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Greenhouse Gas Emission Policies

Is There a Way Forward?

Report to
Greenhouse Policy Coalition

September 2005

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1 Introduction

The objective of this report is to consider a reasonable set of policies and targets for New Zealand with respect to greenhouse gas emissions.

Until recently, New Zealand's approach to climate change policies has been conditioned by an expectation that significant reductions in greenhouse gas emissions could be achieved without correspondingly significant social and economic dislocations. The main articles of faith included:

- A belief that energy use in New Zealand was generally inefficient, and hence that substantial reductions in emissions could be achieved without economic costs
- A belief that the New Zealand economy was rapidly evolving away from the "old" activities associated with greenhouse gas emissions, and towards "new", service oriented sectors which did not emit. This provided the basis for a further view that even if some economic losses had to be incurred in the "old" sectors, they could be easily absorbed by the growth in the "new" sectors
- A belief that it was possible to reconcile the protection of New Zealand's economic activities whose competitiveness was at risk from countries which did not adopt climate change policies, with on-going reductions in greenhouse gas emissions
- An overarching belief that, if all else fails, New Zealand's economic well-being would be protected through the surplus of emissions sinks generated by the "Kyoto" forests planted after 1990.

The belated realisation that New Zealand would not enjoy a surplus of emission sinks over emission reduction targets has focused attention on the other assumptions underlying New Zealand's climate change policies. The on-going difficulties in implementing meaningful Negotiated Greenhouse Agreements (NGAs) have highlighted the lack of realism in the expectation that low-cost energy efficiency improvements by the industry were possible. The clamour for a more realistic definition of competitiveness at risk is drawing out the irreconcilable conflict between the objectives of avoiding "leakage" and of achieving substantial emission reductions.

This report draws on the existing research and the available statistical evidence to set out the main features of the New Zealand economy, the key drivers of greenhouse gas emissions, and, hence, the kinds of greenhouse emission policies which would be consistent with on-going economic growth and improved standard of living for New Zealanders.

2 The Key Facts

This section sets out the key facts about the New Zealand economy and society: the facts which are essential to understanding the basis for greenhouse gas policies, but which are frequently overlooked by policy makers.

First, we look at the sources of greenhouse gas emissions.

Table 2.1: New Zealand Greenhouse Gas Emissions Shares by Source (2003)

Households' consumption		
	Energy	**8.5 %**
	Transport	**10.8 %**
Commerce and Industry		
	Energy[1]	**15.8 %**
	Transport	**7.8 %**
	Industrial Processes	**5.3 %**
Agriculture		**49.4 %**
Other		**2.4 %**

Source: MfE National Inventory Report[2]

The most obvious feature of this pattern of emissions is that almost half of all emissions are largely irreducible without a corresponding reduction in the volume of agricultural activities. The current policy recognises the impracticability of reducing agricultural emissions per unit of output by exempting agricultural methane emissions from the proposed carbon tax. However, the most critical implication of this feature is typically ignored. What this means is that for any national emission reduction targets, the burden of emissions reductions imposed on other sectors would need to be nearly double the national target. For example, if New Zealand aimed to reduce its greenhouse gas emissions by 10 percent without damaging its agricultural output, emissions from all other activities would have to be cut by 20 percent[3].

The second important feature is that industrial process emissions are all associated with sectors where "leakage" is highly likely. These include steel making, cement production, aluminium production, oil refining, wood processing and food processing. In other words, there are no viable policies which could lead to substantial reductions in such emissions in New Zealand, without causing a corresponding increase in the emissions in

[1] This includes both electricity consumption and direct production of industrial energy (such as steam) using mainly coal and gas

[2] Transport split: From EECA report pages 66 and 67 energy use in passenger transport was 110 PJ in 1997 and in freight transport was 60 PJ in 1997. Assuming 90 percent of the energy used in passenger transport was for households, the split households/commerce and industry was 99:71.

[3] Given the current relative weight of emissions from various sectors. If agricultural emissions grew more slowly than energy-related emissions, then eventually the proportions would change. However, on current forecasts, the proportions are not expected to change substantially.

other countries. Policies designed to prevent "leakage" make these types of emissions largely irreducible in New Zealand.

The third critical feature relates to transport emissions by individuals, business and industry. A significant proportion of transport activity is directly linked to the level of economic activity in New Zealand. In fact, New Zealand's economic welfare is directly tied to increases in transport activities – and hence, without significant changes in technology – the level of emissions. Transport is necessary both to move New Zealand's growing output of primary and manufactured products and to maintain the growth of service sectors, such as tourism. Transportation is also essential to maintain the growth of all urban activities.

The combination of these three features of the pattern of emissions is particularly important. What they mean is that, even if we believe that energy is used inefficiently by industry and by households, and that considerable reductions in household-related emissions are possible, the feasible target of emission reduction policies consists of household related emissions and of emissions from business-related use of energy. These categories of emissions, together with emissions from waste, sum to 36 percent of New Zealand's total greenhouse gas emissions.

By 2012, New Zealand's emissions are expected to exceed its Kyoto target for the first commitment period by about 35 percent.[4] In other words, if we were to try to meet our targets through a substantive attempt at emissions reductions (as is expected under the Kyoto Protocol), the emissions from the target categories would need to be almost entirely eliminated. This is clearly not plausible, even with massive expansion in public transport, and significant increases in energy efficiency.

In fact, as long as economic growth is maintained, growth in emissions can not be reversed with existing technologies. The best that any greenhouse gas emission policy can achieve alongside economic growth is a slowing in the growth of emissions.

Overall, the goal of meeting Kyoto targets through actual emission reductions in New Zealand is simply not achievable without significant and unjustified damage to the New Zealand economy. Such damage is not justified because emission reductions caused through contraction of primary production or through reduction in industrial activities, such as cement, steel and aluminium manufacture, would simply be offset by increased emissions from the same activities elsewhere in the world.

[4] From the CCO, emissions in 1990 were 61.6 Mt CO2 equivalent. The allowed amount for the first commitment period is therefore 308 Mt CO2e. Sinks absorb 71 Mt CO2e. CCO expects a deficit of 36 Mt CO2e. That gives emissions of 415 Mt CO2e, an increase of 35 percent.

3 The New Zealand Economy

In this section of the report, we look at the key driving forces of the New Zealand economy, and consider the extent to which these forces are tied to the growth in emissions. Like all developed countries, New Zealand is progressively deriving a greater share of its GDP from services, while the relative weight of primary and manufacturing sectors is declining. Since greenhouse gas emissions directly associated with the service sectors are much lower than those associated with the primary and secondary sectors, this on-going shift has been used as a justification for the belief that emission reductions in New Zealand can be achieved without significant overall economic costs. The belief is that policies which increase the costs of agriculture, other primary industries and manufacturing will simply serve to accelerate the already occurring shift of resources towards the less emitting activities.

However, this is a mistaken implication to draw from this underlying shift. As Table 3.1 shows New Zealand's exports remain largely dependent on the traditional sectors of the economy. In fact, it is this reliance which explains much of New Zealand's strong economic growth in recent years. If New Zealand had diversified into more manufacturing and other service exports, as many had hoped in the 1990s, we would have been worse off.

Table 3.1: Composition of New Zealand's Exports[5]

March Year	2002	2003	2004	2005
Meat	4486	4308	4270	4747
Dairy Products	7491	5918	5706	5687
Fish	1513	1414	1170	1240
Fruit and Vegs	1684	1646	1617	1908
Other Food and Bevs	1146	1180	1221	1635
Primary	4456	4348	3787	3812
Industrial Raw Material	811	657	482	559
Metals	1707	1532	1419	1689
Manufactured Products	6947	6859	6913	7373
Other	1286	1306	919	1075
All Merchandise	31527	29168	27504	29725
Services	10595	11277	10966	
Total	42122	40445	38470	
Services/Total (%)	25.2	27.9	28.5	
Tourism	7233	7614	7435	
Tourism/Total (%)	17.2	18.8	19.3	
Traditional/Total (%)	49.3	46.5	46.2	

Source: NZTE and Statistics Department

[5] Tourism expenditure is included in exports of services

3.1 Traditional Commodities

The big story of the early 21st century is the reversal of the relative values of commodities and manufactured goods. Call it the China effect: China's massive economic growth bid up the prices of commodities, while, even more importantly, forcing down the prices of manufactured goods. Between December 1998 and December 2004 New Zealand's terms of trade for goods improved by 13.3 percent. While our export prices increased by 0.6 percent during this period, most of the improvement came from a more than 11 percent decline in import prices. All this happened during the time when the price of imported oil increased sharply. In other words, prices of other goods imports – mainly cars, consumer goods and other manufactured products – declined by more than 11 percent. In simple terms, what this means is that even if we did not improve our productivity and our exports, we still would have been able to buy 13 percent more imported goods than we did 6 years ago. No wonder the economy has done well, particularly since it has also been bolstered by a 19.6 percent improvement in the terms of trade for services during this period.

In other words, with the declines in global prices of most manufactured goods and services, New Zealand's position as a commodity exporter turns out to be desirable. In fact, this trend is likely to remain for the foreseeable future, as growing competition from China and India continues to make manufactures and many services cheaper, while strong economic growth, particularly in the emerging economies which will remain outside the Kyoto obligations, underpins the demand for commodities.

The critical point to understand is that the apparent shift towards a more service-oriented economy in New Zealand is a product of the strength of the primary sectors, not a substitute for those sectors. Increased incomes from primary exports underpin the overall income growth in New Zealand (in fact, they account for most of the growth experienced over the past 5 years). As New Zealanders get richer, they consume relatively more services and fewer goods. Since most of New Zealand's recorded GDP consists of output which serves the needs of New Zealand consumers (the net impact of exports minus imports is fairly small), services will account for an increasing share of GDP. However, this increase in incomes, and hence in the output of the service sectors, is only possible because of the strength of the traditional sectors of the New Zealand economy.

If the output of the traditional sectors was to be undermined through inappropriate policy interventions, the overall decline in income would make New Zealanders poorer, with minimal effect on the global temperature.

3.1.1 Dairy

The dairy industry has been expanding significantly over the period 1990 to 2005. The expansion has occurred because greater returns have been available per hectare of land from dairying than from other forms of pastoral farming and from forestry. Land has therefore been converted to dairying from these other activities. In part, the greater returns have been obtained from sustained prices following trade reforms under the WTO, and, in part, they have arisen from economies that have been achieved in dairy processing. That activity, however, is energy intensive. It essentially involves the removal of water from milk (90% of which is water) largely by evaporation, which is energy intensive. That will continue, and, because of its high cost relative to the price of the product, is already carried out efficiently in New Zealand.

The economies in processing costs have in part been achieved through the construction of larger processing plants. These plants are more efficient, which reduces emissions, but in order to achieve this efficiency in manufacturing, milk has to be aggregated over greater distances. The increased aggregation requires higher transport distances and generates increased emissions accordingly.

3.1.2 Meat

In a similar manner, meat production has continued to increase during the latter part of the period because of better returns for many products. Aggregation of processing and marketing companies, however, has meant that there are fewer plants, which achieves economies of scale in processing, but animals are trucked greater distances to enable it.

3.1.3 Forestry

Plantings of new forests increased substantially in the period 1992 to 1998. These forests will be due for harvesting in the period 2020 to 2026. If they are not harvested then, they will soon reach an equilibrium size and net production on the land will diminish. The felled trees can either be processed into pulp, paper and other products in New Zealand, or be exported as logs and processed overseas. If they are processed in New Zealand, they will need to be transported to the mills, which generates emissions, and then the processing itself is emission intensive. If they are exported as logs, again there is transport to the ports, which generates emissions. The processing emissions will be generated overseas, contributing as much GHG emissions as if they were processed in New Zealand, warming the globe just as much, but not counting as New Zealand emissions under the Kyoto Protocol rules.

