) + (38.1 MJ/L * 0.066 L/km * 0.112)
Total energy use/vkm = 2.33 MJ/vkm

Coaches:
Total energy use/vkm = (34.5 MJ/L * 0.479 L/km * 0.083) + (38.1 MJ/L * 0.623 L/km * 0.917)
Total energy use/vkm = 23.1 MJ/vkm

Camper vans:
Total energy use/vkm = (34.5 MJ/L * 0.134 L/km * 0.2) + (38.1 MJ/L * 0.118 L/km * 0.8)
Total energy use/vkm = 2.33 MJ/vkm

Shuttle bus and van:
Total energy use/vkm = (34.5 MJ/L * 0.097 L/km * 0.588) + (38.1 MJ/L * 0.079 L/km * 0.412)
Total energy use/vkm = 3.21 MJ/vkm

Attractions/Activities

Energy use associated with walking tracks

The calculation of energy use per visitor on a walking track is based on data obtained in personal communication with the Department of Conservation in Hamilton, Christchurch and Ohakune.

Appendix B:1: Energy use for building and maintaining walking tracks in different geographical regions

<table>
<thead>
<tr>
<th>Name activity</th>
<th>Tourists</th>
<th>Total energy use (MJ)</th>
<th>Energy use per tourist (MJ)</th>
<th>Petrol (total) (MJ)</th>
<th>Road petrol (MJ)</th>
<th>Diesel (total) (MJ)</th>
<th>Road diesel (MJ)</th>
<th>Aviation fuel (MJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kauaeranga</td>
<td>174106</td>
<td>344650</td>
<td>1.98</td>
<td>0</td>
<td>242880</td>
<td>60960</td>
<td>40810</td>
<td></td>
</tr>
<tr>
<td>Coromandel</td>
<td>100000</td>
<td>16043</td>
<td>0.16</td>
<td>0</td>
<td>17250</td>
<td>17250</td>
<td>81001</td>
<td></td>
</tr>
<tr>
<td>Christchurch</td>
<td>45000</td>
<td>341571</td>
<td>7.59</td>
<td>21060</td>
<td>32051</td>
<td>0</td>
<td>247650</td>
<td></td>
</tr>
<tr>
<td>Ohakune</td>
<td>32535</td>
<td>98251</td>
<td>3.02</td>
<td>0</td>
<td>16043</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

An average energy use per tourist (walker) of 3 MJ could be estimated.
Propotion of guided (organised) and privately undertaken activities

The following questionnaire was posted (or faxed) to experts who were asked to provide an estimate for the proportion of guided tours in their geographical area of expertise.

Commercial tours and self-organised activities

This is part of a research project on energy consumption in the tourism sector undertaken jointly by Lincoln University and Landcare Research New Zealand Ltd. The activity/attraction sector forms an important part of the tourism product and is assumed to be relevant in terms of total energy use of tourists. The energy use for a specific activity, however, depends upon the organisational style of the activity, namely whether it is part of a commercial package (organised) or is undertaken privately. To obtain the most accurate figures as possible we are asking an expert panel to estimate the proportion of tourists joining a commercial tour for a specific activity.

Example: If you estimate that 5% of all trampers in New Zealand or in your area of reference are on a guided walk, please note down 5%.

What is the geographic area you are referring to with your estimate?

------------------

Activities

Please note down your estimate of the proportion of visitors on a commercial tour for this activity.

- Walking, Tramping __________________________ %
- Cycling ___________________________________ %
- Off-road mountain biking ____________________ %
- Mountaineering, rock climbing ________________ %
- Viewing wildlife in the natural environment ______ %
- Kayaking, Surfing __________________________ %
- Lake/river fishing __________________________ %

Thank you very much for your participation.

