Final Report

Review of Policy Instruments to Reduce Greenhouse Gas Emissions in the Transport Sector: Improving Fuel Economy of the Fleet

Prepared for

Ministry for the Environment

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Background
This report reviews a selection of policy options that can be used to reduce greenhouse gas emissions from vehicles. It focuses on instruments that affect the average fuel economy of the transport fleet, particularly through changes to purchase and vehicle retirement decisions. It is not a comprehensive policy review as there are other exercises that will examine, or have examined, other instruments. Explicitly, this review does not examine:

- road pricing;
- fuel consumption standards and vehicle labelling; and
- fuel price measures, including fuel taxes, carbon taxes and tradable permits.

Vehicle Fleet
The transport sector is a very significant source of greenhouse gas emissions in New Zealand, accounting for close to 19% of the total. Of the emissions from transport, 88% are from road transport. Transport greenhouse gas emissions are dominated by carbon dioxide (CO_2) resulting from fuel combustion. Emission reductions are achieved through reduced fuel consumption.

There are a number of characteristics of the vehicle fleet and the way it changes over time that affect the average fuel economy. Second hand imports are the largest source of new vehicle registrations in New Zealand. In 2004 petrol cars were first registered at 5.1 years old on average, and diesel vehicles at 7.8 years. Because, for any individual class of vehicle, fuel economy has improved over time, introducing second-hand as opposed to new vehicles leads to a lower average fuel economy of the fleet.

In addition, the current fleet is increasing in average engine size over time. The average engine size of new registrations is increasing and, amongst smaller vehicles, de-registrations are greater than new registrations.

Policy Options
A number of policy options have been introduced in other countries that aim to change the average fuel economy of the fleet through changing vehicle purchase decisions and/or de-registrations.

Early Retirement Incentives
Early retirement incentives that encourage vehicles to be scrapped early may remove the least efficient vehicles from the market but this is only bringing forward in time what would happen anyway. The emission savings may be short lived and may be overtaken by increases in future emissions as early retirement leads to early introduction of a new (or imported second hand) vehicle whereas delay would have meant the introduction of a vehicle that was more fuel efficient, because of ongoing improvements in vehicle technology.

Early retirement measures will be more effective if they permanently reduce the age at which vehicles are retired rather than having small marginal effects on individual vehicles. This might be more likely through changes in vehicle price such that the costs of replacement vehicles were reduced.

Differentiated Registration Fees
Differentiated registration fees are fees on first acquisition, or regular annual fees, that differ with the fuel economy (or CO_2 intensity) of the vehicle. The impacts of these schemes are uncertain because of the dynamic effects on the vehicle market.

Fees on first acquisition (whether NZ-new or second hand imports) increase the relative price of fuel-inefficient vehicles and will lead to substitution by more fuel-efficient vehicles. However, they can also lead to substitution by second hand vehicles already on the market. This results in an increased market value for second hand fuel-inefficient vehicles and extends their lives; for the market as a whole, life extension is an alternative to adding a vehicle to the fleet.

Annual registration fees can change vehicle import decisions, although often purchasers take limited account of full lifetime costs. Because the vehicle stock that is already in the country is set to some extent, underlying vehicle prices would be expected to change to compensate for the introduction of the differentiated annual fees, with the value of fuel inefficient vehicles falling. This will also result in earlier retirement of these vehicles.

Empirical evidence suggests that registration fees have limited effectiveness. Research in the US and the EU notes that the overwhelming majority of efficiency improvements are associated with vehicle manufacturers improving the average fuel efficiency of the vehicles on the market, as opposed to customers choosing the more fuel efficient vehicle within the overall market. In observing these conclusions, it is noted that it is difficult to separate out the effects of individual policy measures, and differentiated fees have been introduced at the same time as other instruments, including fuel price measures. However, there is no clear evidence that, within this policy mix, differentiated registration fees have had any significant impact, and the researchers suggest that they have not. Because New Zealand has very little vehicle manufacturing industry (and none for passenger cars), it is limited to achieving the more limited effects relating to customer choice. The international experience suggests that these will be small.

Feebates
Feebates are a variant on the differentiated registration fee that include both a fee, for fuel-inefficient vehicles, and a rebate (or subsidy) for fuel-efficient vehicles. Depending on how they are designed, the fee differential between efficient and inefficient vehicles can be greater than under a simple fee programme.

The limitations of registration fees apply to feebates also. However, an additional concern is that, because of the subsidy component, vehicle purchase prices (albeit for fuel-efficient purchases) are reduced whereas prices of other potentially efficient transport choices are not. Thus, in addition to shifts in vehicle purchase, there may also be shifts from public transport to vehicle purchase and use.

Company Tax Measures
Company tax measures include those that alter the treatment of different types of vehicle under fringe benefit tax and varied rates of depreciation. Because many new vehicles are purchased by companies, these measures could be expected to have some effects.

Fuel and Technology Switching
Direct encouragement of specific technologies such as via subsidies has been used before in New Zealand to encourage uptake of LPG and CNG vehicles. It is also employed in other countries, such as Australia, particularly for heavy vehicles. There is likely to be potential for some large reductions from targeted improvements. However, they may not be the most cost-effective options for limiting emissions; these would be expected to be discovered more widely using fuel pricing measures.

Insurance Measures
Insurance measures, such as Pay as You Drive insurance has been encouraged in a number of countries. These provide additional incentive at the margin, over and above the costs of fuel, for reduce transport activity. Pay as You Drive insurance could be encouraged through direct dialogue with the insurance industry.

Most Promising Measures
The analysis of options has been limited to those measures that aim to encourage shifts in purchase and de-registration decisions. The analysis suggests limited scope for significant reductions in CO_2 emissions from introducing these measures.

Company tax measures would be likely to lead to changes in vehicle purchase decisions and show some potential for small reductions in total emissions.

Of the measures that aim to change purchase decisions more widely, the differentiated annual registration fee is likely to hold most promise. The empirical evidence for significant reductions in emissions is not strong and it is limited by the potentially limited extent to which purchasers take account of future costs of vehicle ownership. However, the effect may be greater in New Zealand than in other countries because of the second hand import market. First entrant vehicles are purchased by a wider cross-section of socio-economic groups, including purchasers that will be price elastic across the range of vehicle types.

1. Introduction

1.1. Objectives of the Review

This report reviews a selection of policy options that can be used to reduce greenhouse gas emissions from transport. It focuses on instruments that affect the average fuel economy of the transport fleet, particularly through changes to purchase and vehicle retirement decisions. It is not a comprehensive policy review as there are other exercises that will examine, or have examined, other instruments. Explicitly, this review does not examine:

- road pricing;
- fuel consumption standards and vehicle labelling; and
- fuel price measures.

The review identifies options that might be suitable for implementation in New Zealand on the basis of New Zealand and international literature; it assesses the likely costs and effectiveness of the different measures and discusses practical implementation issues.

1.2. Transport Emissions

In 2003, greenhouse gas emissions from the transport sector made up approximately 40% of national CO_2 emissions and 19% of aggregate greenhouse gas emissions on a CO_2-equivalent basis (Table 1).[1] Transport sector emissions are dominated (99%) by CO_2, with small proportions of methane (CH_4) and nitrous oxide (N_2O).

Table 1 Greenhouse Gas Emissions from Transport

	Transport emissions (tonnes)	Transport emissions (tonnes CO_2-equiv)	National emissions (tonnes CO_2-equiv)	Transport as % of gas	Transport as % of total GHGs
CO_2	13,788,130	13,788	34700	39.7%	18.3%
CH_4	2,478	52	26645	0.2%	0.1%
N_2O	470	146	13500	1.1%	0.2%
Other			501		
Total		13,986	75,345		18.6%

Source: Ministry for the Environment (2005) New Zealand's Greenhouse Gas Inventory 1990-2003

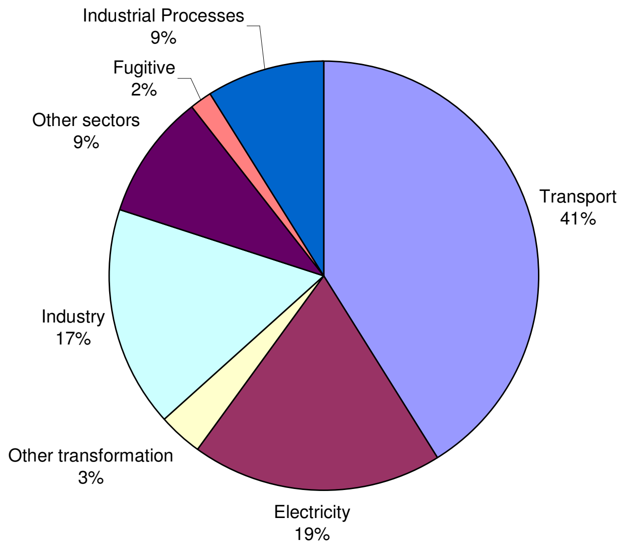
Figure 1 shows the sectoral contribution to total CO_2 emissions in 2003.[2] Figure 2 shows the ways in which these sectoral contributions have changed over time since 1990. Transport is a very significant proportion of the total CO_2 emissions and the second fastest growing sector, behind electricity generation. Electricity sector emissions growth

[1] This is taken as the aggregate of greenhouse gas emissions with a global warming potential and included in Annex A of the Kyoto Protocol. The total excludes land use, land use change and forestry (LULUCF) emissions.

[2] This is on the basis of MED's energy emissions inventory. It estimates higher transport CO_2 emissions and a higher percentage contribution of transport emissions to total emissions.

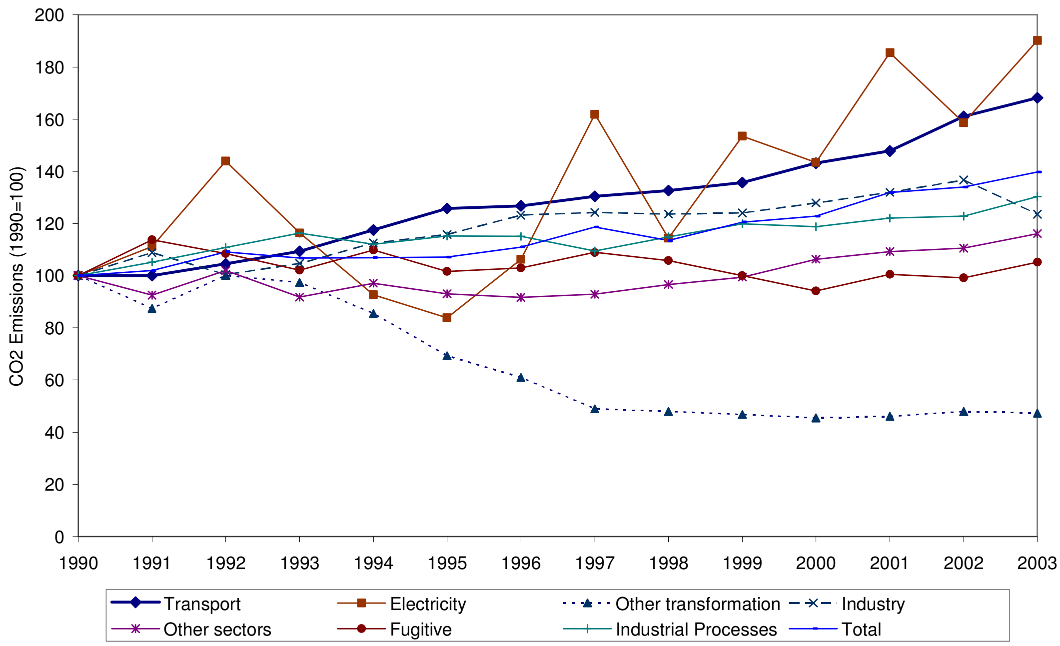
reflects the shift towards greater percentage contribution of fossil fuel generation as demand for electricity grows in New Zealand.

Figure 1 Sectoral Contribution to Total CO_2 Emissions



Source: Ministry of Economic Development (2004) New Zealand Energy Greenhouse Gas Emissions 1990-2003

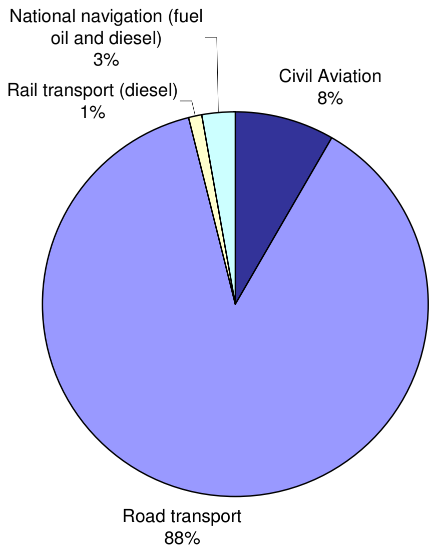
Figure 2 Emissions Growth by Sector



Source: Ministry of Economic Development (2004) New Zealand Energy Greenhouse Gas Emissions 1990-2003

Within the transport sector, emissions are dominated by road transport (88%) (Figure 3), with smaller emissions from aviation and marine (national navigation) transport. This review is limited to considering road transport emissions.

Figure 3 Sources of Transport Sector Emissions



Source: Ministry for the Environment (2005) New Zealand's Greenhouse Gas Inventory 1990-2003

1.3. Structure of Report

The next section sets out information about the vehicle fleet which is used as an input to the analysis of measures. A range of policy options is set out and assessed in Section 3.

2. The Vehicle Fleet

Greenhouse gas emissions from the transport sector are dominated by CO_2 emissions from combustion of road transport fuels. CO_2 emissions are directly proportional to fuel use and thus emission reductions require a reduction in total fuel combustion. Reducing fuel use can occur as a result of changes to:

- the structure of the fleet to reduce its fuel intensity;
- the use of the fleet, eg by reducing total transport activity or shifting activity to more fuel-efficient vehicles.

To provide a structure to the identification of options, we have divided up the decisions that will lead to these changes into three categories:

- entry to the fleet—ensuring vehicles entering the fleet are fuel efficient;
- use of the fleet—ensuring fuel inefficient vehicles are used less;
- exit from the fleet—ensuring that the least efficient vehicles exit the fleet.

In very broad terms, the current fleet includes approximately 3 million vehicles. Approximately 9% are added to the fleet each year and 5% are retired.

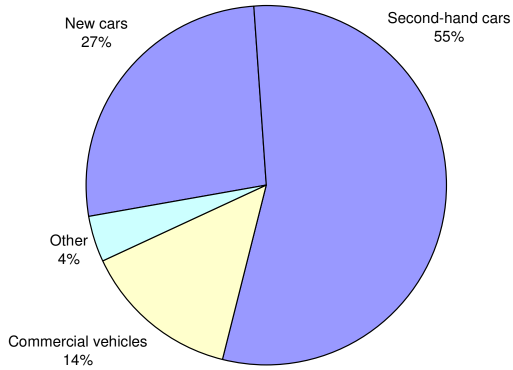
A number of commentators have noted the risk of the rebound effect[3] – as fuel economy improves, people may use their vehicles more because of the reduced costs. This will take away some of the gains but some will be expected to be retained.