The world supply of trees is likely to remain high relative to demand during this period and prices are likely to remain low. As a result, a significant part of the land on which these forests stand is likely to be converted to other uses rather than be replaced with new forests. There will therefore be another effect on GHGs as this land will no longer support trees that absorb CO2 as they grow.

In this report we are dealing with gross emissions. In the Kyoto accounting, however, forest plantings, fellings and deforestation generate credits and debits that significantly affect each signatory's achievement of its Kyoto commitments. The movement of land from forests to other land uses will adversely affect New Zealand's position under the Protocol particularly in the third and fourth Commitment Periods.

3.2 Tourism

Tourism is New Zealand's main service export (particularly since the decline in the "export" of education services). Again, the relative increase in the value and importance of tourism has led to the belief that, in future, New Zealand would be able to maintain and increase its exports without reliance on the traditional "emitting" sectors. However, while tourism is clearly emerging as an important export sector, it is not a substitute for, but an addition to, the existing export activities. Moreover, international tourism-related activities are an important source of greenhouse gas emissions, and New Zealand's income from international tourism is just as at risk from Kyoto-style policies, as income from the more traditional sectors.

The most obvious factor is the role of air travel in bringing visitors to New Zealand. International air travel has, so far, escaped the attention of policy makers. However, any serious global attempt to reduce greenhouse gas emissions would focus attention on the contribution of this sector to global transport-related emissions. Moreover, while substitutes for fossil fuels may become increasingly available for land vehicles, no new technologies are likely to emerge for air travel for quite some time. Since New Zealand is a long-haul tourism destination, it is highly vulnerable to any policies which make long-haul travel less attractive relative to short-haul travel.

Once travellers are in New Zealand, their presence is also emission intensive. Tourists place a high priority on mobility. Bus tours are an option for lower value tourists. However, as New Zealand aims to attract higher value tourists, such tourists increasingly opt for independent travel. Table 3.2 shows the emissions per passenger-kilometre for the different modes of transport used by international tourists. As the proportion of international tourists choosing to travel within New Zealand by air, campervan and car increases, the emissions per international tourist will rise. Emissions will also rise with the increase in the volume of international tourists.

Table 3.2: Tourism Energy Use by Transport Category 2001

Transport Category	Energy Use (MJ/person-km)	Average distance/tourist (km)
Ferry	2.63	19
Domestic Air	2.54	375
Campervan	2.39	85
Private Car	1.03	144
Hitchhiking	1.03	7
Rental Car	0.94	423
Motorcycle	0.87	2
Scheduled Coach	0.51	87
Backpacker Bus	0.39	45
Train	0.38	25
Coach (tour bus)	0.32	279

Source: Landcare Research Contract Report LC 0203/180

In addition, an increase in the number of tourists, combined with a shift towards higher value tourists, has resulted in increased demand for higher quality accommodation. Modern hotels, no matter how efficient they are, use more energy per visitor than motels and backpacker accommodation, as shown in Table 3.3. The higher energy use arises because hotels provide higher standards of heating and air-conditioning than motels and backpacker accommodation, and offer a wider range of services and appliances. Again, an increase in the proportion of international tourists seeking higher standards of accommodation will increase emissions faster than the growth in their numbers.

Table 3.3: Tourism Energy Use by Accommodation Category 2001

Category	MJ/visitor-night	Average nights/tourist
Hotels	140.1	3.3
Motels	44.3	1.9
Backpacker	36.7	2.6
Home	na	10.3
Other	na	2.0

Source: Landcare Research Contract Report LC 0203/180

3.3 Peak oil

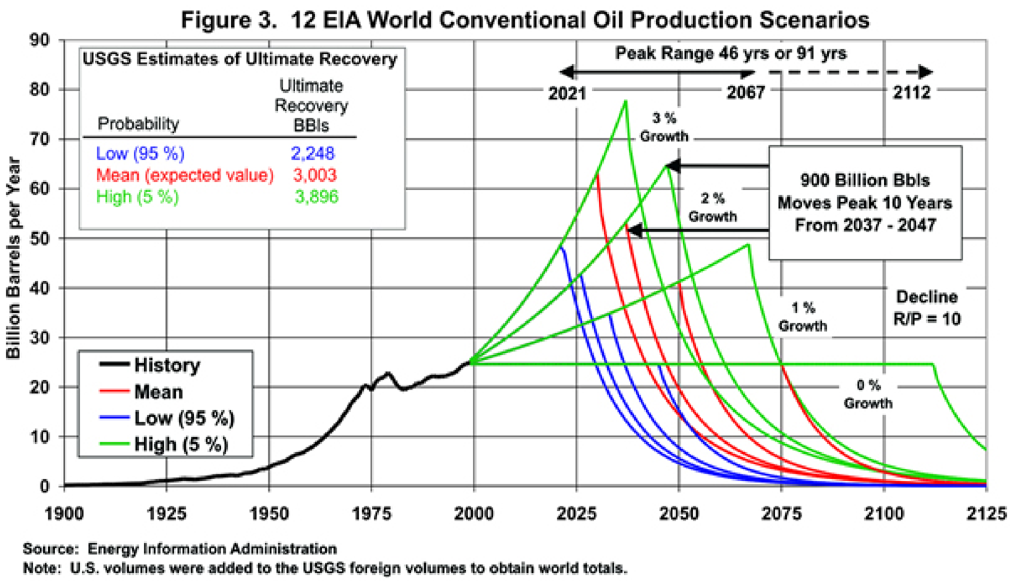
At this point, we would like to turn to the concept of peak oil, and the likely impact on the New Zealand economy. This is important because arguments about the availability of oil supplies are being increasingly woven into the arguments for greenhouse gas emission policies. The logic goes that we should move rapidly to reduce emissions from fossil fuels since such fuels will soon run out anyway. According to this argument, even if we admit that emission reductions are economically costly, such costs cannot be avoided anyway. In fact, we might benefit from reducing emissions and the use of fossil fuels rapidly, since doing so now would prevent us making unsustainable investments.

An example of this logic was a recent Green Party campaign against additional investments needed to make Hamilton airport more attractive for international travellers. The argument was that, with the advent of peak oil, international air travel was bound to decline, and hence New Zealand should not be investing in greater facilities which will not be needed.

Earth's endowment of conventionally reservoired crude oil is a large but finite volume. All or nearly all of Earth's petroleum basins are believed to have been identified, and most are partially to nearly fully explored. All or nearly all of the largest oil fields in these basins have already been discovered, and are in production. Production is clearly past its peak in some of the most prolific basins, such as those in the continental United States. Hence, world production of conventionally reservoired crude oil can be expected to peak, and then decline.

World crude oil demand has been growing at an annualised compound rate of slightly more than 2 percent per annum in recent years, driven in particular by strong economic growth in China and India. New Zealand's consumption of oil and oil products has grown from 3.06 million tonnes in 1990 to 4.68 million tonnes in 2004, an annual growth rate of 3.1 percent — in line with the growth in the economy.

Figure 3.1: Peak Oil Flow from Conventional Sources



Source: US Energy Information Administration

Over the past year, global demand has caught up with the available global capacity, resulting in a surge in oil prices. Some have interpreted this as a sign of peak oil. In fact, most thorough analyses indicate that, depending on assumptions about growth in demand for oil, and the technologically feasible ultimate recovery, the supply of oil from the conventional sources would be likely to peak some time in the second half of the 21st century. The US Energy Information Administration estimates puts the peak dates between 2021 and 2112, with the extreme dates considered unlikely. Using US Geologic Survey lowest (most conservative) estimates of the ultimate possible recovery, and on-going demand growth of 2 percent per year, indicates a peak in 2026. With the same sustained demand, but a mean expected level of ultimate recovery, the peak from conventional sources does not occur until 2037[6].

While 20 to 30 years away does not appear to be so long, on current predictions this is longer than the expected horizon for the substantial shift to new propulsion technologies for vehicles, which would lead to significant reduction in the demand for oil. Moreover, in addition to the conventional reservoirs, considerable oil deposits exist in mined forms (tar sands and oil shales). In addition, technologies exist to produce liquids from gas and coal. Non-traditional sources of petroleum products are being increasingly developed, and may well offset the declines in the traditionally reservoired oil production, if other technologies are not available by then.

Two key conclusions can be drawn from this analysis. First, it makes no sense to try to anticipate a mythical de-industrialised future through policies which deliberately undermine New Zealand's capacity to create wealth. Rather, it is more plausible to continue making policy and commercial decisions on the expectation that on-going growth in the mobility of goods and people will continue. In fact, considerable private investment which can be observed around the world in airport development, airline fleet purchases and vehicle production is a good indicator of the judgements being made by people who have to put their money where their mouths are (unlike those who express the extreme views).

Second, and perhaps more importantly, policies to reduce greenhouse gas emissions and policies to deal with the problem of peak oil production from the conventional sources may in fact work against each other. One of the most likely responses to reductions in conventional oil production (or to increases in the cost of such production) is the exploitation of alternative sources of carbon. For example, South Africa has well established 1970s technology for the production of liquid fuels from coal, developed due to trade embargoes during the apartheid era. If reliance on such technologies becomes more important, policies which inhibit development and exploitation of New Zealand's coal deposits could harm our ability to cope with changes in the international oil markets.

3.4 Summary

Exports remain the key drivers of the New Zealand economy. Continued growth in the traditional primary sectors, together with growth in tourism, will be directly associated with growth in greenhouse gas emissions for the foreseeable future. While New Zealand's emissions per dollar of GDP may well continue to decline[7], due to greater demand for services associated with growing affluence, the total level of emissions is likely to grow. In essence, we will need to transport a greater volume of primary commodities. Any improvements in our ability to process more of the primary commodities on-shore will also directly translate into increases in emissions.

Similarly, our economy will rely on our ability to transport and comfortably accommodate a greater number of people, whether for the tourism or education sectors. Again, total greenhouse gas emissions will grow.

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[6] See www.eia.doe.gov/pub/oil_gas/petroleum/feature_articles/2004/worldoilsupply/oilsupply04.html

[7] From 1990 to 2003 emissions increased at an average rate of 1.6 percent per annum and GDP at 3.0 percent per annum. From 2003 to 2010 CCO forecast emissions increasing at 1.4 percent per annum and Treasury forecasts GDP growing at 3.1percent per annum.

4 Greenhouse Gas Emissions

Given the above background discussion of the New Zealand economy, we now turn specifically to the main sources of greenhouse gas emissions which may be targeted by policy makers. We do not discuss emissions from agriculture or from industrial processes because, as we mentioned before, there are no sensible policy instruments to address those sources of emissions. While NGAs and the small research programme funded by the farmer levy may constitute an appearance of action, the reality is that only limited reductions in emissions from agriculture are likely to be achieved as a result of these programmes.

4.1 Emissions from electricity generation

The main culprit for past policies appears to be a strongly held belief among some government officials and politicians that New Zealand uses energy inefficiently, and that it would be almost costless to reduce growth in demand for electricity below current trends. Hence, the logic goes, we lose nothing by making it hard on ourselves to develop new electricity supply using coal.