Yours Sincerely,
### Appendix B

**Answers received**

#### Appendix B.2: Estimates by experts referring to a specified geographical area

<table>
<thead>
<tr>
<th>Expert and area of reference</th>
<th>Walking</th>
<th>Cycling</th>
<th>Mountain biking</th>
<th>Mountain/ rock climbing</th>
<th>Wildlife</th>
<th>Kayaking</th>
<th>Lake, river fishing</th>
</tr>
</thead>
<tbody>
<tr>
<td>J. Higham, Otago University, New Zealand</td>
<td>2%</td>
<td>20%</td>
<td>5%</td>
<td>10%</td>
<td>25%</td>
<td>60% kayak, 2%surfing</td>
<td>15%</td>
</tr>
<tr>
<td>K. Booth, Lincoln University, New Zealand</td>
<td>10%</td>
<td>5%</td>
<td>2%</td>
<td>5%</td>
<td>25%(^1)</td>
<td>1%</td>
<td>10%</td>
</tr>
<tr>
<td>DoC, Fiordland Abel Tasman Coastal Track (DoC)</td>
<td>30%</td>
<td>20%</td>
<td>3%</td>
<td>5%</td>
<td>60%</td>
<td>65%</td>
<td>35%</td>
</tr>
<tr>
<td>DoC Nelson/ Marlborough</td>
<td>10%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3%</td>
<td>95%</td>
<td>-</td>
</tr>
<tr>
<td>DoC North Canterbury</td>
<td>3%</td>
<td>-</td>
<td>0.50%</td>
<td>0.10%</td>
<td>3%</td>
<td>0.20%</td>
<td>8%</td>
</tr>
<tr>
<td>DoC, greater Kaikoura area</td>
<td>5%</td>
<td>-</td>
<td>5%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>DoC Waikato Tauranga Visitor Centre (Mt Maunganui, Te Puke, Katikati)</td>
<td>60-70%</td>
<td>10%</td>
<td>5%</td>
<td>5%</td>
<td>90%</td>
<td>40-60%</td>
<td>-</td>
</tr>
<tr>
<td>DoC Coromandel DoC King Country</td>
<td>2%</td>
<td>5%</td>
<td>0%</td>
<td>20%</td>
<td>5%</td>
<td>2%</td>
<td>-</td>
</tr>
<tr>
<td>Doc Aniwaniwa (Lake Waikaremoana)</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>-</td>
<td>0%</td>
</tr>
</tbody>
</table>

\(^1\) Only 7% when whale watching and dolphin activities are excluded

The range of estimates for different activities (and also for different geographical boundaries) with regard to the proportion of organised or guided tours is extremely large. Furthermore, the estimates would need to be weighted, for example the 90% of organised wildlife tours in the Kaikoura area count more than the 2% in King Country, since a large proportion of tourists engage in wildlife activities in Kaikoura. For these reasons, it was decided to uniformly assume that half of all activities are undertaken in an organised form, while the other half is undertaken on an individual and private basis. It is acknowledged that this is a rough estimate, even more so when applied to both international and domestic tourists.
Appendix C:

Four sub-samples used to identify international tourist types
### Appendix C: Four sub-samples used to cluster international tourists based on their travel choices.