2.1. Fleet Entry

In New Zealand, cars enter the fleet as new vehicles and as second-hand imports. In 2004, 280,000 vehicles entered the fleet, 82% of which were cars. Of the cars, 67% (55% of total vehicles) were imported second-hand.

[3] OECD (2001) Good Practice Greenhouse Abatement Policies: Transport. OECD Environment Directorate and International Energy Agency. COM/ENV/EPOC/IEA/SLT(2001)6

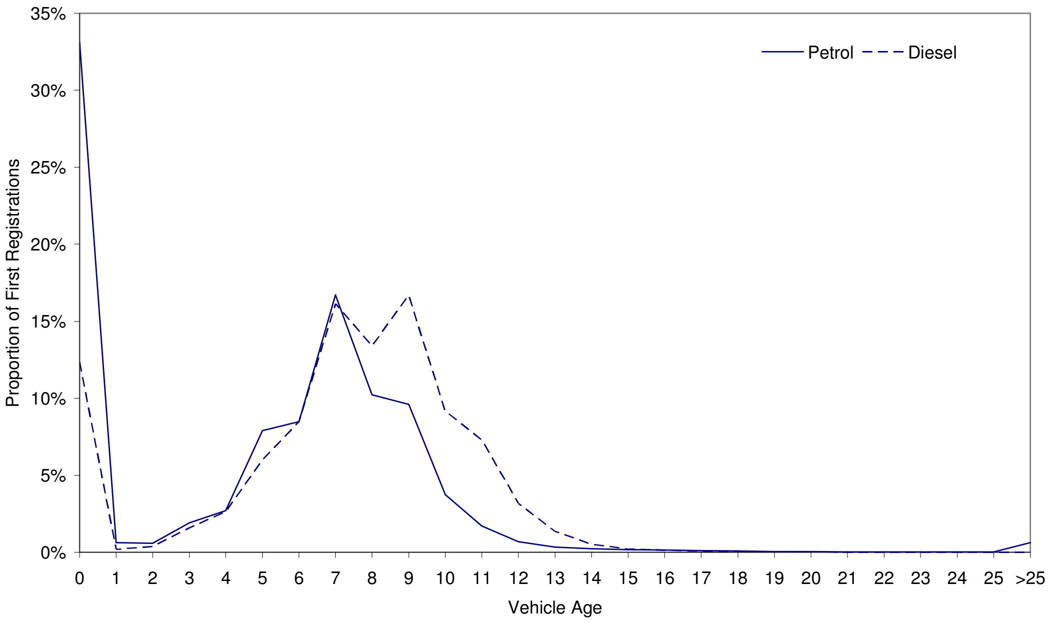
Figure 4 Motor Vehicle Registrations 2004



Source: Statistics New Zealand

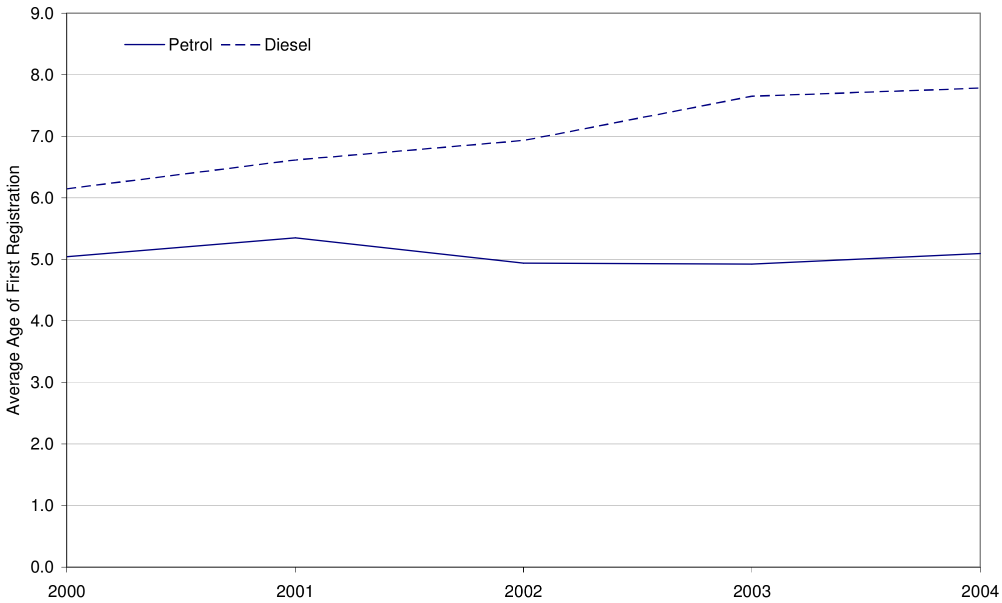
New registrations in New Zealand are dominated by second hand vehicle imports because, on the demand side, there are no restrictions on entry of vehicles that meet safety criteria and on the supply-side, because of the availability of large quantities of second hand vehicles from Japan. Figure 5 shows, for petrol and diesel vehicles, the proportion of total first registrations in New Zealand of vehicles of different ages; it is an average for the last five years of data. In 2004, the average age of first registrations was 5.1 years for petrol vehicles and 7.8 years for diesels; these averages have been reasonably constant for petrol vehicles over the last five years but are increasing for diesel vehicles (Figure 6).

Figure 5 Age of Vehicles on First Registration in New Zealand (Average 2000-2004)



Source: LTNZ, Covec analysis

Figure 6 Average Age of First Registrations of Vehicles in New Zealand



Source: LTNZ, Covec analysis

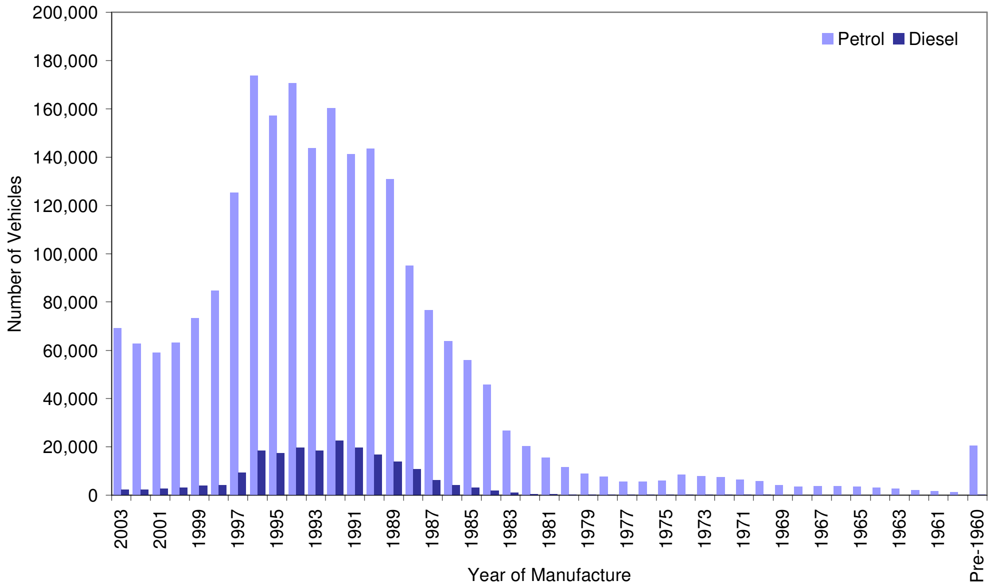
Figure 5also shows that a larger proportion of petrol vehicles (33%) are purchased new than of diesel vehicles (12%).

Supply of second hand vehicles to New Zealand is very largely from Japan; new cars in Japan are sold with a “shaken", a fitness warranty that is valid for three years. At the end of those three years the shaken can be renewed, but at a substantial cost, upwards of ¥120,000 (cNZ$1600). Further renewals are required at two-year intervals. The high renewal cost leads many Japanese to replace the cars when the shaken expires, thus creating a large supply of almost-new used cars; the strict regulations translate to a higher rate of depreciation in the value of automobiles in Japan than elsewhere in the world.[4]

As a result of the volume of second-hand imports, the New Zealand vehicle fleet age profile is very different from that in other countries in which, assuming a growing vehicle population, there will be more new vehicles than of any other age. Figure 7 shows the current age profile of the New Zealand vehicle fleet for petrol- and diesel-powered passenger cars. The highest percentage of the fleet is of 7-15 year old vehicles.

[4] Sofronis K Clerides (2003) The Welfare Effects of Trade Liberalization: Evidence from Used Automobiles University of Cyprus/Yale University (www.econ.yale.edu/seminars/trade/tdw03/clerides-030512.pdf)

Figure 7 Age Profile of New Zealand Passenger Vehicle Fleet

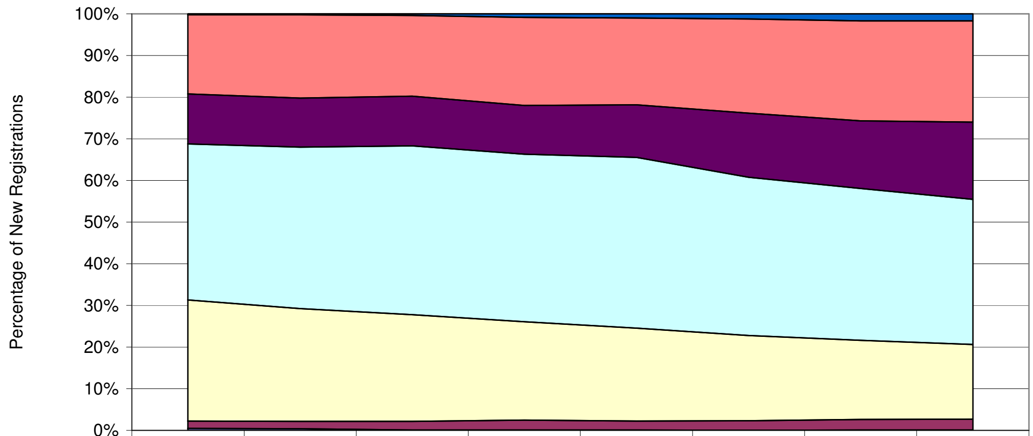


Source: Land Transport New Zealand

The age profile is significant because of the improvement in vehicle fuel economy over time. Later model year vehicles will have improved fuel economy; New Zealand's average fuel economy is worse than it would be if all new registrations were new vehicles.

Also of note, there are differences in the fuel economy of vehicles entering the fleet because there is a shift towards larger vehicles. Figure 8 shows the proportion of vehicles entering the fleet in different years in size classes; larger cars are increasing as a proportion of the total, eg cars over 2000cc have increased from 31% of new registrations in 1997 to 45% in 2004. There is a significant fall in the number of 1301-1600cc vehicles—from 29% in 1997 to 18% in 2004.

Figure 8 Representation of Different Size Classes in New Registrations

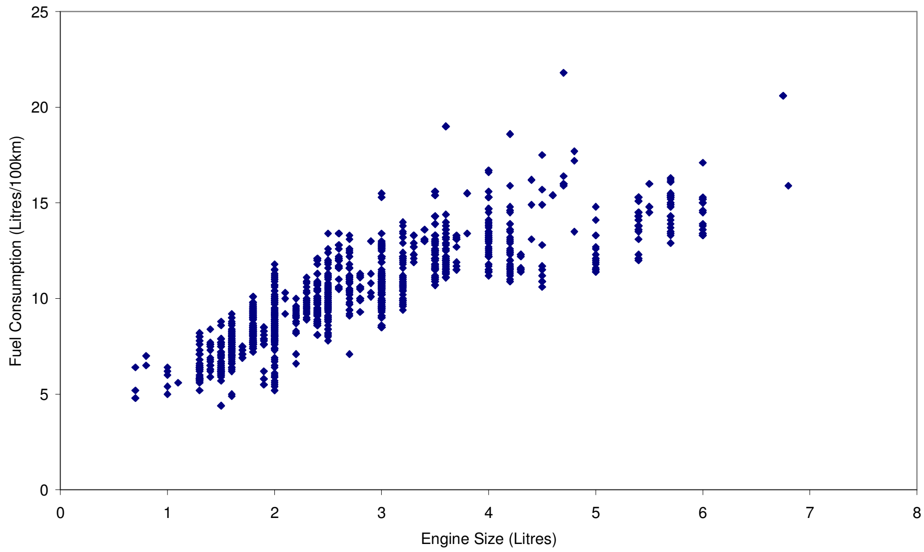


	1997	1998	1999	2000	2001	2002	2003	2004
5001 & over	0.2%	0.2%	0.4%	0.8%	1.0%	1.2%	1.6%	1.6%
2501-5000	19.0%	20.0%	19.4%	21.2%	20.9%	22.6%	24.0%	24.4%
2001-2500	12.0%	11.7%	11.9%	11.7%	12.6%	15.4%	16.3%	18.5%
1601-2000	37.5%	38.9%	40.6%	40.2%	41.1%	38.0%	36.4%	34.9%
1301-1600	29.1%	27.0%	25.6%	23.7%	22.3%	20.5%	19.0%	18.0%
851-1300	1.7%	1.7%	2.1%	2.4%	2.2%	2.2%	2.5%	2.5%
850 or less	0.4%	0.4%	0.1%	0.1%	0.0%	0.0%	0.0%	0.1%

Source: Statistics New Zealand

In general, a shift to larger vehicles means a shift to less-fuel efficient vehicles; to illustrate, Figure 9 shows the relationship between engine size and fuel economy for vehicles in the Australian market.

Figure 9 Engine Size and Fuel Consumption for New Vehicles in Australia (2005)



Source: Australian Greenhouse Office (www.greenvehicleguide.gov.au)

2.1.1. Other Effects

Although, as noted above, there is a clear link between engine size and fuel use (and therefore CO_2 emissions), there are other effects also. More specifically:

- diesel cars are more fuel efficient than petrol vehicles, have higher emissions of other pollutants, particularly small particulates which are responsible for a wide range of health effects and are the primary focus of government policy efforts to improve vehicle emission rates;

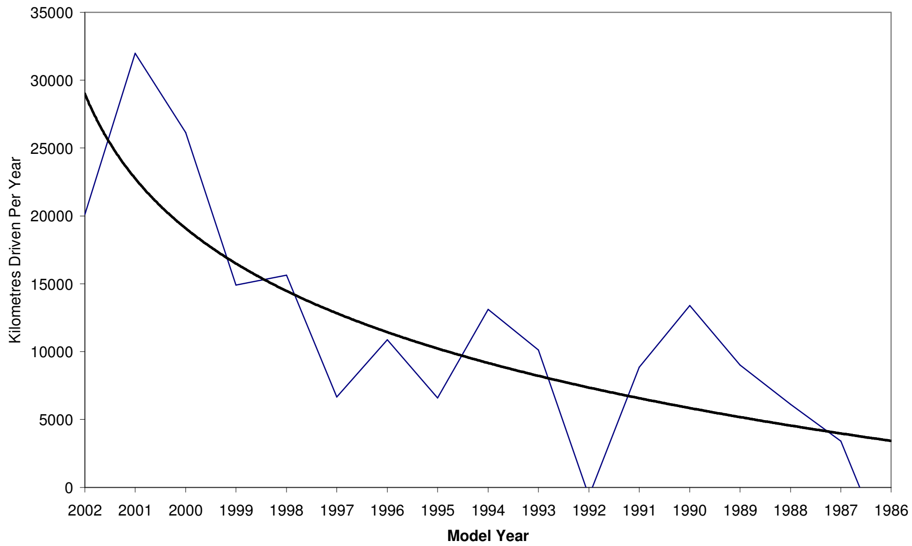
- larger vehicles, which have higher CO_2 emissions, are also likely to be safer (for passengers and drivers of those vehicles).