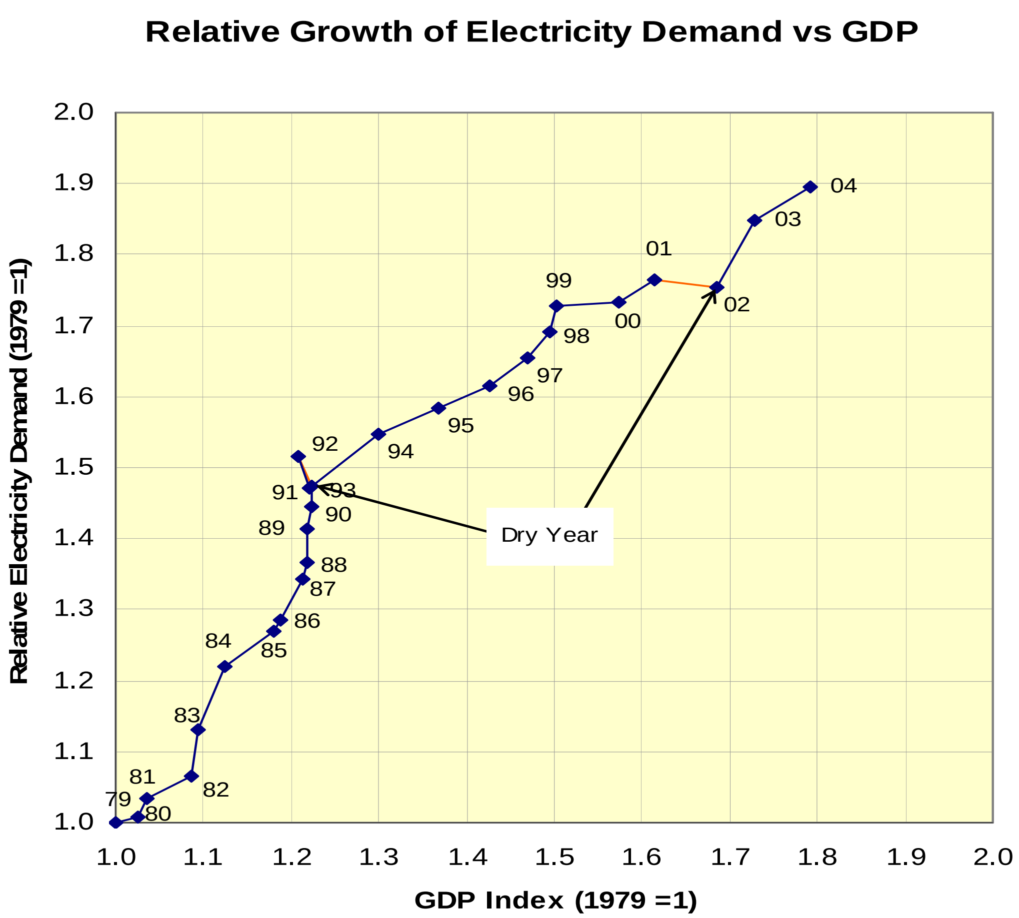
This belief seems to be based on two fundamental confusions. The first confusion is between energy efficiency and energy intensity. Energy efficiency is the amount of energy used per unit of output (eg GJ per tonne milkpowder). Energy intensity is a measure of the amount of energy used to produce every dollar of GDP. New Zealand has one of the highest energy intensities in the world. This very high level of energy intensity is quoted as proof of our inefficiency. Yet, the overall energy intensity of the economy tells you almost nothing about how efficiently energy resources are used. It simply says that New Zealand's economic activity is relatively concentrated in the sectors that use a lot of energy. For example, it would come as no revelation that you need more energy to dry milk for exports than to produce computer software. It also does not require a great deal of awareness to know that New Zealand is a major dairy exporter, and a very minor player in the software market. To claim that New Zealand is inefficient in using energy because its economy is relatively energy intensive is simply to deny our comparative advantage.

The second confusion seems to stem from the view that energy is costly, but capital and other resources are costless. It is common to point out how easy it is to cut electricity use by insulating buildings, installing double glazing, putting timers on lights and so on. However, all of these things consume real resources. The efficient thing to do is to use more of the resource you have in abundance and less of the resource that is relatively scarce. If our electricity can be made cheap and abundant, there is nothing wasteful in using more of it relative to the capital investment needed to reduce demand. Of course, it is equally true that energy conservation is the efficient thing to do if it is cheaper than creating more supply. The key point is that the answer can go both ways.

If we strip these confusions away, the reality is that we have no particular reason to believe that energy is used less efficiently in New Zealand than in other countries, or that, in relative terms, less energy will be required in the future to maintain our economic growth than we have needed in the past. The "low energy growth future" envisaged by the believers in major cost-free energy efficiency gains is a theoretical possibility, but on current evidence it does not appear probable.

In this context, it is interesting to look at what is actually happening to the relationship between New Zealand's economic growth and electricity demand. Figure 4.1 plots the relationship between GDP growth and electricity demand from 1979 to 2004 (March years). The graph also highlights the two dry years: the dry winter of 1992 falls into the year to March 1993, and correspondingly, the dry winter of 2001 falls into the year to March 2002.

Figure 4.1: Relative Growth of GDP vs Electricity Demand



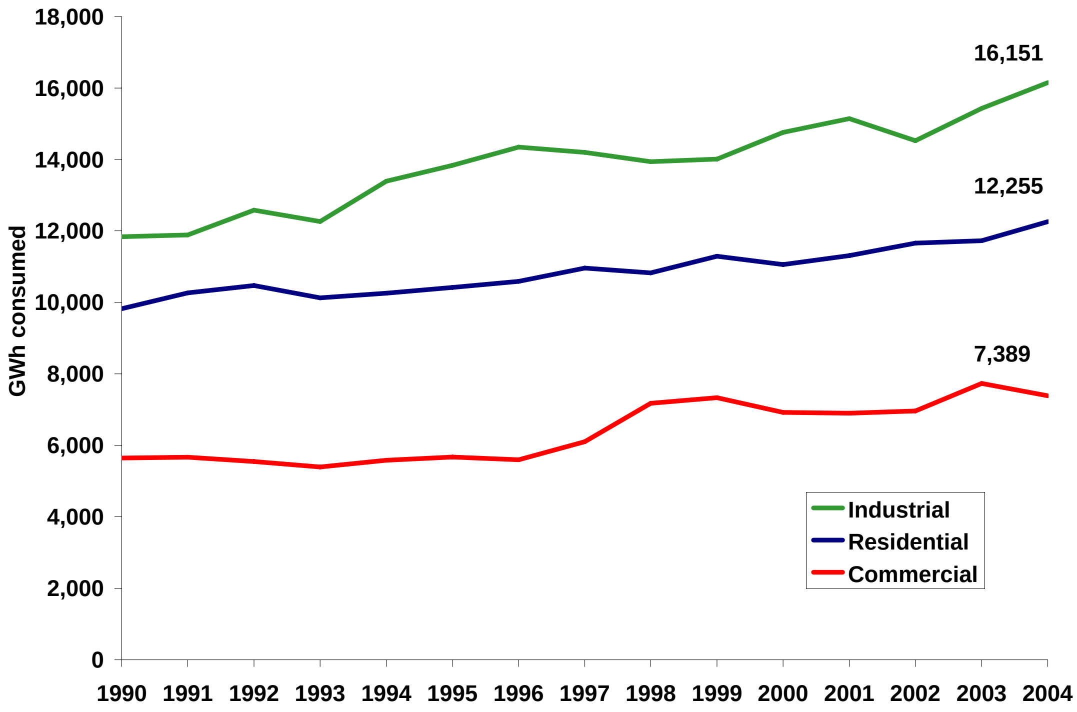
Source: MED Energy Data File and Statistics NZ

First, good news for those who assert the relationship between GDP growth and energy demand can change over time. The graph clearly shows that there was a break in the trend around 1993. Between 1979 and 1993, the curve sloped sharply upwards: we had lots of electricity demand growth, and little economic advance. Since 1993, the curve has flattened: we have had more economic growth compared to electricity demand growth.

But here is the bad news: there is no evidence that the trend established in the 1990s is changing, despite increasing efforts to promote "energy efficiency". It is true that there seemed to be a break in the trend in the year to March 2002. However, it is hardly surprising that demand fell in the dry year (the winter of 2001), given the extraordinary conservation efforts (and not a little discomfort). What is more relevant is that demand grew by more than 5 percent in the following year, and bounced right back to trend.

The graph below sets out the components of electricity demand.

Figure 4.2: Electricity Consumption By Sector



Source: MED Energy Data File

Let us now look at the components of electricity demand in more detail.

4.1.1 Demand for electricity by households

In this section we consider electricity demand by households, and examine the likely pattern of demand (and the associated emissions). Do we observe any inefficiencies in the use of electricity by households, and are there changes which could lead to a slow-down in demand growth?

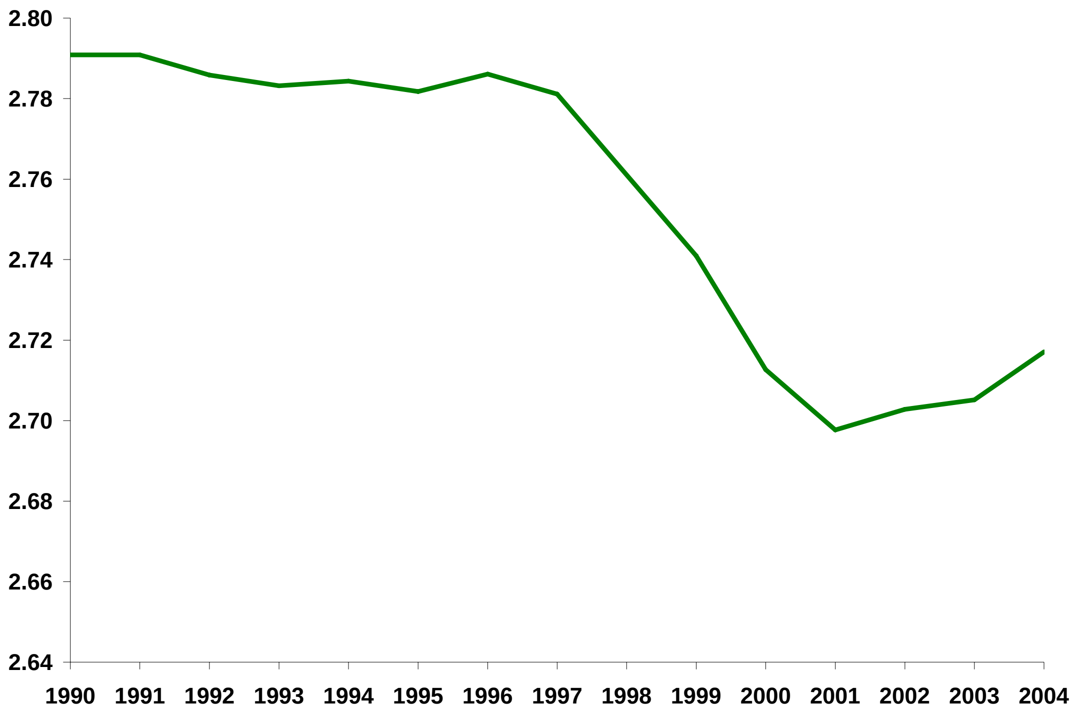
The first point that needs to be made is that, in New Zealand, the growth in the number of households has exceeded the overall growth of the population, and both have been growing in New Zealand more rapidly than in other developed countries. While the total population increased by 18 percent from 1990 to 2004, the number of households during that period grew by 21 percent. This obviously means that the average household size has been declining.

The focus on households is important because there is a certain floor level of demand for energy which is associated with each household, regardless of how few people it has. For example, two people living together would share a fridge, a washing machine, a TV and so on. If they establish two separate one-person households, each of those households is likely to acquire one of those appliances. Separate households are less "efficient" in their utilisation of electric appliances, and hence two people in separate households are likely to consume more power than the same two people sharing a household.

In fact, the totalitarian fantasy of communal living is based on the "efficiency" of combining households. In a free society, an underlying social trend towards smaller households would result in a perceived reduction in the "efficiency" of power consumption.

As the figure below shows, in the late 1990s New Zealand went through a significant social transformation, with a rapid decline in the average household size over a short period of time. Two factors explain this transformation. The first is the delayed effect of economic growth, which commenced in 1993. During the prolonged recession from 1987 to 1992, young New Zealanders who would have otherwise moved out of parental homes delayed their move. The late 1990s were a period of catch up. The second explanation is the high level of immigration during the late 1990s, with immigrant households on average being smaller than resident households.

