

Tourism and Transport in New Zealand

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Tourism and Transport in New Zealand – Implications for Energy use



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Contents

Contents.....	i
List of Tables.....	iii
List of Figures	iii
Equation	iii
Chapter 1 Introduction.....	1
Chapter 2 Transport in Tourism Studies.....	3
Chapter 3 Energy Use of the New Zealand Transport Sector	5
Chapter 4 Supply of Transportation – A Tourism Perspective	7
Chapter 5 Energy Intensities of Transport Modes.....	9
5.1 Road Transport.....	9
5.2 Rail, Sea and Air Transport.....	12
5.3 Comparison Between Alternative Modes.....	12
Chapter 6 Options to Reduce Energy Use and Emissions.....	15
6.1 Efficient Use of Vehicles.....	15
6.2 Modal Shift.....	16
6.3 Regional Promotion.....	17
6.4 Economic Mechanisms.....	18
6.5 Alternative Technologies.....	19
Chapter 7 Conclusion	21
References.....	23

List of Tables

Table 1	Average fuel consumption per 100 km (MoT, 1995).....	10
Table 2	Energy consumption for different vehicle types in New Zealand.....	13
Table 3	Comparison of different transport modes for a trip from Christchurch to Dunedin ..	14

List of Figures

Figure 1	Routemap of the Travel Pass New Zealand (InterCity Coachlines, 2001)	8
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Equation

Equation 1	Energy intensity of a specific transport mode	9
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Chapter 1

Introduction

Securing and conserving our long term future is the number one objective of the recently released New Zealand Tourism Strategy (2001). Previous research showed that an essential 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 in 1997. This report 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. Clearly, to achieve the stakes set by both the Tourism (Tourism Strategy Group, 2001) and the Energy Strategy (Energy Efficiency and Conservation Authority [EECA], 2001), transport of tourists plays a critical role.

Chapter 2

Transport in Tourism Studies

Transport has long been part of tourism studies. In a tourism system approach, for example, transportation connects tourist generating and destination regions via transit routes (Leiper, 1990). 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 transport 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.

Chapter 3

Energy Use of the New Zealand Transport Sector

Transport is the dominant sector in terms of energy consumption in New Zealand, accounting for 40.1 per cent of the total energy use (442.3 PJ) in 2000 (Ministry of Economic Development, 2001). Total CO₂ emissions from fuel combustion were 27 million tonnes in 1999, with transport making up 43.2 per cent 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 (ibid). Most of this imported oil (about 90%) is used by transportation.

The energy use of the transport sector is increasing at an annual rate of 3.8 per cent and is expected to make up about 52 per cent of the total consumer energy by 2020 (EECA, 1999a). These figures include passenger and freight transport, whereby passenger transport accounts for 65 per cent of all transport energy use. Passenger transport breaks down into a share of 89 per cent (99 PJ) for cars, 7.4 per cent for domestic air travel (8 PJ), 2.9 per cent for buses (2.1 PJ), and 0.3 per cent 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 Tourism Satellite Account (TSA) 1997 reports tourism industry ratios, which give the proportion of industry's gross output that is consumed by both domestic and international tourists (Statistics New Zealand, 2001). From these ratios, it can be seen that tourism contributes considerably to the transport industries. Tourists consume 23 per cent of the products supplied by the (aggregated) 'Road passenger and Rail Transport' industry, 17 per cent of the 'Water Transport' industry, and 81 per cent 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 per cent within the 'Other Transport, Storage and Transport Services' industry (Statistics New Zealand, 2001). According to the TSAs 1998-2000, 45 per cent of all tourist expenditures (international and domestic) are on transport, with air transport making up 23 per cent of total expenditures, other transport 12 per cent, and retail of fuel and automobile products 10 per cent (ibid).

Chapter 4

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 per cent in 2000, accompanied by an increase in total domestic seat capacity of 4.7 per cent. The load factor (average passenger occupancy) increased to 67 per cent, 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 per cent are State Highways, 27.0 per cent are urban and the remaining 54.4 per cent 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 per cent of all international tourists (Tourism New Zealand, 2001). 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 among 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 per cent of all international visitors

(Tourism New Zealand, 2001). 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 1.). 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 1), 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 1: Routemap of the Travel Pass New Zealand (InterCity Coachlines, 2001)



Chapter 5

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 differences of more than 20 per cent (Lenzen, 1999). The energy figures used in this study are mainly derived from reports of the New Zealand Ministry of Transport (1995, 1997) and EECA (1999b) and are therefore reported as consumer energy. 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 km (MJ/km) or per passenger km (MJ/pkm) depending on the availability of passenger load factors. Another parameter is energy use per available seat km, 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 measure in megajoules per kilometre (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).

Equation 1: Energy intensity of a specific transport mode

$\text{Energy use/km} = \sum \text{GCV (MJ/L)} * \text{fuel consumption L/km} * \text{proportion of vehicle type}$
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5.1 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 (Figure 1). 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 1: Average fuel consumption per 100 km (MoT, 1995)

	Car - Petrol	Car Ex-Overseas – Petrol	Taxis – Petrol	Car Rental – Petrol	Car - Diesel	Bus - Petrol	Bus - Diesel	Motorcycle	Car – CNG	Car - LPG
Fuel consumption rate ¹	9.2L	9.5L	9.0L	6.7L	6.6L	47.9L	62.3L	3.5L	8.2kg	7.7kg

1. L: L/100 km; Kg: kg/ 100km

5.1.1 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 per cent 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 1).