Encouraging new entrants to the fleet to have lower CO_2 emissions, without considering these other effects, may lead to encouragement of more diesel vehicles that do not meet appropriate emission standards for harmful pollutants, and a concern from the public that the government is not allowing them to purchase vehicles that they feel safe in.

2.2. Fleet Use

Vehicles are used differently at different ages. Analysing the kilometres travelled data by year of manufacture suggests that the marginal additional distance travelled falls with age, ie older cars are driven less (Figure 10). The average kilometres driven for any year is estimated by taking the difference between the average odometer reading for one model year, less the average odometer reading of the previous model year. This produces a curve for the marginal kilometres travelled with age. These data can be used to estimate the impacts of changing the fuel efficiency of the fleet, recognising that there are greater benefits from changing the fuel efficiency of newer vehicles.

Figure 10 Average Additional Kilometres Driven by Vehicle Age



Source: LTNZ, Covec analysis

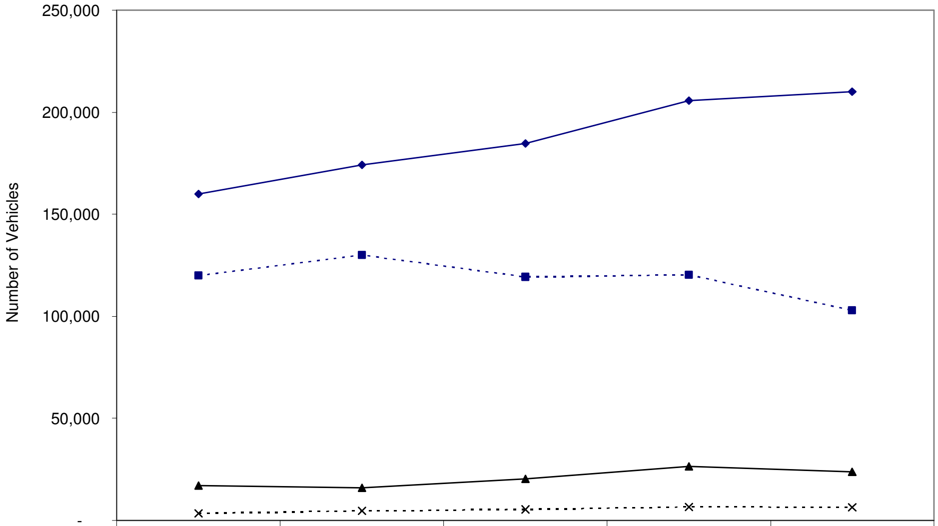
The other important piece of information relates to the fuel efficiency of vehicles of different ages. In general, over time, the fuel efficiency of vehicles of any particular class has improved.

Assuming that older vehicles are taking shorter individual trips in addition to lower total kilometres, the most inefficient vehicles will also be taking inefficient trips.

2.3. Fleet Exit

The current vehicle fleet is growing in size because registrations exceed de-registrations, both for petrol and diesel vehicles (Figure 11).

Figure 11 Registrations and De-registrations



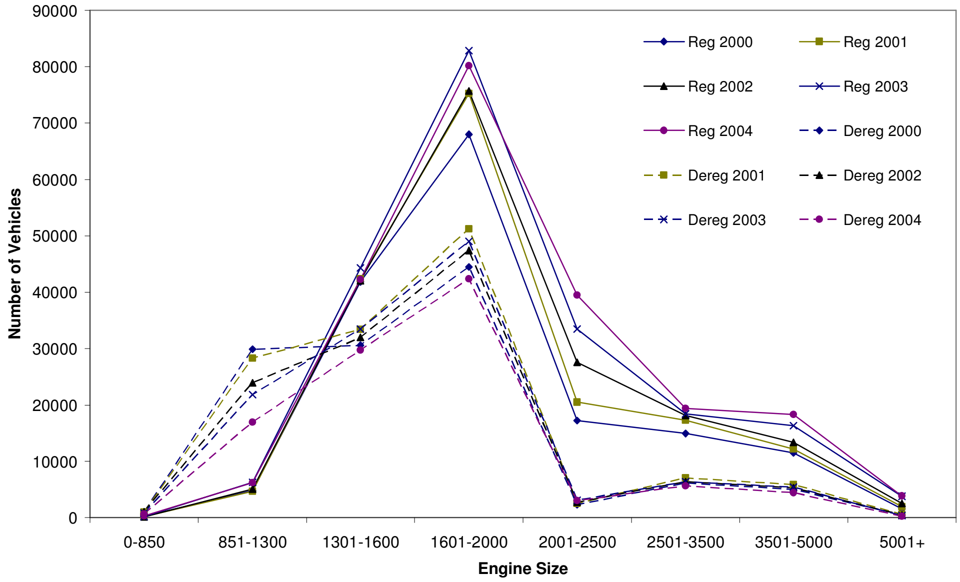
	2000	2001	2002	2003	2004
Registrations - Petrol	159,914	174,272	184,598	205,667	209,935
De-registrations - Petrol	119,886	129,992	119,249	120,347	102,967
Registrations - Diesel	17,065	16,045	20,264	26,400	23,794
De-registrations - Diesel	3,516	4,722	5,468	6,532	6,439

Source: LTNZ

The pattern of registration/de-registration is leading to a shift in the average size of the vehicle population. Figure 12 shows registrations and de-registrations by vehicle size between 2000 and 2004 for petrol vehicles. There are more de-registrations than registrations for the smaller categories of cars but fewer for all other categories.

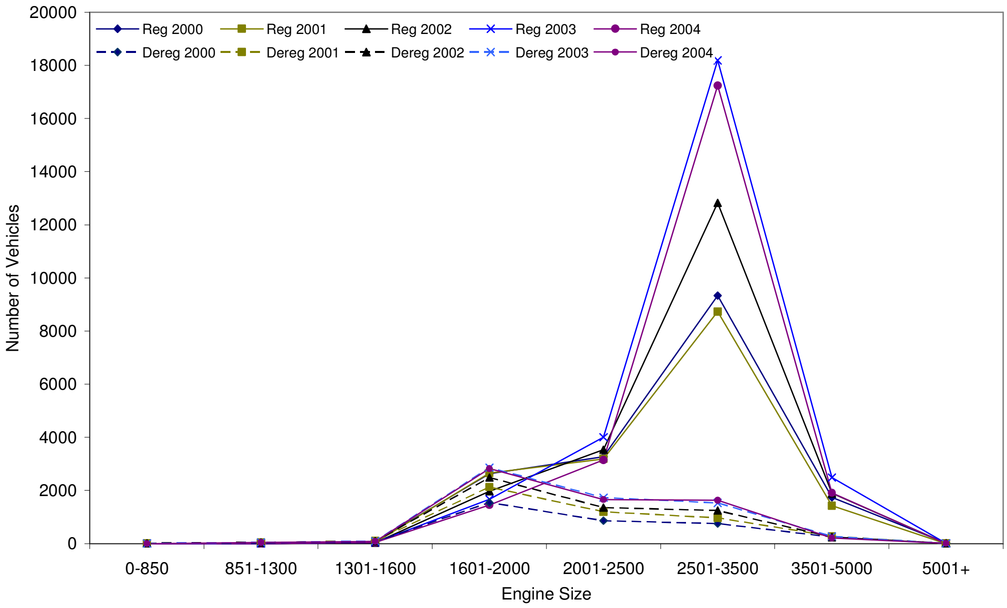
Figure 13 provides the same analysis for diesel vehicles. It is a similar pattern, although there is a more significant relative gap between registrations and de-registrations for 2501-3000cc vehicles, and the gap is widening over time. The implications of this pattern are that the average vehicle size is increasing over time.

Figure 12 Registrations and De-registrations by Vehicle Size (Petrol Vehicles)



Source: LTNZ, Covec analysis

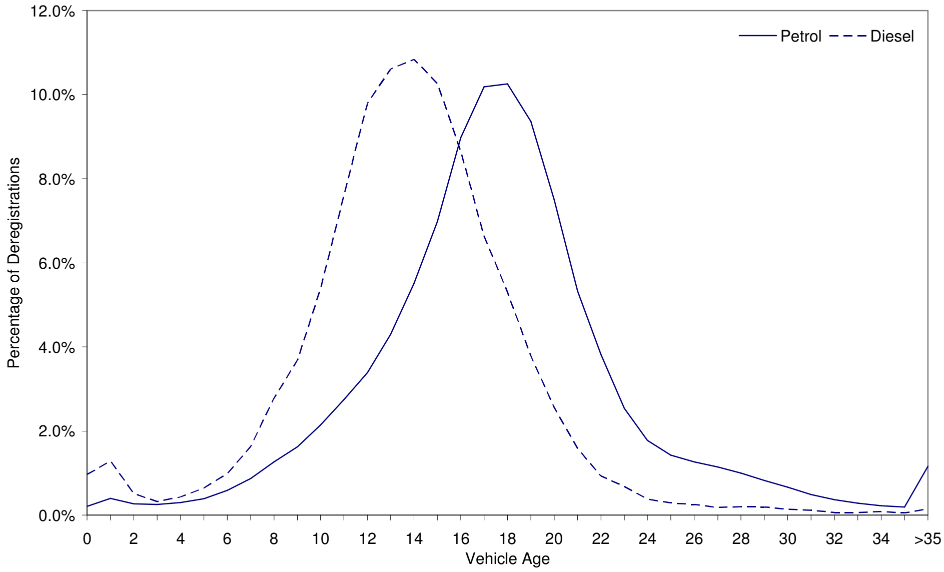
Figure 13 Registrations and De-registrations by Vehicle Size (Diesel Vehicles)



Source: LTNZ, Covec analysis

Figure 14 shows the proportion of total de-registrations by vehicle age. The average age of de-registration is later for petrol vehicles (17.7 years) than for diesel vehicles (13.8 years).

Figure 14 De-registrations by Vehicle Age



Source: LTNZ, Covec analysis

Petrol vehicles are thus kept for much longer than diesel vehicles—they enter New Zealand at an earlier age on average and are retired later. For diesel vehicles the lifetime in New Zealand is short and getting shorter, as the age of first entry is getting later.

2.4. Vehicle Registration Requirements

Currently in New Zealand there is no import fee for vehicles first entering the country, but GST is payable. Annual (or six-monthly) registration fees are charged. These vary across broad vehicle types (Table 2) but do not vary with engine size as they do in a number of other countries.

Table 2 Vehicle Registration Fees

		3 months	6 months	12 months
Passenger vehicle	Private - Petrol driven	55.7	103.8	200.1
	Private - Non-petrol driven	75.95	144.35	281.1
Private passenger	0-3,500 kg GVM - Petrol driven	55.7	103.8	200.1
	0-3,500 kg GVM - Non-petrol driven	82.55	157.5	307.45
	3,501-6,000 kg GVM - Petrol driven	56.05	104.55	201.6
	3,501-6,000 kg GVM - Non-petrol driven	82.9	158.25	308.95
Transport Licensed Goods	0-3,500 kg GVM - Petrol driven	61.7	115.8	224.1
	0-3,500 kg GVM - Non-petrol driven	88.55	169.5	331.45
	3,501-12,000 kg GVM - Petrol driven	62.1	116.6	225.6
	3,501-12,000 kg GVM - Non-petrol driven	88.9	170.25	332.9

Source: www.ltsa.govt.nz/vehicle-ownership/registration.html

Other requirements are for:[5]

- **Warrant of Fitness (WoF)**—a periodic safety inspection that is compulsory for light vehicles (eg, most cars, vans, utes and 4WDs). Vehicles first registered anywhere less than six years ago must have WoF inspections every 12 months. All other vehicles must have WoF inspections every six months.

- **Certificate of Fitness** (CoF) inspections are regular safety checks. They are required for
  - heavy vehicles such as trucks, tractors, buses, large motorhomes and large trailers,
  - all passenger service vehicles, such as taxis, shuttles and buses, and
  - rental vehicles.

Taxes and charges are levied to raise revenue for roading and other purposes. They differ by fuel type. For petrol, there is a series of taxes that apply per litre consumed (Table 3). For diesel vehicles, the Petroleum Fuels Monitoring Levy applies at the same rate as for petrol and there is a local authority tax rate of 0.33c/litre. However, Road User Charges are levied in addition.

Table 3 Petrol Taxes

Charge	Level (cents/litre)
Petroleum Excise Tax	18.708
National Land Transport Management Fund	17.492
Petroleum Fuels Monitoring Levy	0.025
ACC Levy	5.08
Local Authority Tax	0.66
Total	**41.965**

Source: MED (2005) Energy Data File January 2005.

Road User Charges (RUCs) are levied per kilometre travelled on the basis of odometer readings. The rate, expressed in dollars per 1,000 kilometres, varies by vehicle type and by vehicle weight. Rates are published by Land Transport New Zealand.[6]

[5] http://www.ltsa.govt.nz/vehicle-ownership/index.html

[6] Land Transport New Zealand (2005) Road User Charges

3. Policy Options

3.1. Options to be Considered

This section analyses a number of different potential options for reducing the fuel use of vehicles. It includes:

- Early retirement of vehicles;
- Vehicle taxes on acquisition and as annual registration fees;
- Feebate systems;
- Low interest loans;
- Other taxation measures;
- Tradable permits.

3.2. Previous Analyses in New Zealand

In the development of climate policy in New Zealand, initial focus was placed on economy-wide economic instruments (taxes or permits) that would cover all sectors. Examination of transport sector-specific policy developed under the frameworks of the National Energy Efficiency and Conservation Strategy and the New Zealand Transport Strategy. An initial review of measures that could be used to reduce CO_2 emissions from road transport was undertaken in 2000[7] alongside the development of the Ministry of Transport's Vehicle Fleet Fuel Model. This 2000 study examined a range of supply and demand measures including vehicle technologies, demand management measures, fuel and road pricing.

Subsequently, Fuels and Energy Ltd, with PWC undertook a study focussed on supply side measures to improve fuel economy of the NZ fleet.[8] It suggested three pillars of a policy response:

- arrangements with the NZ auto industry to match vehicle fuel economy targets being met by the manufacturing industries overseas;

- provision of information to the consumer on fuel economy;

- fiscal measures to encourage consumers to change purchasing behaviour.