Figure 4.3: New Zealand – Number of Inhabitants per Household

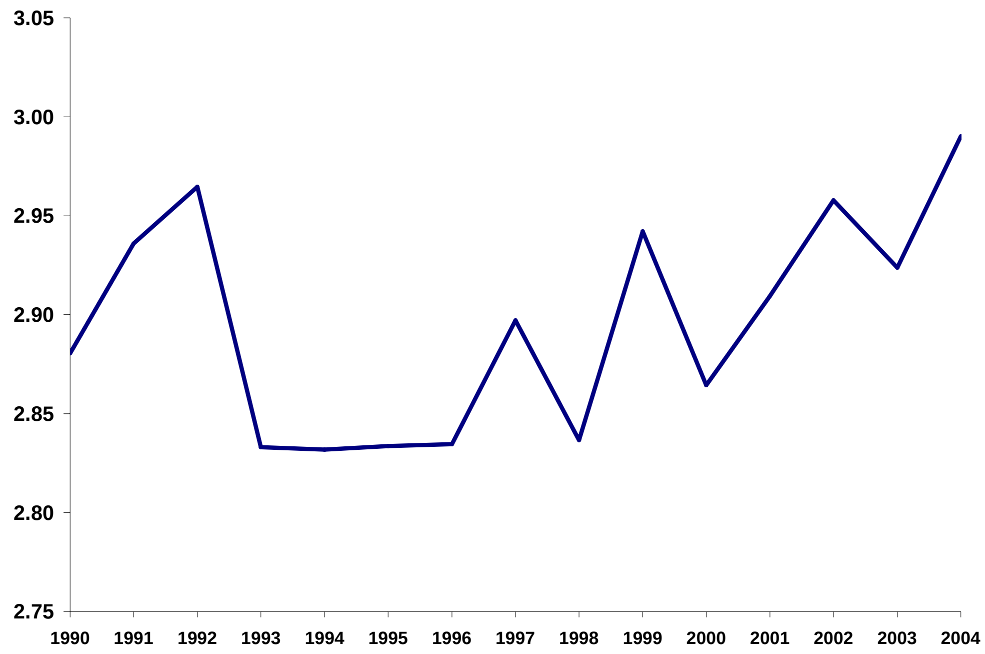


Source: Statistics NZ

The creation of additional households, with a reduction in the average household size, explains the pattern of demand for power in the household sector. While individual appliances may have been getting more efficient, the growing number of households would have offset much of that efficiency improvement.

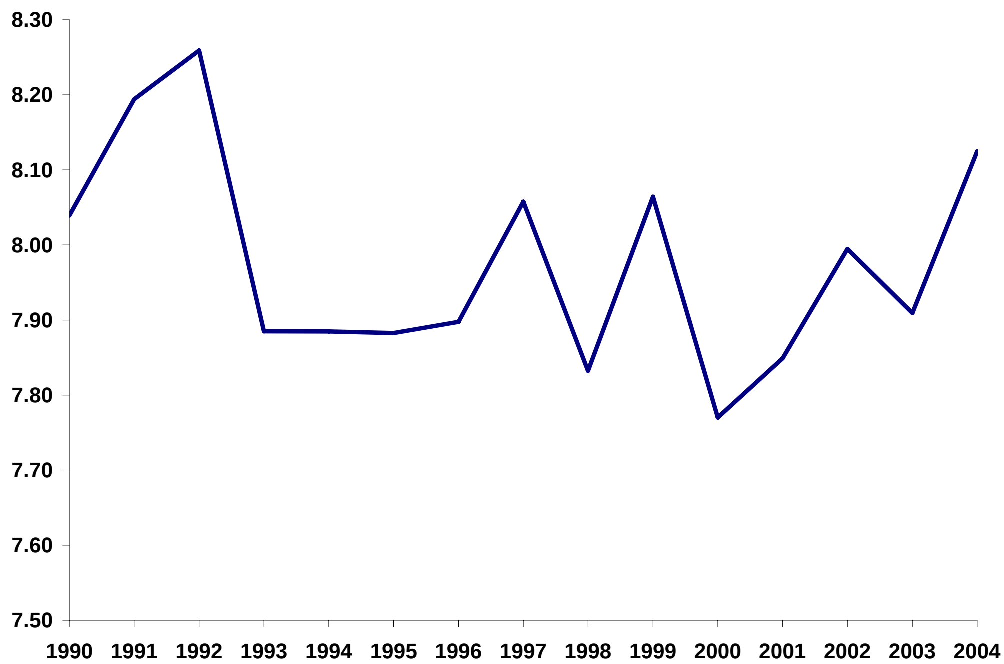
The two charts that follow show residential electricity demand per person and per household. The picture of demand per person since the early 1990s appears consistent with the view that New Zealanders may not be using energy efficiently. Demand per person is growing. However, when we look at demand per household, the picture is reversed. Electricity consumption per household has been generally stable, on a slight declining trend.

Figure 4.4: Residential Electricity Consumption (MWh per Person)



Source: MED Energy Data File and Statistics NZ

Figure 4.5: Residential Electricity Consumption (MWh per Household)



Source: MED Energy Data File and Statistics NZ

The table below disaggregates electricity consumption by category. The key observation is that 75 percent of electricity consumption goes on heating (including water heating).

This is despite the fact that New Zealand houses are generally regarded as being too cold. As New Zealand becomes more prosperous, households are likely to demand a higher standard of heating.

Table 4.1: Use of Electricity by Households

Electronics and Lighting	13.5%
Heating	75.0%
Stationary Motive Power	11.5%
Total	**100%**

Source: EECA Energy End Use Database

Overall, the above analysis suggests that there are few opportunities to reduce residential demand for electricity without a substantial cut in welfare and a draconian enforcement policy. As household size continues to fall, and the number of households grows, total consumption is likely to rise even if slight improvements in the efficiency of household appliances lead to a slow reduction in consumption per household.

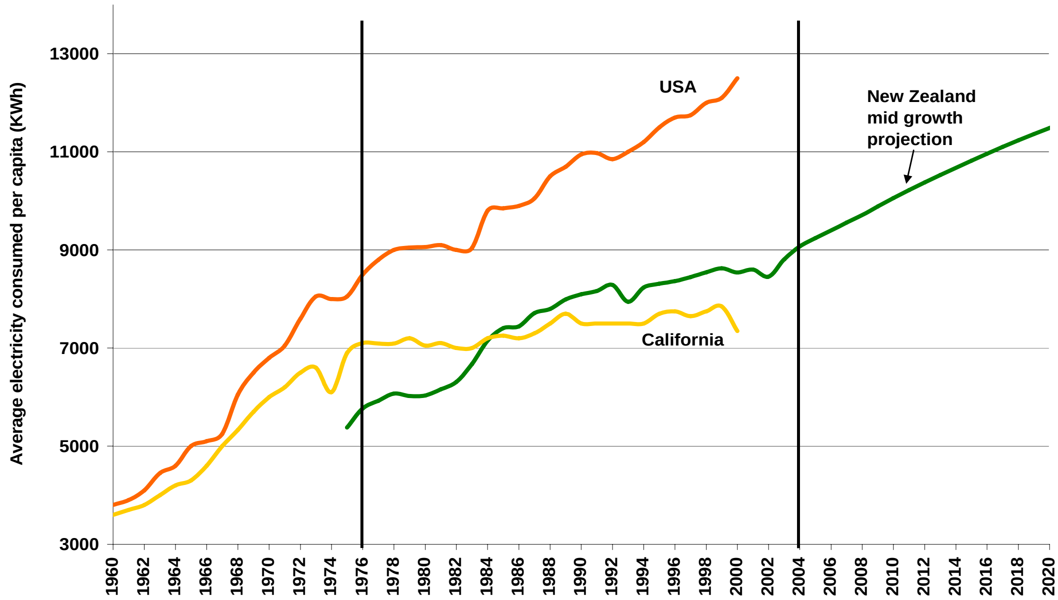
The demand for better heating and air conditioning of dwellings is likely to continue growing. While over time, greater prosperity will also lead to improved construction standards, and some retro-fitting of the existing poor quality housing stock, better insulation and increased efficiency are unlikely to offset greater demand. In other words, at present, people only heat some rooms in their houses, and that to an inadequate standard. As the cost of heating per square metre of space declines due to investments in energy efficiency, people will heat more of their dwelling, and will expect a more consistent standard. Overall, demand for heating may increase with energy efficiency rather than decline.

4.1.2 Demand for electricity by businesses

Much of the debate on whether New Zealand will be able to reduce emissions from electricity generation is focused on the question of whether New Zealand industry and commerce use power efficiently. The hope for an economically cost-less cut in emissions comes from the belief that New Zealand businesses are largely inefficient in how they use energy. In part, this belief is supported by various pieces of research commissioned by the Government which indicate that there are many specific examples of energy-saving projects which would generate high rates of return, but which are not taken up.

This observation is bolstered by reference to other developed country jurisdictions, which appeared to have been successful in reducing growth in electricity demand through energy efficiency programs. The most frequently cited example is California, which has been implementing energy efficiency and demand management policies since the mid-1970s, and which has diverged sharply in its trend growth of energy consumption from the rest of the United States (as shown in the chart below). The suggestion is that, if New Zealand was to implement similar policies, it could achieve a similar deviation from its previous trend.

Figure 4.6: Comparison of Total Electricity Consumption Per Capita



Source: New Zealand Electricity Commission

However, while some improvements at the margin are always possible, and no business in the world operates at peak efficiency, we believe that substantial changes in the underlying trend growth rate of electricity consumption are unlikely. This is because the trend is driven by the pattern of industrial and commercial development in New Zealand, and the influence of that pattern is likely to dominate the influence of improved efficiencies.

It is instructive to start by plotting New Zealand's electricity consumption per capita alongside that of California and the US, as we did in the chart above. The increase in consumption per capita from the mid 1970s to the late 1980s in New Zealand is mainly explained by the Think Big projects, which involved both adding new generation capacity and attracting energy-intensive industries which would require that power. It is striking, however, that since 1990, the pattern of consumption growth in New Zealand is more like that in California – flat – than like the rest of the US. In other words, in the absence of energy efficiency programs, with cheaper power and very high economic growth during the 1990s, we appeared to achieve a lower pattern of demand growth than the US.

This suggests that the divergence in power consumption growth between California and the rest of the USA may be more plausibly explained by the different pattern of industrial and commercial development. For example, California has been de-industrialising in relative terms, with high growth in service industries, and decline in manufacturing (particularly since the downsizing of the defence industries in the early 1990s). By contrast, processing and manufacturing investment in the US has been occurring proportionately more in other states.

In the New Zealand context, the observed pattern of slow overall growth in electricity consumption per capita, despite high economic growth, suggests that there may be few easy opportunities to achieve policy induced improvements in efficiency. In fact, despite political pressure, EECA activities and increased energy prices in recent years, we see little change in the pattern of growth.

Table 4.2: Uses of Electricity

	Agriculture	Commerce	Industry	Transport
Aluminium and Steel Manufacture	0.0%	0.0%	34.3%	0.0%
Electronics and Lighting	7.7%	34.7%	2.4%	21.7%
Heating	18.0%	30.7%	12.7%	0.0%
Stationary Motive Power	74.3%	34.6%	50.6%	14.5%
Transportation	0.0%	0.0%	0.0%	63.8%
Total	**100%**	**100%**	**100%**	**100%**

Source: EECA Energy End Use Database

The table above summarises what electricity is used for in different sectors[8]. It is easy to see why demand for electricity across sectors is continuing to grow despite continuous improvement in the energy efficiency of individual appliances:

- In the commercial sector, demand for higher quality accommodation (both office and hotels) continues to outstrip demand for more traditional, low quality facilities. This means that New Zealand's overall stock of commercial buildings is gradually improving. Since better quality also means higher energy demand (more lifts, better climate control etc), this is gradually adding to demand for power
- New Zealand is continuing a substantial transformation in its retail sector, from "ma and pa" shops to shopping malls and other high quality retail locations. Such locations consume considerably more power per square metre of retail space as they offer better heating and air conditioning, and typically better lighting
- Greater demand for processing of primary commodities will lead to more demand from the industry.