<table>
<thead>
<tr>
<th>Tourist type</th>
<th>Sub-sample 1</th>
<th>Sub-sample 2</th>
<th>Sub-sample 3</th>
<th>Sub-sample 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coach</td>
<td>75% domestic air (total 1,116 km), 68% coach (total 1,210 km), 99% hotel</td>
<td>75% domestic air (total 1,116 km), 68% coach (total 1,210 km), 99% hotel</td>
<td>75% domestic air (total 1,124 km), 78% coach (total 1,080 km), 98% hotel</td>
<td>67% domestic air (total 1,155 km), 74% coach (total 1,098 km), 99% hotel</td>
</tr>
<tr>
<td>(N= 364+ 381+ 366+ 307)</td>
<td>Stay: 7 days</td>
<td>Stay: 7 days</td>
<td>Stay: 7 days</td>
<td>Stay: 7 days</td>
</tr>
<tr>
<td>VFR</td>
<td>54% private car (total 1,003 km), 40% domestic air (total 854 km), 96% 'home'</td>
<td>56% private car (total 1,025 km), 38% domestic air (total 902 km), 96% 'home'</td>
<td>59% private car (total 1,018 km), 37% domestic air (total 988 km), 93% 'home'</td>
<td>58% private car (total 1,101 km), 43% domestic air (total 1,025 km), 94% 'home'</td>
</tr>
<tr>
<td>(N= 235+ 275+ 257+ 261)</td>
<td>Stay: 24 days</td>
<td>Stay: 31 days</td>
<td>Stay: 26 days</td>
<td>Stay: 29 days</td>
</tr>
<tr>
<td>Camper</td>
<td>54% camper van (total 2,811 km), 48% rental car (total 1,999 km), 100% camping</td>
<td>73% camper van (total 2,622 km), 28% rental car (total 2,301 km), 99% camping</td>
<td>56% camper van (total 2,711 km), 34% rental car (total 2,124 km), 99% camping</td>
<td>59% camper van (total 2,293 km), 37% rental car (total 2,293 km), 98% camping</td>
</tr>
<tr>
<td>(N= 71+ 75+ 94+ 86)</td>
<td>Stay: 21 days</td>
<td>Stay: 22 days</td>
<td>Stay: 23 days</td>
<td>Stay: 21 days</td>
</tr>
<tr>
<td>Backpacker</td>
<td>53% scheduled bus (total 896 km), 40% rental car (total 2,499 km), 30% backpacker bus (total 2,201 km), 98% backpacker hostel</td>
<td>55% scheduled bus (total 811 km), 35% rental car (total 2,499 km), 26% backpacker bus (total 2,014 km), 99% backpacker hostel</td>
<td>61% scheduled bus (total 958 km), 29% rental car (total 2,164 km), 26% backpacker bus (total 2,481 km), 83% backpacker hostel</td>
<td>48% scheduled bus (total 1,340 km), 37% rental car (total 2,029 km), 29% backpacker bus (total 2,238 km), 94% backpacker hostel</td>
</tr>
<tr>
<td>(N= 125+ 97+ 118+ 104)</td>
<td>Stay: 32 days</td>
<td>Stay: 31 days</td>
<td>Stay: 25 days</td>
<td>Stay: 34 days</td>
</tr>
<tr>
<td>Auto</td>
<td>76% rental car (total 1,680 km), 69% motel, 56% hotel, 28% B&amp;B</td>
<td>82% rental car (total 1,924 km), 68% motel, 58% hotel, 34% B&amp;B</td>
<td>80% rental car (total 1,621 km), 65% motel, 60% hotel, 29% B&amp;B</td>
<td>86% rental car (total 1,595 km), 76% motel, 56% hotel, 6% B&amp;B</td>
</tr>
<tr>
<td>(N= 224+ 221+ 206+ 181)</td>
<td>Stay: 14 days</td>
<td>Stay: 15 days</td>
<td>Stay: 13 days</td>
<td>Stay: 12 days</td>
</tr>
<tr>
<td>Soft comfort traveller</td>
<td>100% train, 46% domestic air</td>
<td>100% cycle</td>
<td>100% motorcycle, 100% B&amp;B, 100% motel, 100% campground</td>
<td>65% rental car, 100% B&amp;B, 51% hotel</td>
</tr>
<tr>
<td>(N= 37+ 3+ 1+ 43)</td>
<td>Stay: 16 days</td>
<td>Stay: 24 days</td>
<td>Stay: 55 days</td>
<td>Stay: 22 days</td>
</tr>
</tbody>
</table>

1) In brackets are the tourist numbers in each sub-sample for the different types. Aggregating the sample is equivalent to adding the numbers of the sub-samples.
APPENDIX D:

Deriving carbon dioxide emission factors
Calculating CO₂ emissions

New Zealand specific conversion factors provided by Baines (1993) were used to first convert consumption measured in units such as kilogram or litres into megajoules and second to convert megajoules into CO₂ emissions (Appendix D:1). The energy content shown in Appendix D:1 is the gross calorific value (see Baines for more detail on gross and net calorific values).

Appendix D:1: Energy content and carbon dioxide emission factors

(Source: Baines, 1993)