It suggested that the most viable approach was a negotiated sales-weighted average fuel economy targets for vehicle importers, coupled with vehicle labelling. The report noted, however, that such a target was not feasible until there was reporting on fuel consumption for vehicles entering the fleet. The government confirmed in 2001 that work would progress on a system to record fuel consumption and provision of

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[7] Fuels & Energy Management Group Ltd (2000) Road Transport Sector Energy Demand & CO_2 Output: Projections & Analysis Of Reduction Strategies Technical Report to Ministry pf Transport

[8] Fuels & Energy Ltd and PWC (2001) Improving Vehicle Fleet Economy—Investigation of Supply Side Measures for New Zealand

consumer information, but that, at that time, a target or "average fuel efficiency standard" would not be further considered. This study includes consideration of policies to achieve the third pillar—fiscal measures to affect purchasing behaviour and does not revisit the use of a fuel economy target or consumer information.

MoT is currently examining a wide range of options that will result in reduced emissions of local air pollutants, triggered by the concerns over premature mortality from fine particulates but covering CO, hydrocarbons and NOx also. This work is expected to examine some of the policy options that are of interest to the Climate Change Office also, eg early scrappage and measures to improve the overall age of the NZ fleet. There is also a programme of work to examine the potential for road charging.

3.3. Early Retirement

Early retirement programmes provide incentives for cars to be scrapped earlier than they would be otherwise. For example, programmes provide monetary incentives for vehicles to be scrapped, particularly if they fail an emissions test.

Table 4 examines the possible impacts of early retirement using three different approaches to analysis. The table includes data on expected activity, ie kilometres travelled per annum for different ages of vehicle; these are based on the analysis in Figure 10. We have made assumptions about the expected fuel economy of vehicles of different ages, with a simple projection of declining fuel economy with age. This allows the calculation of the expected fuel use by vehicles of different ages.

Table 4 First Year Impacts of Early Retirement

Vehicle Age	Activity	Fuel economy	Fuel consumption	"New for Old"	"All Change"	"Late Entry"
(Years old)	(km/annum)	(l/100km)	(litres)	(litres)	(litres)	litres
0	29007	6.0	1740	1740	1740	1740
1	22749	6.3	1440	1440	1365	1440
2	19088	6.7	1271	1271	1208	1271
3	16490	7.0	1153	1153	1098	1153
4	14475	7.3	1060	1060	1012	1060
5	12829	7.7	981	981	939	981
6	11437	8.0	913	913	875	913
7	10232	8.3	850	850	816	816
8	9168	8.6	792	792	762	762
9	8217	9.0	737	737	710	710
10	7356	9.3	684	684	660	660
11	6571	9.6	633	633	611	611
12	5848	10.0	582	582	563	563
13	5179	10.3	533	533	516	516
14	4556	10.6	484	484	469	469
15	3973	11.0	435	238	422	422
Total			**14289**	**14092**	**13767**	**14087**
Reduction				**197**	**522**	**202**

The first analysis of the impact is based on the simple assumption that the owner of the old vehicle, that is retired, subsequently purchases a new vehicle and does not change driving behaviour, ie a new vehicle is driven the same number of kilometres as would have been expected of the 15 year old vehicle. In the analysis here the estimated reduction in fuel consumption is 197 litres. An alternative result (the “All Change” scenario) is that, because an old (15 year old) car drops out of the market, the owner purchases a 14 year old car; the owner of the 14-year old car purchases a 13-year old car and so on, with a new car entering the fleet and bought by the current owner of the 2-year old vehicle. The impact of this scenario, with changes to fuel economy distributed throughout the fleet, is greater, with an estimated reduction in total fuel consumption of 522 litres. The third scenario (“Late Entry”) shows the effects if the new addition to the fleet is an imported six year old car by the current owner of a 7-year old car, with the impacts on fuel economy for vehicles older than that; here the fuel reduction benefits are reduced to 202 litres. If the replacement vehicle for the fleet is later the benefits reduce accordingly.

This is the first year benefits of the measure. The ongoing effect is more complex to measure and will depend on how many years of life have been taken from the new vehicle. If the 15 year-old car that is replaced would have lasted another 2 years before being scrapped, then the beneficial effect may last for two years but then, taking the “Late Entry” scenario as an example, the fleet now has an 8 year old vehicle when it might have had a 6 year old vehicle.

To understand the dynamic effects, the assumptions from the “Late Entry” scenario are used in analysis. This results in two years of fuel savings—approximately 200 litres in the first year and 180 litres in the second. This is then followed by additional fuel use of approximately 64 litres in year 3, 57 litres in year 4 and so on; most or all of the savings may be lost over the subsequent years, if vehicle fuel economy continues to improve with time. The effect is likely to be largely that of shifting the timing of emissions rather than reducing total emissions.

Even if we assume some savings, say a maximum of 250 litres for removing a vehicle, the savings in CO_2 emissions is approximately 0.6 tonnes.[9] Comparing this with a carbon tax of $15/t as a willingness to pay for reductions, this represents a willingness to pay of $8.60 to retire a vehicle early. This is unlikely to provide any incentive for early scrapping.

The analysis above takes a marginal approach; it evaluates the impacts of retiring one vehicle early. The impacts will be different if measures permanently change the age at which vehicles are scrapped. This would be the case if the value of a vehicle declined faster over time. Below we explore examples of measures targeted directly at early scrappage. Other measures, such as registration fees that vary with fuel economy would have an effect also—if there was a higher annual registration fee for an old car, its sale value would reduce. These issues are explored in Section 3.5.

[9] This is based on an estimated 2.3kg CO_2/litre using assumptions for regular petrol of 66.2kt CO_2/PJ (MED (2004) New Zealand Energy Greenhouse Gas Emissions 1990-2003) and 34.67MJ/litre (MED (2005) Energy Data File January 2005).

3.3.1. British Columbia Scrap-It

The British Columbian Scrap-It programme is a voluntary scheme. It started in 1996 with a pilot demonstration programme with a target of removing 1,000 vehicles.[10] The primary objective was reducing tailpipe emissions by removing older, higher polluting vehicles.[11]

In the pilot programme the incentives offered were: $750 toward the purchase of a new car, $500 toward the purchase of a used car, or a public transport pass for one year. The pilot program took almost two and a half years to reach the objective of scrapping 1,000 vehicles. The results are shown in Table 5.

Table 5 Scrap-It Pilot Results

	Lower Fraser Valley	Victoria
Cars approved for scrapping	1149	85
Cars scrapped	900	55
Incentive chosen:		
New Car	243	21
Used Car	147	10
Transit (Public Transport) Pass	431	19

Source: Sokol C and Harmacy A. (2002) A Feasibility Study on The Implementation of a Vehicle Scrappage Program in Winnipeg, Manitoba. Environment Canada

Despite the extended period, the programme was considered a success in one area (the Lower Fraser Valley) and operations were continued, but not in another (Victoria), where it was discontinued.[12]

In the current programme, to be eligible the vehicle must be a 1993 or older car or light-duty truck, have been insured for the last 12 months in the eligible area, and have failed an emissions test at some point in its history. If the vehicle is insured for "Pleasure-use" only, it must have travelled at least 5000 km over the last year.[13] The incentives offered are now:

- $750 toward a new vehicle or $1000 toward a new hybrid vehicle;
- $500 toward a 1994 or newer used vehicle;
- Up to $500 towards a bicycle;
- $750 toward vanpooling or carpooling or $500 toward membership in a car sharing cooperative; and
- public transport passes.

[10] www.cleanairnet.org/caiasia/1412/article-37169.html In comparison, there are c.2.7 million vehicles registered in British Columbia (Statistics Canada— www40.statcan.ca/l01/cst01/trade14c.htm)

[11] Sokol C and Harmacy A. (2002) A Feasibility Study on The Implementation of a Vehicle Scrappage Program in Winnipeg, Manitoba. Environment Canada

[12] Sokol C and Harmacy (op cit)

[13] www.gov.bc.ca/air/vehicle/sip.html

The most popular incentive has been the public transport pass, partly at least because it is the best value among the incentives. In a survey conducted of public transport pass recipients 77% expected to continue using transit when their passes ran out, and 70% had not purchased a vehicle after participating in the program.[14]

The effectiveness of the programme is enhanced through the AirCare emissions standard; vehicles that fail must be repaired before they can be re-insured. This encourages individuals to take the incentive when it becomes too costly to continue fixing the vehicle.

3.3.2. Ontario—Car Heaven

Car Heaven was launched as a charity in 2000. Vehicles receive a free tow (valued at $200) and a minimum $60 charitable receipt for the donated car. From May 1st, 2005, if the vehicle is a 1994 model year or older and currently on the road it may be eligible to receive: $1,000 certificate towards a new vehicle. Owners are also entered into a draw for various other prizes, such as bicycles, public transport passes, hiking boots.

Donated cars are picked up and processed by a local member of the Ontario Automotive Recyclers Association (OARA). Cars that are eleven years old or newer, plus exotic or low mileage cars, are bid on by members of OARA; they are recycled or repaired. Cars that are 12 years and older have a set value of $60.

In the first five months of operation, Car Heaven took 1,500 to 2,000 vehicles off the road.

The Car Heaven programme is also eligible to produce emission credits that can be sold into the emissions trading scheme operating in the state. Credits for reductions of SO_2 or NO_x can be sold into the programme that requires electricity generators and other industrial plants to hold allowances or credits equal to their annual emissions. It is planned to use this process to obtain additional finance to help run the programme and increase numbers of cars scrapped.

The sale of some of the emission reductions can help to finance the removal of more cars (by expanding the scale of the program or providing other incentives), thereby removing more emissions from the air.

3.3.3. Calgary – Scrappage Project

Calgary launched its pilot vehicle scrappage programme in 2002, modelled on the BC Scrap-it scheme. It too is organised by charity with the Kidney Foundation earning the benefits of the programme.

[14] Innovatech Energy Systems Ltd, Constable Associates Consulting Inc & Alchemy Consulting Inc (1997) *Evaluation of the Scrap-It Pilot Program (Final Report)* Report for Scrap-It Program Steering Committee. In: Sokol C and Harmacy A. (2002) A Feasibility Study on The Implementation of a Vehicle Scrappage Program in Winnipeg, Manitoba. Environment Canada

The transit pass has the highest value of the incentives ($660). The City of Calgary Transit is supplying the passes as a contribution in-kind. All motor dealers in Calgary are expected to participate in the programme. Their contribution is $165 toward each new or used vehicle purchased from an authorised dealer. To follow the process, an applicant makes their best deal possible with the car dealer, and then presents their certificate for $500 to the dealer. The dealer will reduce the price of the car accordingly, and bill the scrappage program for a $335 reimbursement.

3.3.4. The Kidney Foundation of Canada – Cars for Kidney

The Kidney Foundation of Canada also operates a vehicle scrappage program in British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, and Quebec. The program has been in operation in Manitoba since 1994. They accept all light or medium duty vehicles that are towable with four inflated tires. Participants receive a charitable tax receipt for the value of the vehicle, as determined by the Manitoba Motor Dealers Association.

Cars for Kidney receives approximately 60 to 70 cars a month in Manitoba, and normally resells as many as 10 per month. They will accept any vehicles, including functioning vehicles, as well as non-operating, non-registered vehicles. Kidney Manitoba normally has approximately 800 vehicles go through the program each year.

The programme differs from conventional scrappage programs as the Kidney Foundation does not scrap all vehicles it receives. Some are sold at auctions, and some are used for parts.

3.3.5. Other Programmes

Several other US states have programmes including:

- Illinois Accelerated Vehicles Scrappage Program—light duty vehicles or trucks, from a model year 25 years or older, continuously registered in the State for 12 months prior, legally drivable and able to drive to the site on its own, and also pass an operability check. If all these conditions are met, the individual will receive money from the vehicle scrappage sponsor.

- Texas "Cash for Clunkers" started in 1999. Eligibility consists of cars and light duty trucks from 1986 or earlier, driven to the site on their own power and in working order. The incentive to scrap the vehicle is an average of $500, with additional premium incentives of $700 for vehicles rated as high emitters, such as vehicles older than 1975.

- California instituted a similar program in 2000 in conjunction with their "Smogcheck Program." To qualify it must be a passenger vehicle, or light or medium duty truck, have failed a Smogcheck within the last 90 days, currently registered and continuously operated for the last 2 years, and pass a visual and operational inspection. If a vehicle meets these criteria, the owner will receive $1,000 from the State to retire the vehicle. Recommendations from this program indicate that a substantial incentive is needed for participation, a good public relations campaign to increase awareness is required, good infrastructure, and clear and simple qualifying rules must be in place.

Recommendations from these programmes have included suggestions that:

- Incentive payments are limited to the worst vehicles only, eg those failing emission test;
- That they are limited to "commuter cars" rather than "recreational vehicles", with evidence provided via insurance.

These types of suggestions, alongside our analysis above which highlights the limited effectiveness of these programmes, suggest that early scrapping incentive programmes are not worth pursuing further.

3.4. Differential Acquisition Fees

Here we discuss "first registration" or acquisition fees separately from annual registration fees. Acquisition fees apply to vehicles on first entry to the market. In New Zealand this is at import, either as new or second hand vehicles. Acquisition fees are also termed registration taxes as opposed to circulation taxes for annual fees.[15]

A number of countries have acquisition fees that differ with fuel consumption or factors that affect fuel consumption—engine size (cc) and vehicle age (for second hand imports) (Table 6). Austria's system varies with fuel consumption, Ireland and Portugal have systems that vary with engine size, and the system in Belgium varies with engine size and age, albeit a fairly small amount.

Denmark, in particular, plus Finland, the Netherlands and Portugal apply very high levels of acquisition taxes.

3.4.1. Market Definition

Assessing the effects is aided through an understanding of vehicle market definition. Vehicle markets might be separated by:

- **vehicle type**, eg a market for Sports Utility Vehicles/Four Wheel Drives, or for 3 litre vehicles; and/or
- **age**, eg a market for new vehicles.

If vehicles are differentiated more by vehicle type, then second hand vehicles are a substitute for new vehicles (or second hand imports). As a result of the introduction of an acquisition fee on imported vehicles, which raises the price of fuel-inefficient

[15] COWI A/S (2002) Fiscal Measures to Reduce CO_2 Emissions from New Passenger Cars. Main Report A study contract undertaken for European Commission's Directorate-General for Environment (http://europa.eu.int/comm/environment/co2/cowi_finalreport.pdf)

imports, demand for second hand vehicles will rise. This would increase the value and, in turn, extend the lives of existing SUVs, 3 litre vehicles etc.