4.1.3 Production of electricity

This section examines to what extent the expected growth in demand for electricity could be met from non-greenhouse-gas-emitting sources. As we show below, despite the increased focus on the renewable sources, such as wind, the share of thermal electricity generation will continue to ***grow***, rather than decline in New Zealand. In other words, regardless of the level of the carbon tax, the electricity sector emissions will continue to grow. The simple reason for this is that, unlike most other countries, we already have a very high proportion of renewables in our electricity generation base, and going forward, we have more thermal than renewable options.

It is useful to start by looking in more detail at the period from now to 2012, to consider where we are likely to end up at the end of Kyoto's First Commitment Period. We use the information presented in the Electricity Commission's recently published *Initial Statement of Opportunities* (SOO)[9] as the basis for analysis.

[8] For example, 7.7% of electricity used in agriculture is used in electronics and lighting.

[9] Electricity Commission (May 2005), *Initial Statement of Opportunities: Draft for Consultation.*

Chapter 6 of the SOO discusses the derivation of the Electricity Commission's load forecasts out to 2025. These forecasts are not controversial and are in line with the standard estimates used by others in the sector. The Electricity Commission's load forecast for three growth scenarios are shown out to 2012 in Table 4.3:

Table 4.3: Load forecasts taken from SOO, 2005-2012

		GWh		
Year	**Baseline**	**High**	**Low**	**Peak MW**
2005	37,371	37,792	36,892	6,324
2006	38,372	38,948	37,751	6,503
2007	39,394	40,153	38,588	6,685
2008	40,428	41,381	39,418	6,871
2009	41,456	42,635	40,232	7,055
2010	42,444	43,843	40,998	7,232
2011	43,408	45,072	41,706	7,403
2012	44,350	46,269	42,416	7,572

Source: Electricity Commission

Chapters 7 and 8 of the SOO outline the Electricity Commission's five generation scenarios that form the basis of their generation forecasts out to 2025. Some 75 new plants are identified as being possible to come on stream over that period. We restrict our focus to the period ending 2012.

Looking across the Electricity Commission's five generation scenarios, we identify the year in which the Electricity Commission first indicates that a possible new plant might be commissioned. Twenty-three plants are thus identified as being commissionable by 2012 and are listed in Table 4.4. In the SOO, not all possible plants appear in all generation scenarios and some plants are commissioned at different dates across the various scenarios. Hence, on the one hand, adding up the plant capacities by year overstates what the EC are forecasting under any particular scenario. On the other hand, it adds up by year what the EC consider to be commissionable in that year.

Of these 23 plants, the Electricity Commission indicates that four have already attained resource consents. A further two have already been commissioned in 2004. Our research indicates that, of the remaining 17, the process is well advanced for two more. That leaves 15 of the 23 plants yet to begin the process of obtaining resource consents.

Table 4.4: Possible new plants; type, capacity and commissioning dates

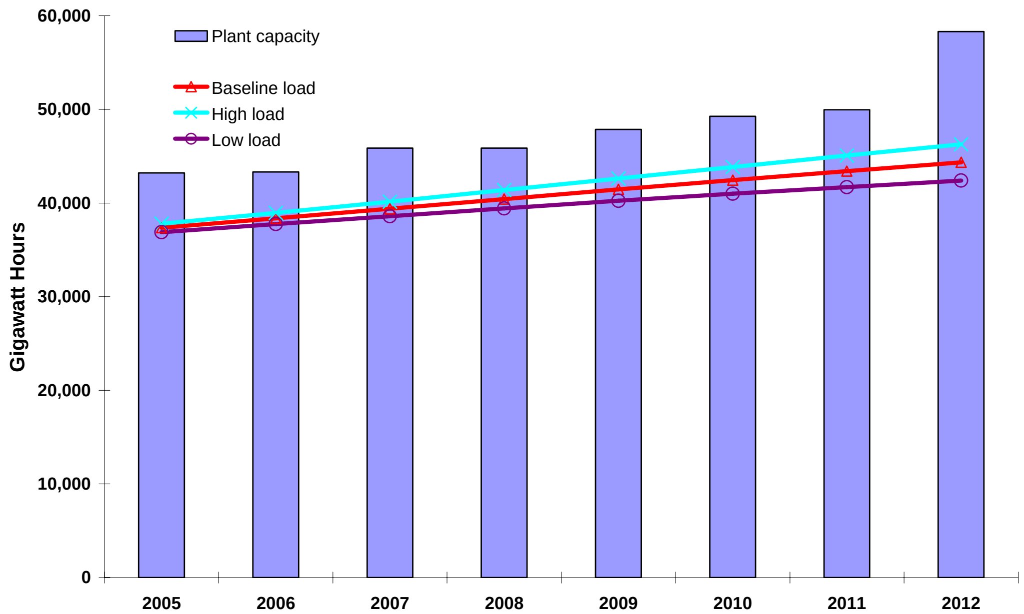
Plant name	Type	Note	MW	GWh	Date
Manapouri	Hydro	1	25	158	2004
Te Apiti	Wind	2	90	355	2004
Wairakei Extension	Geothermal	3	14	118	2005
Manapouri II	Hydro	3	16	105	2005
Kiwi Cogen	Gas		15	100	2006
Huntly e3p	Gas	3	365	2,560	2007
Invercargill	Wind		180	550	2008
Marsden Cogen	Gas		84	690	2008
Makara Wind Farm	Wind		24	95	2008
Coal - WC Rail to Chch	Coal		50	130	2009
Canterbury Wind Farm	Wind		50	150	2009
East Coast Wind Farm	Wind		75	275	2009
Lower Waitaki	Hydro		260	1,500	2009
Stockton Coal Plant	Coal		150	985	2009
Tararua Expansion	Wind		100	395	2009
Kawerau	Geothermal		150[10]	1,200	2010
Marsden Coal	Coal		320	2,000	2011
Mokai III	Geothermal		100	800	2011
Rotokawa II	Geothermal		150	1,200	2011
Belmont Wind Farm	Wind		120	473	2012
Dobson	Hydro		60	270	2012
Southland Lignite	Coal		380	2,650	2012
Wairakei Geothermal	Geothermal		180	1,400	2012

Source: Electricity Commission and Castalia

We can now compare the load forecasts and forecasts of generating capacity in Figure 4.7.

[10] The capacity of this plant may be lower under alternative scenarios

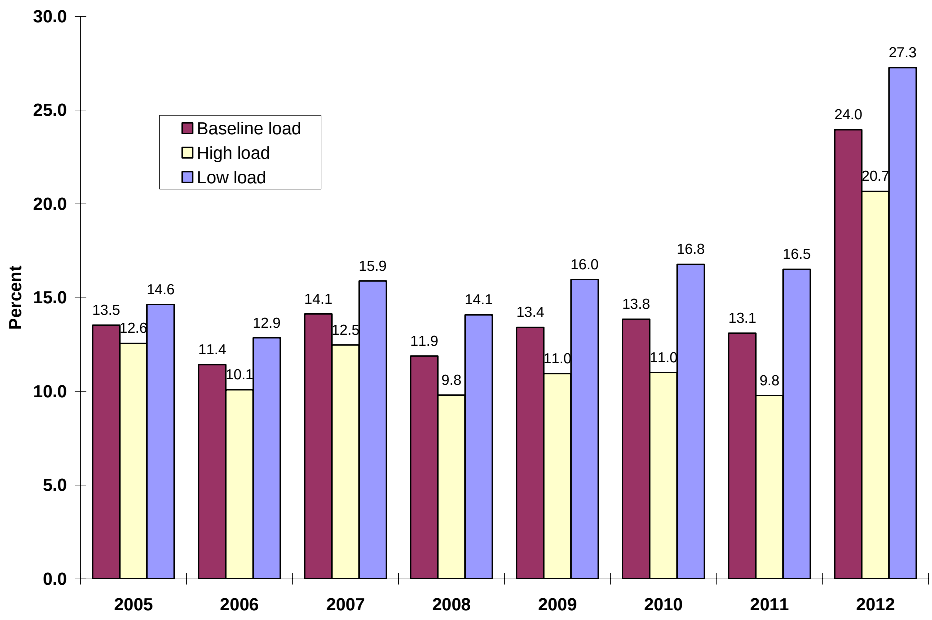
Figure 4.7: Forecast plant capacity and load, 2005-2012



Source: Castalia and Electricity Commission

The capacity margins implied by Figure 4.7 are shown in Figure 4.8. Clearly, the excess of capacity over load is very tight in every year out to 2011. The situation then eases somewhat as four significant plants potentially come on stream in 2012 — Kawerau geothermal, Rotokawa II geothermal, Southland lignite coal, and Wairakei geothermal. Even under a low load growth scenario, capacity margins remain under 17%. Up to 2011 this margin is very slight to cope with dry year risks, unanticipated plant outages and other contingencies. We would emphasise that under a high load growth scenario, the reserve margin falls to particularly low levels in 2006, 2008, and 2011. This is important, since most market participants regard the MED's high load growth scenario as the more likely one, and many market forecasts exceed that level.

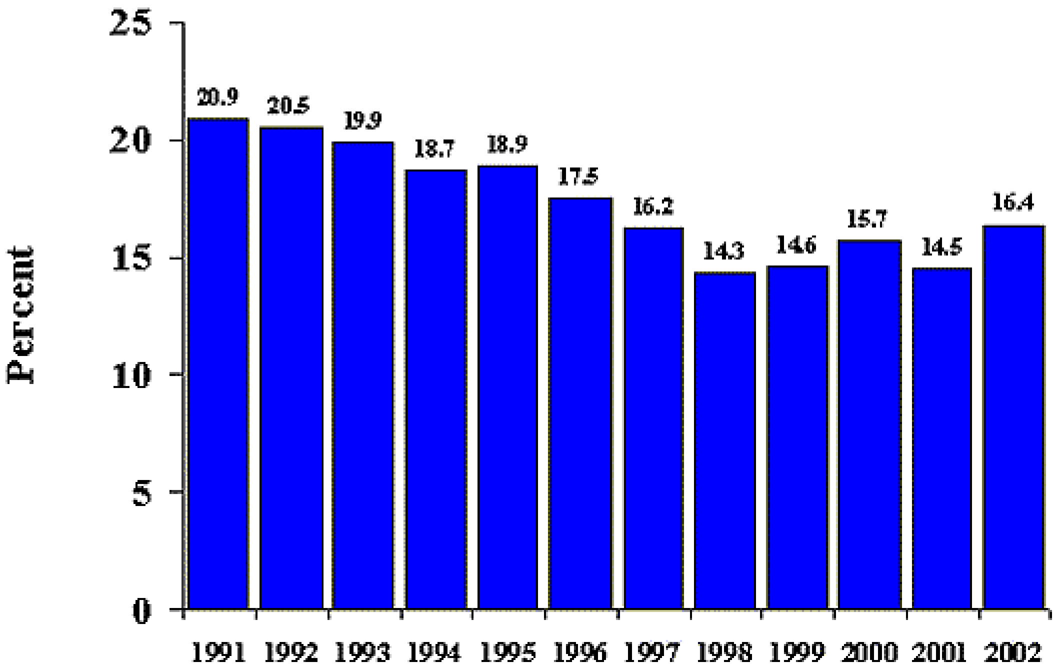
Figure 4.8: NZ capacity margins, 2005-12 (assuming 2-yr consenting delay)



Source: Electricity Commission and Castalia

By way of comparison, Figure 4.9: shows capacity margins for the US. The US margins compare with those found in the UK, i.e. they have declined to about 14% since deregulation of the electricity sector, but are now trending back up as system operators seek to rebuild reserve margins towards what is regarded as safe levels. In other words, the New Zealand electricity system is likely to be insufficiently secure.