According to the MfE (2000), the New Zealand car fleet consisted in 1999 of 93.7 per cent petrol and 6.2 per cent diesel cars. The alternative fuel sources CNG, LPG and electricity contributed less than 1 per cent, 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 per cent 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 that 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.

5.1.2 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 L/100km and for petrol vans 13.4 L/100km. 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/km including fuel, and 4.54 MJ/km including fuel and oil. No previous research on the energy use of camper vans could be found to verify these figures.

5.1.3 Coaches (tour buses and scheduled buses)

The coaches category 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 1), 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 loading 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).

5.1.4 Motorcycles

Motorcycles use 3.5 litres of petrol per 100 km (Table 1). This is consistent with information obtained from Christchurch companies stating a consumption of 4.5 litres per 100 km petrol and one litre of oil per 5000 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/km. This compares to 1.88 MJ/km primary energy use for motorcycle in Great Britain (Waters, 1992).

5.1.5 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 carrying a maximum of 12 passengers, including the driver. The fuel consumption was presumed to be that of light goods vehicles of 9.7 L/100 km for petrol vehicles and 7.9 L/100 km for diesel vans (MoT, 1997). The total fleet of light commercial vehicles consisted in 1998 of 58.8 per cent petrol and 41.2 per cent diesel vehicles (MoT, 1998). Therefore, an average shuttle or van consumes 3.21 MJ/km. Assuming the same oil consumption as for cars, the total energy use is 3.22 MJ/km.

5.1.6 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 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/km an average energy use of 1.03 MJ/km for hitchhikers was calculated.

5.2 Rail, Sea and Air Transport

5.2.1 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/pkm in 1998 (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.

5.2.2 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).

5.2.3 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 now reported to be 2.75 MJ/pkm (EECA, 1999b).

5.3 Comparison Between Alternative Modes

A direct comparison of the different transport modes' energy intensity was made based on per passenger energy use (Table 2). This was calculated by using average load factors gained in a tourist survey on New Zealand's South Island (West Coast). A more detailed description of the survey is provided elsewhere (Becken, Simmons & Frampton, 2001). 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. 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.

Table 2: Energy consumption for different vehicle types in New Zealand

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

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 hypothetical journey from Christchurch to Dunedin was analysed to compare transport alternatives with regard to convenience, cost, and energy use (Table 3). 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 numerous 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 demonstrates that 92 per cent ($F=45.6$, $p= 0.003$) 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.

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.

Table 3 Comparison of different transport modes for a trip from Christchurch to Dunedin

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

1) South Island Connections

2) Air New Zealand one-way fare

3) Fare for a small rental car for one day

Chapter 6

Options to Reduce Energy Use and Emissions

6.1 Efficient Use of Vehicles

The most efficient use of an independent vehicle is the one that is adapted to the 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. Customer 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 staff/students at 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 per cent (Van den Brink & Van Wee, 2001). The use of air-conditioning increases the fuel bill by 10 to 15 per cent, and an extra load of 100 kg increases the fuel consumption by another 7 to 8 per cent (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 of about 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 price for car usage and constitute an incentive for travelling less.

Time efficiency is not the major issue in travel (Høyer, 2000), and it could be assumed that slow means of transport that often stops on the way could be made more popular. Often, the tourist does not gain anything 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 and 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 very slow pace, strongly motivated by exploring the area in more detail and experiencing nature and scenery (Ritchie, 1998). In fact, cycle tourists spend 75 per cent 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).

6.2 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 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.

6.2.1 Public Transport

Public transport is often rejected for 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) provide adequate information on the systems.

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).

6.2.2 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 per cent 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 per cent 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).

6.3 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, Tourism New Zealand suggest on their web-page "100 per cent Pure New Zealand" travelling only one island, when being in New Zealand for a limited time (2000). Moreover, this site offers a regional descriptions 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.

6.4 Economic Mechanisms

Economic mechanisms to manage fuel consumption have been described as a 'carrots and sticks' analogy (Holding, 2001). Incentives for sound travel alternatives ('carrots') are often favoured by the public and politicians, but alone are considered insufficient, while 'sticks', being more efficient at changing behaviour, are unpopular and generally opposed by the public. A possible 'stick' is full cost pricing, that would include costs already charged for the use (e.g. insurance), plus 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 more environmentally 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 (Ministry for the Environment, 1997 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).

6.5 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 pollutions, 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 (Environmental Protection Agency [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 (approx 36%) of electricity generation (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 produce water as a by-product. This is a highly efficient mean to store and generate power, compared with traditional combustion engines. Hydrogen is considered a long-term option 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 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 per cent (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 per cent. 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 up to 85% petrol) achieves reductions of about 40 per cent. 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 (1999) 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). In New Zealand the trend toward 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.

Chapter 7

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 of technological progress and an increase in disposable incomes. While high mobility in itself is the main driver underpinning 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 kilometre 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. Energy intensity is strongly dependent on vehicle occupancy. A fully occupied car is competitive with public transport, while offering additional convenience with regards to availability, transfer, and luggage.

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 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 less distance and use alternative means of transport are conceivable, as are 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. Tourism New Zealand (2001) 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).

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