Table 6 Taxes on Vehicle Acquisition (EU)

	Sales/Registration tax			Registration charge
	VAT[1]	Passenger Cars	Commercial Vehicles	
Austria	20%	Based on fuel consumption (MVEG) max.16%	none	€ 165.55
Belgium	21%	based on cc + age e.g. 1.8 litres : € 123	none	€ 31
Denmark	25%	105% up to DKK 61,400 180% on the remainder	95%of value exceeding DKK 14,300 (below 2t) of value exceeding DKK 34,100 (2 - 4t)	DKK 1180
Germany	16%	None	None	€ 25.6
Spain	16%	< 1.6 litres: 7% > 1.6 litres: 12%	None	€ 65.20
Finland	22%	petrol car : 28% - € 650 diesel car : 28% - € 450	None	
France	19.6%	none	none €	€16 - 30 parafiscal charge
Greece	18%	new car : 5-50%	new vehicle: 6-26%	€ 100 - € 300
Ireland	21%	< 1.4 litres : 22.5% 1.4 - 1.9 litres : 25% > 1.9 litres : 30%	LCV 13.3% Others € 51 - 127	none
Italy	20%	IPT 2%	IPT	53: € 150.81 € 3.51 x kw
Luxembourg	15%	none	none	€ 28.90
The Netherlands	19%	petrol car: 45.2% - €1,540 diesel car: 45.2% + € 328	none	€ 32 - 42
Portugal	19%	based on cc eg 1.6 litres: € 5,264	none	€ 85
Sweden	25%	none	none	none
United Kingdom	17.5%	none	none	£ 38

[1] equivalent to GST
Source: European Automobile Manufacturers Association (ACEA) (www.acea.be)

If the market is more clearly defined as a new as opposed to second hand market, then the flow through effect on the second hand market is less pronounced. If purchasers are in the market for a new vehicle they will be more likely, as a result of the acquisition fee, to shift from a high to a low fuel consumption vehicle, rather than to a similar second hand vehicle. However, the shift to more fuel efficient vehicles would be limited in New Zealand because the market for new vehicles is smaller than in other countries. And it is extremely unlikely that consumers will distinguish between a NZ second hand vehicle and a newly imported second hand vehicle. Thus vehicles already in the market are perfect substitutes for most imports, and the impacts of an acquisition fee will extend to the rest of the market via increased value for second hand vehicles, and extended lives, particularly for the less fuel efficient vehicles. This in turn may lead to greater use (higher vehicle kilometres travelled) for older vehicles.

Offsetting these effects will be some shift towards more fuel efficient vehicles at all vehicle ages because of the lower relative price.

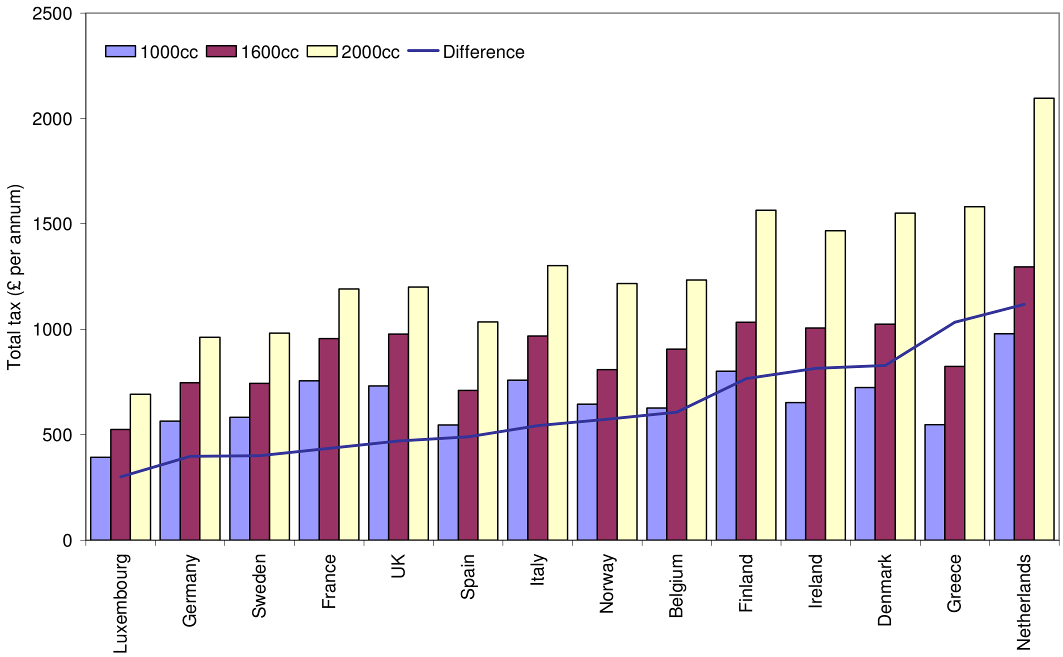
The market definitions may differ by purchaser type. For example, it is more likely that company fleet buyers will be in the market for new vehicles than individual purchasers.

In summary, the impacts of a differentiated acquisition fee are complex, and there is the potential for perverse outcomes. We turn now to the empirical evidence.

3.4.2. Empirical Studies

In looking at empirical evidence of the effects of the tax levels in EU countries, the acquisition tax cannot be examined in isolation. The whole of life tax impacts may be taken into account in initial purchase decisions**.** Figure 15 shows an estimate of the lifetime tax on three different sizes of vehicle in EU member states; these include acquisition, annual registration and fuel taxes. The figure also shows the difference in tax rate between that for 1000cc and 2000cc vehicles.

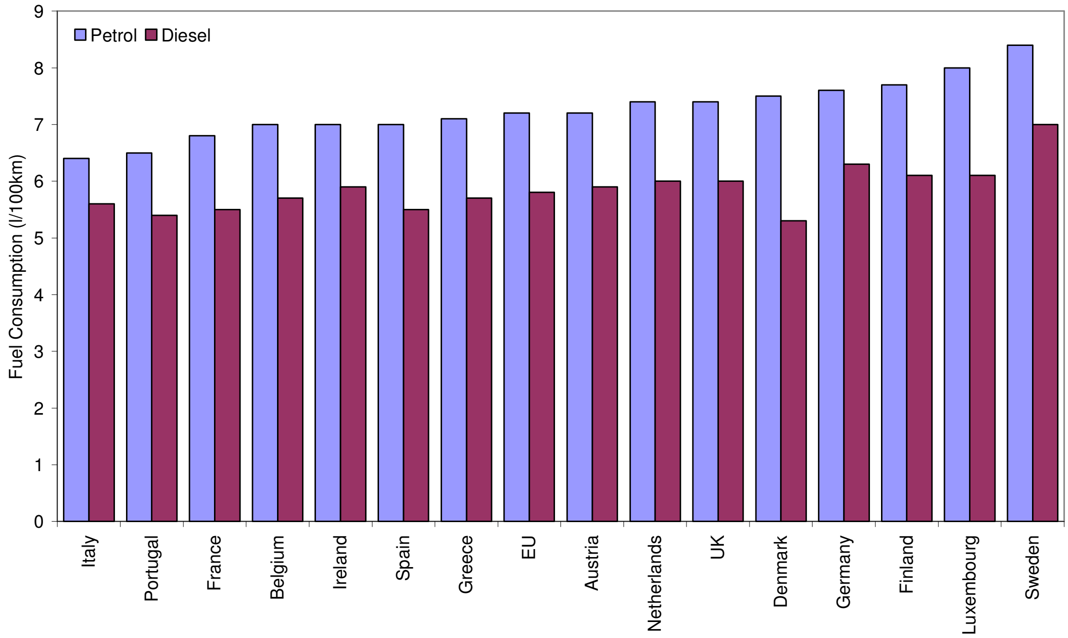
Figure 15 Summary of All Taxes for an Average Car Life of 14 years (£ per annum)



Source: Burnham J (2001) European Comparison of Taxes on Car Ownership and Use. Review of the Report for the Scotland Office by Colin Buchanan and Partners. Comparison of Motoring Taxation Across Europe. Review produced for the Commission for Integrated Transport

To assess the impacts, we examine the fuel consumption average of newly registered vehicles in the different member states (Figure 16). The years do not exactly correspond—the tax data are for a slightly earlier period— but we assume that the relativities between countries have remained. The expectation would be that, those countries that had a greater tax differential between vehicles would have a lower average fuel consumption of new vehicles. This is tested in Figure 17. It plots average fuel consumption of newly registered vehicles in the different member states against the difference in tax take between a small (1000cc) and large (2000cc) vehicle.

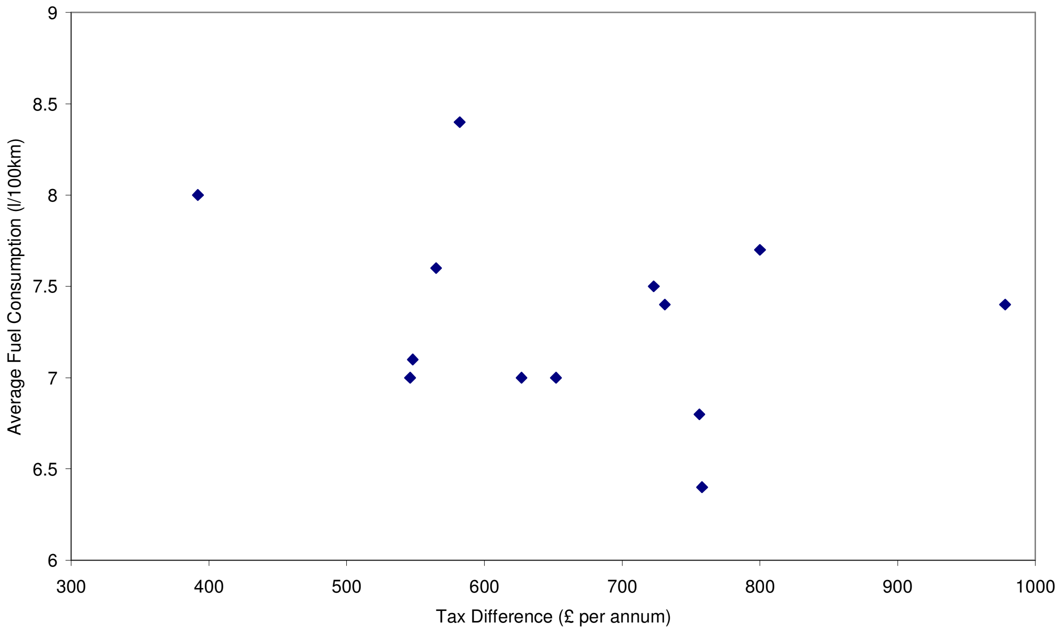
Figure 16 Fuel Consumption Average of All Newly Registered Vehicles (2003)



Source: Commission of the European Communities (2005) Commission Staff Working Paper SEC (2005) 826 (http://europa.eu.int/comm/environment/co2/annexes/com_05_269_annex.pdf)

There is no obvious or statistically significant trend in the data, ie it is not clear from these data that a larger difference between the tax rate on small- and large-engined vehicles has had any impact on the average fuel efficiencies of new registrations.

Figure 17 Fuel Consumption versus Total Lifetime Tax Level



Source: Covec analysis

This result is consistent with the results of the analysis of the EU programme to encourage reductions of CO_2 from transport. The programme has three components:

- commitments of the automobile industry to improve the fuel economy of vehicles;
- fuel-economy labelling of vehicles; and
- promotion of car fuel efficiency by fiscal measures.

A recent significant review of the overall programme concluded that the reduction in CO_2 emissions "have been overwhelmingly achieved by technological developments" and that "observed market changes did not influence the CO_2 emissions significantly".[16] The review acknowledges that it is difficult to distinguish the influence of fiscal measures and other market factors, from technological factors, but notes that technological developments penetrated practically all vehicle categories in contrast to the limited scope of the fiscal measures.

It is not clear that the lack of effect is because of the size of the differentiation, rather than the nature of the policy itself. However, consistent with these conclusions, the analysis in Figure 17 shows no relationship between size of fee differential and fuel economy of new purchases. And, as discussed above, acquisition fees can lead to a number of price changes throughout the second hand market that can limit their effect. These conclusions of the EU review are significant. They suggest that the introduction of the fiscal measures will have little effect on vehicle choices and overall emission rates. This may be too strong a conclusion on the basis of the evidence, and notably, separating out the impacts of individual policy measures is difficult when they are introduced alongside others, including fuel price escalators. However, there is clearly no strong evidence that differential acquisition fees have any significant positive effect on fuel economy.

The New Zealand market differs from other markets, because of the extent of imports of second hand vehicles. In EU countries, the great majority of new registrations are new vehicles. And new vehicles tend to be purchased by companies and higher income individuals and households.[17] Willingness and ability to pay, and price elasticity of demand, would be expected to be quite different from that of the lower income households that are purchasing lower-priced imported second-hand vehicles in New Zealand. This factor suggests that differential acquisition fees might have a greater effect in New Zealand than in other countries, but it is set against the other influence of the second hand-dominated market—the greater likelihood that acquisition fees will lead to substitution of imports by existing second hand vehicles.

On balance, it is not clear that acquisition fees will have a significant impact on vehicle fleet fuel economy. The potential market response is complex and the empirical

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[16] Commission of the European Communities (2005) Communication from the Commission to the Council and the European Parliament. Implementing the Community Strategy to Reduce CO_2 Emissions from Cars: Fifth annual Communication on the effectiveness of the strategy COM (2005) 269 final

[17] Paszkiewicz L (2003) The Cost and Demographics of Vehicle Acquisition. Consumer Expenditure Survey Anthology, 2003: 61-66.

evidence does not provide any strong support. The EU analysis has only recently been published; and there is no evidence that countries are scaling back their use of these instruments in response. However, the fact that differential acquisition fees have been widely used is not sufficient reason to adopt in New Zealand.

3.5. Differential Annual Registration Fees

Differential annual registration fees, ie registration fees that differ with the fuel economy or engine size of the vehicle, have been used in a number of countries to provide incentives for changes to more fuel efficient vehicles. However, as for acquisition fees, the effects are not straightforward.

Once a vehicle has entered the fleet, a differential annual registration fee may have little effect. It increases the fixed cost of ownership but not of use at the margin. The higher fixed costs of ownership may encourage an owner to sell the vehicle earlier, but subsequently the costs of the registration fee may be internalised in the vehicle price, ie the sale value of a vehicle will fall by an amount equal to the discounted future increased costs of registration. Thus the value of less fuel efficient vehicles fall.

The circumstances in which the registration fee would be expected to have a greater effect would be in changing demand for new vehicles (including imports of second hand vehicles) and in leading to earlier retirement of vehicles, particularly those that are less fuel efficient. The impacts on early retirement will be systematic across all fuel inefficient vehicles and would be expected to lead to a permanent reduction in the age of vehicle retirement for these vehicles.

For new purchases (imported new or second-hand), the impact of the annual registration fee is equal to the discounted costs spread over the car's lifetime. In practice these costs may not be taken into account or may be very heavily discounted—research in the US has found that consumers expect, on average, a 2.8-year payback on investment in higher fuel economy.[18] If the annual registration fee applies to all cars on the market, there should be no effect on relative prices in the second hand market (ie cars already in New Zealand). In contrast, if the annual registration fee applies only to new cars entering the market, as in the UK system, the effects are the same as for an acquisition fee.

In theory, an annual registration fee on all vehicles, differentiated by fuel efficiency/engine size, would lead to a shift in new purchases towards more fuel efficient vehicles, without the downside risk of increases in the value of second hand vehicles, and thus extension of their lives. In practice, the effect on new vehicles might be limited because of high discount rates or simple failure to take full running costs into account. And for vehicles already on the market, the instrument would be expected to have very little effect because of the price adjustments noted above.