Figure 4.9: Summer capacity margins, contiguous US, 1991-2002



Source: Energy Information Administration, Form EIA-411, *Coordinated Bulk Power Supply Program Report.*

The key point is that the expected plants will be required regardless of which demand growth projection we use because we are starting with very low levels of reserve capacity in New Zealand.

Referring back to Table 4.4, of the 18,159 GWh projected by the Electricity Commission to come on stream by 2012, 5,765 GWh comes from coal (4 plants); 3,350 GWh is gas (3 plants); 4,718 GWh is geothermal (5 plants); 2,033 GWh is hydro (4 plants); and 2,293 GWh is wind (7 wind farms). In other words, of the likely additional electricity production capacity to be required and installed between now and 2012, about half will come from thermal sources. By contrast, at present, about a third of electricity production comes from thermal sources, excluding geothermal. Hence, New Zealand will become incrementally more dependent on greenhouse-gas-emitting thermal energy sources through to 2012. Beyond 2012, we are likely to face even greater reliance on coal or imported LNG as our primary energy sources. The only escape would be by going nuclear.

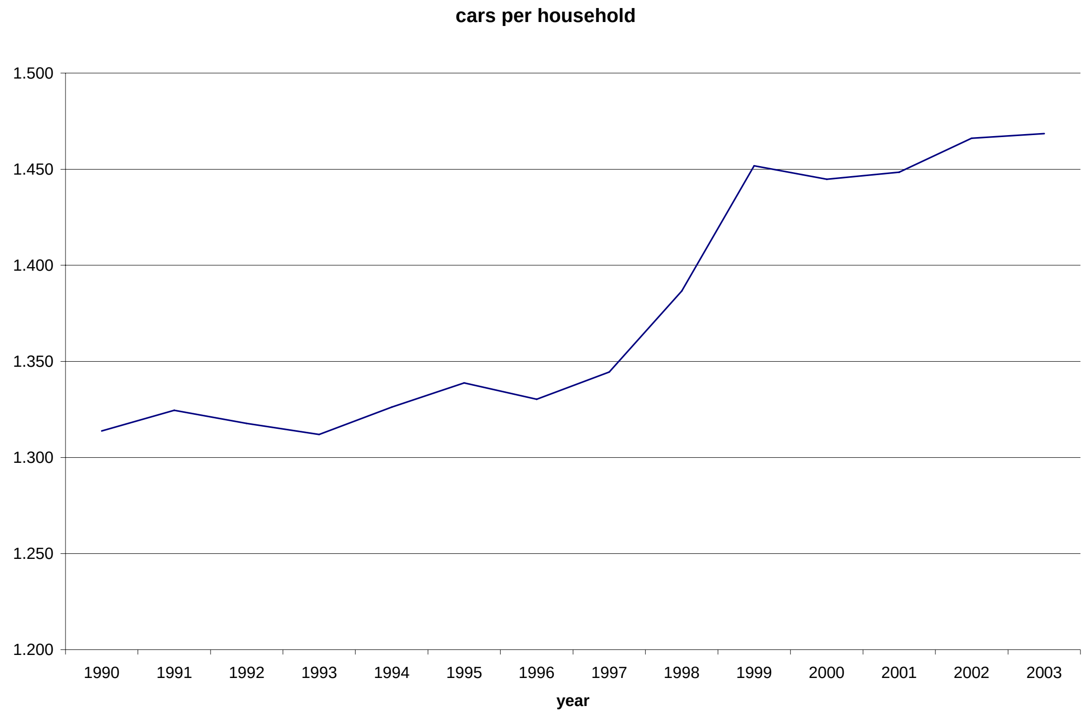
4.2 Emissions from transport

Transport accounts for 18 per cent of New Zealand's greenhouse gas emissions. Emissions from transport are almost entirely CO2. Road transport accounts of 89 per cent of these emissions, given the method for accounting for aviation and maritime emissions which excludes international flights and voyages.

4.2.1 Household transportation

Cars represent 80 per cent of the national vehicle fleet, and represent about 60 per cent of road transport emissions. Car ownership per household tends to have a stable pattern, as shown in Figure 4.10 for the period 1990 to 1997 and for the period 1999 to 2003. The jump in car ownership per household from 1997 to 1999 occurred as a result of the final removal of tariffs on imports of cars, which caused a step change in the pattern of car ownership and use by households in response to the reduction in the relative capital costs of cars. This jump placed New Zealand among the nations with the highest ownership of cars per household. As the number of households continues to rise, so too will the national fleet of private cars.

Figure 4.10: Cars per household



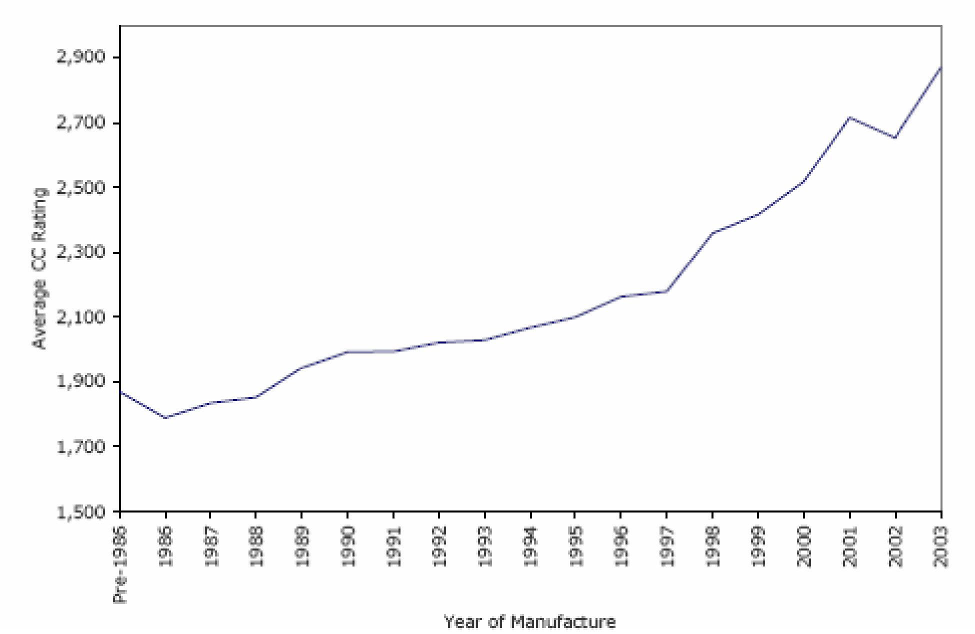
Source: LTSA, Statistics New Zealand

Turning now to emissions, figures for emissions are not available for private cars only. They are calculated from petrol sales, which, on the one hand, include a large proportion of the LCVs (light commercial vehicles) and, on the other hand, exclude diesel fuelled private cars. The proportion of the car fleet which is diesel fuelled has risen from 1.5 per cent in 1990 to 7.3 per cent in 2003. In 1990 emissions per petrol vehicle were 3.28 tonnes CO2. They rose to 3.40 in 1997, then fell back to 3.16 in 2000 and 2001, and have since risen back to 3.28. A number of factors have combined to bring about this result: fuel efficiency, car size and congestion.

Fuel efficiency (vehicle-kilometres per litre) has improved over the period as manufacturers introduced technological improvements. For the same sized car, fuel consumption has trended downwards. This trend eased off recently as major potential technological improvements to petrol only engines have been implemented. The extent to which this improvement has kept emissions per vehicle down in New Zealand has been dampened by the age distribution of the national fleet, given an average age of 12 years. The next generation of technological changes is now beginning to be adopted, such as hybrid gasoline-electric vehicles, bringing about further improvements in fuel efficiency.

A second tendency affecting emissions has been households' desires to own larger vehicles in line with continued improvements in living standards. Figure 4.11 shows the increase in vehicle size, as measured by engine capacity, from 1986 to 2003 of vehicles manufactured in each year (and in the fleet in 2004). This growth is not, however, the growth in the average engine capacity of the national fleet because cars on average have a lifetime of 12 years, but it indicates the trend towards larger cars. That trend is a reflection of what households want. They seek larger cars for the increased space for personal comfort and to carry belongings and equipment, and for greater safety (partly from other large cars). This tendency is illustrated most clearly in the increasing proportion of SUVs in the national fleet. Countries with higher living standards, for instance, have higher proportions of SUVs in their private vehicle fleets.

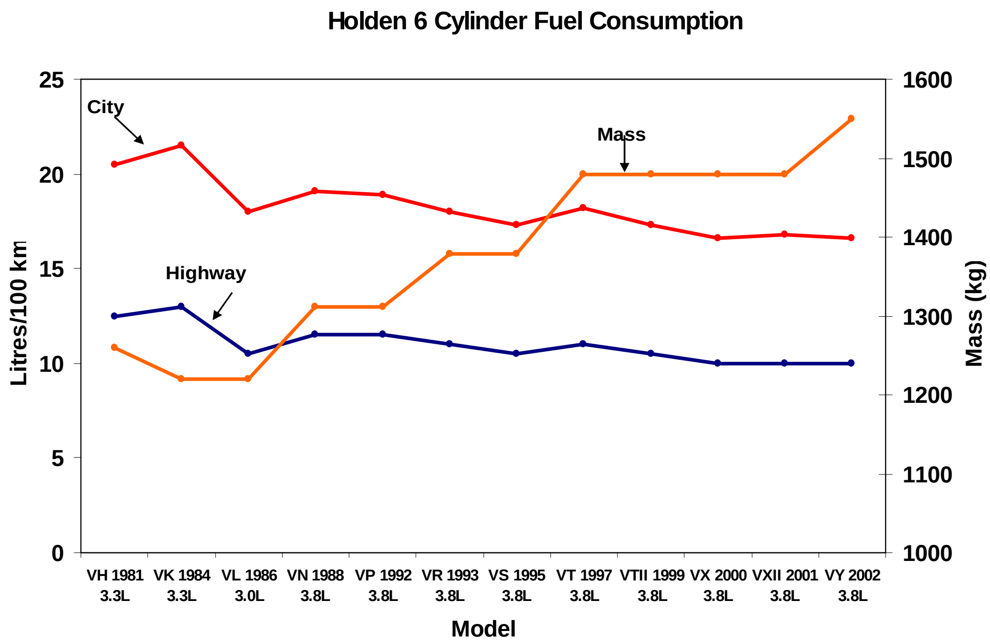
Figure 4.11: Average Vehicle Size



Source: LTNZ, Covec report to MOT

The above two tendencies — for fuel efficiency to improve for a given car and for individuals to prefer larger cars — are illustrated in Figure 4.12 for Holden Commodores. It shows that while some reduction in fuel consumption has been achieved for Commodores, most of the technological improvements have come out in the form of higher vehicle mass (largely representing improvements in safety) for a given level of fuel consumption.