<table>
<thead>
<tr>
<th>Fuel type</th>
<th>Energy content</th>
<th>CO₂ emission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petrol</td>
<td>34.5 MJ/l</td>
<td>66.6 g/MJ</td>
</tr>
<tr>
<td>Diesel</td>
<td>38.1 MJ/l</td>
<td>68.7 g/MJ</td>
</tr>
<tr>
<td>Marine Diesel Oil</td>
<td>38.3 MJ/l</td>
<td>68.8 g/MJ</td>
</tr>
<tr>
<td>Aviation fuels</td>
<td>36.9 MJ/l</td>
<td>68.7 g/MJ</td>
</tr>
<tr>
<td>Kerosene</td>
<td>36.8 MJ/l</td>
<td>68.7 g/MJ</td>
</tr>
<tr>
<td>Avgas</td>
<td>37.0 MJ/l</td>
<td>65.9 g/MJ</td>
</tr>
<tr>
<td>Wood</td>
<td>7791 MJ/m³</td>
<td>No net emissions</td>
</tr>
<tr>
<td>LPG</td>
<td>50 MJ/kg</td>
<td>60.4 g/MJ</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>40 MJ/m³ to 46 MJ/m³</td>
<td>56.2 to 52.7 g/MJ (55)</td>
</tr>
<tr>
<td>Coal</td>
<td>25.1 MJ/kg</td>
<td>90.4 g/MJ</td>
</tr>
<tr>
<td>Electricity</td>
<td>3.6 MJ/kWh</td>
<td>42 g/MJ</td>
</tr>
</tbody>
</table>

The conversion factors for different fuel types were directly applied to energy intensities of different transport modes. For accommodation and attraction/activity categories it was first necessary to identify the average ‘fuel mix’ and then apply the conversion factors proportionally to the energy use per visitor-night or visit, respectively. The emission factor for electricity has been derived in Chapter 2 – Methodology.

Appendix D:2: Fuel mix for six accommodation categories

<table>
<thead>
<tr>
<th>Category</th>
<th>Electricity</th>
<th>LPG</th>
<th>Natural Gas</th>
<th>Wood</th>
<th>Coal</th>
<th>Fuel</th>
<th>Energy use per visitor-night (MJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hotel</td>
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</tr>
<tr>
<td>B&amp;B</td>
<td>43%</td>
<td>14%</td>
<td>0%</td>
<td>31%</td>
<td>13%</td>
<td>0%</td>
<td>110</td>
</tr>
<tr>
<td>Motel</td>
<td>94%</td>
<td>6%</td>
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<td>0%</td>
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<td>0%</td>
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</tr>
<tr>
<td>Backpacker</td>
<td>79%</td>
<td>6%</td>
<td>3%</td>
<td>9%</td>
<td>4%</td>
<td>0%</td>
<td>39</td>
</tr>
<tr>
<td>Campground</td>
<td>44%</td>
<td>4%</td>
<td>3%</td>
<td>8%</td>
<td>19%</td>
<td>21%</td>
<td>25</td>
</tr>
<tr>
<td>Home (EECA)</td>
<td>70%</td>
<td>4%</td>
<td>9%</td>
<td>11%</td>
<td>2%</td>
<td>-</td>
<td>41</td>
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### Appendix C:3: Fuel mix for attraction/activity categories

<table>
<thead>
<tr>
<th>Category</th>
<th>Electricity</th>
<th>LPG</th>
<th>Wood</th>
<th>Coal</th>
<th>Petrol</th>
<th>Diesel</th>
<th>Aviation fuel</th>
<th>Natural gas</th>
<th>Energy use per visit (MJ)</th>
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</thead>
<tbody>
<tr>
<td>Building</td>
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<td>0%</td>
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<td>0%</td>
<td>39%</td>
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<tr>
<td>Park</td>
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<td>4%</td>
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<td>0%</td>
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<td>Amusement</td>
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<td>2%</td>
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<tr>
<td>Nature attraction</td>
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<td>0%</td>
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<td>0%</td>
<td>0%</td>
<td>8.5</td>
</tr>
<tr>
<td>Performance</td>
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<td>0%</td>
<td>0%</td>
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<td>0%</td>
<td>4%</td>
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<tr>
<td>Other entertainment</td>
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<td>0%</td>
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<td>26.5</td>
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## List of publications based on research undertaken for the PhD

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<thead>
<tr>
<th>Publication</th>
<th>Excerpt or modified from ...</th>
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<tbody>
<tr>
<td>Beckens, S., Frampton, C. &amp; Simmons, D. (2002). Identifying tourist types to promote energy efficiency – a travel-pattern based segmentation analysis. Accepted at <em>Journal of Travel Research</em> (depending on minor revisions).</td>
<td>Chapter 4 – West Coast pilot study</td>
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