[18] Green DL and Schafer A (2003) Reducing Greenhouse Gas Emissions from US Transportation. Pew Center on Global Climate Change.

The market definition issue can be less problematic for annual registration fees, because the fee can apply to second hand as well as imported vehicles—there is no shift from new to second hand purchases. However, this assertion is based on an assumed approach to implementation. When introduced in the UK, the differential annual registration fee applied to new vehicles only. From the date of introduction, new vehicles had to pay the differential annual registration fee for the rest of their lives, but the fees did not apply to vehicles already on the market. Such an approach leads to the same problems as noted above—where second hand vehicles are substitutes for new vehicles, the demand for second hand vehicles may increase. But this problem does not occur if the differential annual registration fee applies to all vehicles on the market.

The empirical evidence noted above for acquisition fees applies to annual fees also. It was based on an assessment of lifetime tax costs per vehicle and showed little impact on the fuel economy of vehicles first entering the market.

There are a number of examples of differential fees systems in other countries (Table 7).

Table 7 Annual Registration Taxes in Europe—Tax Base

	Passenger Cars	Commercial Vehicles
Austria	Kilowatt	Weight
Belgium	Cylinder capacity	Weight, axles
Cyprus	Cylinder capacity, CO_2	-
Czech Republic	-	Weight, axles
Germany	Cylinder capacity, exhaust emissions	Weight, pollution, noise
Denmark	Fuel consumption, weight	Weight
Estonia	-	Weight, axles suspension
Spain	Horsepower	Payload
Finland	Weight	Weight, axles
France	-	Weight, axles, suspension
Greece	Cylinder capacity, horsepower	Payload
Hungary	Weight	Weight
Ireland	Cylinder capacity	Weight
Italy	Kilowatt	Payload, weight, axles
Luxembourg	Cylinder capacity	Weight, axles
Latvia	Weight	-
Malta	Cylinder capacity	-
Netherlands	Weight	Weight
Portugal	Cylinder capacity	Weight, axles, suspension
Sweden	Weight	Weight, axles
Slovakia	-	Weight, axles
UK	CO_2	Weight, axles

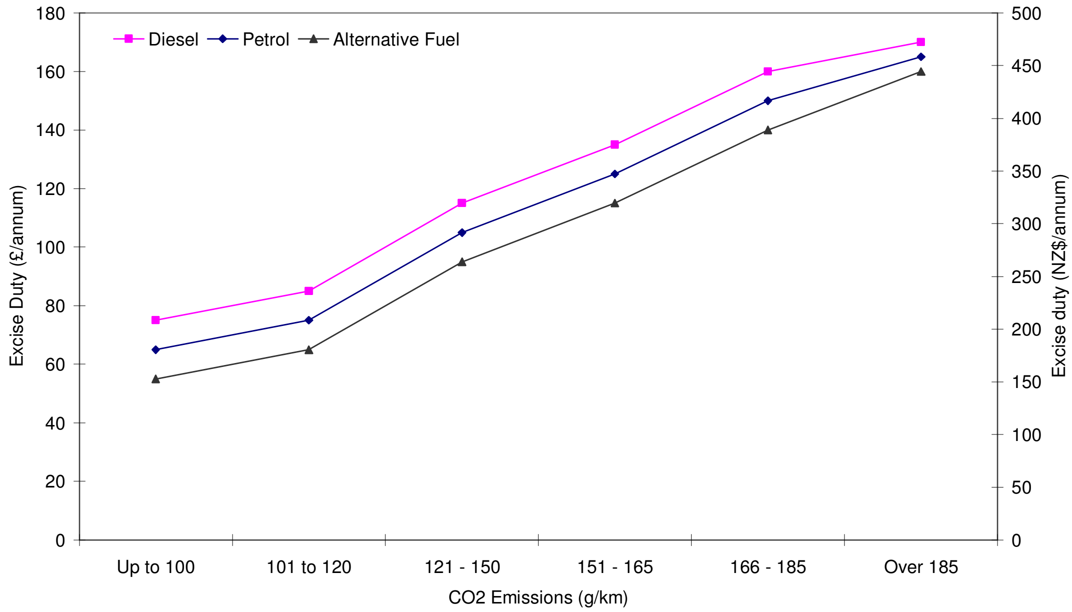
Source: European Automobile Manufacturers Association (2005) Tax Guide. Motor Vehicle Taxation in Europe 2005 Edition.

We examine the UK system below because of the availability of studies that review its cost-effectiveness, while noting the difference in the UK market from that in New Zealand.

3.5.1. UK

The UK Government introduced significant financial incentives in favour of cleaner vehicles, including graduated vehicle excise duty (VED) and a reform of company car taxation.[19] From 1 March 2001 vehicle excise duty (VED) has been based on CO_2 emissions for new vehicles (Figure 18). The rates for vehicles first registered prior to 2001 were based on engine size (Table 8).

Figure 18 Vehicle Licence Fee for Private/Light Goods Vehicles (goods vehicles not over 3,500kg) (registered on or after 1st March 2001)



Source: http://www.dvla.gov.uk/vehicles/taxation.htm

Table 8 Vehicle Licence Fee for Private/Light Goods Vehicles (goods vehicles not over 3,500kg) (registered before 1st March 2001)

	12 months rate £	6 months rate £
Registered before 1st March 2001		
Not over 1549cc	110.00	60.50
Over 1549cc	170.00	93.50
Light Goods Vehicles registered on or after 1st March 2001	165.00	90.75
Light Goods Vehicles registered on or after 1st March 2003	110.00	60.50

Source: http://www.dvla.gov.uk/vehicles/taxation.htm

A recent review of the Impact of Graduated Vehicle Excise Duty (VED) scheme found:[20]

- new car purchasing is dependent on a number of key factors. Environmental considerations and, specifically, road tax rates are not among the most significant;

- overall price, fuel consumption, size, reliability and comfort are the most important factors in the decision making process for new car purchasers. Running costs, including fuel costs, insurance, servicing and fuel type, are most important to new car owners/buyers;

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[19] http://www.dft.gov.uk/stellent/groups/dft_roads/documents/pdf/dft_roads_pdf_506887.pdf

[20] Lehman C, McLoughlin K and Dewhurst M, MORI (2003) Assessing the Impact of Graduated Vehicle Excise Duty: Quantitative Report

- how VED is calculated and the merits of the graduated scheme are not well understood. The majority still believe that road tax is calculated using the cc size of a car's engine. While this is related to a car's CO_2 emissions, the message that this is how VED is established has not reached many private car buyers;

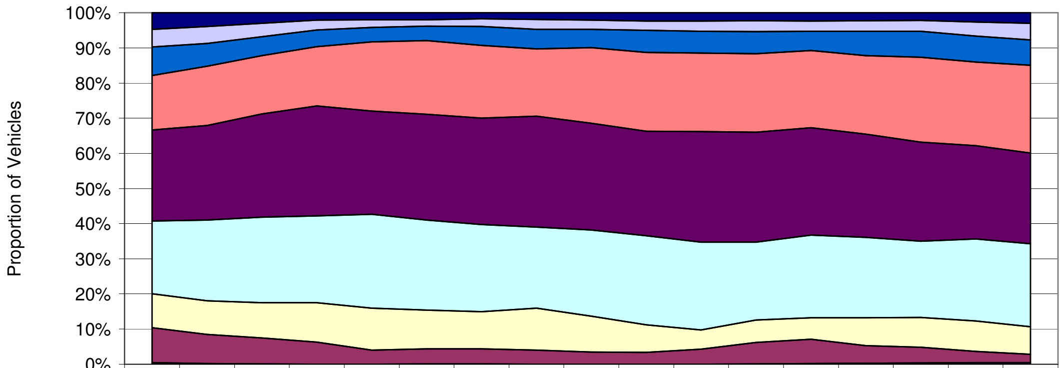
- when the scheme is explained to respondents, those who have bought a car privately after March 2001 say that it was not part of their decision making process. Those who are planning to buy indicate that it may be a factor that they will consider in the future, however, given the behaviour of those who actually have purchased since the introduction of graduated VED it is possible that this intention will not be followed through;

- focusing on recent private purchasers the data support the qualitative research conclusion that the current graduated scheme does not offer a large enough incentive to encourage behavioural change;

- looking to the future and possible changes to the scheme, a differential between bands of £50 would be enough for some buyers to choose a different car (33%). Others would consider it. At a differential of £150, 55% would change to a lower emission car to benefit from the saving. There is however a core of buyers who would not change their vehicle choice regardless of the differential (28%). This hard core is typically older, of higher income and own or intend to buy a larger-sized engine vehicle.

Backing up these comments, data on vehicle registrations by size band show no obvious discontinuity in the trends from 2000/2001 (Figure 19).

Figure 19 Proportion of Vehicles by Year and Size Band in the UK (2004)



	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
>3000	4.7%	3.9%	3.0%	2.1%	1.9%	2.0%	1.7%	1.9%	2.1%	2.3%	2.4%	2.2%	2.3%	2.3%	2.1%	2.6%	3.0%
2501-3000	5.1%	4.8%	3.8%	2.8%	2.3%	1.9%	2.2%	2.9%	2.7%	2.6%	2.9%	3.1%	2.9%	3.0%	3.1%	4.0%	4.8%
2001-2500	8.1%	6.5%	5.3%	4.7%	4.0%	4.1%	5.3%	5.6%	5.1%	6.3%	6.2%	6.3%	5.5%	6.9%	7.3%	7.4%	7.2%
1801-2000	15.5%	16.9%	16.6%	16.9%	19.7%	21.0%	20.8%	19.2%	21.5%	22.5%	22.4%	22.3%	21.9%	22.3%	24.2%	23.8%	25.0%
1501-1800	25.9%	26.9%	29.3%	31.3%	29.4%	30.1%	30.2%	31.5%	30.4%	29.7%	31.5%	31.3%	30.6%	29.4%	28.2%	26.5%	25.8%
1201-1500	20.7%	23.0%	24.4%	24.7%	26.7%	25.7%	24.8%	23.1%	24.6%	25.4%	25.0%	22.2%	23.6%	22.9%	21.7%	23.4%	23.7%
1001-1200	9.6%	9.6%	10.0%	11.2%	12.0%	11.0%	10.6%	11.9%	10.2%	7.9%	5.4%	6.3%	6.1%	7.9%	8.5%	8.6%	7.8%
701-1000	10.0%	8.2%	7.4%	6.3%	4.0%	4.3%	4.3%	4.0%	3.4%	3.3%	4.3%	6.1%	6.9%	5.0%	4.5%	3.2%	2.4%
<700	0.4%	0.2%	0.1%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.2%	0.2%	0.3%	0.4%	0.5%

Year of First Registration

Source: National Statistics (2005) Transport Statistics Bulletin. Vehicle Licensing Statistics 2004 (www.dft.gov.uk/stellent/groups/dft_transstats/documents/downloadable/dft_transstats_037930.pdf)

However, there is a useful comparison with trends in the New Zealand fleet (Figure 8) where there has been an increase in purchases of vehicles in the 2-2.5 litre band and in vehicles above 2.5 litres. The UK, in contrast has seen some increase in the proportion of vehicles in the 1.8-2 litre band but not in vehicle bands above this size. A range of factors will have contributed to this difference between the trends in the two countries, including differential registration fees, but also fuel costs (which are significantly higher in the UK)[21], road conditions and parking space. Total vehicle numbers per head of population is higher in New Zealand (0.61) than in the UK (0.48) but the rate of increase in the vehicle population is greater in the UK (10% increase in vehicles per capita from 2000-2004 compared with 8% in New Zealand).[22]

Registration fees are taxes on vehicle ownership. They do not change the marginal costs of use of the vehicle. An alternative approach is one that charges a registration fee on the basis of distance travelled.

3.6. Distance Based Registration Fees

Distance-based registration fees introduce a charge that varies with the distance travelled. This is the same approach used to apply Road User Charges in New Zealand. Currently road user charges are paid by owners of diesel-powered vehicles (or any powered by fuels not taxed at source) and by vehicles with a manufacturer's gross laden weight of more than 3.5 tonnes. Vehicles must be fitted with a distance recorder that is "of a type and accuracy sufficient to provide a reliable record of distance travelled".[23] All vehicles greater than 3.5 tonnes in weight must be fitted with an approved hub odometer. Approved hub odometers are specified in regulation (The Road User Charges Regulations 1978).

One option would be to extend the method to petrol vehicles, and to vary the rate with the fuel economy of the vehicle. It would be used to replace registration fees that currently apply to petrol- and diesel-powered vehicles.

This approach mimics a fuel tax as a way to charge vehicles. It has the same effect as a fuel tax but the charge is paid periodically (eg for 1,000 km) rather than for every tank of fuel. There would appear to be no advantage in using this approach rather than a fuel tax, and it requires the installation of a distance recorder on petrol vehicles, a considerable additional expense. Assuming an average 15,000 km per annum per vehicle and a fuel consumption of 9 litres/100km, a $200/annum registration fee would be equivalent to a 14.8 c/litre tax.

[21] In July 2005, Unleaded 95 averaged 88.7p/litre (c.NZ$2.29/litre) (www.theaa.com/onlinenews/allaboutcars/fuel/2005/July2005.doc)

[22] Sources: LTNZ, National Statistics UK

[23] Land Transport New Zealand (2005) Road User Charges.

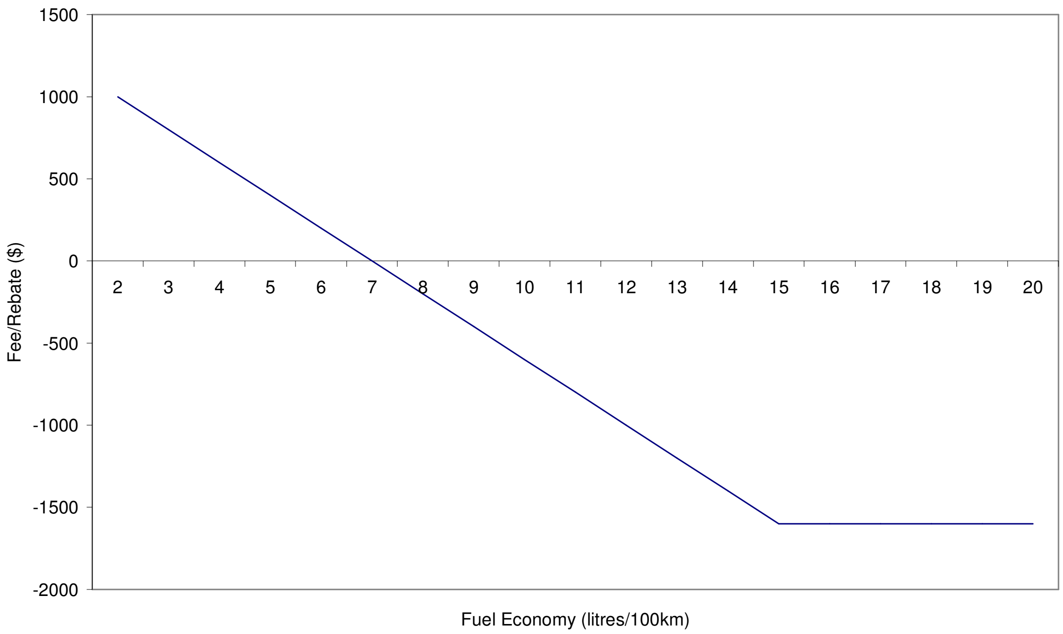
Todd Litman from the Victoria Transport Policy Institute[24] argues that distance-based charges are better than fuel charges at charging true marginal costs, but this is largely because he is concerned with internalising the costs of other pollutants that are not as directly related to fuel burn as are CO_2 emissions.