Figure 4.12: Holden 6 Cylinder Fuel Consumption



Source: Holden NZ

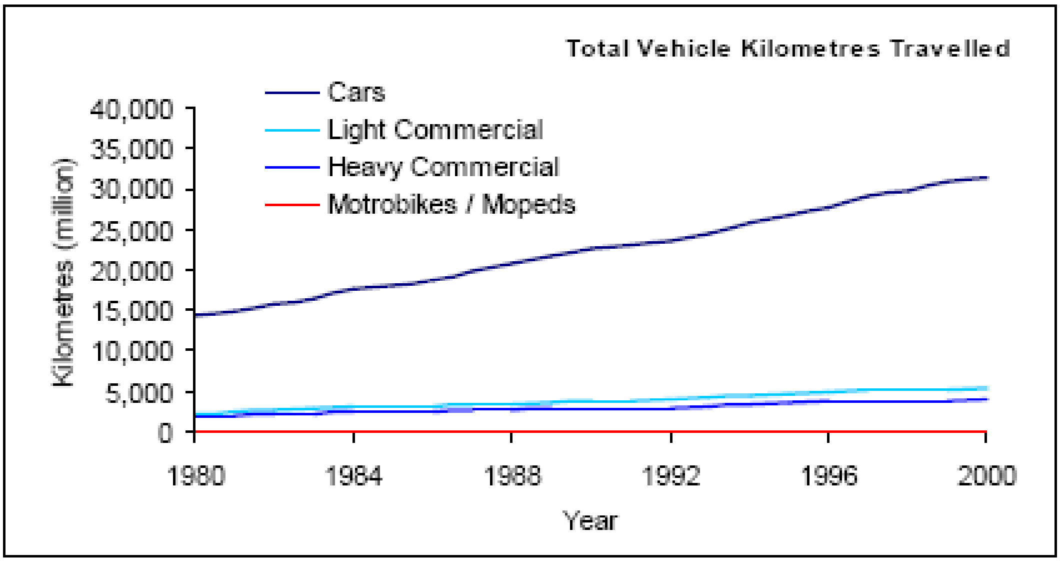
Another major influence on emissions per vehicle is the distance travelled and the driving conditions. Figure 4.13 shows the total vehicle-kilometres travelled since 1980, which are dominated by cars. It represents an increase in annual distance per car from 1990 to 2000 of 0.7 percent per annum. Emissions, however, have increased at a higher rate because more of the vehicle–kilometres are travelled in situations of congestion. About 40 per cent of vehicle journeys are either work or education related and tend to suffer from congestion in Auckland, and to a lesser extent in Wellington and Christchurch, which account for a high proportion of the private cars in New Zealand. Fuel efficiency deteriorates markedly when vehicles are caught in congestion with more idling at intersections and more crawling at low gears in queues.

BTE report[11] "fuel consumption and therefore emissions are greater under congested conditions. Vehicle emissions can be twice as high under congested conditions due to longer idling times, stop-start driving and less than optimal running speeds." De Nocker et al[12] also observe that the impact of congestion on pollution is very marked: "For petrol cars peak values are a factor 2 to 3 higher than free flow externalities for a small city and a factor of 3 to 4 for a big city, with the higher range for the most recent vehicle types."

[11] Bureau of Transport and Regional Economics, Australia 2002 Greenhouse Policy Options for Transport – Report 105

[12] De Nocker, L. Vergote, S. Vinckz, L. and Wouters, G. 1999 Marginal External Costs of Peak and No-peak Urban Transport in Belgium.

Figure 4.13: Distances Travelled



Source: Austwick and Fisher, MfE and NIWA

Looking to the future, there are a number of public policies through which emissions from private cars could be lowered below the level they would be without the policies. Sales taxes or duties on new and used imports can be structured to drive consumers towards smaller or newer cars, but the effect on emissions is not likely to be significant in the absence of draconian measures. As long as economic growth continues, people will demand bigger and more powerful cars.

There are other public policies that can influence demand for travel by private cars. They include subsidisation of buses and trains, congestion pricing, parking restrictions and land use planning. These policies could be adopted to a greater extent than at present and would have some effects on emissions, but we have to be realistic about possible increases in the use of public transport. New Zealand cities tend to be spread out at low density compared to cities in major developed countries. In order to meet the multitude of varying needs, people's origins and destinations are scattered all over large suburban areas and are not usually both on public transport routes. It is difficult to provide public transport to meet these needs without either massive subsidies, which represent a loss of whatever the taxpayer would have bought with the same income foregone in tax, or imposing substantially increased travel times on people. As the country's living standards rise, individuals value the flexibility and time savings that can be achieved by the private car, and are not likely to be easily influenced away from the convenience of travel by private car.

Overall, without a radical imposition of choices which people would not make themselves, it is likely that emissions from private cars will continue to grow in line with the number of households, given the continued desire that individuals have for greater flexibility and time savings as their living standards rise. Apart from being politically unsustainable, the ability of any government to re-engineer a different life-style in New Zealand would be limited by the opportunity to migrate to Australia, where a car-based life-style is generally supported by substantial investments in road infrastructure. The crushing economic impact of loss of property values which would be associated with the increased cost of reaching the more distant suburbs and settlements would also make a substantial shift away from the private car politically and economically unsustainable.

4.2.2 Commercial transportation

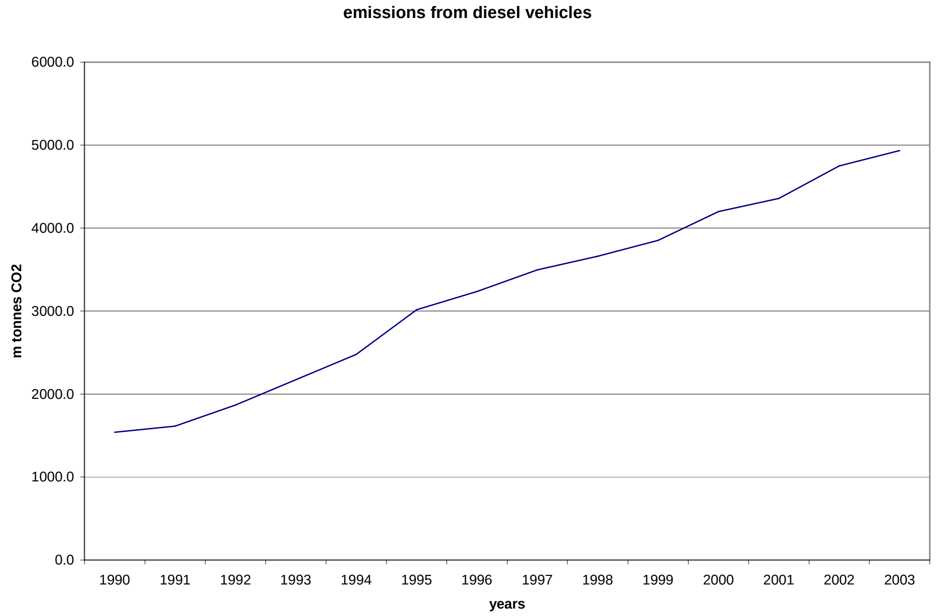
Freight transport accounted for 20.6 percent of the energy used in land transport in 1990 and for 40.3 percent in 2003. Emissions have grown at 9 percent per annum over that period. The growth has been driven by an increase in the number of heavy vehicles at 3.0 percent per annum and an increase in vehicle–kilometres travelled of 4.5 percent per annum. This increase reflects an increase in economic activity — GDP grew at 2.9 percent per annum over this period. All sectors of the economy that have been growing have required this increase in the transport task, and, as a consequence, generated this increase in emissions. These industries include dairy, meat, horticulture, forestry, manufacturing, construction, along with many others. The increase in transport requirement is accentuated where industries have built larger plants in the pursuit of economies of scale in manufacturing, at the expense of greater distances for assembling raw materials.

There are many actions that can be taken to improve fuel efficiency:

- Driver behaviour (speeds, gears selected and idling time)
- Lower vehicle speeds
- Reduced aerodynamic losses through deflectors and other devices
- Better maintenance
- Correct tyre inflation
- Better logistics to improve vehicle utilisation.

There are already strong economic signals to adopt these measures. We believe it is not plausible to expect a significant change in the underlying trend improvement in efficiency. Given this, growth in the demand for transport (i.e. more tonne-kilometres) is likely to more than offset any reductions in emissions that could come from greater efficiency (i.e. emissions per tonne kilometre).

Figure 4.14: Diesel Emissions from Road Transport



Source: MfE

4.3 Emissions from Industrial Processes and from Direct Production of Industrial Energy

We do not propose to discuss emissions from industrial processes in any detail. These emissions come from a limited number of sources: aluminium, steel and cement production and the Marsden Point oil refinery accounting for most of the process emissions. There are no realistic opportunities for noticeable reductions in such emissions short of the closure of these facilities in New Zealand. Since such closures would not reduce global demand for refined petroleum, cement, steel or aluminium, they would be futile and would raise costs to other sectors of the New Zealand economy.

We note that the definition of emissions from industrial processes used for inventory purposes does not include emissions from production of industrial energy, using mainly coal and gas. Those emissions are included under the heading of "energy", which mainly covers electricity production.

Industrial energy, such as steam production, is directly relevant to industries such as dairy, meat and wool, forestry, minerals and food processing industries. Some industries, like dairy, have undertaken major technology improvements, while others may have potential for improvement. Improved efficiency in smaller industrial and commercial enterprises and health and education institutions is being targeted by EECA programs. Moreover, it is notable that companies which are going through the NGA process have been found to already be at world-best practice or close to it in energy production and use.

Overall, while greater efficiencies per unit of energy are likely to continue to be achieved, the growth in demand for energy in processing industries, given the expansion of volumes in dairy and forestry in particular, are likely to lead to on-going (albeit slower) growth in emissions.

4.4 Energy efficiency and Increased Demand

Despite considerable investment of public resources, the national debate on energy efficiency has largely remained empty and futile. The reason for this is the confusion between increases in energy efficiency (output per unit of energy input), and the growth in the overall energy demand associated with greater consumption (the number of energy units consumed). For example, there has been a steady increase in the efficiency of internal combustion engines. In commercial transport, this has been reflected in a significant reduction in fuel use per tonne-kilometre of product. However, overall fuel consumption in New Zealand (and around the world) has been growing because increased economic activity has resulted in greater number of movements, both of people and goods, and for greater engine size (i.e. as we get richer, we want bigger cars). The same logic applies to other forms of energy use, such as heating or air conditioning, as we have already discussed.

Over the past 30 years, the demand effect has generally overwhelmed the efficiency effect. It is likely that we will observe the same trends going forward.

5 Policy Prescriptions

The key step forward for policy-making with respect to greenhouse gas emissions is to abandon unrealistic targets and recognise that total emission growth in New Zealand is inevitable as long as we continue on the current trend of economic growth, and as long as people continue to show similar kinds of preferences to the ones they have demonstrated to date.

We assume there is a general consensus that a deliberate slow down in economic growth in order to achieve a reduction in greenhouse gas emissions is not an acceptable policy. The main conclusion to draw from the analysis in this paper is that, short of a major technological break-through, any set of policies which is consistent with the on-going economic growth and improved incomes for most New Zealanders, would also be associated with the continuation of growth in the total volume of greenhouse gas emissions.

This is not to say that nothing can be done to change the trend in the growth of emissions. Below, we will discuss some policy ideas which may contribute to reducing emissions per capita or per unit of GDP over time. However, it raises two fundamental questions:

- Does it make sense to have a greenhouse gas emission policy targeted at total emissions, knowing that such targets would not be achievable as a result of that policy (although some emission reductions may be achieved as a result of technological breakthroughs that New Zealand would be able to import)?
- If all politically and economically feasible policy options for reducing greenhouse gas emissions only achieve a marginal slow down in the growth of emissions, and hence – on current climate models – can never do more than slow down global warming by a few years, does it make sense to expend resources on emissions reduction, or would resources be more productively used for mitigating the possible effects of global warming?

In our view, these important questions have been ignored in the previous round of debate on the Kyoto Protocol. However, these questions need to be answered explicitly if we are to have any hope of a greenhouse emissions policy which goes beyond feel-good slogans and has any real effect on reducing the costs of climate change.

It is increasingly clear that as Kyoto policies are being introduced around the world, they are being watered down due to the undesirable economic effects. Moreover, the relatively modest economic costs of the policies associated with the First Commitment Period appear to be politically infeasible even in countries with strong political commitment to the Kyoto Protocol. The EU as a whole, for instance, will be struggling to hold emissions below their 1990 level, yet have a target reduction of 8 percent.[13] Canada has a target reduction of 6 percent, but is forecast to increase emissions by 34 percent. Japan has a target reduction of 6 percent, but is forecast to increase emissions by 8 percent. In short, there is little chance that even the modest emission reduction targets of the First Commitment Period will be achieved by any ratifying countries.

[13] The reason for the EU's initially ambitious target was the fact that a wholesale change from coal to gas base-load electricity generation was expected to lead to significant cuts in emissions. It is important to note that the change from coal to gas had nothing to do with greenhouse gas policies, but was motivated by the relative cost of the two fuels.

Hence, it is no longer plausible to consider the First Commitment Period as a launching pad for more demanding commitment periods, with tougher targets. Rather, the consensus among the main emitting countries – US, China, India and Japan – is moving towards a focus on technology-based solutions, rather than solutions which depress demand and economic growth. Japan's position is signal, given its Kyoto commitments. While the US, China, India and Japan clearly do not account for the international community, they are the key nations that matter in terms of making any difference to the global emissions of greenhouse gases. Whether we like it or not, their policies will be the only ones that matter for climate change.

The key difference between the Kyoto-based approach to the control of greenhouse gas emissions, and the emerging alternative approach appears to lie in the time profile of emission reductions. Under the Kyoto approach, the expectation was that policies would be introduced over the next few years to stop emission growth, commence emission reductions by 2012 and accelerate reductions from then on. Under a technology based solution, emissions would be expected to continue growing until a technological transformation can take place, but would then decline much more rapidly than would have been possible under the Kyoto approach. The reason for the more rapid decline further out into the future is that the global economy would arrive at the time when the new technology becomes available in a much healthier shape than it would be in under the Kyoto-based pressure to restrict growth. Hence, the world will have greater resources at its disposal to adopt the available new technologies, and the new technologies would be available earlier.

The key question is which approach is more credible. The supporters of the Kyoto-based approach, quite reasonably, point out that a technology solution, which will not deliver any tangible results for a number of years, may be no more than an excuse for inaction at least in the short term. Promises of future technological transformation may not be fulfilled, and policy-makers need to be constrained by binding commitments to demonstrate on-going reductions in emissions.

On the other hand, Kyoto's opponents argue that Kyoto is not credible, since the only way to achieve its binding commitments is to impose the politically and socially unacceptable level of economic costs. Emission reductions of the kind that would be consistent with the objective of preventing further climate change are clearly not achievable with the existing technology, and reductions in economic growth would tend to delay technological transformation. Hence, the argument goes that the only credible way to commit to reducing the effects of climate change is to continue promoting strong economic growth around the world, while devoting tangible resources to research, development and dissemination of new technologies.

Our overview of how the New Zealand economy is likely to grow, and hence of the likely path of greenhouse gas emissions from this country, clearly puts us in the second camp. Moreover, we are concerned that any international or domestic policies which undermine the global and local mobility of goods and people are likely to be very costly for New Zealand.

Hence, we believe that New Zealand policies on greenhouse gas emissions should be based on the recognition that:

- Total emissions in New Zealand will continue to grow for the foreseeable future, as long as our economy continues to grow, and New Zealanders continue becoming better off

- New Zealand's welfare is critically dependent on continued growth in the global mobility of goods and services. On current technology, this requires acceptance of continued world-wide growth in transport emissions
- New Zealand's welfare is also critically dependent on continued global economic growth. Again, this means acceptance of global greenhouse gas emissions growth
- New Zealand's ability to undergo a technological transformation when the time comes would critically depend on the strength of our economy.

On this basis, we now set out a suggested direction for policy development, both in terms of New Zealand's domestic policies, and in relation to the policy positions New Zealand should adopt in international negotiations.

5.1 Domestic Policies

We would recommend the following principles for domestic policy development:

5.1.1 Transport

Clearly, transport policy is going to be highly contentious, given the strong ideological antagonism between those who promote reliance on private cars and those who emphasise public transport. We think it is important to base future policies both on a realistic expectation of how greenhouse gas emissions can be affected by various decisions, and on a clear understanding of the likely technological transformations that may take place.

Our reading of the available evidence suggests two key assumptions which should underlie transport policy:

- First, while some increases in the use of public transport are possible, the nature of New Zealand cities and the strong demonstrated preferences of the New Zealand population suggest that only a very limited reduction in greenhouse gas emissions can be expected from a shift towards more public transport
- Second, likely future technological transformations may change the motive power of private vehicles — biofuels and hybrid vehicles may be more widely adopted sooner rather than later — but, while private cars may have significantly reduced emissions one day, they will still be private cars.

This suggests that it is important to consider which policies would be both compatible with the future technological transformation, and could deliver some short term gains in terms of emission reduction. On this basis, perhaps somewhat counter-intuitively, allocating resources towards greater investment in road construction is likely to be more productive than spending on public transport projects. Upgrades in New Zealand's road infrastructure aimed at reducing congestion would not only reduce wasted time, but also emissions as emissions from congested driving appear to be two or three times greater than those from free flowing traffic for the same distance travelled. Road investment would be valuable in the short term, but would also retain value in the long term under alternative technologies. By contrast, excessive reliance on the development of public transport may prove to be ineffective in cutting emissions in the short run, and may end up being wasteful in the broader sense in the long run.

There is some scope for emission reductions through hybrid vehicles and the use of biofuels, and through restrictions on imported cars that influence them towards greater fuel efficiency. Again, technological transformation is the answer.

5.1.2 Carbon Tax

If we accept that emission reductions will come from technological solutions rather than from demand suppression, it is important to consider whether the existing policies are compatible with such an approach.

Carbon tax can have two effects: it can make less emitting technologies more competitive at the margin, and it can suppress demand, thus reducing emissions. While it makes sense to impose carbon tax where it would shift choice in favour of better technologies, it is inappropriate to use tax to suppress demand.

For example, carbon tax on petrol, unless set at an economically and politically destructively high levels, is unlikely to have any significant effect. Demand for transportation by households is fairly price inelastic, while commercial transport passes costs on, simply reducing profitability and competitiveness of other sectors. The experience of the recent spike in the price of oil is a good guide to the likely effects of the tax – while higher oil prices are already having an effect on New Zealand's economic growth, and the well-being of New Zealanders, the effect on demand for vehicle travel (as expressed in the volume of petrol sales) has so far been negligible.

Equally, carbon tax is unlikely to make much difference to the technology choice in the generation of electricity. If further gas is found, it will be unambiguously used for electricity generation. Similarly, additional coal plants will be needed in order to maintain the reliability of a power system with significant hydro and wind components.

Moreover, since all sectors with competitiveness at risk will be sheltered, we wonder how much behaviour change could be gained from the remaining carbon tax. The main question that needs to be asked is whether and how such a tax would alter outcomes **without** undermining economic growth and reducing welfare.

Overall, we believe that the carbon tax should be re-examined.

5.1.3 Emissions trading

Emission trading is often suggested as the most economically efficient way of addressing greenhouse gas emissions, and as a better alternative to the carbon tax. We would caution against the view of carbon trading as a panacea. Carbon trading is a process through which a market price can be assigned to the right to emit. The rights would be allocated to the most efficient users through emitters buying and selling rights at the market price.

Indeed, a trading process is an efficient way of allocating a scarce resource. However, any carbon trading is only as efficient as the process for deciding on what the cap in emissions should be in the first place. Trading can not take place without a cap, as emission rights would be worthless without a limit on emissions[14]. As we discussed, we struggle to see how it would be possible to impose an economically sensible overall cap on emissions. It is not possible to decide with any degree of certainty what level of emission growth is absolutely necessary. Any cap on emissions needed for a trading process would likely be arbitrary and damaging to economic growth.

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[14] There are numerous ways to create to create scarcity value for the right to emit. Not all of them may look like a cap. For example, they may be based on growth compared to baseline, or be expressed in terms of credits against avoided emissions. However, such differences are superficial, and do not affect the fundamental economic logic of any trading scheme, which relies on scarcity value generated from some (arbitrary) quantitative limit or target.

Moreover, just as with carbon tax, it would make no sense to cap emissions in sectors where production, and emissions, would simply be shifted away off-shore. While a cap can be set to protect the existing level of activity, it makes just as little sense to encourage "leakage" from future growth opportunities, as it does with "leakage" associated with the transfer of the existing activity to other jurisdictions. In other words, any trading regime in New Zealand would have to consist of sector-specific caps, only applying to sectors without competitiveness at risk. This would further add to the distortions of such a regime.

An international trading regime is even more difficult to implement without an economic distortion. For example, the EU has applied a cap and trade regime to large industrial companies. In theory, New Zealand could enter an agreement with the EU to develop a joint cap which would cover some large companies in New Zealand. Those companies could then participate in the EU-New Zealand market. But is there any rational way to decide what that joint cap should be and which New Zealand companies should be included? We would suggest not.

If a cap under a trading regime generates a carbon price which is the same as the level of the carbon tax which would have been applied, then the impact of the two policies is identical. In theory, caps can be calibrated to replicate the effects of the carbon tax. However, we fail to see the point.

5.1.4 Alternative policies

Overall, we believe that a more sensible alternative to the carbon tax could be a suite of policies to encourage compliance with world-best energy efficiency standards for new capital investment. The objective should be not to force an artificially early retirement and replacement of the existing capital stock – since this would undermine growth, and may in itself promote "leakage" – but to create an environment where new additions to the capital stock as well as voluntary replacements utilise the best internationally available technology.

Adoption of new technologies will require continued, and perhaps more rapid, upgrading of New Zealand's capital stock. For example, allowing more rapid depreciation of machinery for tax purposes may contribute more to reducing the growth in emissions than any punitive measure impacting on existing assets.

In essence, an alternative approach would not aim for a single "silver bullet" – such as a carbon tax – but would promote a wide range of interventions aimed at technological transformation. One possible model could be the new US Energy Act, which is based on a wide range of measures to encourage adoption of new technology.

In principle, of course, a technology-based approach is compatible with the logic of the Kyoto Protocol. The key difference, however, relates to the timing of emission reductions. By insisting on immediate cuts in emissions, before the necessary technologies are available and cost effective, the Protocol in effect favours demand suppression as the tool for emission reduction. A non-punitive technology-based approach, which avoids demand suppression, will inevitably mean that emissions reductions will come later in the century.

Box 5.1: US Energy Act

The Energy Act:

- supports research that promotes advances in energy efficiency
- offers consumers tax credits for making energy efficiency improvements in their homes
- repeals outdated rules that discourage investment in new infrastructure
- offers tax incentives for new transmission construction, and encourages the development of new technologies, such as superconducting power lines and clean coal technologies
- promotes the use of renewable energy sources with tax credits for wind, solar, and biomass energy
- encourages hybrid gasoline-electric cars
- encourages the expansion of nuclear energy
- expands research into developing hydrogen technologies and establishes a flexible, national Renewable Fuels Standard to encourage greater use of renewable fuels like ethanol and biodiesel.

5.2 International Policy Position

The same logic should be applied to New Zealand's negotiating position in any relevant international forums. It is worth re-stating again that it is critical to prevent anything that suppresses mobility of goods or people, or biases against New Zealand's isolated position (such as miles to market rules). New Zealand's exports – whether of goods or services, such as tourism – will always embody a higher energy content than the products of countries which are not located so far away from the main markets.

As we explained before, it makes no sense for New Zealand to enter into any agreement which calls for an actual reduction in total emissions in the short term, since such an agreement could never be fulfilled without significant negative impact on the New Zealand economy. While the allowance for carbon sinks under the current regime may mask the unreality of such a commitment to some extent in the short run, it is already clear that there is little protection for New Zealand from an approach aimed at emission reductions in the long run.

A possible alternative could be to agree to emission targets expressed in per capita or per dollar of output terms. However, again, such indicators are still subject to the vagaries of demographic change and change in the pattern of economic growth. Hence, it may be difficult to identify a target which is not limiting in terms of economic growth, and which captures the actual commitment to greater efficiency. We believe that a more credible approach for New Zealand is to focus on ensuring that it is part of any agreement which promotes technology adoption and technology transfer. It is from these avenues that global emissions will eventually be reduced without economic sacrifices that nations, in the event, will not be prepared to make.