Fuel taxes are not the subject of this review, however. We do not pursue distance-based registration fees further. We do examine the option of encouraging distance-based insurance below (Section 3.11).

3.7. Feebates

Feebates are designed to combine elements of both a fee and a rebate for different categories of passenger vehicle. Vehicles are charged a registration fee that varies with the fuel economy (or CO_2 intensity) of the vehicle as discussed in Sections 3.4 and 3.5 above. A point is defined in fuel economy or CO_2 intensity terms; vehicles that perform worse than this pay a fee and those that perform better than this receive a rebate. An example is shown in Figure 20 relating to a variable acquisition fee. Vehicles that have a fuel economy that is better than 7 litres/100km receive a rebate on their vehicle purchase costs of up to $1000; those worse than 7 litres/100km pay a fee up to a maximum of $1600.

Figure 20 Example Feebate Scheme



These schemes can be designed to be revenue neutral. By taking account of the expected number of vehicles in different size classes, the amount collected in fees can be equal to the amount offered in rebates.

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[24] Litman T (1999) Distance-Based Charges; A Practical Strategy for More Optimal Vehicle Pricing Victoria Transport Policy Institute Transportation Research Board 78th Annual Meeting January 1999 Session 458 Paper No. 99-0678 (www.vtpi.org/db_crg.pdf)

A key question in the design of the scheme is whether it applies as an acquisition fee or an annual registration fee. For the acquisition fee, there would be a charge on high fuel consumption new imports of vehicles (new and second hand) and a rebate on low fuel consumption vehicles imported. For an annual fee, the scheme would apply a higher annual fee to the high fuel consumption vehicles and so on. Internationally feebates have been applied typically as an acquisition fee.

3.7.1. Acquisition Feebates

Acquisition feebates have two effects:

- they increase the differential between high and low fuel consumption vehicles on import, providing greater incentive for purchase of low fuel consumption vehicles; but

- they also subsidise purchases of low fuel consumption vehicles relative to other forms of transport, eg public transport (where available).

The issues of market definition are the same as for acquisition fees (Section 3.4). The feebate scheme will increase the price of vehicles on first introduction, but this may be in a way that leads also to a corresponding increase in the value of second hand vehicles. This will extend the lives of existing SUVs, 3 litre vehicles etc. For purchases of fuel-efficient vehicles, the value of second hand vehicles would fall, because new vehicles fell in value. This has the potential to lead to earlier scrapping of older fuel efficient vehicles. There are thus two opposing effects. For fuel efficient vehicles, the stock would become younger, enhancing further its fuel efficiency. For less fuel efficient vehicles, the stock would grow in age. There would be an overall shift towards more fuel efficient vehicles.

There has been some international experience with feebate schemes and some analyses that suggest they will be highly effective,[25] but they operate in quite a different market from that in New Zealand.

There are some risks because of the subsidy element of the feebate. The lower price of small, fuel-efficient vehicles, might also encourage greater purchase of vehicles as a whole, and may lead to shifts from public transport to vehicle purchase. This can be a perverse outcome of the scheme, potentially leading to higher vehicle use as a result.

A variant on the scheme might be to extend the rebate to a wider set of options than simply subsidising purchase of new low fuel consumption vehicles. For example, income might be made available to fund public transport also.

On efficiency grounds, a scheme would best charge vehicles for their emissions of CO_2, proxied by fuel use. Introducing a subsidy element is inefficient and can have perverse

[25] Mark A. Euritt, Mike Martello, Jiefeng Qin, Angela Weissmann, Stephen Bernow Mark Fulmer, Irene Peters, Tellus Institute. Strategies for Reducing Energy Consumption in the Texas Transportation Sector (www.tellus.org/energy/publications/e6-sb02.pdf)

outcomes because it can never capture the full range of possible decisions that will have low carbon outcomes and this includes not owning a vehicle and not undertaking some trips.

A feebate scheme is complex and it is difficult to identify the likely outcomes. However, the conclusions that applied to the registration fee systems apply here also, and there is no guarantee that it will result in significant fuel economy improvements. Feebates differ from registration schemes in terms of revenues raised as they are (often) established to be revenue neutral. This would require revenues to be raised elsewhere to meet the funding gap from the loss of registration fee revenues.

3.7.2. Annual Feebates

An annual feebate might charge an annual registration fee only to vehicles above a specified fuel consumption rate or engine size, but pay out the rebate on new purchases of fuel-efficient vehicles.

In comparison with an acquisition feebate, this reduces the incentive for purchases of fuel-efficient new vehicles, as it lowers the difference between purchase prices from that under an acquisition feebate; specifically the up-front fee for importing a fuel-inefficient vehicle would be less than under an acquisition feebate. However, it also reduces the incentive to shift towards purchase of second hand fuel-inefficient vehicles.

The price of small and other fuel efficient vehicles would react to two effects. On the one hand, the reduced price of new fuel-efficient vehicles would push down the price of second hand fuel-efficient vehicles, if they are to compete. On the other hand, the increased annual registration fees on the less fuel-efficient vehicles may allow smaller cars to raise prices. The effect depends on which is the stronger market definition: the market for a vehicle or for a particular vehicle class.

The effects on fuel use and emissions are highly uncertain.

3.7.3. Effectiveness

A recent US research paper notes the advantages of feebate schemes, particularly because of perceived market failures with respect to consumers' decision making about fuel economy, ie there is a perception that consumers do not fully take fuel savings into account in making vehicle purchases.[26]

The researchers modelled the effects; it suggested that a feebate rate of $500 per 0.01 gallon per mile (GPM) produces a 16% increase in fuel economy, while a $1000 per 0.01 GPM results in a 29% increase, even if consumers count only the first 3 years of fuel savings. However, they estimated that the vast majority (95%) of fuel economy improvement is due to adoption of fuel economy technologies rather than shifts in sales.

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[26] Greene DL, Patterson PD, Singh M and Li J (2005) Feebates, rebates and gas-guzzler taxes: a study of incentives for increased fuel economy. Energy Policy 33(6): 757-775.

They concluded that "the economics of fuel economy improvement strongly favour technological solutions over changing the mix of vehicles sold".[27]

Transferring this to New Zealand is complicated by the absence of a local manufacturing industry, whereby the effects are limited to consumer choice amongst the vehicles available. This research suggests that simply influencing choices amongst the technologies available in new Zealand will have a small effect on fuel economy, relative to the effect that is associated with the change in technology which New Zealand, as a technology taker, receives anyway.

3.8. Company Vehicle Tax

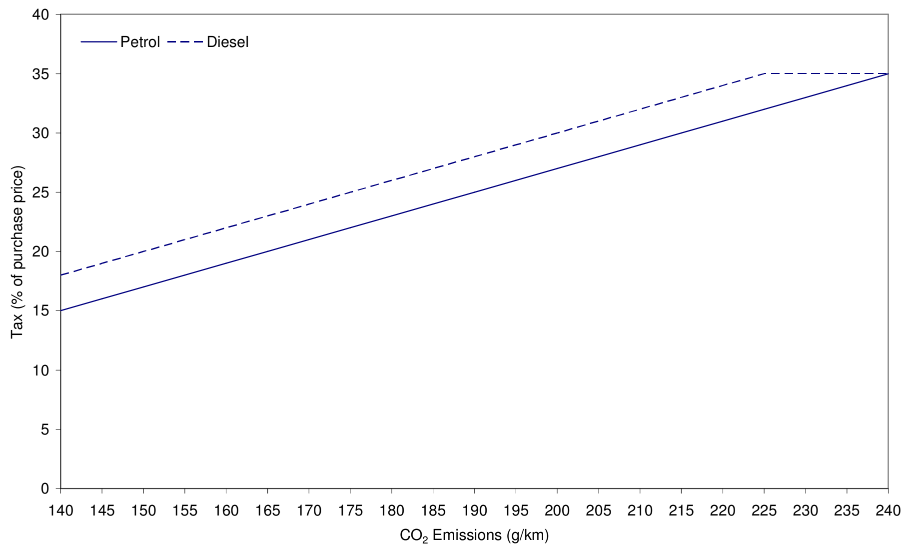
As at 2001, government and companies accounted for 70-80% of NZ-new car sales. It suggests that measures aimed at companies may be a fruitful area for policy focus. We start by looking at recent UK experience with changes to levels of company vehicle tax, followed by an evaluation against current NZ practice.

3.8.1. UK Fringe Benefit Tax

The company car tax regime in the UK has been changed. The old scheme had a tax rate on cars as fringe benefits that totalled:

- 35% of the price of the car if it was driven less than 2,500 business miles during the tax year
- 25% if driven 2,500 to 17,999 business miles
- 15% if driven 18,000 or more business miles

Figure 21 UK Company Vehicle Tax (2005/06)



Source: HM Revenue & Customs IR172–Income Tax and Company Cars (www.hmrc.gov.uk/pdfs/ir172.htm)

[27] Greene et al (op cit)

Since April 2002, the company car tax system no longer includes the mileage discounts that had encouraged greater business miles, and is based on vehicles' CO_2 emissions. This allows company car drivers to save hundreds or even thousands of pounds each year by choosing the most fuel-efficient cars. If you are an employee earning £8,500 a year or more, or are a director, you have to pay a tax on a company car. The tax rate varies with the purchase price and CO_2 emission rates.

An initial evaluation of the impacts of the company car tax regime[28] shows that, in 2003 alone, the reforms saved 150,000-200,000 tonnes of carbon. By 2010, the annual carbon saving is forecast to be much higher—perhaps between 0.5 and 1 MtC. The differential registration fee has had a less significant impact, largely because the rewards for choosing more fuel-efficient vehicles are currently much smaller.

The findings from the research included:

- very high levels of awareness of the reform among company car drivers, although knowledge of the CO_2 information on which the tax charge is now based was low;
- around two thirds of company car drivers surveyed said that they had worked out the financial implications they thought the changes would have on their benefit-in-kind tax charge;
- of drivers who were aware of the reform at the time when they last chose a company car, 61% received a car with CO_2 emissions attracting a charge of 20% or less. This compares to those who were not aware of the reform when they last chose a company car, where 55% received a car with CO_2 emissions attracting a 20% charge or less;[29]
- over three-quarters of employers who provide company cars were aware that CO_2 emissions are now taken into account in the company car tax charge at the time of the survey. Over half of all employers surveyed said that their organisations were actively encouraging employees to switch to cars with lower CO_2 emissions. In addition, 27% of employers noted that their employees were actively encouraging them to change the types of cars provided for company car drivers;
- 59% of employers said that they have changed their policy towards CO_2 emissions and 36% said they had changed their policy towards car list prices.

Currently there is no duty on vehicles entering New Zealand. GST is the only tax paid. This contrasts with many other countries (see Section 3.4). Company vehicles are affected by two aspects of tax regulation—depreciation rules and fringe benefit tax.

[28] Inland Revenue (2004) Report on the Evaluation of the Company Tax Reform. (www.hmrc.gov.uk/cars/cct_eval_rep.pdf)

[29] It is not clear whether this is a statistically significant result.

3.8.2. New Zealand Fringe Benefit Tax

Where a vehicle is made available for an employee to use privately, the employer must pay Fringe Benefit Tax (FBT), regardless of whether the employee actually uses the vehicle privately. FBT is also payable on subsidised transport (if worth $1,000 or more annually).[30]

Work-related vehicles are exempt from FBT but must meet certain criteria, eg light pick-up trucks. Vehicles with a gross laden weight of more than 3.5 tonnes are not subject to FBT.

FBT is charged on the total taxable value of benefits either at 64% or 49% of the taxable value of the benefits. The taxable value is estimated either from the actual cost or the market value. It is equal to 24% (6% per quarter) of the value of the vehicle times the proportion of time for which it is available. Incentives for more fuel efficient vehicles might be made by changing the calculation of taxable value, eg to use a lower multiplier than 24%.

In the year to June 2004 $410 million was paid in FBT and it is estimated that approximately 67% of this ($275 million) is paid on vehicles.[31] Assuming an average vehicle price for cars subject to FBT of $40,000, this amount of FBT would correspond to 29,000 vehicles (assuming they are available all the time) or 57,000 if available half the time (on average); of these, we might assume that one quarter (14,000) were new vehicles in any year and therefore could be affected by policy shifts.

Table 9 sets out an estimate of the first year savings in CO_2 that might result if all vehicles shifted from the average fuel economy to the best fuel economy in each class. These data were taken from the Australian Greenhouse Office Green Vehicle Guide.

Table 9 Potential First Year CO_2 Savings from Changes to Fringe Benefit Tax

	Engine size (cc)		
	2000	2500	3000
Fuel Consumption Rate (l/100km)			
Average	8.68	9.90	10.50
Minimum	5.20	7.80	8.50
Fuel Consumption (Litres) (assuming 30,000km/year)			
Average	2603	2970	3151
Minimum	1560	2340	2550
Potential Saving (litres) (Average to Best Switch)	1043	630	601
Potential Saving/vehicle (tonnes CO_2) (@2.3kg/litre)	2.40	1.45	1.38
Total saving (tonnes CO_2) (14,000 vehicles)	33,571	20,278	19,350

Source: Covec estimates with data from www.greenvehicleguide.gov.au

The quantity saved will increase over time as, each year, additional vehicles are added. However, these estimates are the greatest that could be expected in the first year,

[30] Inland Revenue (2003) Fringe benefit tax guide. A guide to working with FBT. IR409.

[31] Sri Varley, Inland Revenue, personal communication. This was the percentage of FBT paid on vehicles in 2001, the last year that the data were collected at a disaggregated level.

assuming all vehicles are encouraged to change and change to the very best possible vehicle. They are also likely to be an over-estimate as they include all vehicles in the size band. In practice the number of vehicles that will be considered for purchase by any individual is likely to be a sub-set of this total.

3.8.3. Depreciation

Capital expenditure cannot normally be deducted from revenues in calculating the profit and tax liability of a business. What can be deducted is depreciation; this is an allowance that acknowledges that assets eventually wear out or become out-of-date. For tax purposes, the reduced value of an asset is recognised by allowing a deduction against income for the depreciation of that asset from the time it is used in a business until it is sold, disposed of, or discarded. The end result is that the cost of the asset will be written off over its useful life.[32] There are two methods that can be used:

- the Diminishing Value method in which depreciation is calculated each year by using a constant percentage of the asset's adjusted tax value—this is 26% for passenger vehicles (there is an additional 20% for new vehicles taking this to 31.2%)[33]; and

- the Straight Line method in which an asset depreciates every year by the same amount, which is a percentage of its original cost price—this is 18% for passenger vehicles (21.6% for new vehicles).

The implications of the two approaches are shown in Table 10.

Table 10 Implications of Current Depreciation Rates

	Diminishing Value Method (26%)		Straight Line Method (18%)	
	Adjusted Tax Value ($)	Depreciation ($)	Adjusted Tax Value ($)	Depreciation ($)
Year 1	25000	8250	25000	4500
Year 2	16750	5528	20500	4500
Year 3	11223	3703	16000	4500
Year 4	7519	2481	11500	4500
Year 5	5038	1662	7000	4500

The incentive on firms is to depreciate faster as it allows reduced tax liability in early years. One policy approach would be to vary the depreciation rates according to the classification of the vehicle in fuel economy terms. There is already a table of different rates for different types of assets including different rates for different types of vehicle (Table 11). This approach would be to increase the number of categories.

[32] Inland Revenue Department (2004) Depreciation - a guide for businesses IR260 (www.ird.govt.nz/resources/file/eb2cf9014568e48/ir260.pdf)

[33] Inland Revenue (2004) General Depreciation Rates (IR 265)

Table 11 Motor Vehicle Depreciation Rates-Selected Categories

Asset	Diminishing Value (DV)	DV + 20%	Straight Line (SL)	SL + 20%
Motor vehicles (MVs) transporting people	26	31.2	18	21.6
MVs transporting light goods (≥3.5 tonnes)	18	21.6	12.5	15
MVs transporting medium goods (3.5 - 12 t)	15	18	10	12
MVs transporting heavy goods (>12 t)	18	21.6	12.5	15
Motorcycles	26	31.2	18	21.6

Source: Inland Revenue (2004) General Depreciation Rates (IR 265)

The way in which companies would respond to such an approach, and the way in which any variation in depreciation rate is expressed, in uncertain; it will depend on the way in which companies and employees value higher engine size and other attributes of vehicles. Currently prices are lower for smaller vehicles but not at a level at which purchasers are indifferent between purchases. We are not aware of studies that have examined willingness to pay for vehicle attributes. Changing depreciation rates will have some effect at the margin, but is likely to be small.

Changing depreciation schedules is unlikely to have any additional effects, eg on vehicle turnover, because companies will pay tax on the profits from sales. The difference between market and book value, and thus liability to tax on depreciation recovered, will be greater for the fuel-efficient vehicles in early years of ownership.

3.9. Offsets and Tradable Permits

Offsets are schemes that allow companies that have a regulatory requirement at one site to meet this requirement, at least in part, through reductions elsewhere. Such a scheme might be used to provide a mechanism for rewarding shifts to improve fuel economy. Offsets are a kind of tradable permit scheme. There are two requirements for an offset programme to work:

- a party with an obligation, eg to limit emissions to a specified amount; and
- a party that can reduce emissions and thus create a credit that can be sold to the party with the obligation.

There are currently no parties with obligations to meet a specific level of emissions of CO_2 or other greenhouse gases. However, options might include:

- including such a requirement within NGAs, allowing purchased credits to be used to meet the requirement if it was not possible to meet it at the site;
- achieving the CO_2 benefits using obligations for reductions of other pollutants, eg SO_2 and NOx.

If a party with an obligation could be identified, the second challenge is to estimate the way in which credits can be identified. As with all credit-based trading schemes, it requires the definition of a credible counter-factual or baseline[34] against which actual emissions can be compared. For example, if a company was buying a new vehicle fleet, or adding to its existing fleet, purchasing fuel efficient vehicles might be rewarded with a credit if it could be proven that, normally (ie without payment for a credit), the company would have purchased some less fuel efficient alternative. Credit-based trading schemes have the difficult task of developing rules that can be used to define such baselines. They are generally contentious and are best avoided if an alternative scheme can be developed that does not require the definition of a baseline.

3.10. Fuel and Technology Switching

Direct encouragement of specific technologies could be used as an alternative method to limit emissions. For example, low-emission technologies such as hybrid vehicles or those using biomass fuels, could be subsidised to encourage entry.

New Zealand has historical experience with such programmes, and notably subsidies for conversion to LNG or CNG. New Zealand in the late 1980s had approximately 100,000 CNG and 50,000 LPG vehicles.[35] However, following the removal of subsidies and the introduction of excise duty on CNG and LPG, numbers dropped off rapidly. By 1995, there were approximately 27,000 CNG vehicles and 20,000 LPG vehicles.

Converting to natural gas will reduce CO_2 emissions, although reductions may not be significant—studies suggests that emission levels may be similar to those of diesel vehicles.[36] The CO_2 performance of natural gas vehicles is expected to improve over time as technologies improve and, by 2010, emission rates per km are expected to be 13% better than diesel and 16% better than petrol vehicles.[37]

3.10.1. Australian Alternative Fuels Conversion Programme

The Alternative Fuels Conversion Programme (AFCP) assists operators and manufacturers of heavy commercial vehicles and buses (>3.5 t GVM) to convert to Natural Gas (NG) or Liquefied Petroleum Gas (LPG). The programme provides grants to vehicle owners to offset costs of fuel conversions and upgrades and to purchase new vehicles.[38] A public register is kept of approved engine products. Customers who purchase products listed on this register are eligible to apply for AFCP grants.

The programme also helps manufacturers to develop and test engine technologies that can demonstrate greenhouse gas benefits and maintain air quality emissions performance and to place these on the Type Approval Register. This aspect of the programme would not be relevant to New Zealand.

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[34] The definition needs to describe what would happen in the absence of the policy measure.

[35] http://fueltaxinquiry.treasury.gov.au/content/Submissions/Industry/Origin_Sup_341.asp

[36] European Commission (2003) Market Development of Alternative Fuels Report of the Alternative Fuels Contact Group

[37] European Commission (op cit)

[38] http://www.greenhouse.gov.au/transport/afcp/index.html

The AFCP provides grants of up to 50% of the eligible costs to vehicle owners to purchase LPG or NG vehicles or convert or upgrade existing vehicles. Payments are made for:

- the difference between the purchase price of new NG or LPG fuelled vehicles and their conventionally fuelled equivalents; or
- the cost of converting conventionally fuelled vehicles to operate fully or partly on NG or LPG; or
- the cost of upgrading the fuel systems of vehicles already operating on NG or LPG.

In all cases a minimum of 5% reduction in greenhouse gas emissions needs to be demonstrated and the engine must continue to meet noxious emission limits.

3.10.2. Options for New Zealand

Direct promotion of specific technologies might be used in New Zealand, as it was used in New Zealand in the past. Subsidies have a wide range of disadvantages however, not least because they require the identification of specific technologies to support. There will always be other options that may also be effective at reducing emissions that are not rewarded.

3.11. Insurance Measures

A number of countries have had experience with linking insurance payments to vehicle distances travelled.

In the US, the Progressive Casualty Insurance Corporation began testing a usage-based auto insurance product “Autograph” in Houston in 1998, and expanded the programme throughout Texas in August of 1999.[39] The system used retrofitted Global Positioning Satellite (GPS) and cellular technology to record and collect data. Drivers were charged according to amount of time, time of day, and place of driving. This method allowed drivers to save money by spending less time in their vehicles, especially during congestion periods when trips take the most time.

Progressive discontinued selling new policies in April 2000, but continued to service existing usage-based policies until July 15, 2001, when the company discontinued the programme. The costs involved were high, set against a small number of policy holders.

In the UK, Norwich Union, recruited 5,000 customers to participate in a pilot programme which began in late 2003 to test the benefits of and demand for Pay as Your Drive insurance. The programme is now in the next phase of the pilot—data gathering used to calculate appropriate premiums. Policyholders will pay a monthly premium to

[39] http://www.serconline.org/payd/background.html

cover the basics like fire and theft protection, and then will pay itemised add-on charges reflecting vehicle usage

Norwich Union collects real-time vehicle data using a 'black box' device installed in each vehicle. It uses GPS technology and a mobile telephone signal to send data. The technology also allows the company to offer associated in-car services, such as emergency assistance and real-time route planning.[40]

To date these programmes have been introduced voluntarily by companies. In the US, in 1998 the National Organization for Women developed model legislation that could be used to require insurance companies to provide such insurance cover.[41]

There are a number of ways in which distance-based pricing might be introduced (Table 12).

Table 12 Distance-Based Pricing Options

Type	Description	Equipment Costs	Operating Costs	User Inconvenience	Price Adjustability
Odometer Audits	Odometer readings are collected by certified odometer auditors, usually during scheduled maintenance	Low	Low	Low	Low
VUDAR	Vehicle operating hours are recorded by a small instrument installed in each vehicle. Data are transmitted annually at a special station.	Medium	Low	Low	Medium
On Board Data Collection	Electronic system in each vehicle tracks mileage. Data transmitted to a central computer, automatically or by users.	High	Medium	Medium	Low-Medium
GPS	A GPS system is used to track the location of each vehicle. Data are automatically transmitted.	High	Medium	Low	High

Source: http://www.vtpi.org/tdm/tdm10.htm

Distance-based insurance would provide some additional incentive for reduced vehicle activity over an above that provided by the costs of fuel. To the extent that it was a reflection of the risks faced by insurance companies, then use of such an approach would be both economically efficient and result in reduced greenhouse gas emissions.

3.12. Heavy Vehicles

The incentives for fuel economy are likely to be greater for heavy vehicles because of their greater use of fuel, their commercial use and incentives on owners for cost minimisation. Thus fuel economy can be expected already to be a significant consideration in vehicle purchase decisions.

In addition, the measures discussed above for other vehicle types would apply equally to heavy vehicles.

[40] http://www.norwichunion.com/pay-as-you-drive/

[41] http://www.now.org/issues/economic/insurance/bill.html

One further option for consideration relates to the bus fleet and the role that local government contracting plays in bus purchases. Fuel economy might be introduced as a criterion in contract evaluation and be used to offset contract price. Central government's role would be that of advocating such an approach to local government. The difficulty with this option is that it requires that local government takes account of greenhouse gas reduction benefits, something that they are explicitly required not to do, eg Section 70(A) of the Resource Management Act states:

> … when making a rule to control the discharge into air of greenhouse gases … a regional council must not have regard to the effects of such a discharge on climate change, except to the extent that the use and development of renewable energy enables a reduction in the discharge into air of greenhouse gases …

3.13. Combinations of Measures

The discussion above treats the policy options in isolation. The benefits might be enhanced through combinations of measures. The most obvious is for measures that affect vehicle purchase (eg registration fees and feebates) and de-registrations (scrappage incentives). However, the scrappage incentive programmes discussed were less able to provide a systematic reduction in retirement age, than annual registration fees that reduced the value of vehicles in use. In this sense the annual registration fee functions like a combined instrument, with incentives that apply both to imports and de-registrations.

We see limited scope for other combinations that would have greater effects in combination than alone.

4. Conclusions

This review has identified a number of policy options for reducing greenhouse gas emission from transport. None would be expected to provide significant cost-effective emission reductions.

- **Early Retirement Incentives** that encourage vehicles to be scrapped early may remove the least efficient vehicles from the market but this is only bringing forward in time what would happen anyway. The emission savings may be short lived and may be overtaken through increases in future emissions as early retirement leads to early introduction of a new (or imported second hand) vehicle whereas delay would have meant the introduction of a vehicle that was more fuel efficient, because of ongoing improvements in vehicle technology.

  Early retirement measures will be more effective if they permanently reduce the age at which vehicles are retired rather than having small marginal effects on individual vehicles. This might be more likely through changes in vehicle price such that the costs of replacement vehicles were reduced.

- **Differentiated Registration Fees** are fees on first acquisition, or regular annual fees, that differ with the fuel economy (or CO_2 intensity) of the vehicle. The impacts of these schemes are uncertain because of the dynamic effects on the vehicle market.

  Fees on first acquisition (NZ-new or second hand imports) increase the relative price of fuel-inefficient vehicles and will lead to substitution by more fuel-efficient vehicles, but they can also lead to substitution by second hand vehicles already on the market. This results in an increased market value for second hand fuel-inefficient vehicles and extends their lives.

  Annual registration fees can change vehicle import decisions, although often purchasers take limited account of full lifetime costs. Because the vehicle stock that is already in the country is set to some extent, underlying vehicle prices would be expected to change to compensate for the introduction of the differentiated annual fees, with the value of fuel inefficient vehicles falling. This will also result in earlier retirement of these vehicles.

  Empirical evidence suggests that registration fees have limited effectiveness. Research in the US and the EU notes that the overwhelming majority of efficiency improvements are associated with vehicle manufacturers improving the average fuel efficiency of the vehicles on the market, as opposed to customers choosing the more fuel efficient vehicle within the overall market. In observing these conclusions, it is noted that it is difficult to separate out the effects of individual policy measures, and differentiated fees have been introduced at the same time as other instruments, including fuel price measures. However, there is no clear evidence that, within this policy mix, differentiated registration fees have had any significant impact, and the researchers suggest that they have not. Because New

Zealand has very little vehicle manufacturing industry (and none for passenger cars), it is limited to achieving the more limited effects relating to customer choice. The international experience suggests that these will be small.

- **Feebates** are variants on the differentiated registration fee that include both a fee, for fuel-inefficient vehicles, and a rebate (or subsidy) for fuel-efficient vehicles. Depending on how they are designed, the fee differential between efficient and inefficient vehicles can be greater than under a simple fee programme.

  The limitations of registration fees apply to feebates also. However, an additional concern is that, because of the subsidy component, vehicle purchase prices (albeit for fuel-efficient purchases) are reduced whereas prices of other potentially efficient transport choices are not. Thus, in addition to shifts in vehicle purchase, there may also be shifts from public transport to vehicle purchase and use.

- **Company Tax Measures** include those that alter the treatment of different types of vehicle under fringe benefit tax and varied rates of depreciation. Because many new vehicles are purchased by companies, these measures could be expected to have some limited effects.

- **Technology Encouragement—**direct encouragement of specific technologies such as via subsidies has been used before in New Zealand to encourage uptake of LPG and CNG vehicles. It is also employed in other countries, such as Australia, particularly for heavy vehicles. There is likely to be potential for some large reductions from targeted improvements. However, they may not be the most cost-effective options for limiting emissions; these would be expected to be discovered more widely using fuel pricing measures.

- **Insurance Measures** such as Pay as You Drive insurance has been encouraged in a number of countries. These provide additional incentive at the margin, over and above the costs of fuel, for reduce transport activity. Pay as You Drive insurance could be encouraged through direct dialogue with the insurance industry.

Most Promising Measures
Company tax measures would be likely to lead to some changes in vehicle purchase decisions and show some potential for small reductions in total emissions.

Of the measures that aim to change purchase decisions more widely, the differentiated annual registration fee is likely to hold most promise. The empirical evidence for significant reductions in emissions is not strong and it is limited by the potentially limited extent to which purchasers take account of future costs of vehicle ownership. However, the effect may be greater in New Zealand than in other countries because of the second hand import market. First entrant vehicles are purchased by a wider cross-section of socio-economic groups, including purchasers that will be price elastic across the range of vehicle types.